Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 79 (1998)

Artikel: Erection of long-span suspension bridges by direct hoisting method
Autor: Hirayama, Jun-ichi / Ito, Shinichiro / Asakura, Yoshihiro
DOI: https://doi.org/10.5169/seals-59925

Erection of Long-Span Suspension Bridges by Direct Hoisting Method

Jun-ichi HIRAYAMA
Dir., Eng. Dept
Honshu-Shikoku Bridge Auth.
Kobe, Japan

Shinichiro ITO
Mgr, Eng. Section
Honshu-Shikoku Bridge Auth.
Imabari, Japan

Yoshihiro ASAKURA
Chief Research Eng.
Public Works Research Institute
Tsukuba, Japan

Summary

Direct hoisting method is necessary for erection of box type girders. But it is hard work at straits, because it receive heavy forces by tidal current and obstruct navigation. This paper presents the useful equipments for this method, that is, self-positioning barge and automatic coupling. They shorten the actual duration at hoisting work of the Kurushima bridges.

1. Development of Direct Hoisting Method

In consideration of safety and the influence on economic activities caused by tugboat fleets that obstruct navigation in the areas around erection sites, many truss type girders have been adopted in Japan. However box type girders have the advantage of low fabrication and erection costs. They have gradually gained favor because of this, and because their simple form eases maintenance. But, there has been only one erection method :lifting from directly to installation point. It is hoped that box type girders will be accepted for future long-span bridge construction due to lower costs and shorter construction periods.
The Kurushima Straits are narrow sea lanes with swift tidal currents. The Kurushima Bridges will be built there using box type stiffening girders. In the old direct hoisting method, a deck barge with a girder block was anchored against sea currents with cables. But, due to the prolonged construction period, the wide area of sea lane involved, and the number of accidents that have occurred in the past in the Kurushima Straits, the cable anchoring method will not be adopted. Instead HSBA has developed an erection method whereby the block is hoisted directly by a cargo deck barge which has Dynamic Positioning System (D.P.S.). In addition we also developed the equipment for joining the girder block's "Quick Joint", in a way that saves critical time (Fig. 1). By the developments the duration of hoisting work of Kurushima Bridges took only about 30 min. The duration of the barge positioning also took only about 10 min.

2. Carrying Cargo Deck with D.P.S.

The control method of a cargo deck barge with D.P.S. is to balance tidal forces, wave forces, and wind forces against the force of barge's four thrusters. The goal position of the barge is maintained by measuring and counteracting deviations with the D.P.S. This closed-loop control system minimizes deviation from the goal position by calculating both rotational drift and positional offset. The deviations is solved by calculating the real-time coordinates of the barge. The coordinates are calculated by measuring the distance between two fixed station on land and the traveling station on the barge ,that is, triangulation, and the direction of the barge by gyrocompass. Fixed station and traveling station search each other by its automatic pursuit device. Fixed station transmits distance data to traveling station by light waves.

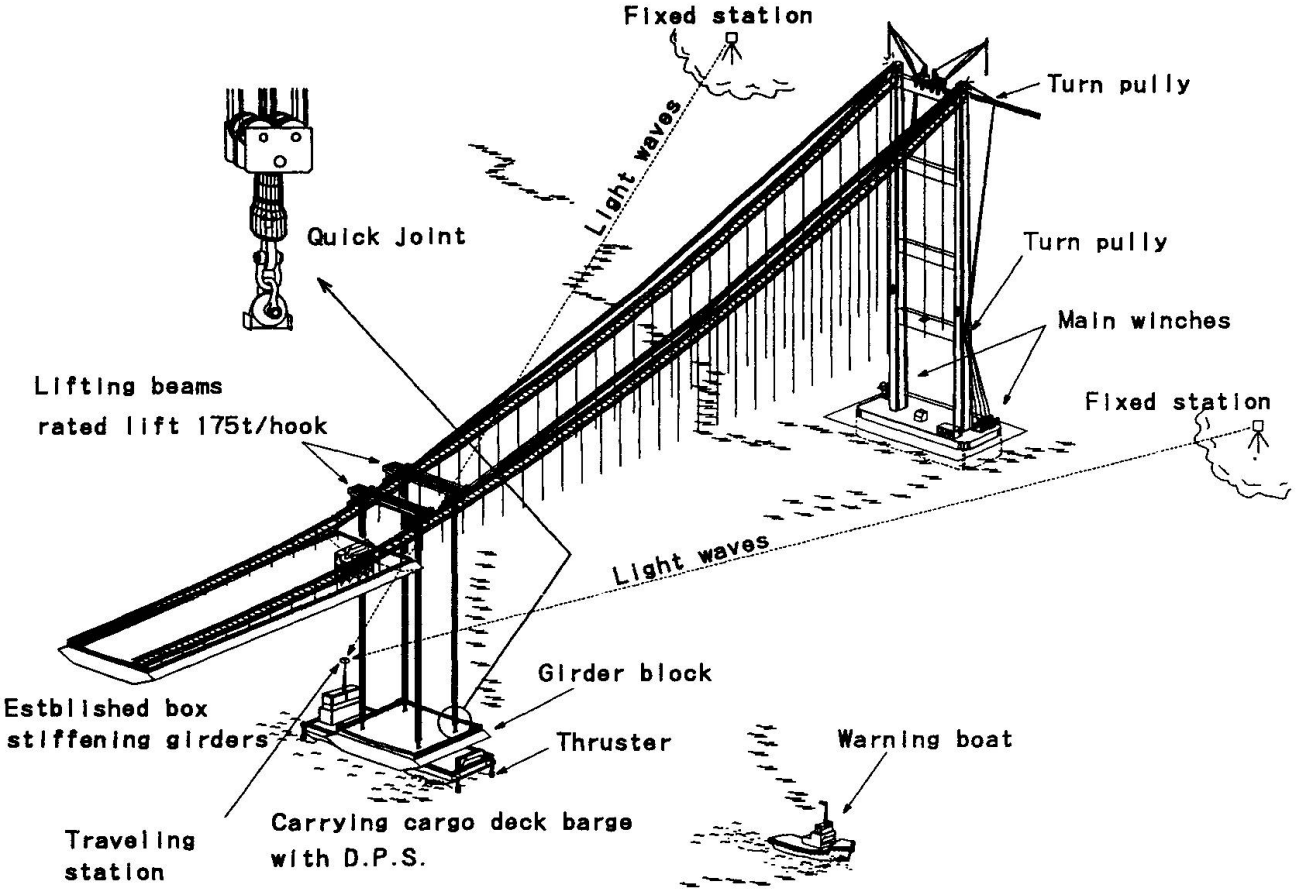

Fig. 1 Direct hoisting method of Kurushima Bridges

3. Quick Joint

Quick Joint is equipment of automatic coupling for hoisting a girder block. it is composed of a pencil plug and a socket. The tension winches on the lifting beams stand the plugs by pulling leading rope that installed on the point. The main winches of lifting beam lower the sockets and they are guided to the plugs by the leading rope (Fig. 2). The plugs push up the inside slide rings of the sockets . they finish pushing and the slide rings return by springs. As the result the plug and the socket is joined firmly by wedge effect.

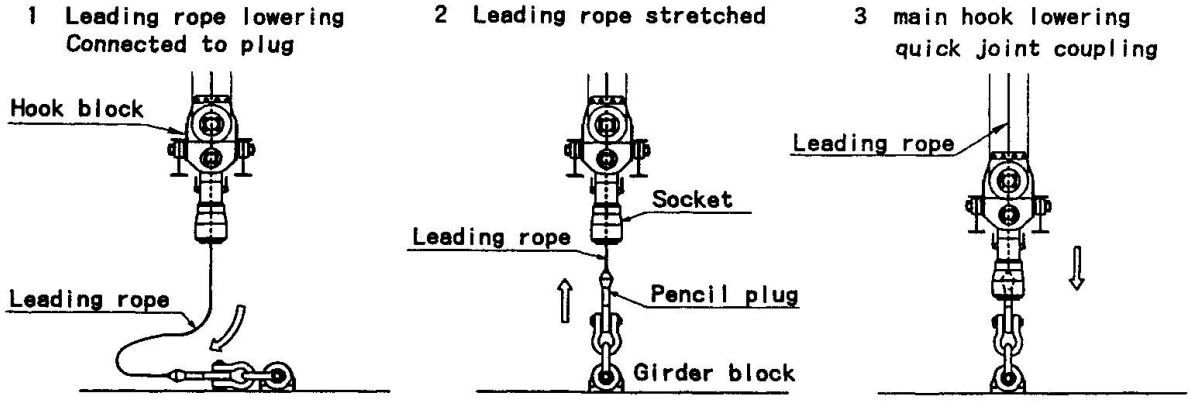

Fig. 2 Movement of joining Quick Joint