Talk on "Gerbang Selatan Bersepadu – Medium Term Link"

CIVIL AND STRUCTURAL ENGINEERING TECHNICAL DIVISION

by Ir. Ong Sang Woh

THE Gerbang Selatan Bersepadu (GSB) - Medium Term Link evening talk organised by the Civil and Structural Engineering Technical Division was held on 2 November 2010 at Wisma IEM and attended by 58 participants.

The speaker, Ir. Teh Tzyy Wooi, opened the talk by giving a brief overview of the GSB – Medium Term Link development project. The Medium Term Link (Inbound and Outbound) provides direct access to the Malaysian Customs and Immigration Building in Johor Bahru and links the existing causeway to Singapore. The project consists of six viaducts/bridges of precast segmental box girder integral with single pier column and portals.

The speaker highlighted the constraints of the existing launcher capacity of 65 Mtons, which restricts the design dimensions of the segmental box. The required width of the segmental box is 16.88m and the segmental length is limited to less than 2.2m since this is dependent on the segmental depth and web thickness. Concrete Grade 50/20 is used for the precast segmental box girder.

The design criterion is based on the BD 37/01, BS 5400 and JKR terms of reference. The design assumptions are as follows:

1) Seismic Load - 10% of the permanent dead load and superimposed dead loads + 20% of longitudinal HA traffic loading in all notional lanes.
2) Crack Width of 0.25mm (for Semi Permanent Bridge) and 0.1mm (for Permanent Bridge).
3) All piers/portals shall be designed as monolithic except for the abutment and existing piers and portals.
4) External pre-stressed shall be used for continuity tendons (bottom tendon).

The analysis of the Superstructure Design is summarised in the following steps:

- Analysis was carried out using Midas Civil.
- Design and Erection using the Balanced Cantilever Method.
- "False Cantilever" was used for the Split Pier or Split Portal.
- Cantilever Internal Tendons were used during the Cantilever Erection Stage.
- Top and Bottom Continuity Tendons for the Continuity Stage.
- All top Continuity Tendons were Internal Pre-stressed.
- Bottom Tendons were Externally Pre-stressed. However, External Bottom Tendon alone was found to be insufficient during the design stage. As such, bottom internal tendon (four strands of 15.7mm dia) was introduced. Maximum tendon size is limited to19 strands of 15.2mm dia.

The speaker informed the participants that there are normally two concepts of stressing the continuity tendons in Balanced Cantilever Box girder design. These are:

1) Stress the continuity tendons at the stitch as much as possible after concreting. This approach was adopted for this project.
2) Minimal stressing of the continuity tendons (one or two pairs of tendon) at every stitch. Then stress all the continuity tendons upon completion of all stitches.

The details on the Transverse Analysis and Pre-stressed Design involved the following steps:

- Using finite plate elements in Midas
  - Model on Bridge 1.
  - To get Self-Weight, Dead Load, SIDL and Live Load's Moment and Shear result.
- Using Beam Element for PS analysis and spreadsheet for design.

The speaker showed typical drawings for the design segmental box segments and explained the components and details of the box segment. Photographs of the inside of the box segment and the anchorage details of the tendons were emphasised. The animation on the sequence of segments erection using the launching gantry was also explained.

Questions on shallow depth beams, shear key design and shear lag effects, over pre-stressed sections and crack width were clarified with the audience. The speaker covered the analysis of the Superstructure Design and the Transverse Analysis and Pre-stressed Design work and highlighted numerous hands-on experiences encountered during the GSB – Medium Term Link project. ■