



## East Tsing Yi Viaduct – A tough schedule to erect a concrete deck 7 km long

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## Summary

At the end of 2004, the Hong Kong Highways Department awarded the contract for the construction of the East Tsing Yi approach viaduct to Stonecutters Bridge, to Dragages Hong Kong, Bouygues Travaux Publics and China Harbour Engineering Company. Forty months later, the elevated roadways, which can be considered as twenty individual bridges separated by movement joints, were supported in the sky by some 94 columns.

The 1939 prefabricated segments cast in mainland China and delivered to Hong Kong by barge, were erected using the balanced cantilever construction method. The structure required the manufacture of specific tools for its construction. The “Fei Long” launching girder (Flying Dragon in Cantonese), 150 metres long and weighing 700 tons, was specially designed for this project and made it possible to install an average of three pairs of segments per shift, with a maximum of seven pairs of segments erected in a single day.

**Keywords:** Prefabricated segment, launching girder, balanced cantilever construction method.

## 1. Introduction

At the end of 2004, the Hong Kong Highways Department awarded a €100m contract for the East Tsing Yi approach viaduct to Stonecutters Bridge, to a consortium of Dragages Hong Kong, Bouygues Travaux Publics and China Harbour Engineering Company.

This project was a «conforming design» and the design and construction supervision consultant was ARUP. The project lasted 40 months.

The project was made up principally of pre-cast segments. These segments were prefabricated in China and transported by barge to the site. A heavy transport convoy was used to deliver the segments from the unloading zone to the site.

## 2. Earthworks and Infrastructures

### 2.1 Earthworks

Significant earthworks were carried out for this project. About 100,000 m<sup>3</sup> of granite was excavated and nailed by 1,000 soil nails over 6 months. These earthworks were carried out for the main part during the wettest rainy season for 20 years.

The East Tsing Yi Viaduct was built partly on a new reclamation area and partly on a hillside.

## 2.2 Foundations

Two types of foundations were used: steel H piles embedded in concrete and large diameter bored piles in the reclamation areas.

The 558 H piles with depths ranging from 9m to 35m covered a total length of about 12 km. These works were finished in 10 months using on average 5 piling rigs.

The 263 bored piles with a diameter of 1.50m, 1.80m and 2.00m and with a depth varying from 15m to 67m were completed in 7 months with 4 piling rigs.

## 2.3 Piers

The construction of 100 piers with a total length of over 4000 metres necessitated the fabrication of 10 sets of steel formwork. One 6-m concrete pour was carried out every 4 days. The piers were crowned either by hammer heads, or by portal frames, or directly by cast in situ segments. All these parts of the structure were cast using special formwork with specific plant handled by mobile cranes.

# 3. Superstructure

## 3.1 Description of the structure



The project is made up of 20 individual bridges, each one separated by a movement joint.

The main bridge, linking the Stonecutters Bridge to the Nam Wan tunnel, comprises of two separate decks each carrying 3 lanes. The spans range in length from 55.00 m to 84.00 m. The construction of these bridges used a total of 1939 pre-cast segments (with the exception of 2 structures- situated at the north of the project, which were cast in situ on scaffolding).

A typical bridge comprises 4 to 5 spans, each one generally having 2 segments on piers cast in situ in the middle and a movement joint type segment on the pier at each end. It took 22 months to construct all the viaducts.

## 3.2 Erection methods

The launching girder, Fei Long – Flying Dragon in Cantonese – was assembled and delivered at the beginning of 2005. Being 150 metres long and weighing 700 tons, this tool was manufactured especially for the project. The erection rate of 3 pairs of segments per shift was quickly reached after only a few spans had been installed to get up to speed! The maximum number of segments erected in one working day was 14 (2 shifts per day, 11 hours per shift).

The side spans were entirely suspended from the launching girder by a system that was specially designed for the project. The biggest challenge for the 150-m launching girder was the installation of the access ramps with a radius of 125m in plan view. Such an installation was made possible by certain features of the launching girder which allow the rotation of supporting struts and transversal frames up to 30°. The 30m transversal frames bearing the launching girder allow the beam to unhinge enough during the curve launching phase