

# STORM WATER MANAGEMENT AND ROAD TUNNEL

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**Abstract :-** SMART TUNNELS stands for “Storm Water Management and Road Tunnel” Project. This project is located at Kuala Lumpur the capital metropolitan city of Malaysia. Malaysia is located in the South East Asia in the equatorial climate region.. Flooding of city has become an annual event. Along with the rapid development of the city, an increasing number of vehicles entering and exiting the city center has also created congestions especially at the southern gateway of the city. In addressing, both issues at one go a brilliant, unique and smart solution was found, that is by constructing a by-pass tunnel to be used for both diverting excessive storm water and as a road tunnel. SMART was built in 2003 and the whole structure was fit for usage in the middle of 2007.

**Key Words:** SMART, Tunnel, Flood, Kuala Lumpur

## 1. INTRODUCTION

SMART features a dual-purpose tunnel, first of its kind in world, incorporating a double-deck motor way with in the middle section of the storm water tunnel. The successful completion of SMART is attributed to the innovative technologies and its skilled team players. Being the first of its kind, whether in technology, construction techniques or products used were employed in order to successfully complete the entire project within the stipulated time frame of 4.5 years.

### 1.1 SMART

SMART is an innovative project of the Government of Malaysia to solve flooding problem in city center of Kuala Lumpur at Klang River and around the vicinity of Masjid Jamek. The project also serves to ease the traffic congestion problems between Kaula Lumpur city center and southern gateway at Sungai Besi. The unique feature of SMART is 3km double-deck motorway tunnel within the 9.7km tunnel which starts near the Kampung Pandan in the city center and ends at Kuala Lumpur –seremban Highway.

## 2. MODES OF OPERATION

The Storm Water management and Road Tunnel have a unique feature that distinguishes the tunnel to other tunnels in the world. This is because the tunnel is the one of the kind project in the world that combines the concept of wet and dry tunnel system. The tunnel caters for vehicle passage way and also channels to divert the storm water from Kula Lumpur city centre. The main operation of the SMART Tunnel mainly evolves on three principles based on the flood discharge at the Klang River and Ampang River confluence includes the operation of the traffic diversion motorway.

The first principle : The overall upper deck and lower deck will be used fully has the traffic motorway.

The second mode: when there is flood water is diverted into the bypass tunnel by using the third deck (lower channel) .

The third mode: when heavy storm hits the city. When this happens the system will close down the upper deck and lower deck to vehicle.

## 3. DESIGN

In November 2001, the outline of the scheme was based on a 9.7 km long tunnel and 11.83m internal diameter bored tunnel and outer diameter is about 12.8m. The center 3km length tunnel would serve as a highway tunnel by providing two decks. The upper deck is provided with two 3.25m wide traffic lanes and an emergency lane of 2.20m flowing south and the lower deck makes similar provision for traffic flowing north.

There would only be enough space for cars and maximum vehicle height was restricted to 2.20m with a clear height between decks of 2.55m. The design speed was restricted to 60km/hr with an indicated speed limit for traffic of 50km/hr.

### 3.1. MAIN COMPONENTS

#### 1) HOLDING POND

Holding pond is the head of SMART that draw water from the river and passes into the tunnel. It is located on the left bank of the Klang River at the Klang /Ampang confluence.

#### 2) STORAGE RESERVOIR

This reservoir is an examining pond situated at the downstream end of the tunnel, just south of the Federal Highway.

#### 3) DIVERSION TUNNEL

The diversion tunnel is the bypass conduit that connects the holding pond to storage reservoir.

#### 4) ROAD TUNNEL

It is a 3km long motorway tunnel that connecting the important cities. A double deck is chosen for the traffic compartment for safety reasons.

#### 5) FLOOD GATES

Flood gates are installed in the junction boxes keep the tunnel either dry or flooded as required during operation.

#### 6) ROAD GATES

Road gates are placed at either end of the traffic compartment will prevent water in the tunnel from reaching the surface at the ingress or egress.

### 4) TUNNELING METHOD

The SMART Tunnel uses the Slurry Shield TBM for the boring of the tunnel. Slurry shield are commonly used in stable condition such as hard rock or cohesive. It operates when required specific gravity and viscosity is pressure-fed into the cutter chamber at the front end of the TBM. . This is done to support the tunnel face by using the pressure exerted of the slurry and the viscosity of the slurry permeated into the tunnel face against the earth pressure and groundwater pressure. The slurry shield is very useful in areas with very high among groundwater flows. Two types are:

1. TUAH TBM
2. GEMILANG TBM

**Table -1: Tunnel Boring Machine(TBM) Details**

Cover Length	10.245m
Cover Weight	1500 Tonnes
Overall Length	70m
Overall Weight	2500 Tonnes
Cutterhead Diameter	13.26m
Maximum Speed	30mm/min
Minimum Steering Diameter	200m
Total Power Supplied	8200kVa
Cutterhead's Electric Power	4000kW

## 5. TUNNEL LINING

In the design of the tunnels lining, SMART Tunnels uses pre-cast tunnel lining segments. The lining installation is simultaneously as the drilling work. This is one of the major advantages of using the Slurry Shield TBM machine as the drilling tool. After the TBM machine progresses with the drilling work, the installation of the tunnel lining work are done using the same rails used by the TBM machine as the movement rail. The rail provides easy access for the tunnel lining to be brought into the tunnel and the installation works progresses as the drilling continues. A single ring-shaped steel reinforced lining segments are used as the mould to support one segment to the other segments as the joining of the segments took place. A crane that is controlled using remote will be used to lift up and place the lining at the location to be installed.



**Fig -1:** Animated View of Smart

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## 6. CONCLUSION

SMART Tunnel is one of the kind projects they have more benefits to the people. The main reason the tunnel was proposed is to solve the flooding and the traffic congestion. This is the only tunnel in the world that combines the storm water channel and also traffic diversion roads in one tunnel system. The transportation system in Kuala Lumpur needs this tunnel as the tunnel is the best solution for the best issue.

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