Category 3: Excellence in Sustainability

Horrocks Highway LBCM Implementation – Technical Excellence meets Sustainability

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Hiway Stabilizers

2022 AustStab Awards of Excellence

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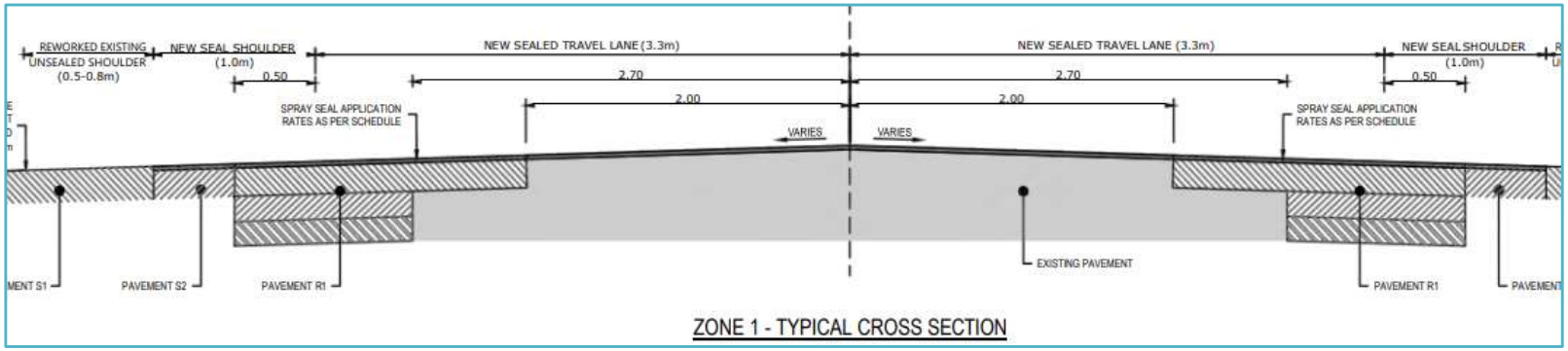
Overview

- To improve the pavement performance through increased shear capacity using the new design protocol developed by Austroads: AP R640-20 *Design Procedures for Lightly Bound Cemented Materials (LBCM)*.
- Construct a homogenous full width pavement and not two narrow widening for a section 19.5km long and lane widths of 8.0m
- Eliminate construction joints in the trafficable lane
- Substantially reduce overall construction time
- Reduce granular material demand
- Minimise the impact on the community by reducing lane closure times through reduced construction time
- Reuse existing insitu pavement materials, not needed to be excavated & cut to waste
- Reduced risk during construction:
  - Eliminate the need to expose the subgrade during the wetter months.
  - Address the possible delays in supplying material – by reducing demand on import granular material.
  - Easier construction methodology and reduced demand for skilled labour.
  - Public exposure reduced, no boxing out of material required causing a drop off adjacent to the trafficable lane.

Description of Initiative

- Widening of the existing pavement – conforming treatment was a traditional methodology of box out existing granular material and replace with imported granular material for widening of the outer wheel path and shoulder.
- This left 4m of original pavement through centre of carriageway



ZONE 1 - TYPICAL CROSS SECTION

- Additional geotechnical investigation was coordinated by Hiways to better define the existing pavement and shoulder material quality and depth.
- Hiways then undertook alternative pavement design using the LBCM protocol developed by Austroads supported by field and laboratory confirmation of cement reactivity for extremes of insitu and import sampled aggregates and dependable subgrade design CBR's.
- Confirm overlay thickness of imported granular material to achieve nominal overall structure, pre-hoe existing pavement to retain and incorporate existing surfacing and cement stabilise composite top 200mm for the full width of the pavement, including sections to be widened.
- First time LBCM protocol has been used in South Australia to provide a cement stabilisation treatment option.

Site Environment and Details Affecting the Project

- Pavement design identified areas of pavement and widening that required additional granular material to be added prior to stabilisation to have a final pavement thickness meeting the design protocols & loading.
- The granular overlay was undertaken directly over the existing sealed pavement, and mixing commenced to granulate and incorporate (rather than cut to spoil) the existing seal and moisture condition existing granular material ready for the addition of the cement binder after structure / geometrics corrected.
- Overlay and stabilisation addressed all surface and existing basecourse defects for the full pavement width and ensured a consistent, high-quality homogeneous 200mm basecourse project-wide.
- The road received a full width reseal providing consistent surface texture, instead of retaining the old seal through central retained pavement and new sealing of the pavement widening both sides.

Challenges in the Implementation

- Introducing the new Austroads AP-R640-20 protocol to the lead designer and client – new technology not seen in South Australia – and seeking approval. Several workshops preceded by Hiways preliminary then final pavement design reports facilitated this.
- Being able to undertake additional pavement design activities, whilst project activities had commenced. Short timeframes for the design to be completed.
- Engaging a NATA lab to undertake supplementary geotechnical investigation, to confirm subgrade strength, existing granular material thickness and quality and mix design of the LBCM (quantifying the cement content required to achieve a UCS value of between (1.0 – 2.0 MPa – while targeting 1.5MPa). Limited geotechnical / lab resources during this time.
- Establishing a relationship between 7-day and 28-day laboratory UCS testing to expedite design, but still ensuring all 28-day UCS testing was concluded
- Providing the necessary comfort to the client that this new protocol was a derivative of work undertaken by TMR over the past 10 years and long term performance of the LBCM for this project would meet the clients needs.

Key Points of Interest

- First Austroads AP-R640 LBCM project undertaken in South Australia.
- South Australia was moving to placing asphalt into rural regions to address the deficiencies and performance limitations of unbound granular pavements under high traffic loadings. This allows for a higher design modulus / performance to be achieved for regional gravels without the risk of block cracking.
- Construction of a homogenous pavement, giving superior performance and not just “tacking on” a widening for both sides of the pavement.
- Reduced roadworks time, reducing the exposure of roadworks to traffic.

Evidence of Success

- Firstly – tangible savings including, substantial time savings, imported aggregate savings, and cost savings to client.
- Secondly – finished pavement presented for surfacing had excellent ride and all quality benchmarks were achieved/exceeded.
- Thirdly – intangible savings such as reduced demand in finite aggregate resources, reduced loading on network from much less removal/import of materials from/to site. Reduced disruption to stakeholders.
- Introduction of an additional design / construction methodology to South Australia and satisfied Main Contractor, Client and Consultant.
- Project savings of $100k per kilometre constructed measured against the conforming design.

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Supporting Data and Design Documentation #1

Table 9: Laboratory Test Results Regarding UCS Reactivity for Site 4 (MM103 to MM121)

Prepared Sample	Test	Binder	Results
100% BC 1	PSD & PI	No binder	PSD OK for LCBM PI = 3
88% BC 1 & 12% Surfacing	Mod Comp 4-day soaked CBR	No binder	4-day Soaked CBR = 110%
	Mod Comp 7 Day UCS & 28 Day UCS	1.5% and 2% GB Cement	7Day 1.5% Cem UCS = 1.7MPa 7Day 2.0% Cem UCS = 2.0MPa 28day 1.5% Cem UCS = 1.7MPa 28day 2.0% Cem UCS = 2.6Pa
	Mod Comp 7 Day UCS Accel Oven Cure 40degC	1.5% and 2% GB Cement	7Day cure 5days @40degC 1.5% Cem UCS = 2.2 MPa 2.0% Cem UCS = 2.8 MPa
55% BC 1 & 12% Surfacing 9% 33% Spalding Class 2 PM2	Mod Comp 28 Day UCS	1.5% and 2% GB Cement	28day 1.5% Cem UCS = 1.2MPa 28day 2.0% Cem UCS = 1.2MPa
100% BC 2	PSD & PI	No binder	PSD OK for LCBM PI = 7
88% BC 2 & 12% Surfacing	Mod Comp 4-day Soaked CBR	No binder	4-day Soaked CBR = 135%
	Mod Comp 7 Day UCS & 28 Day UCS	1.5% and 2% GB Cement	7Day 1.5% Cem UCS = 0.45MPa 7Day 2.0% Cem UCS = 1.2MPa 28day 1.5% Cem UCS = 1.8MPa 28day 2.0% Cem UCS = 2.4MPa
55% BC 2 & 12% Surfacing 9% 33% Spalding Class 2 PM2	Mod Comp 28 Day UCS	1.5% and 2% GB Cement	28day 1.5% Cem UCS = 2.2MPa 28day 2.0% Cem UCS = 2.6MPa
100% Spalding Class 2 PM2	Mod Comp 28 Day UCS	1.5% and 2% GB Cement	28day 1.5% Cem UCS = 1.9MPa
100% Subbase BH02 (0.2 to 0.45m)	PSD, PI & 4-day Soaked CBR	No binder	4-day Soaked CBR = 70% PSD OK for SB PI = 10% LS = 3.0%
100% Subbase BH05 (0.2 to 0.4m)	PSD, PI & 4-day Soaked CBR	No binder	4-day Soaked CBR = 35% PSD OK for SB PI = 16% LS = 9.0%
100% Subgrade BH04 (0.55 to 0.85m)	4-day Soaked CBR	No binder	4-day Soaked CBR = 3.0% PSD 80% Clay PI = 37% LS=16.5%

Pavement – DESA = 2.18E+06			
Chainage	Aggregate Thickness (mm)	Subgrade CBR (%)	Overlay Required (mm)
103.0 L	300	7.0	50
103.7 L	500	10+	0
104.0 R	400	10.0	0
105.0 L	300	10.0	0 marg. SB
106.0 L	300	10.0	0 marg. SB
106.8 R	600	(8)	0
108.0 L	300	8	50
109.0 R	600	(4)	0
109.5 L	450	4	20
109.8 L	600	8	0
110.4 L	300	6	65
110.5 R	600	(6)	0
111.9 L	500	6	0
113	Township		
113.4 L	500	6	0
114.5 CL	400	6	0
115.7 R	450	6	0
117.0 L	550	2.5	45
117.1 R	450	3.5	55
117.9 L	250/450	3.5	55
118.0 R	550	4	0
119.0 L	600	5	0
119.8 L	700	3.5	0
120.0 R	600	4.5	0
121.0 L	600	5	0

Subgrade	Pavement (DESA 2.18E+06)
2	200mm LBCM + 460mm SB
2.5	200mm LBCM + 395mm SB
3	200mm LBCM + 345mm SB
3.5	200mm LBCM + 305mm SB
4	200mm LBCM + 270mm SB
5	200mm LBCM + 210mm SB
6	200mm LBCM + 165mm SB
8	200mm LBCM + 85mm SB (325mm total)
10	Subbase req. dominates (325mm total)

- Design Period 20 years / DESA 2.19E+06
- Design traffic for pavement loading and shoulder loading separately.
- No structural contribution from new surfacing. **Existing surfacing granulated and incorporated into stabilised layer**
- Employ 200mm Lightly Bound Cement Modified Basecourse (500MPa Anisotropic, no sublayering).
- Subbase top sublayer modulus confirmed to be E>150MPa vertical modulus - but limited LBC Base modulus to 500MPa for conservatism.

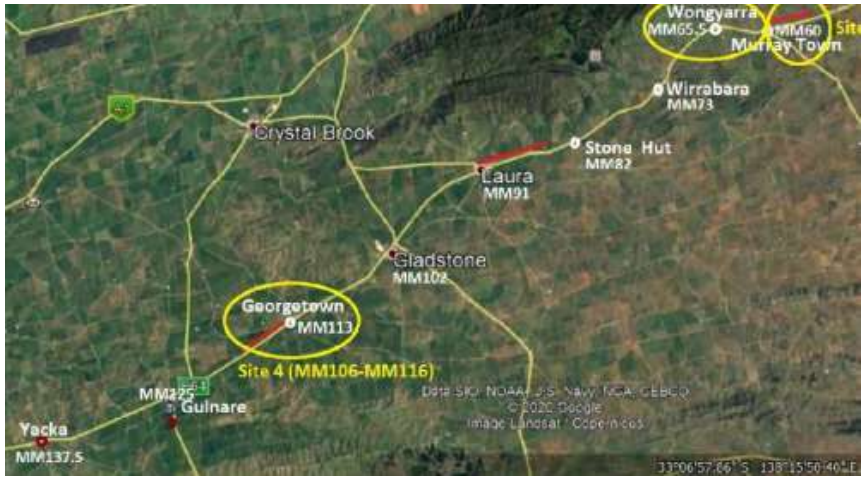
Supporting Data and Design Documentation #2

The table below shows a summary of the granular material and construction days saved by adopting the LBCM design protocol (as supplied by the Main Contractor)

Section	Total Length of Section (metres)	Conforming Material Usage PM1/20 (Tonnes)	Conforming Material Usage PM2/20 (Tonnes)	Alternative Material Usage (PM2/20) (Tonnes)	Material Savings (Tonnes)	Conforming Construction Time (Days)	Alternative Construction Time (Days)	Construction Time Savings (Days)
1.1a	9707	18830	11182	10017	19995	33	15	18
1.1b	9250	28000	24000	9546	42454	58	28	30
Total					62449			48

- There was 62,499 tonne of imported granular material saved and 48 days in construction timing.
- The objective of employing this approach is to:
  - Provide a speedy, robust and cost-effective treatment that will ensure a homogenous 200mm LCBM basecourse across the entire carriageway width. No construction joints near outer wheel-tracks.
  - Form a robust, moisture resilient substrate for the surfacing.
  - Present uniform surfacing / texture across full carriageway.
  - Substantially reduce construction time / cut to waste & corresponding import aggregate & cost to Client.
  - *Performance and evaluation to date suggest these objectives have all been achieved.*

Supporting Images



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Supporting Images

Horrocks Highway before and after at Location MM105 (courtesy DIT)

[post construction - prior to line marking]

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