BRIDGE ERECTION USING SUSPENSION STRUCTURE

Conversion into a Self-anchored Bridge Structure at Completion

1 General

The construction of simple girders using suspended structures makes it possible to erect bridges in places where space for a construction yard is limited and large machinery cannot be brought in. This technology can also minimizes the amount of excavation needed and, because even temporary supports are not required, the impact on the environment can also be kept to a minimum. This erection method involves the construction of the simple bridge girder above a stress ribbon; at completion, it is converted from an externally anchored structure to a self-anchored structure, so it requires no permanent ground anchors. In 2006 the Seiun Bridge (Fig. 1) became the first structure outside Europe to receive a *fib* (International Federation for Structural Concrete) Award for Outstanding Concrete Structures.

2 Structural Features

As shown in Fig. 2, construction work is implemented on a suspended structure, with tensile force during construction being resisted by ground anchors. When the bridge is complete, this tensile force is shifted from the ground anchors to the bridge itself (Fig. 3). As a result, the force at work during construction acts as a prestressing force, and the completed structure becomes a simple girder structure. Moreover, due to the steel diagonal members supporting the girder, the bridge forms a truss, and so in structural terms it is a composite truss bridge. For highway bridges, using concrete for the stress ribbon makes it possible to increase overall rigidity and reduce sag and stress changes in the suspension cables. For pedestrian bridges, this method can be applied even in the form of a string beam. As shown in Fig. 4, a double string beam structure can be used to improve safety during construction.

Fig. 1 Seiun Bridge

Fig. 2 Construction on suspension structure

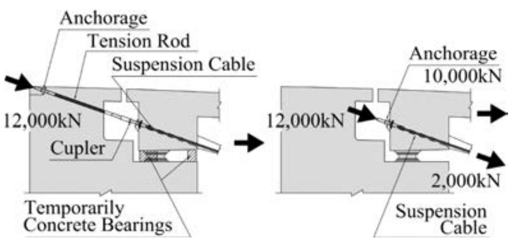

Fig. 3 Structural conversion

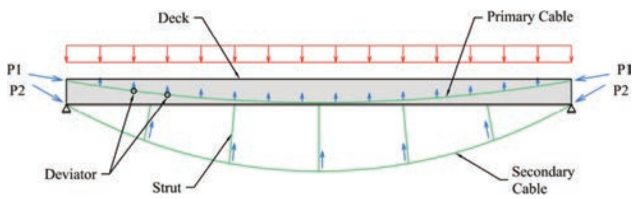

Fig. 4 Double suspension structur

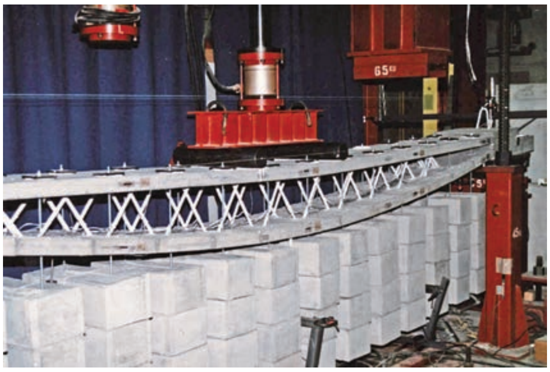

Fig. 5　Laboratory testing

Fig. 6　Ganmon Bridge

Fig. 7　Seishun Bridge

Fig. 8　Hirono Bridge

3 Development history

The feasibility of this method was first tested in the laboratory using a 1/5 scale model (Fig. 5). The results confirmed that it was possible to convert the temporary suspended structure into a simple girder structure, and that it had the load-bearing capacity needed for a composite truss bridge[1]. Subsequently, the technology was applied to a pedestrian bridge with a span of 37m and then to a highway bridge with a span of 97m. A modification to the method was made so as to provide increased stability when in constructing a bridge from top to bottom. The difference from the original approach is that the girder is initially suspended from primary cables, then it is lifted to the specified alignment using secondary cables (Fig. 4).

4 Practical Application

The first use of this technology was for the Ganmon Bridge, completed in 2001 (Fig. 6). It was also used for the Seiun Bridge[2], a highway bridge completed in 2004 (Fig. 1), the Seishun Bridge, when a double string beam was used[3], which was completed in 2006 (Fig. 7), and the Hirono Bridge completed in 2011 (Fig. 8). The Hirono Bridge has a span of 107.5m.

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6 References

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