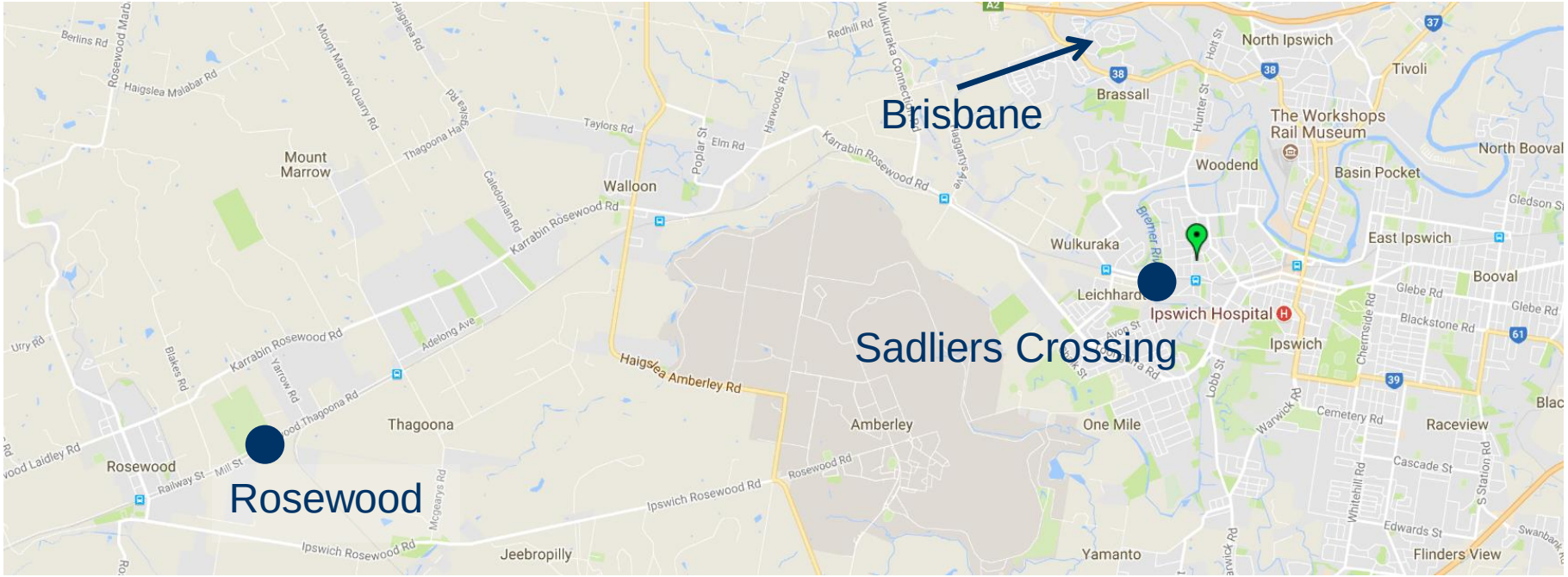
keller.com.au

MICROPILES FOR THE REPLACEMENT OF TIMBER RAILWAY BRIDGES

Lukasz Gawlik, Design Engineer, Keller, Sydney, lukasz.gawlik@keller.com.au

Introduction



Contents

Scope of Work #1

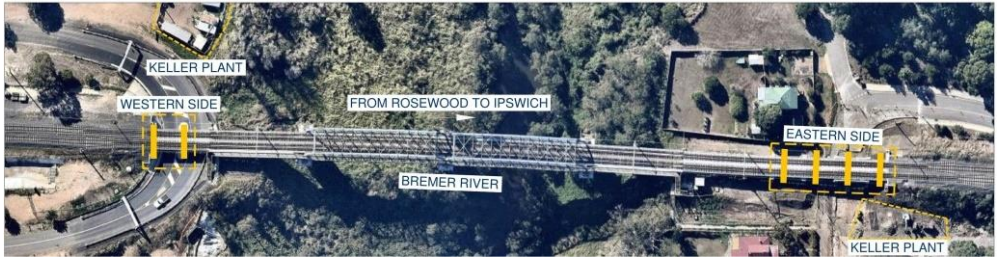
Rosewood Railway Bridge

Sadliers Crossing Railway Bridge

Scope of Work #2

Rosewood Railway Bridge

Sadliers Crossing Railway Bridge



KELLER

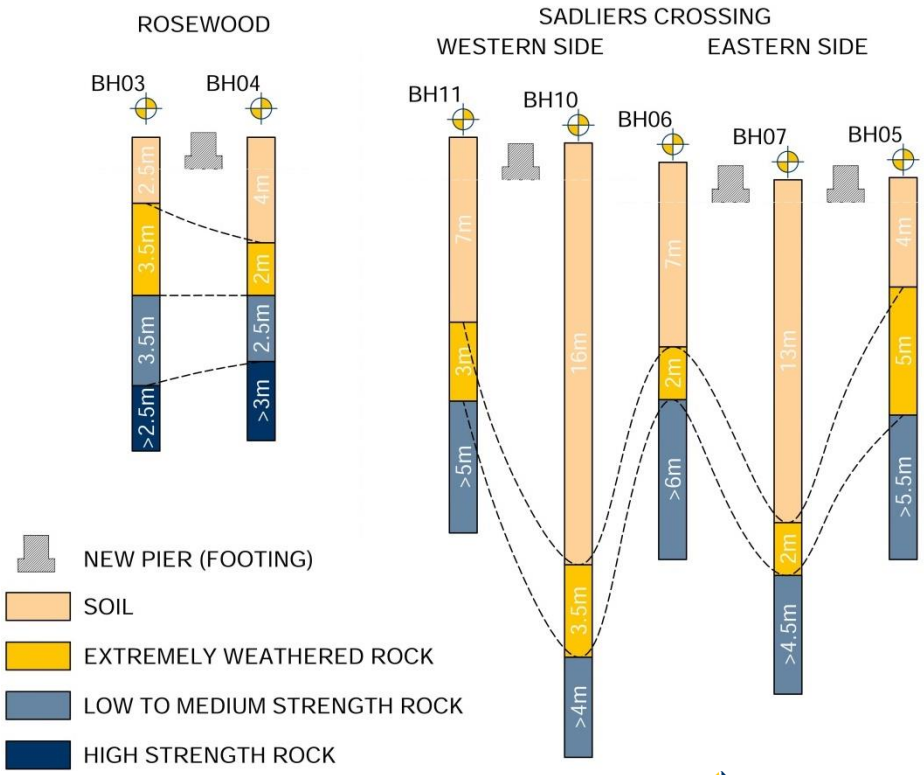
Geotechnical Conditions

Rosewood Railway Bridge

- 2No. Boreholes for 5 piers
- Consistent soil and rock conditions
- Medium to high strength sandstone

Sadliers Crossing Bridge

- 5No. Boreholes for 6 piers
- Highly variable soil and rock conditions
- Low to medium strength sandstone



KELLER

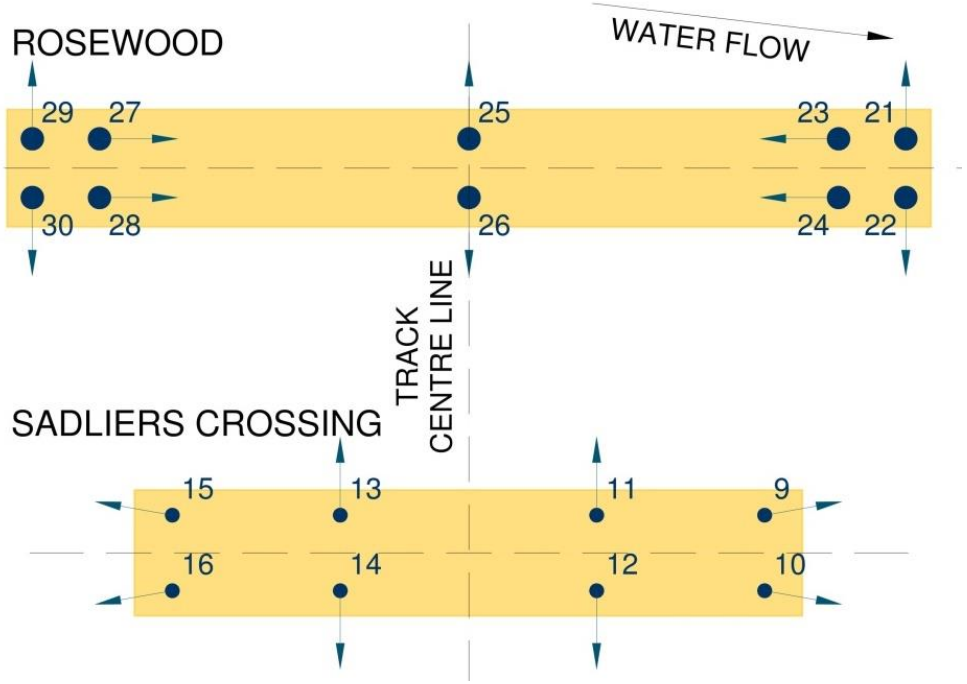
Design Approach

- Large lateral loads up to 1.2MN due to flood (water flow)
- Scour effect up to 2m with consequent potential buckling of the micropiles
- Optimized (minimized) number of high capacity micropiles under single pier
- Micropile inclination and rotation (micropile layout)
- Micropiles embedded in low to medium to high strength sandstone
- Structural capacity provided by central bar and curricular hollow section (CHS)

KELLER

Micropile Configuration

- Micropiles closely spaced
- Micropiles inclined and rotated
- Lateral loads resulting in large compression and tension
- Three-dimensional global stability assessed for each pier



KELLER

Geotechnical Capacity and Testing

- Geotechnical reduction factor $\Phi_{g+} = 0.40$ and $\Phi_{g-} = 0.32$
- Design socket in low to medium to high strength rock

Bridge	Production Micropiles	Design Compression Load (MN)	Design Tensile Load (MN)	Design Rock Socket (m)
Rosewood	50	2.3	0.9	2.3 - 2.8
Sadliers Crossing	56	1.5	0.3	1.5 - 4.0

- 5No. sacrificial test micropiles over 50No. production micropiles at Rosewood
- Sacrificial micropiles tested to validate rock skin friction
- 6No. test micropiles over 56No. production micropiles at Sadliers Crossing

KELLER

Structural Capacity #1

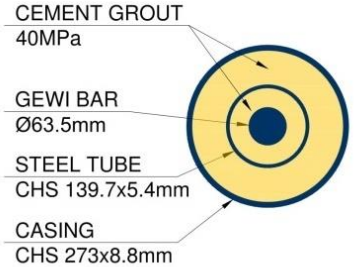
- Structural capacity relied on steel only
- No grout contribution to structural capacity in compression considered
- Strain compatibility for different steel grades (central bar and circular hollow section)
- Steel section splicing (circular hollow section)
- Compression and bending moment reduced capacity due to threaded connections (sacrificial casing)

KELLER

Structural Capacity #2

ROSEWOOD

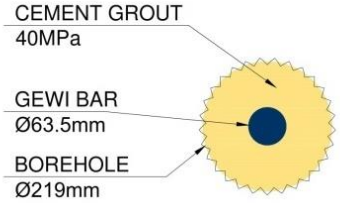
MICROPILE TYPE A
X-SECTION WITHIN SOIL



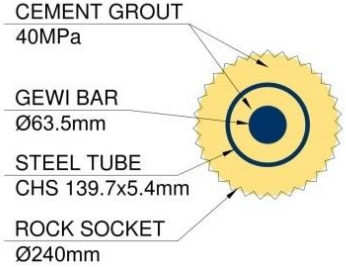
MICROPILE TYPE B
X-SECTION WITHIN SOIL

SADLIERS CROSSING

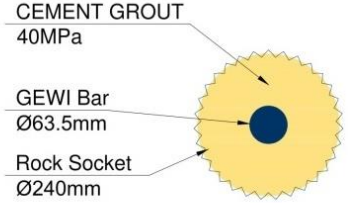
MICROPILE
X-SECTION WITHIN SOIL



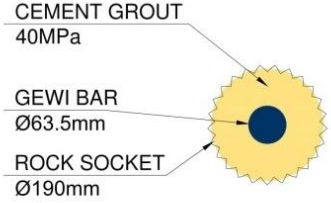
MICROPILE TYPE A
X-SECTION WITHIN ROCK



MICROPILE TYPE B
X-SECTION WITHIN ROCK



MICROPILE
X-SECTION WITHIN SOIL



KELLER

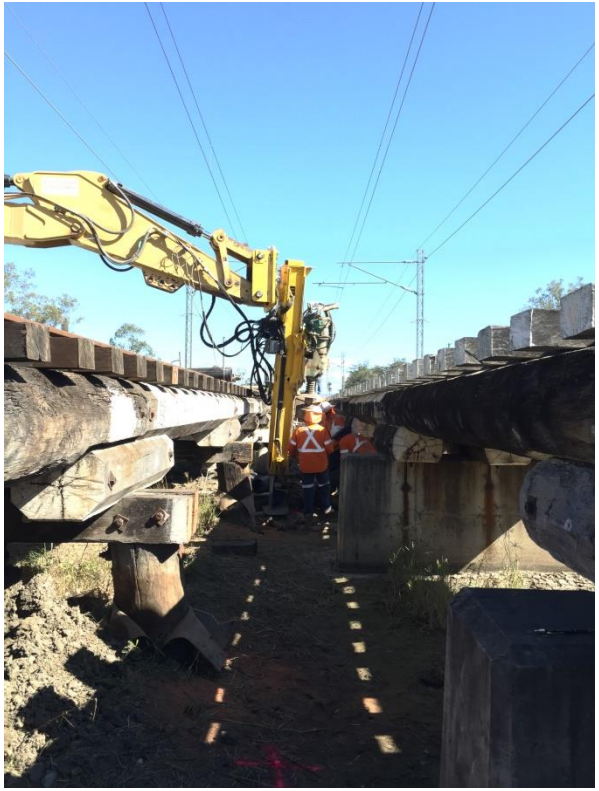
Drilling System

- Cased bored micropile system with casing and PCD (Polycrystalline Diamond) bit
- PCD bit sizes used:

Bridge	Micropiles	Casing OD (mm)	PCD Bit Diameter (mm)
Rosewood	Production	273	240
	Test	152	127
Sadliers Crossing	Production / Test	219	190

KELLER

Construction Limitations – Rosewood



KELLER

Construction Limitations – Sadliers Crossing

KELLER

Summary and Conclusions

- Complexity of foundation design and construction under live bridges
- Design and construction team’s capability of resolving site issues
- Works completion with only minimal delays despite unforeseen problems

KELLER

Thank you for your attention

www.keller.com.au

KELLER