Construction Engineering of the Kanchanaphisek Bridge

David Ferrand
Bridge Design Engineer
JMI Pacific Limited
Bangkok, Thailand
david.ferrand@egis.fr

David Ferrand, born 1977, received his master degree in civil engineering in 2000 from the Univ. Blaise Pascal (France) and his Ph.D in 2005 from the University of Michigan (USA). He works at JMI Pacific Limited since 2005

Summary

The Kanchanaphisek Bridge is the fifth cable-stayed bridge to be built over the Chao Phraya River in the Bangkok Metropolitan area, and with a 500 meter long main span it is also the longest. The bridge is part of a 20 km long elevated highway, the Southern Outer Ring Road, which completes the Outer Bangkok Ring Road project. Building a 500 meter span cable-stayed bridge always presents the construction engineer with great challenges. This paper will present the main solutions and methods used in the construction of the longest cable-stayed bridge in South East Asia. Not only the bridge superstructure had to be erected in the shortest time possible, while not disrupting the important marine traffic on the Chao Phraya River, it also had to be built within very small tolerances to guarantee the integrity of the structure.

Keywords: Cable-stay bridge, Construction engineering, Construction method, Numerical analysis, Unstressed length, Geometry control, Segmental construction, Lifting gantry.

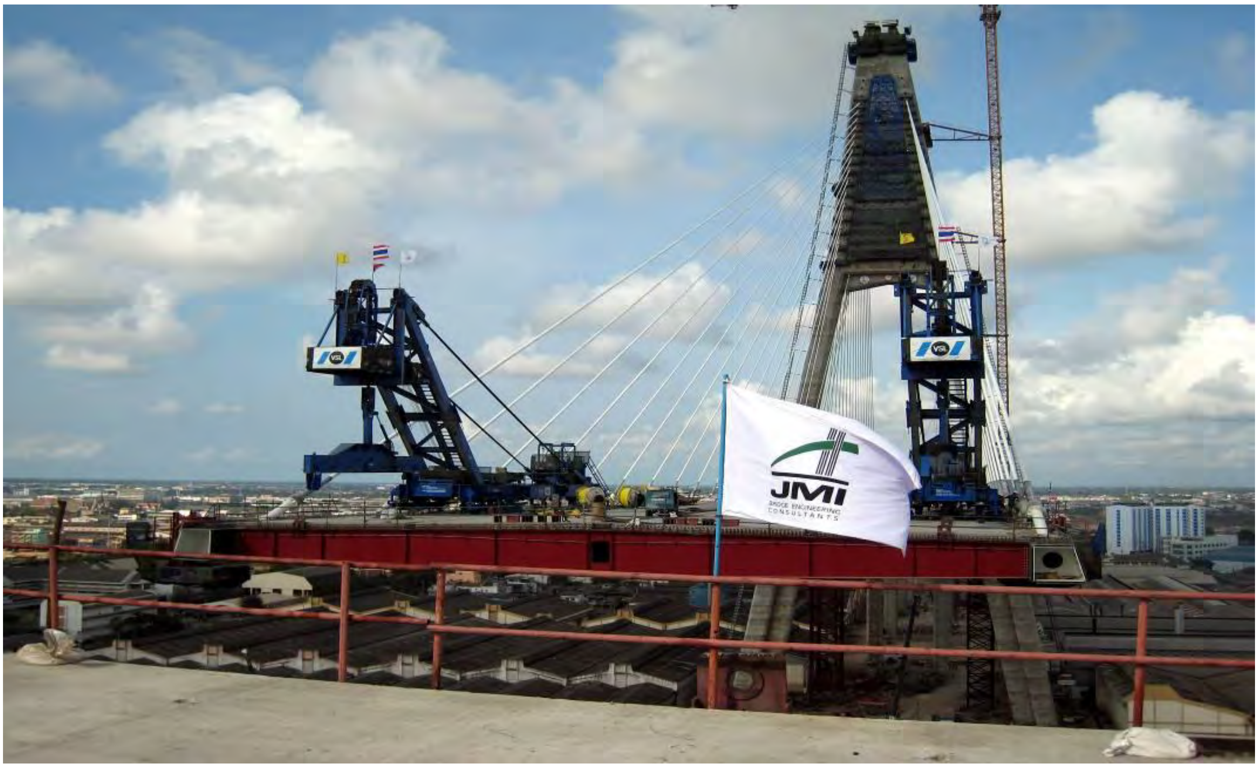

Fig. 1:View of the West cantilever with the two Erection Gantries

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JMI Pacific Ltd was hired as construction engineer of the cable stay bridge by the main contractor, Ch. Karnchang Plc, responsible for the construction of the fifth and longest cable stay bridge in Bangkok. This task presented several challenges that had to be overcome.

One of these challenges was to develop a numerical model with all the different construction phases precisely detailed. The model had to be flexible enough to allow the construction engineer to investigate different construction methods in a very short time period, while it had to be precise enough to check that all forces, stresses and displacements were within the admissible limits. This was a clear advantage as the construction engineer was able to quickly validate, on-site, new construction methods to suit the contractor request.

Another challenge was to accurately define an assembly method for each segment. Because erection gantries of a previous nearby project were used instead of specifically designed ones, several parameters had to be precisely defined to guarantee the integrity of the structure while optimizing the construction cycle time: These parameters include the maximum permissible lifting weight, bolting sequence of the lifted segment to the previous one, definition of several cable stay stressing stages, precast deck panel installation sequence, etc…
Moreover an overlapping cycle between main span erection and back span erection was developed to optimize construction time

Construction methods of the back span anchor piers were also intensively investigated. To avoid the use of falsework to support their construction at a height of more than 50 meters and to facilitate the contractor task, precast concrete troughs having a U-section were assembled by balanced cantilever method with post-tensioning. They were then filled with concrete. This construction technique was a great gain of time for the contractor and allow for a very precise control of the geometry, a important key to the structure integrity. The erection of the deck segment on top of these back span anchor piers was then greatly facilitated.

Another important task of the construction engineer is to achieve the desired deck profile. For this particular project, it was decided in agreement with the designer, Parsons Brinckerhoff (PB), to stress the cable stay by using the unstressed length parameter. This parameter was computed based on the anchors coordinate and stay forces obtained from the numerical model at the different construction stages. Correction were included to incorporate as-built coordinate of the anchorage in the tower as well as in the deck. Then the obtained forces and deck elevation were compared to those of the numerical model. The first cable installations were used to calibrate the deck stiffness of the model by slighty varying the participating width of the deck.
The use of unstressed length as the parameter to define the stressing of the cable stay, instead of cable stay force, presents a real advantage since the unstressed length is an intrinsic characteristic of the cable stay loading. It is a parameter that is independent of the construction sequence and of temporary construction loads. While the required stressing force of a cable stay will vary according to the presence or absence of temporary construction loads, the unstressed length will not. This method therefore provides greater flexibility to the contractor.