Report on Technical Visit to Subang-Kelana Link Project

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WOW! If you have an opportunity to witness three different types of bridge superstructure construction methods in a single technical visit, will you miss it?

Needless to say, most structural engineers will say "No!". In addition to the good opportunity which will not re-appear again in the next few years, the site is just a few kilometres away from the city and participants do not need to endure a long journey to reach the destination. There are around sixty over IEM members on this visit, most of whom with strong interest in the design and construction of bridge structures. They responded eagerly to the invitation to participate in the technical visit to Subang-Kelana Link Project, organised by IEM Civil and Structural Engineering Technical Division on the Saturday morning of 19 May 2007.

Just a short drive from IEM Building in Petaling Jaya, the IEM delegates reached the site at around 9.30a.m. and were warmly welcomed by the host. Ir. Bakri Bin. Ishak from Ahmad Zaki Resources Berhad, who presented a comprehensive briefing to the delegates lasting around one hour. It was followed by a lively question and answer session before the participants were led to the field to witness the three different types of bridge construction methods at various locations within the project vicinity.

Project Brief	
Owner:	Jabatan Kerja Raya (JKR) Malaysia
Turnkey Contractor:	Ahmad Zaki Resources Berhad
C&S Consultant:	Maunsell Malaysia Sdn. Bhd.

The main scope of the project is to construct a four-lane dual carriageway elevated section from Jalan Subang to KESAS Highway at Subang Jaya crossing the Federal Highway. The total length of the mainline structure with a width of 20.6m is around 1.5km. The targeted date of completion is December 2008. For the ease of contract management and administration, the project was divided into three sections.

Main Technical Details

Description	**Concrete Grade (MPa)**	**Section A**	**Section B**	**Section C**
Borepile	35	206 nos.	85 nos.	94 nos.
Pilecap	40	48 nos.	11 nos.	22 nos.
Pier / Crosshead	50	48 nos.	12 nos.	17 nos.
Box Grider	55	767 nos.(precast)	425m (balance cantilever)	972 m (Cat in-situ)

Substructure

Description	Section A	Section B	Section C
Borepile diameter	1000mm & 1500mm	1000mm	1000mm and 1500mm
Pilecap concrete volume	$120m^3$ – $1856m^3$		
Y-shape pier height	6m – 29m		

Section A : From Kewajipan Roundabout to KESAS Highway

Section B: From Mesiniaga Building crossing Federal Highway to Jalan Subang

Section C: Six (6) numbers of ramp connecting the existing roads to the new elevated main line at various locations

Note:

a. The biggest pilecap's dimensions are 25m x 20m x 3.75m with a total concrete volume of 1856m3.
b. The tallest pier is located at Bulatan Kewajipan with a height of 29m.

SUPERSTRUCTURE

There are three different types of construction method for the construction of the bridge superstructure.

Section A:

Precast concrete segmental box girder and erected by balance cantilever method using gantry.

Section B:

Balance cantilever in-situ concrete segmental box girder by using travelling formwork.

Section C:

Continuous span cast in-situ concrete box girder fully supported on falseworks.

PRECAST CONCRETE SEGMENTAL BOX GIRDERS

This is the mainline of the carriageway consisting of 33-span elevated structure with a typical span of either 40m or 47m. The typical segment dimensions are 20.8m width and 2.2m length. A total of 747 numbers of precast concrete segment weights varies between 70 and 110 tonnes to be cast and erected for the elevated section.

The precast segments are to be erected by a 111.75m length, 300 tonnes gantry in a balance cantilever manner. The typical sequence for the main activities of superstructure construction is as follows.

a. Install the pier segment (N)
b. Install one segment at each end of the pier segment (N-1 and N+1) one after another.
c. Hold the installed segments by using temporary prestressed bars.
d. Install another one segment at each end of the cantilever (N-2 and N+2) one after another.
e. Hold the installed segments by using temporary prestressed bars.
f. Install and stress the cantilever prestressed tendons.
g. Release the temporary prestressed bars.
h. Repeat items (b) to (g) above until the particular span of cantilever is erected

Then, the gantry will be launched forward to the next pier and proceed to the erection of the following cantilever. Upon completion of the erection of two adjacent cantilevers, the gap between the cantilevers of around 200mm would be cast by in-situ concrete and form a complete span. Continuity prestressed tendons would then be installed and stressed. It was noted that internal prestressing is used for all the cantilever tendons while external prestressing is adopted for all the continuity tendons.

CAST IN-SITU CONCRETE SEGMENTAL BOX GIRDERS

The bridge over Federal Highway consists of two identical five spans continuous single cell cast in-situ concrete box girders with a span configuration of 55m-95m-130m-90m-55m. The box girders are monolithic at the two centre piers and are supported on bearings at other piers. The cast in-situ concrete segmental box girders with a depth variation between 7.2m (at support) and 2.6m (at midspan) will be constructed in balance cantilever method by using travelling formwork.

There are fifteen segments on each side of the pier with the first seven segment length at 3.1m while the balance eight segments is 4.6m length each.

Form traveller is adopted for the construction of the Federal Highway crossing. A form traveller is a system whereby the formwork for the segment that is to be cast is held by the frames clinging on to the segments that have been cast earlier.

The cantilever construction started off by constructing the pier segment or usually known as 'hammerhead'. In this particular case, the 'hammerhead' is 14m in length and 7.2m in depth. It was constructed by using in-situ concrete fully supported on falseworks. Upon the completion of the 'hammerhead', the form travellers were erected on the cast deck and ready for subsequent 'travelling' construction. The typical sequence for the main activities of superstructure construction is as follows.

a. Launch the travellers forward and fix them on the earlier cast bridge decks.

Figure 1: Y-shape pier at Section 1

Figure 2: Precsat concrete segmental construction at Section 1

Figure 3: "Travelling" construction in progress at Section 2

Figure 4: A completed prestressed concrete box grider ramp under Section 3

b. Survey and adjust the formwork to the required position.
c. Install reinforcement bars and prestressed tendon components (usually without threading in prestressing strand at the moment).
d. Cast the segments.
e. Concrete curing and install prestressing strands to theprestressed ducts which are to bestressed for the particular stage of construction.
f. Upon the attainment of concrete transfer strength, stress the designated prestressed tendons.
g. Release formwork and back to item (a) above.

It was informed that the cantilever construction started around two months ago and a cycle time of around ten working days was observed. However, it was believed that when the site team had completed the 'learning curve' process, and in addition to the fact that the segments become shallower when the cantilever approaches the misdpan, the cycle time can be reduced to around 6 working days.

There are a total of four cantilevers to be constructed. In view that only two sets of form traveller were being adopted for the construction of the cantilevers, a specified construction sequence was planned for implementation. Firstly, the two parallel cantilevers at Jalan Subang side were to be built. Then the two sets of form traveller would be relocated to Subang Jaya side for the construction of the balance two cantilevers. It was foreseen that the completed cantilevers at the Jalan Subang side will be 'free cantilevering' for a period of around six months before joining with the other cantilevers 'growing' from the other side of Federal Highway.

CAST IN-SITU CONCRETE BOX GIRDERS

There are six numbers of ramps spanning between 40 m and 58m which are made of cast in-situ concrete continuous box girders. All the box girders were cast on flaseworks in a 'span by span' method. The typical sequence for the main activities of superstructure construction is as follows.

a. Prepare falseworks and formworks for a designated length with an end construction joint end.
b. Fix the bar reinforcements and prestressed tendons.
c. Cast the particular designated length.
d. Concrete curing.
e. Upon the attainment of concrete transfer strength, stress the prestressed tendons.
f. Remove the falseworks and formworks.
g. Relocate the falseworks and formworks forward and back to item(a) above.

The overall prestressed tendon layout was detailed in a manner in which the location of the designated construction joint positions were taken into consideration. A detail of 'overlapped tendons' was adopted for providing continuity to the bridge superstructure.

At the time of visit, it was observed that the main construction works on four number ramps had been completed. ■

ACKNOWLEDGEMENT

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