Consideration and Strategy behind Design & Construction Requirements of the Bored Tunnels of the Marmaray Project
Speaker; Hideki Sakaeda

Senior Project Manager
Railway & Mass Transit Development
Project Management Section

PACIFIC CONSULTANTS INTERNATIONAL. JAPAN
1. Presentation Agenda

- Outline of the Marmaray Project; Tunnels & Stations in BC Contract
- Unique Characteristic Environment on Project Site
- Geology and Geotechnical Conditions
- Preliminary Design Concept
- Employer’s Requirement for Tunnel Boring Machines
- TBM envisaged to be used by the Contractor
2. Outline of the MARMARAY Project

Total length of the project; 13.6km

Consisting of:

- Immersed tube tunnel; 1.4km
- Bored tunnels; 10.1km, ID=7.04m
  Earth pressure balance shield 1
  Slurry shield TBMs 2, 3, 4 & 5
- C & C tunnels; 1.3km
- 4 nos. Stations
  2 nos. C& C Stn.
  1 no. Tunnel Stn.
  1 no. At grade Stn.
3. Unique Characteristic Environment on Project Site

- World famous historical old city
- Densely populated urban area
- Many unknown wells
- TCDD trains operate on the surface
MARMARAY PROJESİ
ÜSKÜDAR AKTARMA İSTASYONU
MUHTEMEL TASARIMI.

MARMARAY PROJECT
ÜSKÜDAR TRANSFER STATION
POTENTIAL DESIGN
4. Geology and Geotechnical Conditions

- Paleozoic sedimentary rock formations
- Tertiary sedimentary formation
- Quaternary sediments
- Artificial fill
5. Preliminary Design concept

Key points to be considered.

- National and World Heritages
- Many structures and buildings
- There may be some subsurface antiquities
- Limited land availability
- Architectural expression to be in harmony
- Connection with Immersed tube tunnels
- Time constraints
- High ground water level.
Therefore;

- Main running tunnels by TBM with shield shell.
- Closed-face shield TBM where a risk of flooding.
- Non-TBM methods including NATM in limited areas.
- Yenikapı and Üsküdar stations using cut & cover technique.
- Sirkeci station to be deep tunnel station.
- Cut & cover stations located to avoid historical heritages.
- Cut & cover technique used where enough cover not available.
6. Employer’s Key Requirements for Tunnel Boring Machines
For Safety Considerations;

• Safe personnel access into the front chamber

• A min. of two tail void seals
• Emergency water stops at the tail and the articulation joint.

• Environmental monitoring system.

• Electric power lines for main supply and for the fire protection system shall be independent.
For Settlement Considerations;

• Controlled pressure on the tunnel face secured.

• Continuous grouting of the tail void.

• Ports and equipment provided for probing and/or ground treatment ahead.

For Flexibility Consideration;

• The cutter head to have a reverse rotation capability and/or to provide for over cutting
For Production Considerations;

- Articulation of the shield required
- Machine shall cater for various type of ground.
- For earth pressure balance shield it can have dual-mode operation.
- The cutters replaceable from the rear of the cutter head.
7. TBM machines envisaged to be used by the Contractor

Based on functional requirements the Contractor would use these TBMS.

- Hard Formation Slurry Shield TBM
- Earth Pressure Balanced Shield Machine (EPBM)
HARD FORMATION SLURRY SHIELD TBM

EARTH PRESSURE BALANCED SHIELD TBM

[Diagram of a hard formation slurry shield TBM with various components labeled]