Immersed Tunnel in Saigon River

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1. Introduction

Saigon Tunnel is a part of Saigon East-West Highway Construction Project which is constructed by Official Development Assistant (ODA) funded by Japan International Cooperation Agency (JICA). Its design and supervision of works were conducted by Oriental Consultants Company Limited in association with Environmental Technology Company Ltd. and Asia Pacific Engineering Consultants. The tunnel connects District 1 and District 2 of Ho Chi Minh City across the Saigon River. It is expected to ease traffic congestion in the center district of Ho Chi Minh City. Saigon East-West Highway is composed of Package 1 and Package 2. Package 1 is to build a 14km highway from District 1 to Binh Chanh District. Package 2 is to build an 8 km highway which includes 370m Immersed Tunnel and 720m Cut & Cover Tunnel.

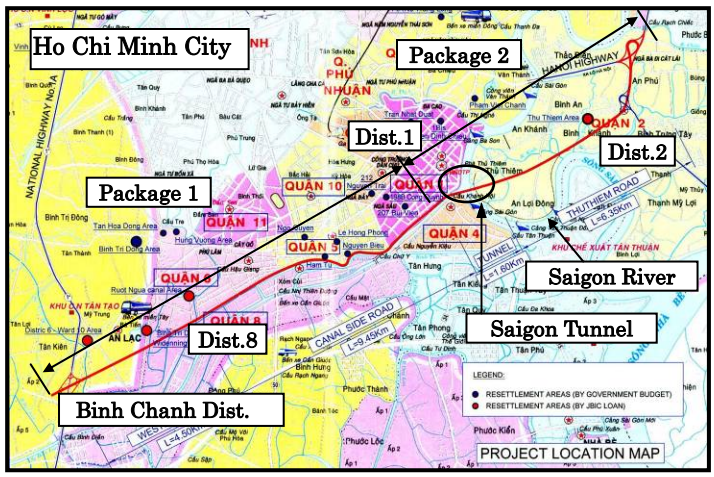

Fig.1 Map of East-West Highway

2. Project Outline

Immersed Tunnel consists of 4 units. Each unit is about 92.4m long, 8.9m high and 33.3m wide. Steel Shell was constructed at both ends of tunnel unit and middle part is a reinforced concrete structure. Dry dock for fabrication of each tunnel unit was located 22km downstream from the sinking location.

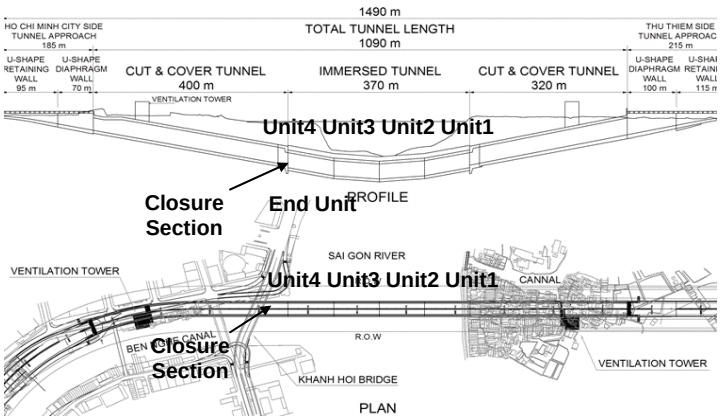

Fig.2 Profile and Plan of Saigon Tunnel

After fabrication of tunnel unit, dry dock was filled with water pumped up from the river. Tunnel unit was floated one by one and two alignment towers and two pontoons were set on the top of tunnel unit for preparation of sinking. Towing is conducted by 4 tugboats with azimuth thruster (Z peller). It took about four and half hours to tow the tunnel unit from dry dock to sinking location.

Photo.1 Towing of Tunnel Unit

Towing and sinking was performed on the consecutive two days and once a month. After sinking of four tunnel units, 1.25 m length of Closure Section was encased with steel closure panel. Concrete was placed from inside the tunnel at Closure Section to connect the tunnel.

Keyword: Saigon River, Immersed Tunnel, Tower Pontoon Method, Pile Foundation, External Jack
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3. Constraints of This Project

(1) Current Velocity Change Caused by Tidal Movement

Although the sinking location is located at about 60km from river mouth, the daily tidal level varies maximum 2.7 m. Current Velocity change due to tidal movement affected the plan of towing and mooring (Towing speed, Selection of tugboat, Size of mooring wire and Weight of sinker) and the sinking work. When towing was completed, tunnel unit was rotated at 90 degree and moored parallel to the tunnel axis. To conduct the mooring work safely, the starting time of towing should be determined by forecasting the time that the current velocity became zero. When sinking, diver work is critical to check the position of sunken unit and connecting unit. The diver work should be completed during the time that the velocity is lower than 0.5 m/s for safety.

(2) Limitation of Construction Schedule

Towing and sinking should be conducted at neap tide which comes twice a month. The schedule was made that the sinking would be performed once a month considering removal of outfitting, construction of sand foundation and backfilling work after sinking. As the available working time for divers was limited because of velocity change, selection of temporary support method for tunnel unit was critical under this time schedule.

4. Method Applied to This Project

Considering the constraints mentioned above, we studied and adopted the following countermeasures.

(1) Tower Pontoon Method

We selected Tower Pontoon Method from other three methods such as Placing Barge Method, Placing Pontoon Method and Crane Barge Method because it could set the tunnel unit precisely and safely even there was a current and it was more economical. The occupied area of this method is relatively small which is also appropriate to the sinking work in the river.

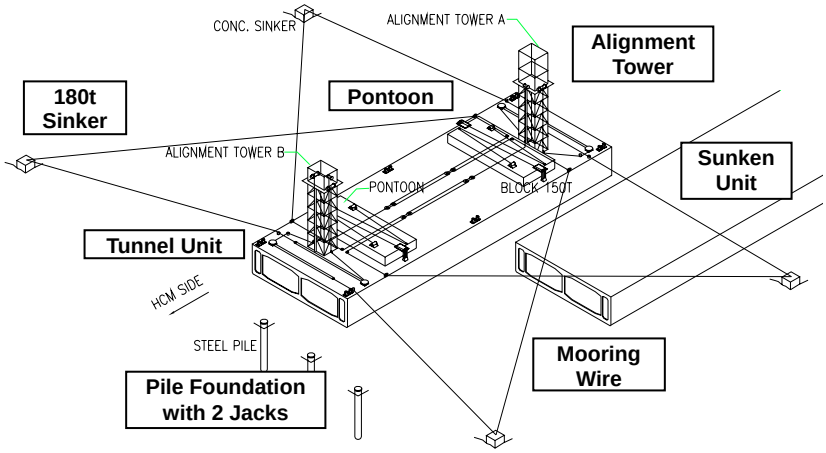

Fig.3 Tower Pontoon Method

(2) Temporary Support by Pile Foundation and External Jack

We selected pile foundation and external jack for temporary support of tunnel unit instead of gravel foundation with concrete slab and embedded jack cylinders. Advantage of this method is that the diver work can be reduced compared with gravel foundation with concrete slab, that piling work can be conducted in advance to the sinking work, and that the external jack can be installed by small crane barge without interruption to other ship navigation in the river. In addition, although the embedded cylinder passes through base slab and might affect the water tightness of tunnel unit, the external jack does not make such a weak point. External jack can be re-used for next tunnel unit, which save the cost compared with installing cylinder inside all units.

5. Summary

Sinking work was performed from March 2010 to June 2010. Total 4 numbers of tunnel units were sunk once a month without any problems following the schedule. The Tower Pontoon Method, pile support and external jack are considered to be effective and practical for the similar project. We believe this tunnel contributes much to the economic development of Ho Chi Minh City for many years to come.

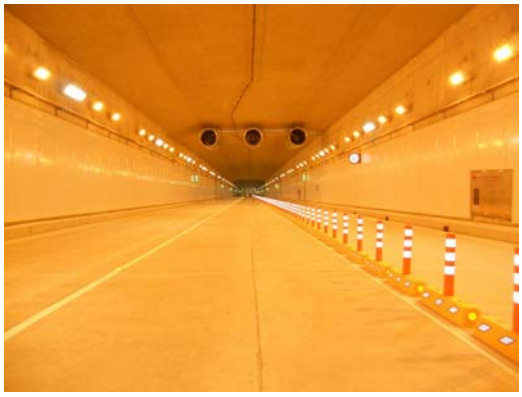

Photo.2 Inside Tunnel after Completion