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Bridge Construction of Malaysia-Singapore Second Crossing

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Summary

Malaysia and Singapore are connected with the only one causeway across the Johor Straight. Therefore it causes a heavy traffic congestion at rush hours every day. Malaysia-Singapore Second Crossing (MSSC) bridge is planned and constructed to stimulate for economic activities of western Malaysia as well as improve traffic conditions at the causeway.
The 1919m long bridge which links Landang in Johor and Tuas in Singapore across the Johor Straight (including 1769m long within Malaysian Territory) was completed on September of 1997 in only 36 months. And in order to complete this bridge in this short term construction period, the pre-cast segment construction method was adopted for approach span of 1,377m long, though remaining 357m long main span was constructed by the method of cast in-situ. This report describes a construction of the bridge in Malaysian territory.

Keywords: pre-cast segment; cantilever, cast in-situ

1. Outline of the Project

Malaysia and Singapore are separated by the Johor straight, where there has been the only one connecting road called "causeway".Traffic between two countries has become so heavy that the causeway caused a chronic jam. In order to avoid it and to accelerate the development of west district of Singapore and southern new town in Malaysia, the Malaysia-Singapore Second Crossing (MSSC) was planned and built 20km apart from the causeway.It will be able to have the capacity of 200,000 cars per day which is about double capacity of existing causeway.

MSSC Bridge is a 1919m long and six lanes (three lanes of 13.5m wide x 2) prestressed concrete box-girder which consists of four continuos bridges which formulate approach span, and one rigid frame which is for main navigation. Each approach bridge is six spans pre-cast concrete girder of 62m to 70m length. Main span consists of 96m, 165m and 96m, which is cast in-situ. The foundation of the bridge is cast in-situ pile with casing which has the diameter of 1.5m and average length of 30m. There were many cavities in lime stone layer which were plugged by concrete. The pile cap in the sea was built by caisson which was cast in the floating dock, towed and settled on the pile foundation utilizing the tide

difference.

The pre-cast segment for approach span was 3.35m long and 78 to 134 tons in weight that amount to 841 pieces. They were erected by cantilever method using an advancing girder. Post-tensioning for positive moment were given by out cable, which enables us the short erection time and less labor. The main span was erected using eight large size travelers with the capacity of 800tm which also contributed to shorten the delivery.
This paper describes mainly on Malaysian side which is 1734.4m long and was completed only 36 months.

2. Segment Production

The most distinctive feature of this project is that the appoch span of total length of 1,377m of Malaysian territory has been constructed by the pre-cast segment method in order to shorten the construction period, though the remaining 357m length of main span has been constructed by the cast in-situ balanced cantilever method with large size traveler formworks.

2.1 Production Yard

A production yard for 840 segments is located approximately 20 miles far from the construction site, and has a area of 439mX150m. It contains materials and re-bars storage yard, re-bar assembling yard, 4 casting machines, segment curing shed and segment storage area. Concrete was supplied from the adjacent concrete mixing plant. The 150 tons gantry crane and a hydraulic powered transport car were used for transporting of segments.
The short line system for the segmental production was applied. All production activities were arranged in a line of 4 casting machines.

2.2 Segment Erection

Construction of the approach viaduct started at Johor abutment and continued through Pier 18 to join up with the main span. The second phase started at the other end of the main bridge and continued over Piers 21 to 23 to the interface line. Both Singapore bound and Malaysian bound lines were constructed simultaneously. (See Fig-3, Eight-Page Paper)
The typical segment erection of 70m span is shown on Fig. 7 of the eight-page paper. The erection procedure of 62m cantilever is in a similar way as for the 70m cantilever. In this case, to built up a balanced cantilever, concrete blocks were installed between the two pier segments at top and bottom slab, then 14 Nos. of temporary cantilever tendons were installed and stressed in the top slab. After placing the cantilever segments at Pier 18, the erection truss had to cross over the completed main bridge to continue working at Piers 21 to 23. The erection truss was walking over the main bridge in the same way as it was launched from pier to pier on the approach viaducts.

3. Conclusions

The entire bridge was founded on 1.5m dia. bored piles embedded into stable lime stone layer. Many cavities in the lime stone layer were specified to be grouted with mortal cement. Because of this grouting, it has spended so much time and money.
In spite of this tight and short term construction schedule, the adoption of pre-cast segment construction method has enabled this project successfully completed within given construction period.