Kirkbride Interchange Project

Hunter White & Iwan Sudarno

SH20A to Airport
Importance of SH20A

• Primary route to the Auckland International Airport (AIAL) from the Auckland CBD
• The airport is the main gateway to and from New Zealand
• Strategic Link between the Western Ring Route (SH20 AND SH16)
Background

• Increased visitor numbers and expected growth in the region = roadway congestion

• Increase traffic volumes north and southbound directions = impact on cross vehicle movement

• Current Kirkbride Road intersection has a high crash rate record on the NZTA network

• Need for an enhanced urban gateway experience for visitors into Auckland
Solution – Grade Separation

Bridge structure over Kirkbride Road.
• 550m bridge; 30m Super-T; 40m piles; extensive G.I.

Embankment and short bridge structure over Kirkbride Road.
• Bridge replaced by Embankment; 7m high; 2m settlements; extensive MSE walls

Trench structure under Kirkbride Road.
• Adopted design
Site Plan – Extent of Works

SH20A to Airport
Trench Plan Layout

SH20A to Airport
Geological Profile

FILL (VERY STIFF CLAYEY SILT)
ASH / RECENT ALLUVIUM (FIRM TO STIFF CLAYEY SILT)
ESTUARINE DEPOSITS (VERY SOFT TO FIRM PEAT)
PUKETOKA FORMATION INCLUDES ORGANIC BEDS (LOOSE SILTY SAND & STIFF SANDY SILT)
PUKETOKA FORMATION ALLUVIUM (DENSE SILTY SAND)
PUKETOKA FORMATION INTERBEDDED ALLUVIUM (VERY STIFF SANDY CLAYEY SILT AND DENSE SILTY SAND)
SHALLOW MARINE DEPOSITS (VERY DENSE SILTY SAND)

SH20A to Airport

NZ TRANSPORT AGENCY
WAKA KOTahi
Fletcher Higgins Beca
Structural Form

- Permanent Prop
- Capping Beam
- Baseslab
- Screw Piles

Diaphragm Walls

SH20A to Airport
Structural Form

SH20A to Airport
Concrete Bored pile option not chosen due to the following:
• unavailability of bored pile rigs at the time
• slower installation and pile head break down

Screw Pile option adopted due to the following:
• availability of screw pile rigs
• constructor preference - faster installation; reduced plant footprint
• environmentally friendly – no mess; no spoil
Baseslab Development

Screw Pile Design Challenges

- Screw piles have low axial stiffness which results in upward deflection of approx. 45mm to develop design tension.
- A uniform 600mm thick baseslab extended to D-walls generates excessive shear and flexural demands at the slab to wall connection.
- Screw pile head anchorage into baseslab.
Baseslab Development

- Not Preferred
- Not Used on SH20A project
Baseslab design model

Full fixity at D-wall

Slab hinge

Pile springs (vertical only)

Slab hinge

Pile springs (vertical only)
_design detail_
Sump Layout

- Motorway slab
- Composite
- Flexible (homogeneous)
- D-wall
- Top slab (composite)
- Strong beam
- Longitudinal wall
- Sump base slab
- Screw pile

SH20A to Airport
Heavily Constrained Site

- Traffic Management Requirements
- Limited scope for removing lanes or turning manoeuvres due to modelled outcomes creating unacceptable levels of disruption
Solution – Delay Footpath Build

Southern footpath thickening
Culture of Innovation

• D-Wall Break Back Challenges
  • High GWL = Increased bentonite head to maintain stability
  • High guide walls
  • Low cut off
  • Reinforcing starter bars with 90 degree hooks
SH20A to Airport
• Site establishment
• Construct temporary realignment of Kirkbride Road
• Divert services for first stage of D-Walls
• Lots of screw piles

January - June 2015
- Hunua 4 pipe continues
- D-Wall continues
- Screw piles continue
- Commence bridge construction
- Commence off-ramp paving
• Continue northern D-Walls.
• Bridge construction continues.
• Breakdown D-Wall and commence capping beam.
• Commence trench excavation and base slab construction from the north.
• D-Walls completed.
• Construct northern half of bridge.
• Installing permanent props and cap beam
• Temporary prop D-Walls, excavate and build base slab
• Dig, prop, excavate, base slab. Repeat.
• Sump excavation and construction.
- Complete Sump
- Install precast facing panels
- Barriers & paving
Baseslab Development

SH20A to Airport
Baseslab Development
SH20A to Airport
SH20A to Airport