

ITA - AITES WORLD TUNNEL CONGRESS 2007 PRAGUE



The 3<sup>rd</sup> Training course  
**TUNNELLING IN URBAN AREA**  
Prague, 4-5<sup>th</sup> May 2007

# **Tunnelling in Urban Area by Slurry Type TBM (Railway Bosphorus Tube Crossing Tunnels and Stations)**

TRAINING MATERIAL PREPARED BY

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(Shield Tunnelling Association of Japan, Taisei Corporation)



ASSOCIATION  
INTERNATIONALE DES TRAVAUX  
EN SOUTERRAIN  
**AITES**



**ITA**  
INTERNATIONAL  
TUNNELLING  
ASSOCIATION



# STA (Shield Tunneling Association of Japan)

- ❑ was established in 1999
- ❑ is joined by 100 companies  
(leading Japanese general contractors, TBM and lining segment manufacturers)
- ❑ is registered 14 reliable, experienced and state-of-the-art shield tunneling technologies
- ❑ is one of the prime sponsors for ITA

1

**Introduction**

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2

**The reason for TBM selection**

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3

**Mechanized Tunnel Construction**

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4

**Connection with Immersed Tunnel  
under Bosphorus**

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5

**Conclusions and references**

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# Introduction

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***Tunnelling in Urban Area by Slurry Type TBM***



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# Introduction

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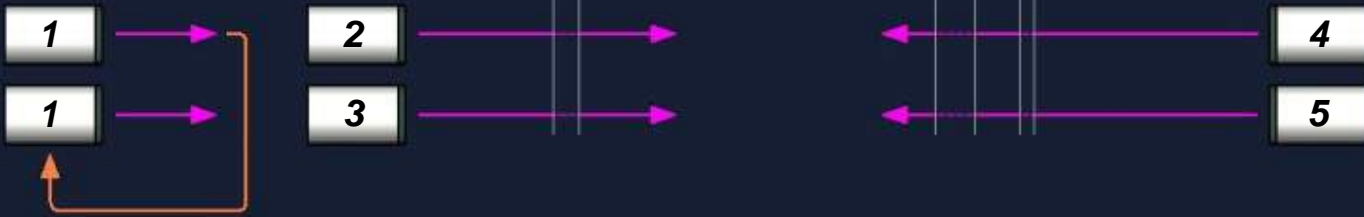
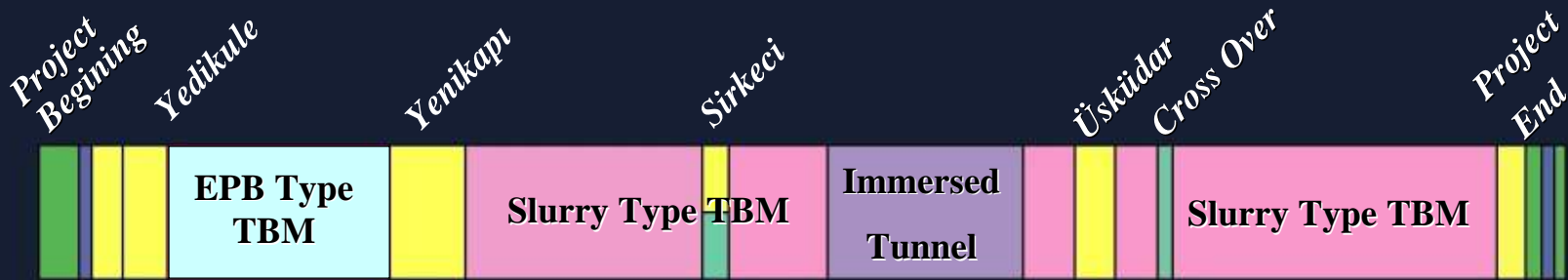
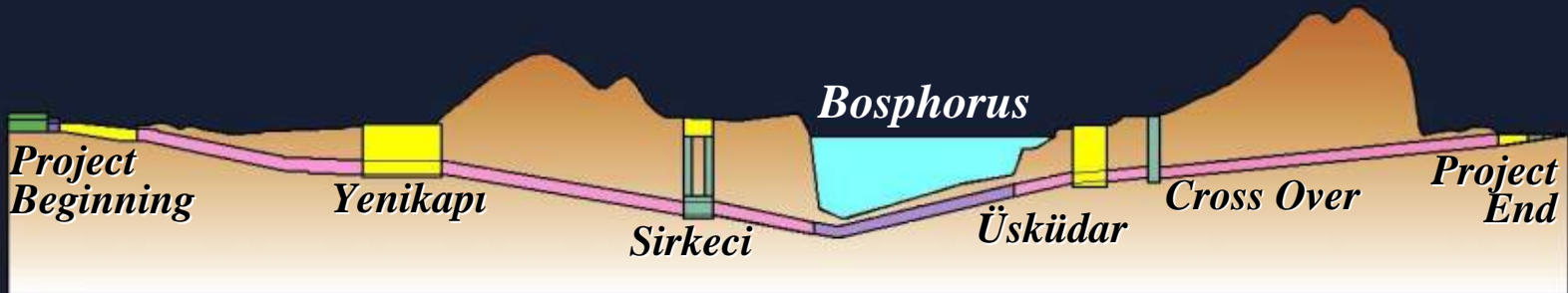
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*European Side*

*Asian Side*



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# Introduction

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*Asian Side*

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*European Side*



*European Side*

*Bosphorus*

*Asian Side*

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# The reason for TBM selection

*Conditions of Performance 1 : In urban area*

*(Under the residential street or the historical building)*

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*Asian Side Portal Area*

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1

# The reason for TBM selection

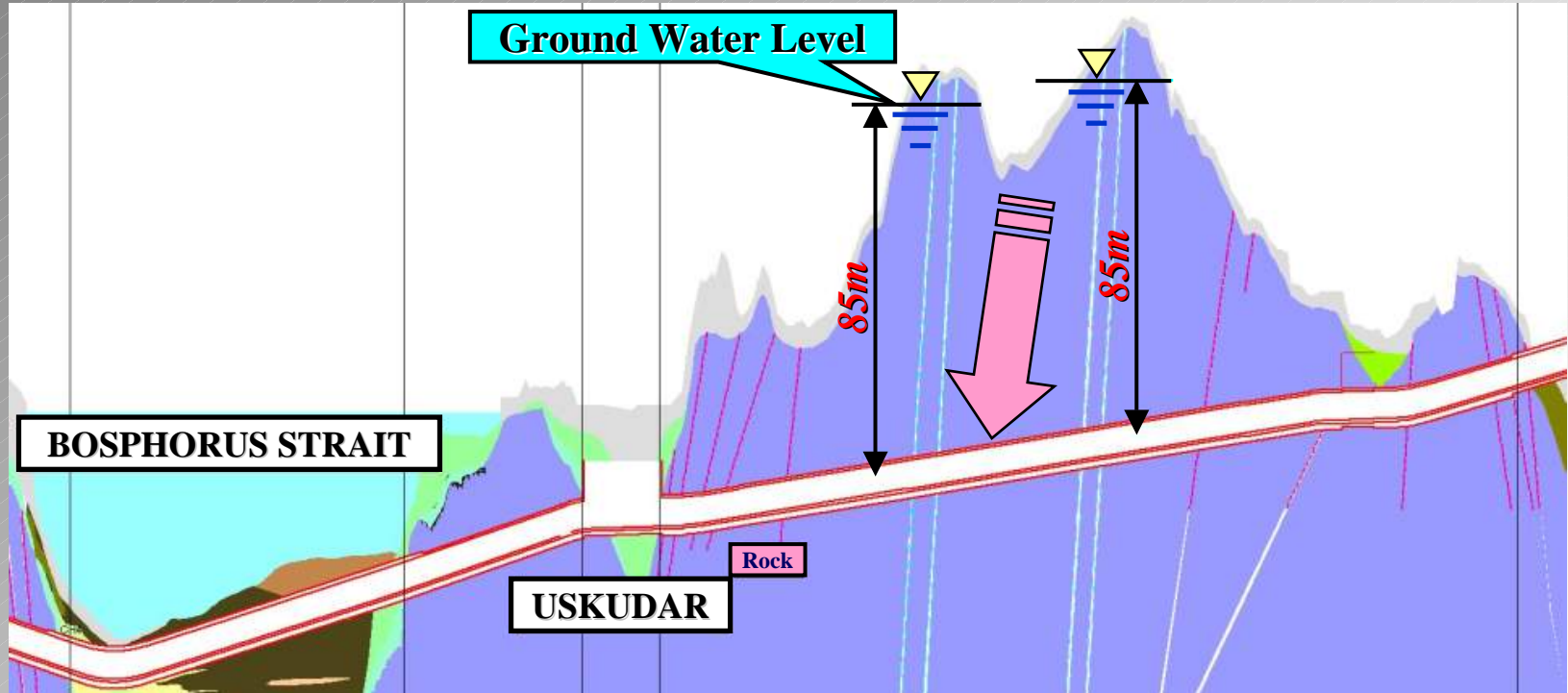
*Conditions of Performance 2 : High groundwater pressure  
(Max 8.5Mpa)*

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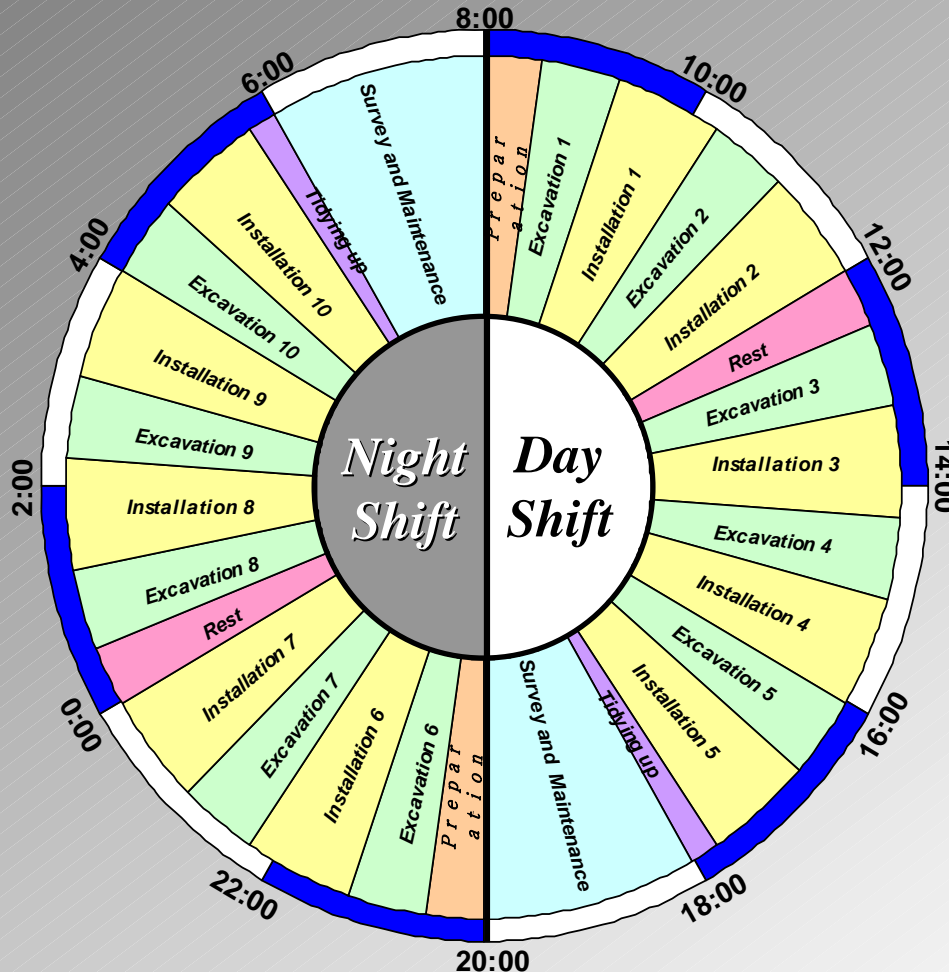
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*Tunnelling in Urban Area by Slurry Type TBM*

# The reason for TBM selection

## Conditions of Performance 3 : Rapid construction



**Total tunnel length**

**Asian side;**

**About 4.2km (14.0 months)**

**European Side;**

**About 3.6km (9.5 months)**

**Average 345m/month  
(15m/day)**

**(Main excavation)**

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# The reason for TBM selection

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## *Slurry Type TBM*

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# MECHANIZED TUNNEL CONSTRUCTION

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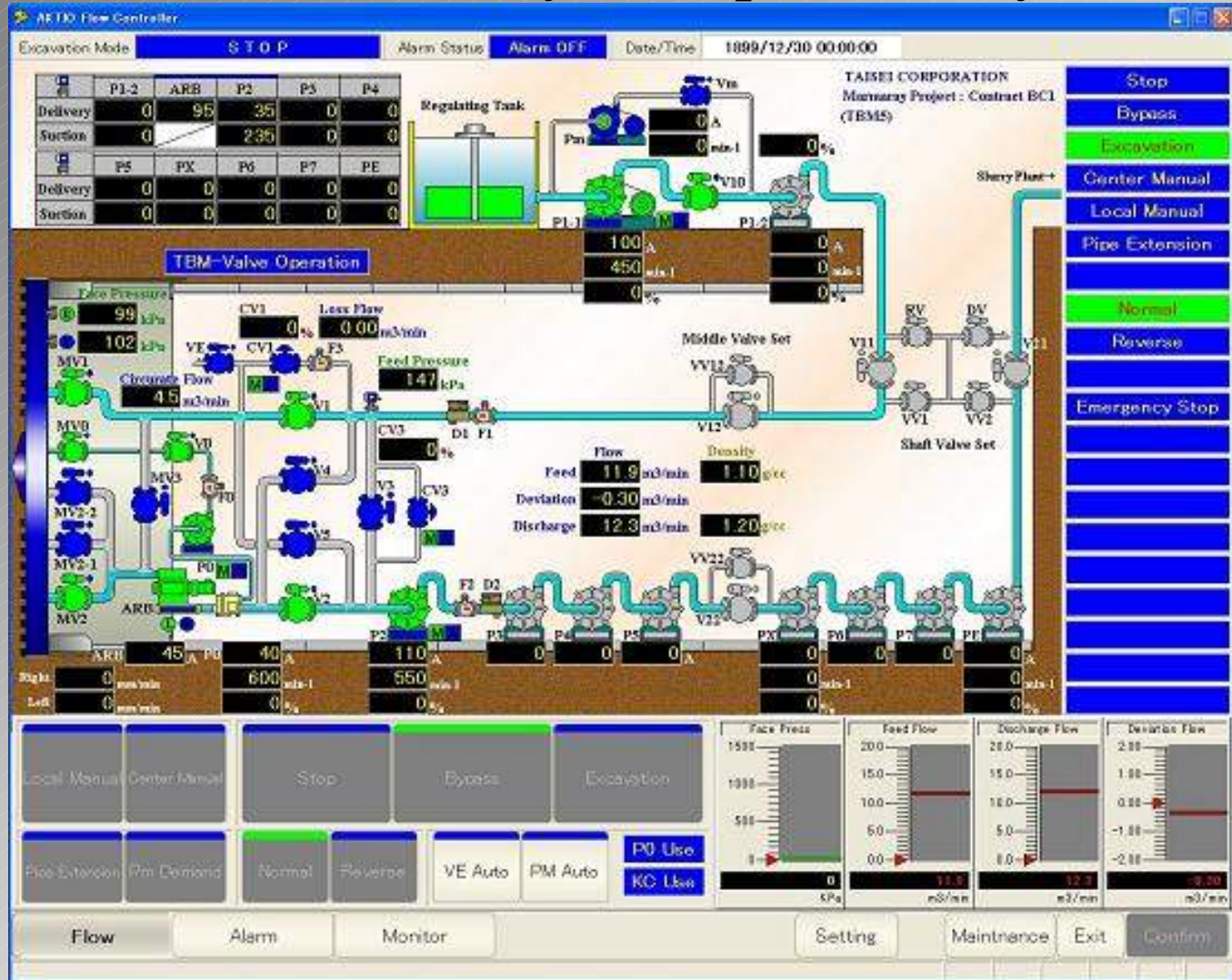
## Mechanization1 : Slurry Transportation System

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# MECHANIZED TUNNEL CONSTRUCTION

1

## **Mechanization1 : Slurry Transportation System**

### *Central Monitoring Panel*

2



**Automatic Control (AC) System**

**To control the slurry pressure, amount of feeding and discharging slurry, pumps and valves are controlled by AC System.**

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**The data necessary for TBM operation can be monitored visually and the record also can be taken.**

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# MECHANIZED TUNNEL CONSTRUCTION

## 1 **Mechanization1 : Slurry Transportation System**

*Slurry Discharging Pump*



*Valve Set*



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*Pipe Extension Equipment*

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# MECHANIZED TUNNEL CONSTRUCTION

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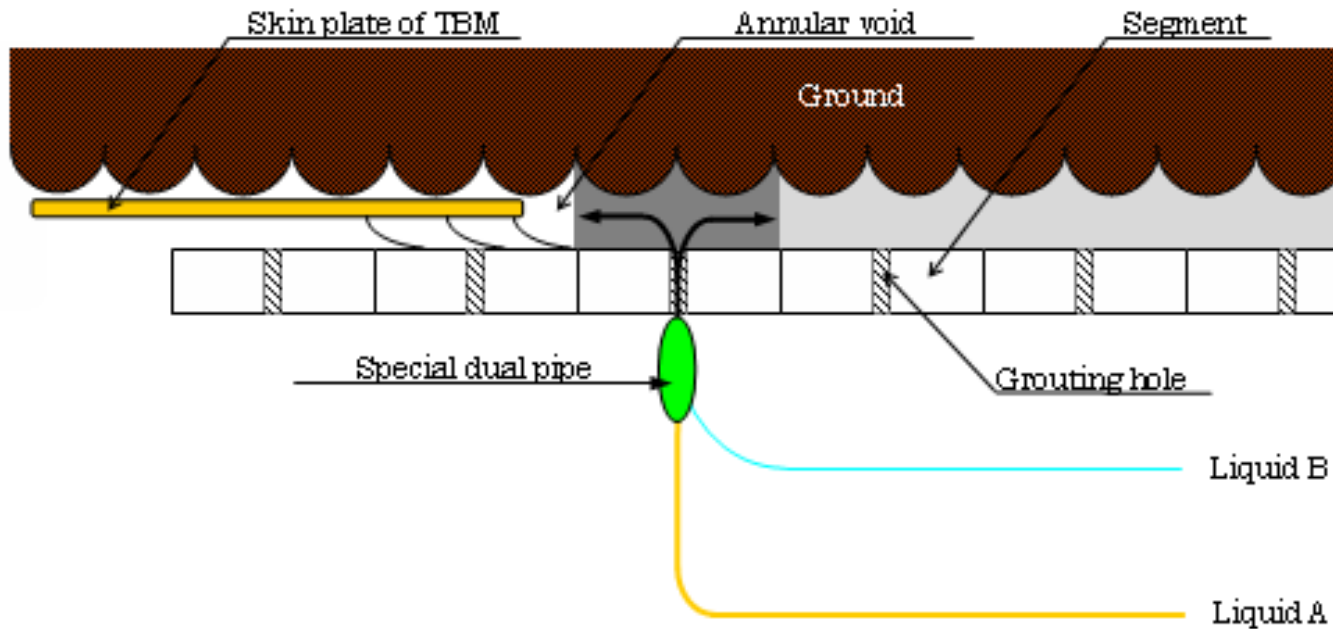
## **Mechanization2 Backfill Grouting System**

*Backfill grouting shall be fed into the annular void without delay from TBM excavation speed.*

2

*Backfill Grouting System control this operation automatically.*

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# MECHANIZED TUNNEL CONSTRUCTION

1

## **Mechanization 2 Backfill Grouting System**

*Automatic Mixing Plant*



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*Injection Unit*



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*Injection Control Panel*



*Injection Work*

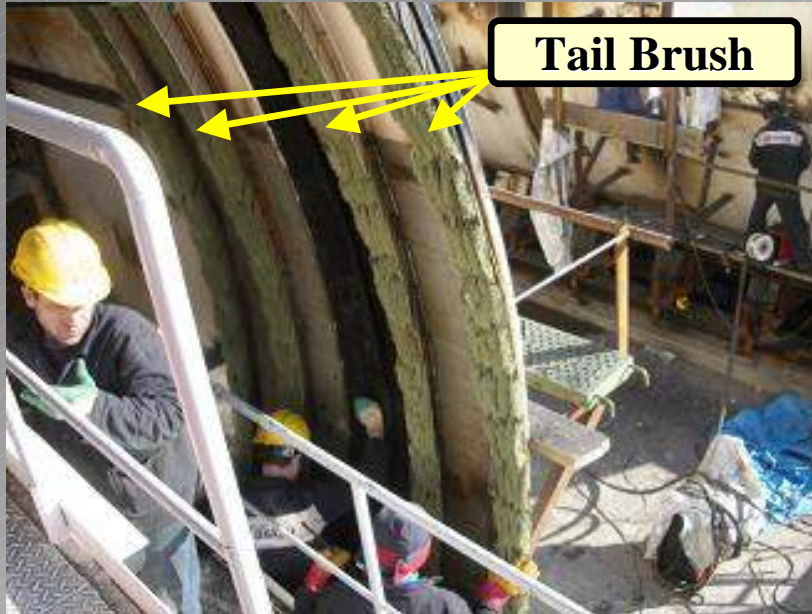
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# MECHANIZED TUNNEL CONSTRUCTION

## 1 Mechanization 3 Tail seal grease injection

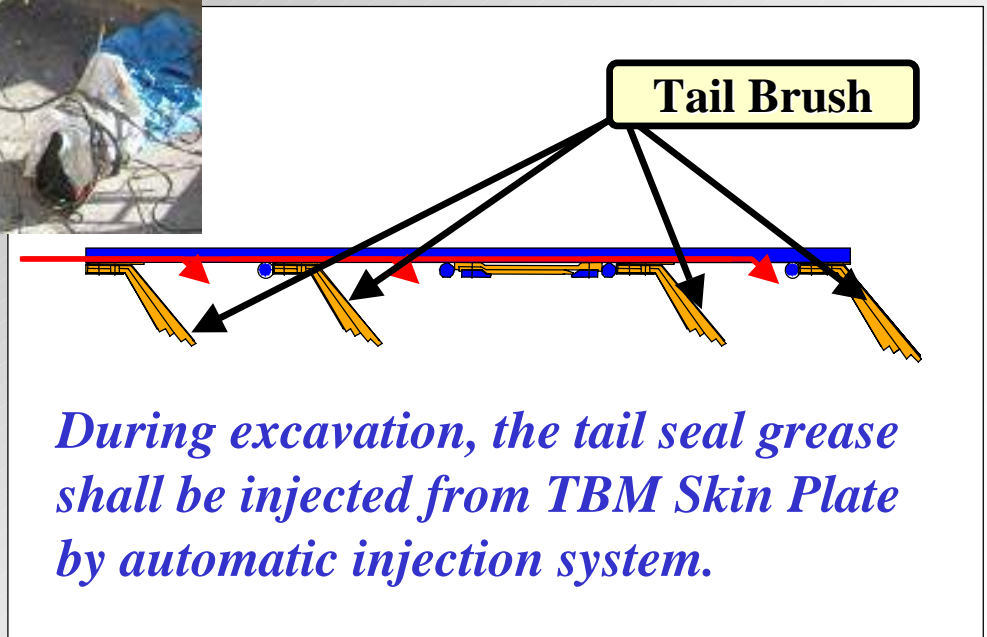
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# MECHANIZED TUNNEL CONSTRUCTION

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## Mechanization 3 Tail seal grease injection

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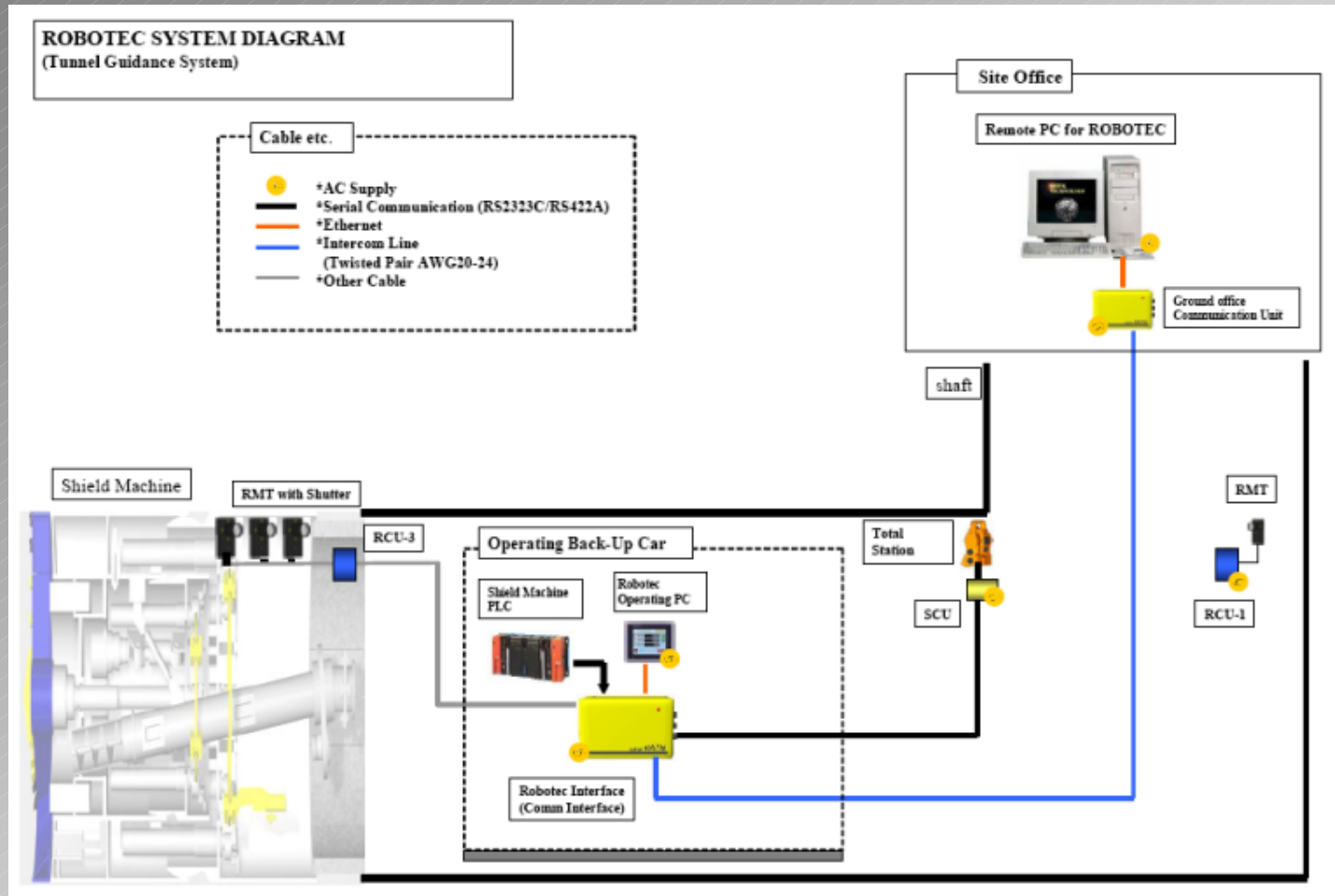


*Automatic Grease Injection Unit*

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# MECHANIZED TUNNEL CONSTRUCTION

## 1 Mechanization 4 Automatic Survey System



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# MECHANIZED TUNNEL CONSTRUCTION

## 1 **Mechanization4 Automatic Survey System**

*In parallel with usual transit survey system, automatic survey system is applied.*

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*Furthermore, high – precision gyroscope is also applied to raise the precision of surveying.*

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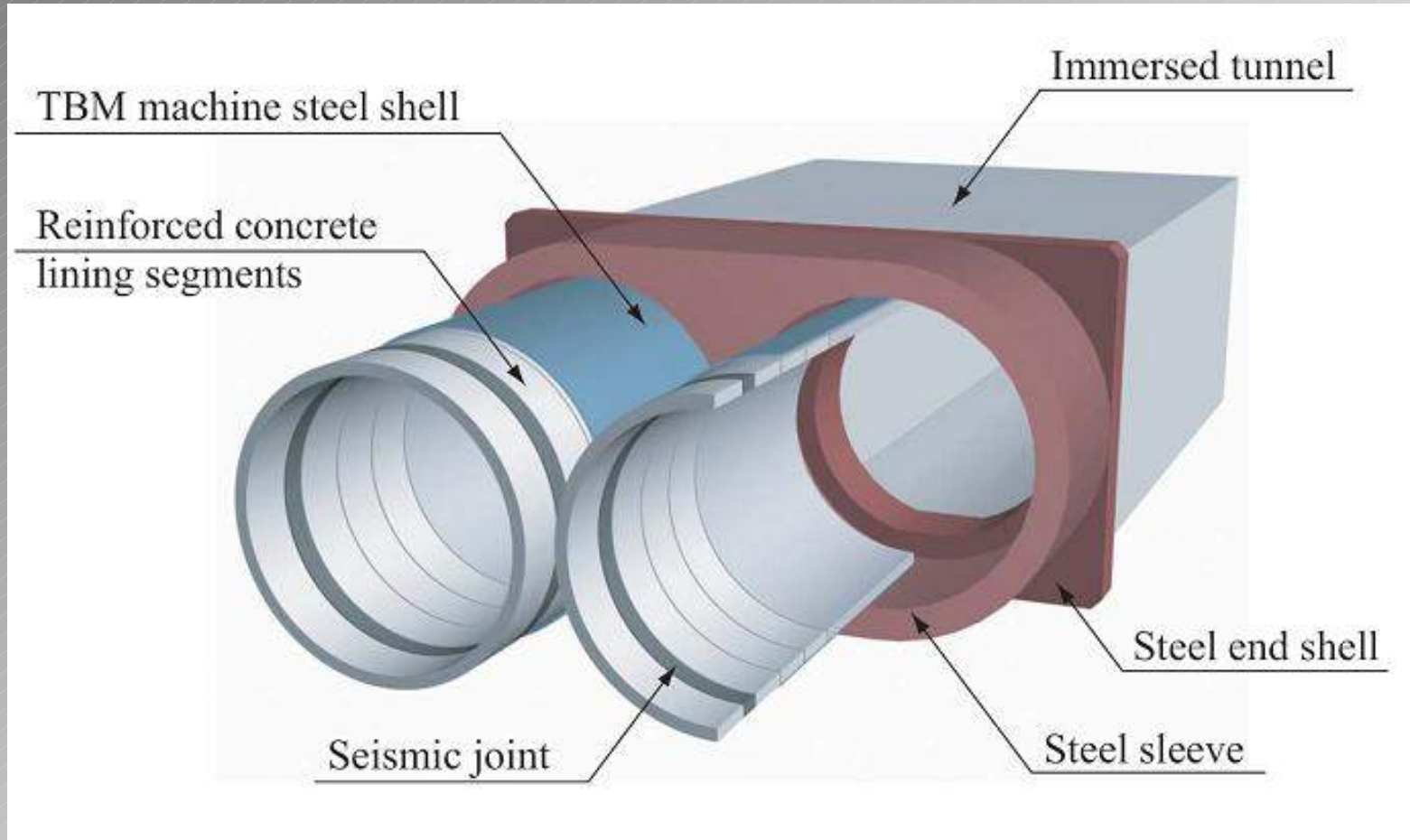
# CONNECTION WITH IMMERSED TUNNEL UNDER BOSPHORUS

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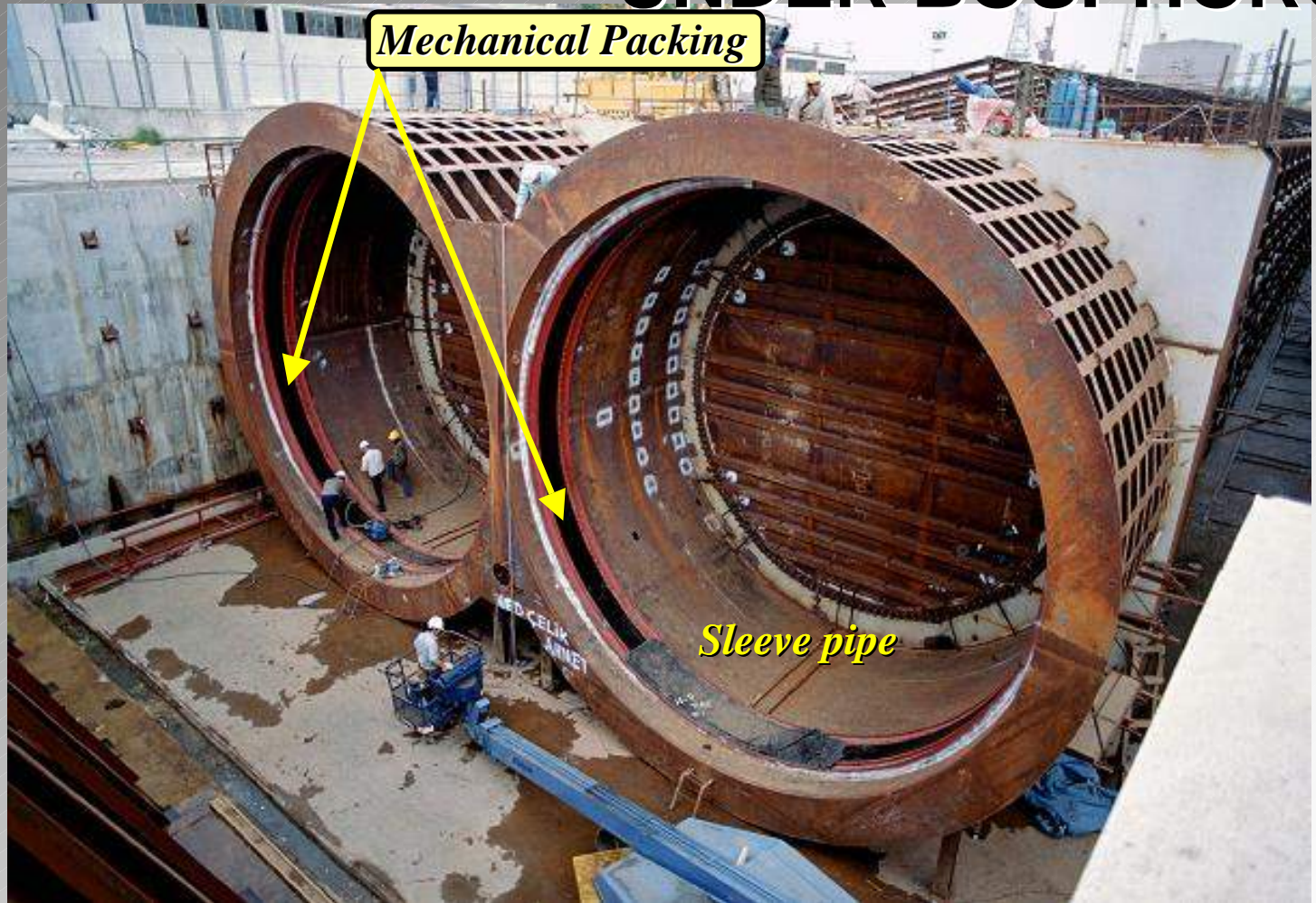
# CONNECTION WITH IMMERSED TUNNEL UNDER BOSPHORUS

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# CONNECTION WITH IMMERSED TUNNEL UNDER BOSPHORUS

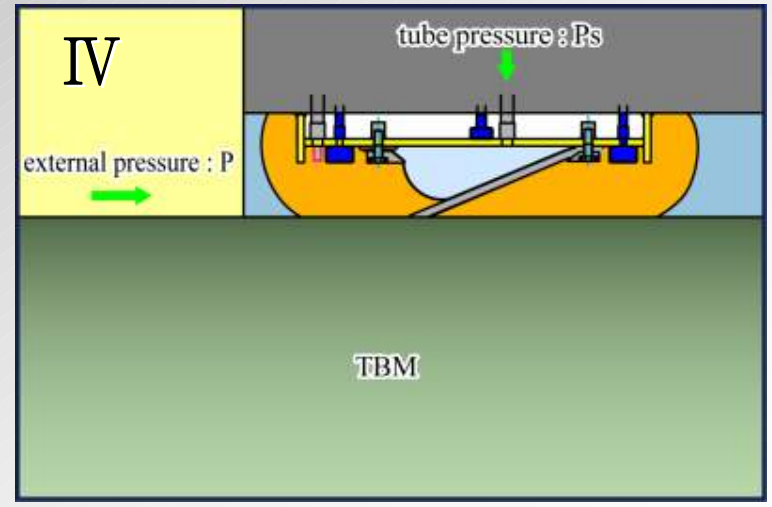
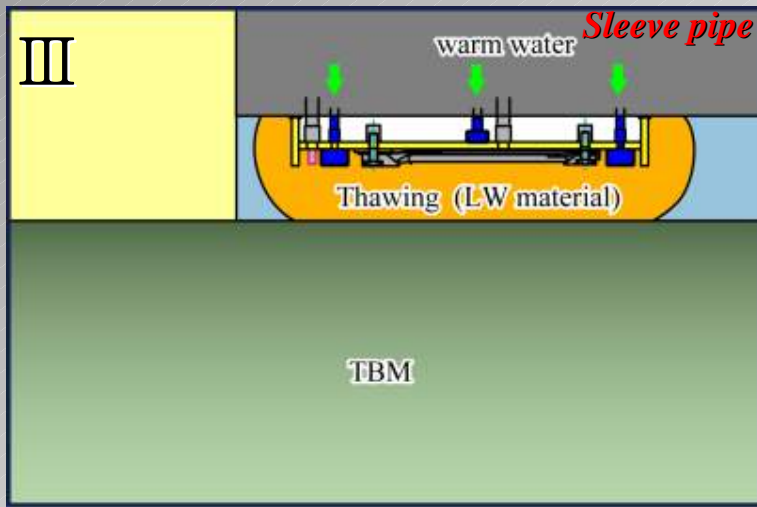
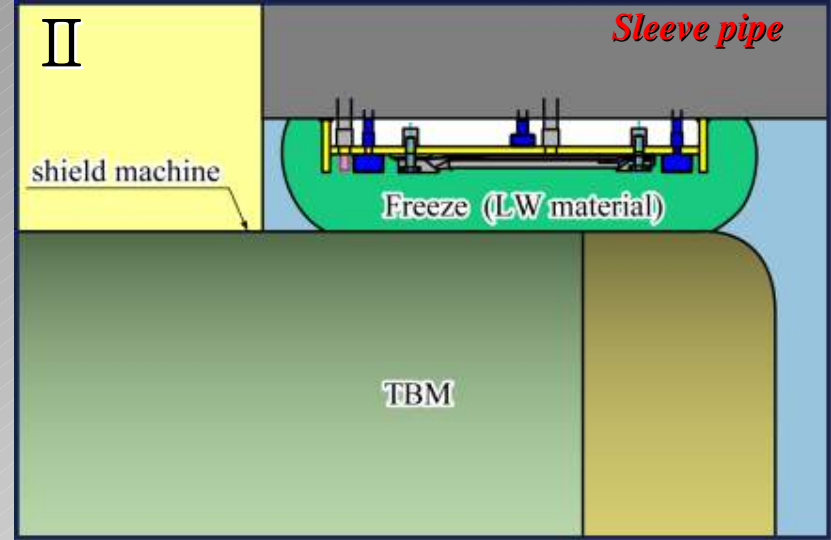
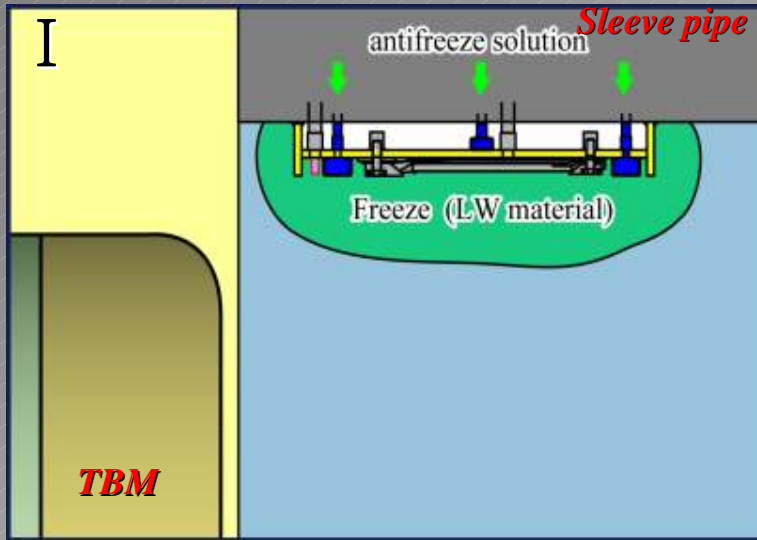
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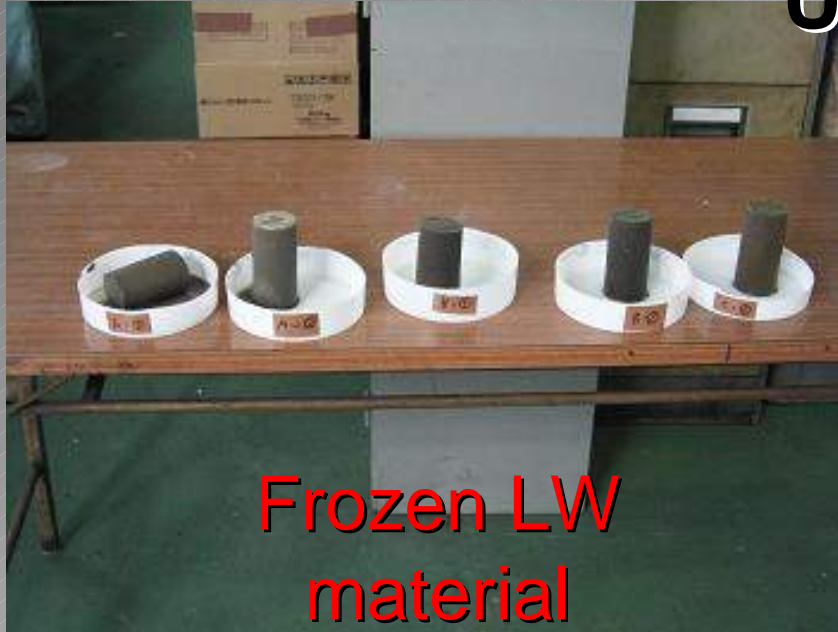
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# CONNECTION WITH IMMERSED TUNNEL UNDER BOSPHORUS

2



Frozen LW material

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Thawed LW material

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# CONNECTION WITH IMMERSED TUNNEL UNDER BOSPHORUS

2

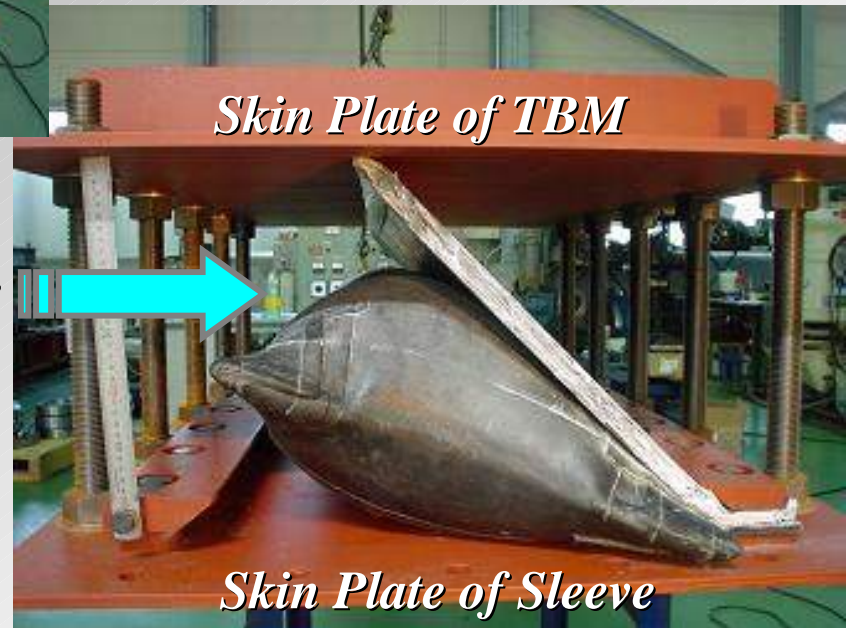


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*Water Pressure*

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***Tunnelling in Urban Area by Slurry Type TBM***



# Conclusions and references

1

In Urban Area, there are many people lives and many infrastructures exist above and underground.

2

Requirements for tunnelling method in urban area are

High reliability from the point of view of Safety and Environment

Method which enable to speedy construction

3

To fulfil these requirements, mechanized and automated TBM method is desirable.

4

TBM method will be developed its mechanized system and automated system continuously and the reliability of this method also be raised in the future.

5

But important thing is that, even the automated system is developed and reliability is raised, without experienced expert who can evaluate the data and can make correct judgement, tunnelling work can never proceed with successfully.

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**Thank you for your kind attention**

**Shield Tunneling Association of Japan**

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