INTRODUCTION OF HAI VAN PASS TUNNEL CONSTRUCTION PROJECT IN VIETNAM

- Longest Highway Tunnel in South-East Asia -

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Abstract : The Hai Van Pass Tunnel construction, a 6.3km long highway tunnel, is being implemented to improve the main north-south road corridor in Central Vietnam, named National Highway No.1. The existing Hai Van Pass is approximately 20km long, with 475m elevation change, of low standard highway with numerous tight bends and a steep gradient. The tunnel project is the first application of the New Austrian Tunneling Method (NATM), longitudinal ventilation system with the Electrostatic Precipitator (EP), Supervisory Control And Data Acquisition (SCADA) for a highway tunnel in Vietnam. The construction started 1st October 2000, the tunnel breakthrough was celebrated on 7th November 2003, and the traffic opening will be early 2005. This paper introduces the general view of the project, as a record of turning point project of civil engineering field in Vietnam.

Key words : Highway, Tunnel, NATM, Longitudinal Ventilation System, Vietnam

1 BACKGROUND

The Hai Van Pass located in coastal Central Vietnam, is the biggest traffic bottleneck on the National Highway No.1, which is the most important North-south longitudinal arterial linking the capital Hanoi with Ho Chi Minh. The Pass rises to an elevation of 475 m for approximately 20 km with continuous small curves and steep grade. From the late 1990's, the rapid development of national economy has increased the logistic volume through the Pass, however, the heavy tracks have been forced to run slowly and fatal traffic accidents increased year by year. In addition, the road is often blocked due to the landslide and slope failure during the rainy seasons. Under such circumstances, the Government of Vietnam decided to construct a new highway segment with a tunnel under the Hai Van Pass by the Prime Minister's Decree in March 1994.

Fig. 1 Project Layout

2 TUNNEL OUTLINE

1) Length:	12,182m
2) Traffic Lane:	2 Lanes 3.75 +1.25 shoulder. Total 10.0m
3) Tunnel Length:	6,274m (Main Tunnel, MT), 6,286m (Evacuation Tunnel, ET) 1,888m (Ventilation Adit, VA)
4) Tunneling Method:	NATM
5) Cross-section:	89m2(MT), 15.5(ET),36.2(VA)
6) Cross-Passage:	400m interval
7) Ventilation System:	Longitudinal System, 23 Jet Fans, 3 EPs, 1 VA

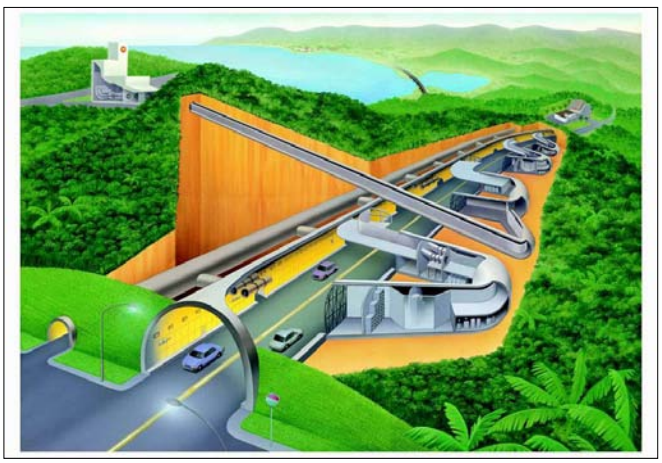
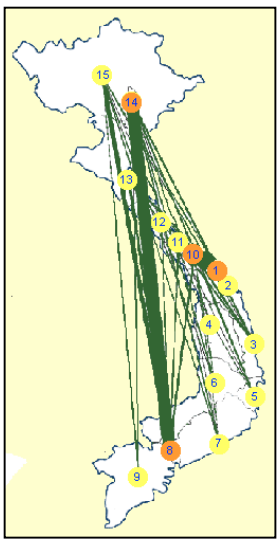


Fig. 2 Tunnel Ventilation System

2.1 Traffic demand forecast



In 2002, the supplemental traffic survey was carried out in order to confirm the proper timing of the 2nd tunnel opening. The study reconfirmed the importance of the project for the development of the national economy: 20% of the traffic passing the Pass was between Hanoi and Ho Chi Min; annual traffic growth rate was approximately 18% and the traffic volume was forecasted to reach the capacity of the tunnel in 2016. Means the 2nd tunnel should be built and opened timely.

Fig. 3 Traffic Movement Pattern through Haivan Pass[1)]

2.2 Distinct characteristics of the project

Distinct characteristics of the project can be summarized as the following items:

1) 6.3km long highway tunnel
2) 1st NATM tunnel in Vietnam
3) Longitudinal Ventilation System
4) SCADA for Overall System Control
5) O&M Company

2.3 Implementation Program

The construction was started on 1st October 2000 and, as of December 2003; the project implementation is scheduled as follows:

Completion of civil works:	December 2004
Completion of mechanical works	April 2005
Completion of electrical works	April 2005
Operation Training	May 2005
Traffic Open	June 2005

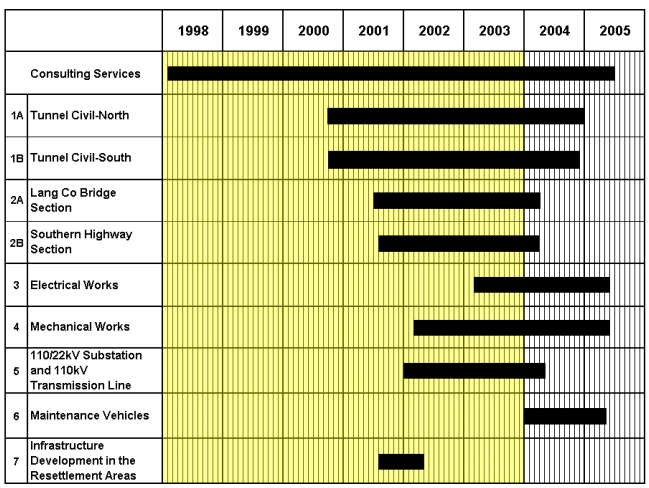


Fig. 4 Implementation Program (As of December 2003)

2.4 The Project Scale

The project is divided into a number of contract packages and the contractors have been selected by International Competitive Bidding (ICB) except Package-VII: Infrastructure Development in the Resettlement Areas which is by Local Competitive Bidding (LCB).

Table 1 Project Scale

(1000USD)

Consulting Services		14,724
Package 1A	North Tunnel Section	43,256
Package 1B	South Tunnel Section	27,863
Package 2A	Lang Co Bridge Section	4,633
Package 2B	Southern Highway Section	3,920
Package 3	Electrical Works	20,686
Package 4	Mechanical Works	23,055
Package 5	110/22kV Substation and 110kV Transmission Line	7,256
Package 6	Procurement of Maintenance Vehicles	(2,000)
Package 7	Infrastructure Development in the Resettlement Areas	413
		147,806

Considering the land acquisition and compensation cost and some additional scope of works, the project scale is some Two Hundred Million US Dollars.

3 PROJECT ORGANIZATIONS

3.1 Bank

The project is implemented by Japanese ODA Loan through Japan Bank of International Cooperation (JBIC). The first Loan Agreement (L/A) was concluded on March 26, 1997, subsequently the second and the third was concluded March 30,1999 and March 29, 2002, respectively. Total L/A amount is 18.859 Billion JPY.

3.2 Executing Agency

The executing agency of the project is the Project Management Unit No.85 (PMU85) under the Ministry of Transport (MOT) of the Government of the Socialist Republic of Vietnam.

3.3 Consultant

The design and supervision services have been carried out by the Consultant Team, Joint Venture of Nippon Koei Co., Ltd., Japan and Louis Berger International Inc., USA in association with Transport Engineering Design Incorporation (TEDI), Vietnam. The Service consists of 1) Special Survey, 2) Detailed Design, 3) Contract Tendering Assistance, 4) Construction Supervision, and 5) Training and Technology Transfer. Consultant Team consists of the following teams as of December 2003:

1) 1: Core Team
2) 4: Resident Teams
3) 1: QS Team
4) 1: Geotechnical Team
5) 1: Supporting Staff Team

3.4 Contractors

All the contract packages were already commenced except Package VI: Procurement of Maintenance Vehicles. Awarded contractors are tabulated below:

Table 2 Awarded Contractors

Package 1A	North Tunnel Section	JV Hazama – Cienco 6
Package 1B	South Tunnel Section	JV Dong Ah – Song Da
Package 2A	Lang Co Bridge Section	JV Thang Long – Truong
Package 2B	Southern Highway Section	JV Cienco 1 – Lung Lo – Vinawaco
Package 3	Electrical Works	JO of ABB – Kinden – Vinainco
Package 4	Mechanical Works	Matsushita – Itochu
Package 5	110/22kV Substation and 110kV Transmission Line	JO of ABB – Kinden – Vinainco
Package 6	Procurement of Maintenance Vehicles	(Not Yet)
Package 7	Infrastructure Development in the Resettlement Areas	Construction Company No. 185

4 TUNNELING PROGRESS

4.1 Portal Location

The locations of the tunnel portal were selected to optimize the tunnel alignment against construction costs including minimizing the soft soil excavation at the portals. Another consideration for the south portal was to drive the main tunnel directly beneath a sacred Banyan tree at the portal.

4.2 Waterproofing Membrane and Drain

The main tunnel is designed as a waterproofed drained single tube with a 2mm thick PVC waterproof membrane or a 0.8mm thick EVA membrane. North contractor applied EVA and the south applied PVC, and both systems have proved equally successful in sealing the tunnel lining. Any water is collected in the fabric installed beneath the water proof membrane to be channeled into the side collector drains and the main center drain.

4.3 Geology

The NATM support type has been determined by the RMR value, Hai Van rock mass has averages at around 70, therefore the support is mostly Type I, which is 50mm of shotcrete and bolting determined locally by the rock jointing. However, for the first 100m at each portal, highly weathered to completely decomposed granite exists and both contractors experienced hard time.

Table 3 Support Type

(m)

	PK1A		PK1B	
TYPE VI	39	1.01%	79.4	3.31%
TYPE V	36	0.94%	35.6	1.48%
TYPE IV	6	0.16%	41	1.71%
TYPE III	111.7	2.90%	170.2	7.10%
TYPE II	324.2	8.43%	753.8	31.44%
TYPE I	3328.9	86.56%	1317.825	54.96%
Subtotal	3845.8	100.00%	2397.825	100.00%
Cut & Cover	10		25.585	
TOTAL	3845.8		2397.825	

4.4 Tunnel Excavation Progress

Average excavation rate is 150m per month for the main tunnel for both sections except the first softground sections.

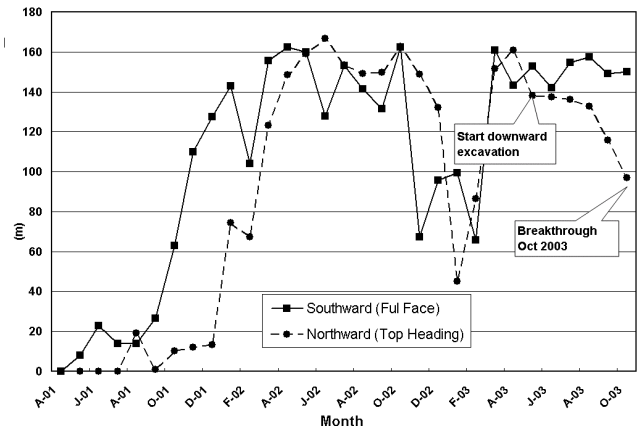


Fig. 5 Tunnel Excavation Rate (Main Tunnel)

4.5 Concrete Lining Progress

Both contractors mobilized two sliding forms for the standard section and one for the lay-by section. Potentially, over 200m per month can be achievable, but this works was not on the critical path for the overall tunneling progress.

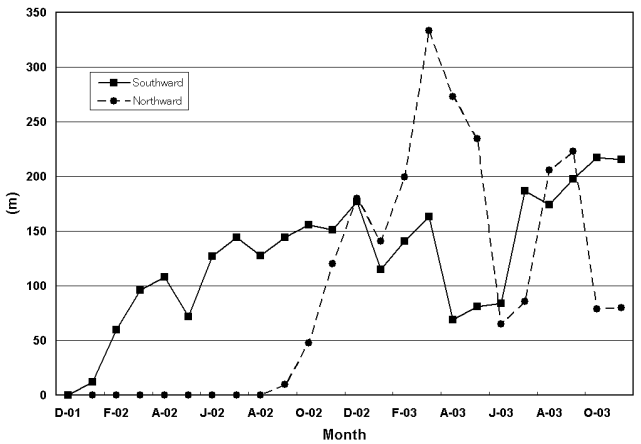


Fig. 6 Tunnel Concrete Lining Rate (Main Tunnel)

4.6 Rear Works

Rear works, i.e. drainage works and cable ducts, have been progressed well and the work zones, approximately 400m interval, have been hand-over to the mechanical contractor for his water-pipe works, approximately every month.

5 LONGITUDINAL VENTILATION SYSTEM

Longitudinal ventilation system with the Electrostatic Precipitator (EP) was invented and developed in Japan. The EP is a device to remove smoke dust by electrical discharge. After the development of the EP, the longitudinal ventilation system with the EP became the standard method of the long highway tunnel in Japan, because it reduces the number of the ventilation shafts, reduces cross-section area of the main tunnel and therefore the requirement electricity. Consequently, the construction and operation costs are lowered. In the Hai Van Pass Tunnel, one ventilation adit, 3 EPs and 23 Jet Fans are required.

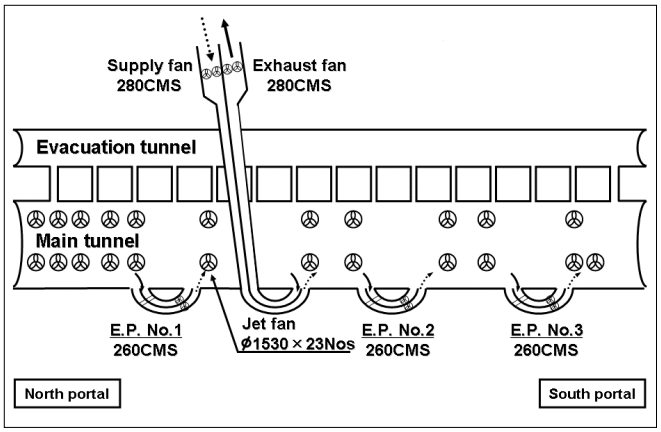


Fig. 7 Layout of Tunnel Ventilation Units

6 SCADA FOR OVERALL SYSTEM CONTROL

"Micro-SCADA" is a microcomputer-based, programmable and distributed Supervisory Control And Data Acquisition (SCADA) system, and applied to the project for over all system control. Following individual system is integrated by SCADA in the project:

1) Power Distribution System
2) Tunnel Lighting System
3) Traffic Management System
4) Telecommunication System
5) Fire Detection System
6) Fire Protection System
7) CCTV System
8) Radio Rebroadcast System
9) Ventilation System

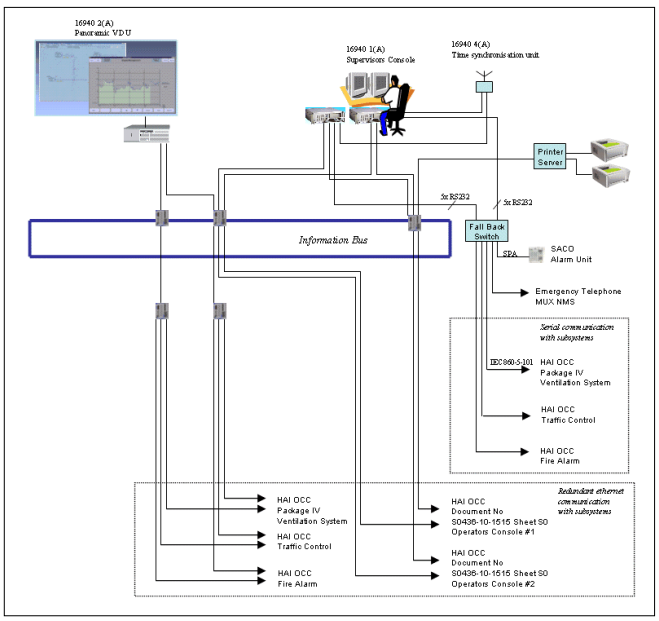


Fig. 8 SCADA for overall system Control

7 O&M COMPANY

Establishment of the organization for operation and maintenance and training has also been an important part of the Project because such long road tunnel is the 1st introduction in the country. The O&M Company, namely HAMADECO, was established by referring the Japanese practice of highway tunnel operation, which was introduced and guided by specialists from Japan.

New concepts of motorization society has been introduced by several teams such as "relation between road-user and road-administrator", "high-speed society and required traffic manner", "traffic safety education".

8 TRANSFER OF TECHNOLOGY

Transfer of technology were carried out through three approaches, 1) through On the Job Training (OJT) of both the Consultant and Contractors, 2) Special training under the Consulting Services contract, NATM training program for design method course and the construction method course, and 3) Contractor's trainings.

Just before the traffic open, overall operation training shall be carried out for O&M Company.

9 PROJECT MANAGEMENT

In addition to the standard duty stipulated in FIDIC[2)], the Consultant has been taking proactive initiative for work coordination among the contractors because all contractors are required to work simultaneously inside the tunnel in order to shorten the overall construction period. Weekly basis work coordination meeting has been held. Primavera P3[3)] was used as scheduling tool. PMBOK[4)] was referred to for the project management.

A result of such project management is opened to the public thru the Internet. URL: http://haivan.cup.com

10 SUMMARY

This report summarized a historical civil engineering project in Vietnam. Introducing new technology to a country requires much effort of all the concerned agencies and people, from planning phase to maintenance phase. Long tunnel project in Vietnam is really timely project to support the rapid growth of the national economy and as an event at the beginning of the motorization era of the society.

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