Construction of bifurcation section of underground expressway underneath residential area, Application of enlargement/widening technology of TBM tunnel

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Construction of Bifurcation – Akihiro Nishimori

Yokohama North Line 8.8km
Dual TBM for 5.5km length, mostly underneath Residential Area
4nos Ramp Tunnels, Bifurcation of road tunnel required at connection
Plan of Bifurcation

Bifurcation (20m width, 200m length) x4
Main Shield Tunnel x2
Ramp Shield Tunnel x4

Long Section of Bifurcation

Ramp Shield Tunnel
Bifurcation
Main Shield Tunnel

20m width Bifurcation Underneath Residential Area
⇒ Construction without open cut method (i.e. tunneling work)
⇒ Prevent adverse impact on residential area, with controlling settlement

Ground Sample

<table>
<thead>
<tr>
<th>Ground</th>
<th>Sample</th>
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</thead>
<tbody>
<tr>
<td>Alluvium</td>
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<tr>
<td>Loam Clay, Diluvium</td>
<td></td>
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<tr>
<td>Kazusa Silt (Quaternary Deposit)</td>
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<tr>
<td>Kazusa Sand (Quaternary Deposit)</td>
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</tbody>
</table>
Conventional NATM

- Ground Settlement
- Permeable Layer
- Water Seepage
- Soft Ground
- Ground Disp.

Supported by LDPR

- Large Dia. Pipe Roof Φ1.2m (LDPR)
- Water Tight
- High Rigidity
LDPR Shaft by Open Cut

LDPR Shaft by ESTM

Land acquisition

Enlargement Shield Tunnelling Machine (ESTM)
Enlargement Shield Tunnelling Machine (ESTM)

Arc Shaped Rectangular EPB 11x3m

Thrust Jacking

Launching Shaft

Enlarged Segment

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Max. Enlarged Section

Mid. Enlarged Section

LDPR Shaft by ESTM
ESTM
STEP1: Grouting Work (Preparation for Bifurcation Construction)

- Main Shield Tunnel
- Grouting for Intermediate Wall (Risk mitigation for seepage)
- Grouting for End Point
- Grouting for ESTM

No disruption of Main Tunnelling Work
STEP2 : ESTM (Enlargement Shield Tunnelling Machine) for Shaft of LDPR (Large Dia. Pipe Roof)
STEP3 : LDPR (Large Dia. Pipe Roof φ 1200)

LDPR Shaft  LDPR Bor. Machine  Thrusting Jack  Thrusting Stage

LDPR (27Nos/Ramp)
STEP4 : Grouting Between LDPR

Grouting Work (low pressure method)

Drilling Work

Grouting Work
STEP5: Widening Excavation & Concrete Lining

Widening Excavation

Concrete Lining

Segment Removal  Excavation  Structural Work  Concrete Lining

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STEP6 : Completion of Bifurcation

Bifurcation Lining
Conclusion

1) Bifurcation with combination of ESTM & LDPR
2) No disruption and acquisition of surface ground
3) Minimize ground displacement
4) Applicable urban Highway/Railway projects
Thank you for your attention