Top-down bridge construction on the Mackays to Peka Peka Expressway

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Mackays to Peka Peka
Introduction – Ngarara Road Underpass

Seismic-
Kapiti Coast – Z = 0.4
Distance to Fault line – D = 2km (Ohariu)
Soil Class D
Importance level 2 + 100 year design life
=> ULS Earthquake= 1/1000 year

Geotechnical-
PGA’s 0.56g
Anticipated Embankment movements
of ~700mm
Wide-spread liquefaction

Consequence-
Unique problems with unique solutions
Introduction – Ngarara Road Underpass
Introduction – Ngarara Road Underpass

DECK (1225 Super T + 200 Slab)

WALER BEAM
GROUND BEAM
ABUTMENT PILE WALL
CENTRAL PILES
ABUTMENT CAPPING BEAM
RETURN CAPPING BEAM
RETURN PILE WALL
SERVICES
MSE BLOCK
STRESS BARS
DOWELL
Why Top-Down?
How does it work? – Stage 1

STAGE 1 - CLEAR SITE
1. EXCAVATE TO RL. 14.30 m
How does it work? – Stage 2

STAGE 2 - PILE INSTALLATION
How does it work? – Stage 3

STAGE 3 - MSE AND CAPPING BEAM INSTALLATION
How does it work? – Stage 4

STAGE 4 - INSTALLATION OF DECK BEAMS
How does it work? – Stage 5

STAGE 5 - CASTING OF DECK
How does it work? – Stage 6

STAGE 6 - GROUND AND WALER BEAMS
Design – Geotechnical Profile

Ngarara Road

Deck

Expressway

Ground beam (Prop)

Non-Liquefied Layer (Medium Dense Holocene Sands)

1.2m

Liquefied Layer (Medium Dense Holocene Sands)

1.13m

Non-Liquefied Layer (Dense Pleistocene Sands)

4.5m

Liquefied Layer (Medium Dense Pleistocene Sands)

4.0m

Non-Liquefied Layer (Dense Pleistocene Sands)

Deep Seated Movement

Shallow Seated Movement

Non-Liquefied Layer (Medium Dense Holocene Sands)

Shallow Seated Movement

Deep Seated Movement

Beca
Design – Structural Model
Design – Soil Modelling

Shear Springs (Kramer, 1996)

Soil Springs

Inertial Loads (Soil and Structure)

Abutment Beam / Stress bar Tie

Soil Elements (Compression only)

Wall Pile

Soil Springs

Soil Springs
Construction - Photos
Conclusion

Concept –

Ideally suited for Ngarara Road Underpass

Not for all situation

Design –

Challenging Environment

Large uncertainty around geotechnical and seismic aspects

Focus on fundamental design principles
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Questions?