GIRDER ALIGNMENT & ERECTION TEMPLATE 2001 Nova Award Nomination 14

The Girder Alignment and Erection Template was conceived in the San Diego office of J. Muller International to facilitate the erection of the Main Girders for the Confederation Bridge, linking Prince Edward Island to the New Brunswick mainland. The further refinement and development of the construction and surveying techniques to be used continued at the offices of Strait Crossing Inc (SCI) in Borden, Prince Edward Island. Opened in June 1997, the 13km crossing comprises a Main Bridge with 43 spans of 250m; a 7-span East Approach with typical spans of 93m; a 14-span West Approach with similar spans; and 2 transition spans of 1 65m. The 2-lane roadway is 11 m wide with two 2m shoulders.

The precast concrete-box-girder structure was built in four basic modules: the Pier Base, the Pier Shaft, the Main Girder and the Drop-In Girders. These modules were precast on-shore and then transported to the site and erected with a massive floating crane so that erection of the modules could be achieved within the 7-month marine-construction window that was available each year. This type of modular construction has been gaining popularity for large crossings, and has been used for the Great Belt and Oresund Projects, in Europe, as well as smaller projects in Japan.

The erection of the 195m-long 7500-tonne Main Girder posed a difficult problem. The heavy, ungainly element had to be erected with only one day of crane time, and placed within extremely tight tolerances to meet the geometric requirements for the roadway. Traditional methods would have required a battery of low-profile “flat” jacks covering a portion of the available cross section at the top of the pier. The “open” portion of the cross section would then be available to be filled with concrete to carry the load, once the alignment of the girder had been achieved. After the first pour of concrete was cured, the jacks were removed; and concrete was placed in the remaining portion of the joint. This method would have been a time-consuming process, because it would have been performed on the critical path of the bridge erection. It also would have been a difficult and delicate operation, since the 195-meter-long Main Girder would have had to be controlled by jacks that could be separated by no more than 9.5 meters. The solution was a relatively small, 100-tonne “Template” that would be pre-installed with a thin grout joint on the pier in advance of the Main Girder. With the Template locked in place, the girder could be lowered onto its alignment keys and released. Prestressing tendons provided the strength required in the joint.

The Template provided several important advantages: it easily and reliably could be controlled and adjusted, it greatly simplified the placement operation for the Main Girder, and it could be handled with significantly smaller and less expensive equipment. The template could be installed off the critical path, well ahead of the erection of the Main Girder (e.g., before the Main-Girder casting was completed). In order to achieve the placement accuracy that was required, the Template was “match-cast” to the bottom of the diaphragm of the Main Girder. The Template was cast first, and then the diaphragm segment, or “Hammerhead” of the main girder was cast on top of it. When the Hammerhead was completed, the two elements were separated. The Hammerhead continued down the Main-Girder casting line, and the Template went to storage. In this manner, the geometric relationship between it and the Main Girder would be maintained when the girder was placed back on the Template during the marine erection.

Although match-casting techniques have been used extensively in the past, this application was different in that it was not possible to establish the geometry control by surveying adjacent slabs, as would be done in the case of a segmental bridge, for example. It also required much greater accuracy, because the Template was being used to control the placement of an object twenty times its own length. Finally, the shear size of the element to be erected is unprecedented.

To address these issues, special surveying techniques were developed to determine the relationship between the targets on the Template and the profile-grade line, for the roadway. Stochastic error-control methods were developed to ensure that the placement accuracy was achieved; and dampening systems were devised to control the vertical load transfer and wind-induced movements of the Main Girder.

The success of the Girder Alignment Template has opened the door for the use of large modules in the construction of bridges and many other types of precast-concrete structures. Contractors have considered it as they have sought to reduce costs and risks in the placement of very large precast piers, and for possible use in the construction of silos as a series of precast rings. As larger and larger erection equipment is used in bridge and other types of construction, this technique will prove to be a useful tool. It has also been examined, in reduced scale, as a way to eliminate the cast-in-place closure pour required in balanced cantilever construction when a cast-in-place pier segment is used. Other applications undoubtedly exist, as the template technique is really a universal method for making a geometrically accurate moment connection between a precast element and an existing structure without supporting it on falsework and pouring a cast-in-place joint.

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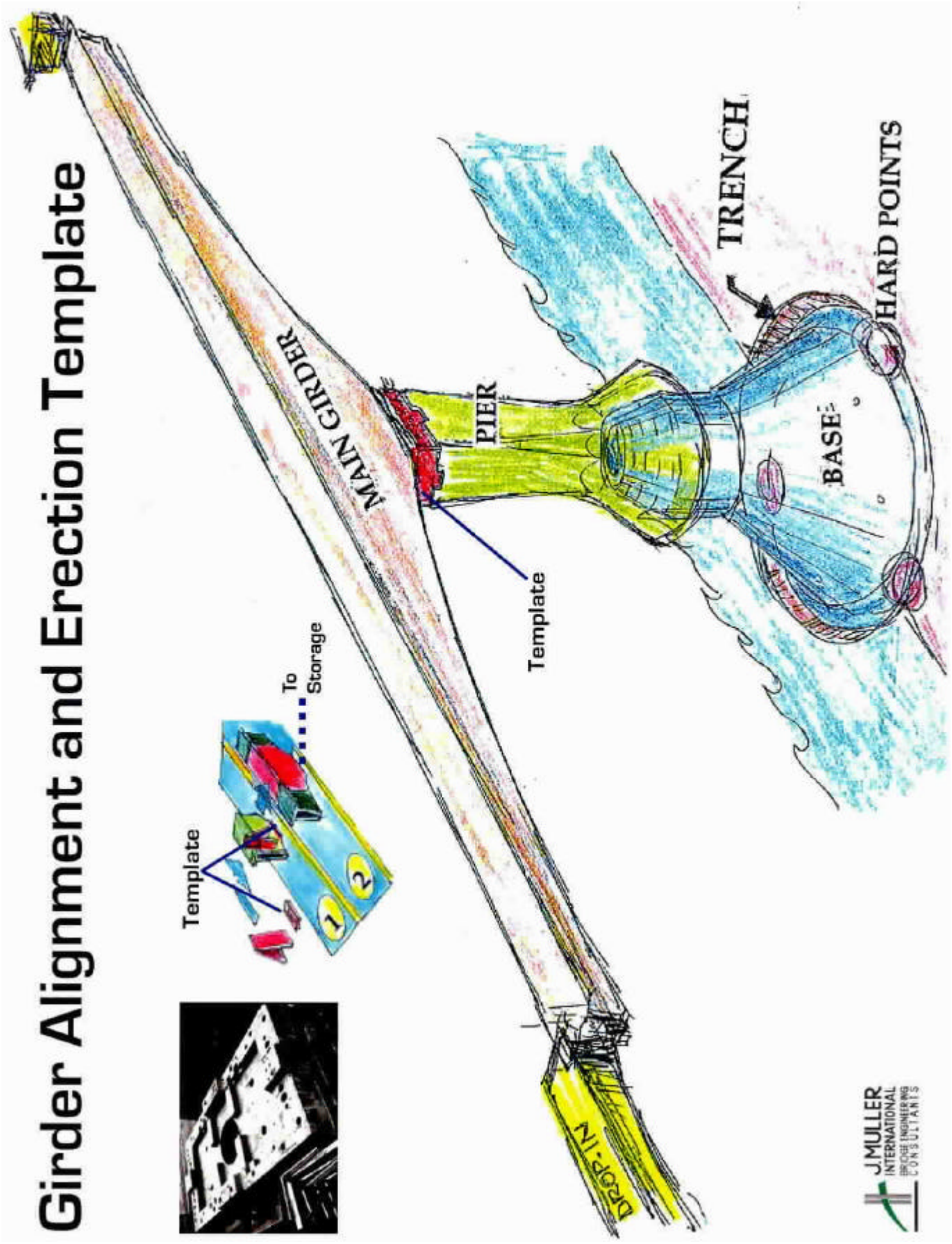
Girder Alignment and Erection Template
MAIN GIRDER
PIER
TRENCH
HARD POINTS
BASE
Template
To Storage
Template
DROP-IN
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