Renolith

Resilient, Sustainable, Nanoengineered Roads

Simple Design Guide

PEOPLE

No ruts. No potholes.
Durable for decades.

PLANET

100% recycled roads.
Low carbon. No waste.

PROFIT

Rapid, low-cost construction.



Executive Summary

Stabilisation is the improvement of a soil or pavement material usually through the addition of a binder. In-situ recycling of pavement material via stabilisation with cement or low-carbon cementitious binders is a highly sustainable and cost-effective approach to the construction of road pavement base layers.

Renolith 2.0 is a water-based admixture of colloidal nanomaterials and polymers. It inhibits macro-cracking and improves the engineering properties of cemented materials. It enables a resilient pavement base layer to be constructed from any inorganic soil or recycled material. The technology has been proven in more than 70,000,000m2 of pothole-free roads around the world.

Pavements are designed and constructed using conventional insitu or plant-mixed cementitious stabilisation methods & specifications. In most cases, a 200-250mm Renolith-enhanced cementitiously bound base layer is an economical approach to producing a resilient road base with high fatigue life. An overlay to bridge reflective cracking is not required - the design may incorporate a spray seal or asphalt wearing course directly over the bound layer.

Renolith 2.0 admixture is applied during the wet-mix phase of the cementitious stabilisation process. The recommended dosage is in granular materials is 5% w/w cementitious binder.

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1. Introduction

Context

Stabilisation is the improvement of a soil or pavement material usually through the addition of a binder. The most common methods of stabilisation involve the incorporation of small quantities of binders. These binders include cement (Portland, Blended Cements and Cementitious blends with slag and/or fly ash); lime; bitumen and miscellaneous chemicals. In-situ stabilisation techniques have long been used by engineers in Australia and many places throughout the world for pavement (usually roads) construction and rehabilitation. These techniques have historically been chosen by managers of pavements because of their significant cost advantages [1]. The economic and sustainability benefits of in-situ recycling and stabilisation are compelling. Nonetheless, more expensive and environmentally destructive pavement construction methods are still commonplace. The underutilisation of stabilisation is partly attributable to the performance limitations of stabilised materials. In short, some soils make poor pavements and cracking is always hard to prevent, particularly at high binder content.

Renolith 2.0 is a unique admixture fusing conventional admixture chemistry with cutting-edge nanochemistry; a nanopolymer admixture. Its super-pozzolanic behaviour significantly improves the engineering properties of cementitiously bound materials. It enables a simple, versatile and proven approach to pavement nanoengineering. It enables durable, resilient pavements to be constructed from any in-situ soil or recycled material. It ensures a greatly reduced susceptibility to cracking, which allows high strength bound layers without the need to mitigate risks of reflective cracking. It imparts self-healing attributes to the pavement. This combination of technical benefits allows pavements to be thinner, more cost-effective and achieve higher fatigue life (ie. traffic capacity). The technology has been proven in more than 70,000,000m^2 of pothole-free roads around the world.

Purpose

This document is a simplified guide intended to:

- Provide guidance on mix design, pavement thickness and construction process.
- Support pavement design.

Scope

This simple guide covers only the most common applications in the Australian context; specifically the construction, rehabilitation or upgrade of regional highways and local road pavements.

Refer to the full Renolith 2.0 Design Guide for more comprehensive guidance.

2. Renolith 2.0 Product

Form: Admixture of nanomaterials and polymers in water.

Function: Enables nanoengineered pavements (road base).

Supply: 1000L IBC.



3. Construction Guidance

Construction Process

Overview

Pavements are constructed/rehabilitated via conventional cementitious stabilisation methods. The figure below shows the key activities for insitu stabilisation: spread cementitious binder, dry mix, wet mix (water+admixture), trim, compact. Optionally, a separate wearing course (eg. bituminous spray seal) is applied.

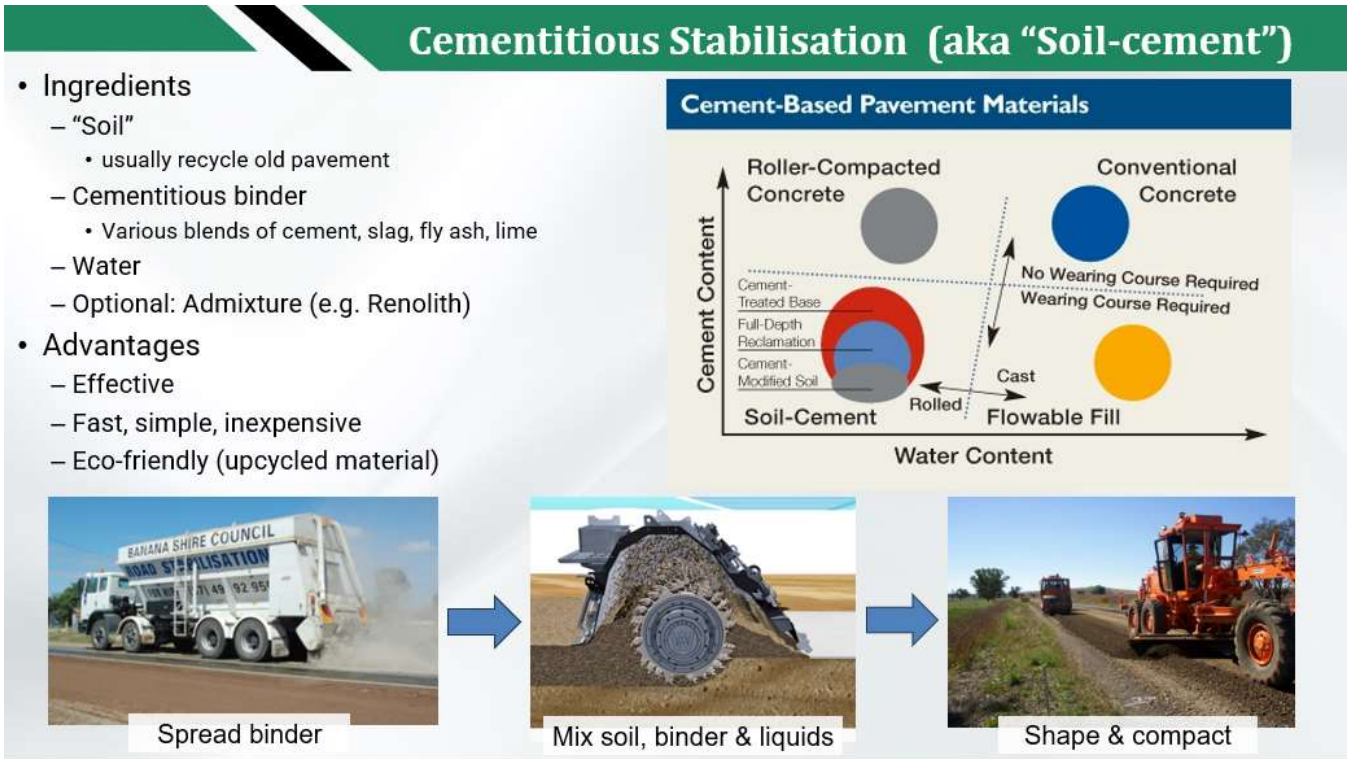


Figure 1: Cementitious Stabilisation (aka "Soil-cement")

Construction specifications

Renolith 2.0 admixture may be used in conjunction with any region specific or general cementitious stabilisation specification, subject to any restrictions on the use of admixtures imposed by the specification. Common specifications adopted in Australia and New Zealand are shown below.

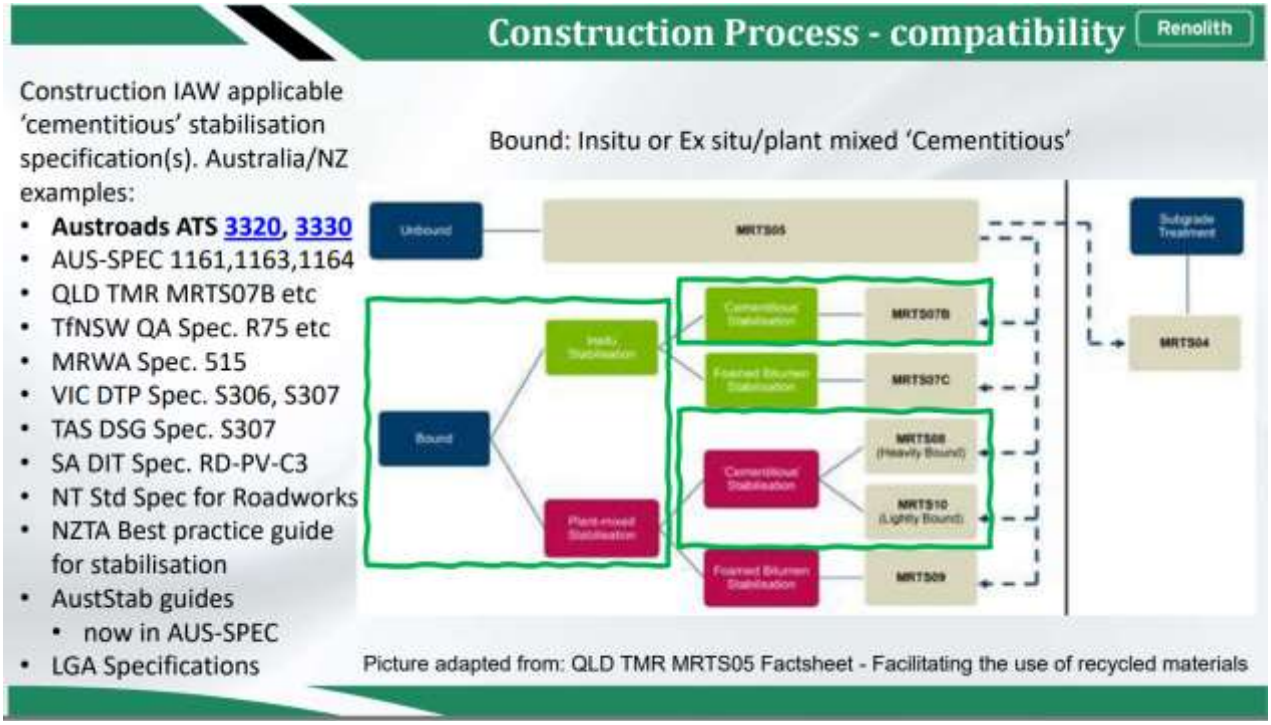


Figure 2: 'Cementitious' Stabilisation specifications

Austroads Technical Specification ATS-3330 In Situ Pavement Stabilisation Using Cement or Cementitious Blends [2] is a free, comprehensive, best-practice specification.



Figure 3: Austroads Stabilisation Specifications

Renolith advantages

Conventional cementitious stabilisation offers cost and performance advantages. However, it introduces challenges with cracking.

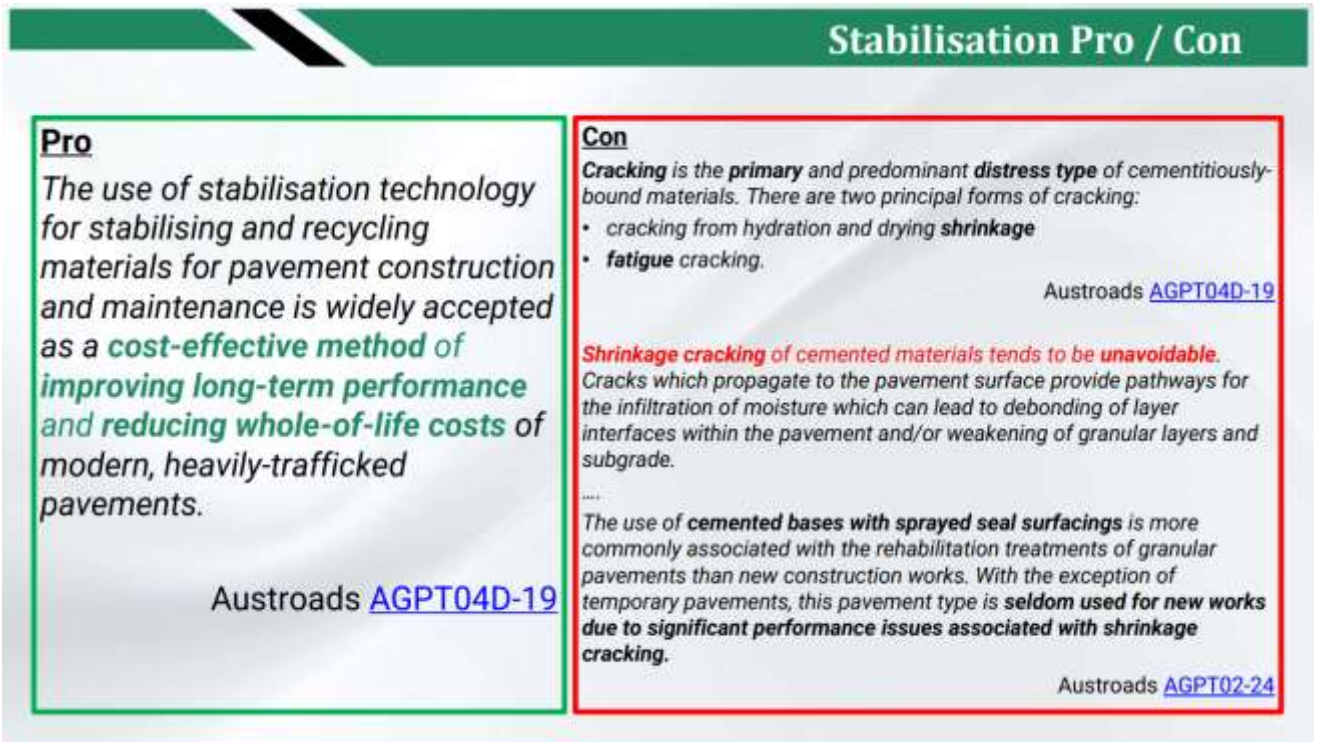


Figure 4: Stabilisation pro / con

A key feature of the Renolith 2.0 product is its ability to prevent macro cracking. This provides multiple opportunities to optimize the pavement design.

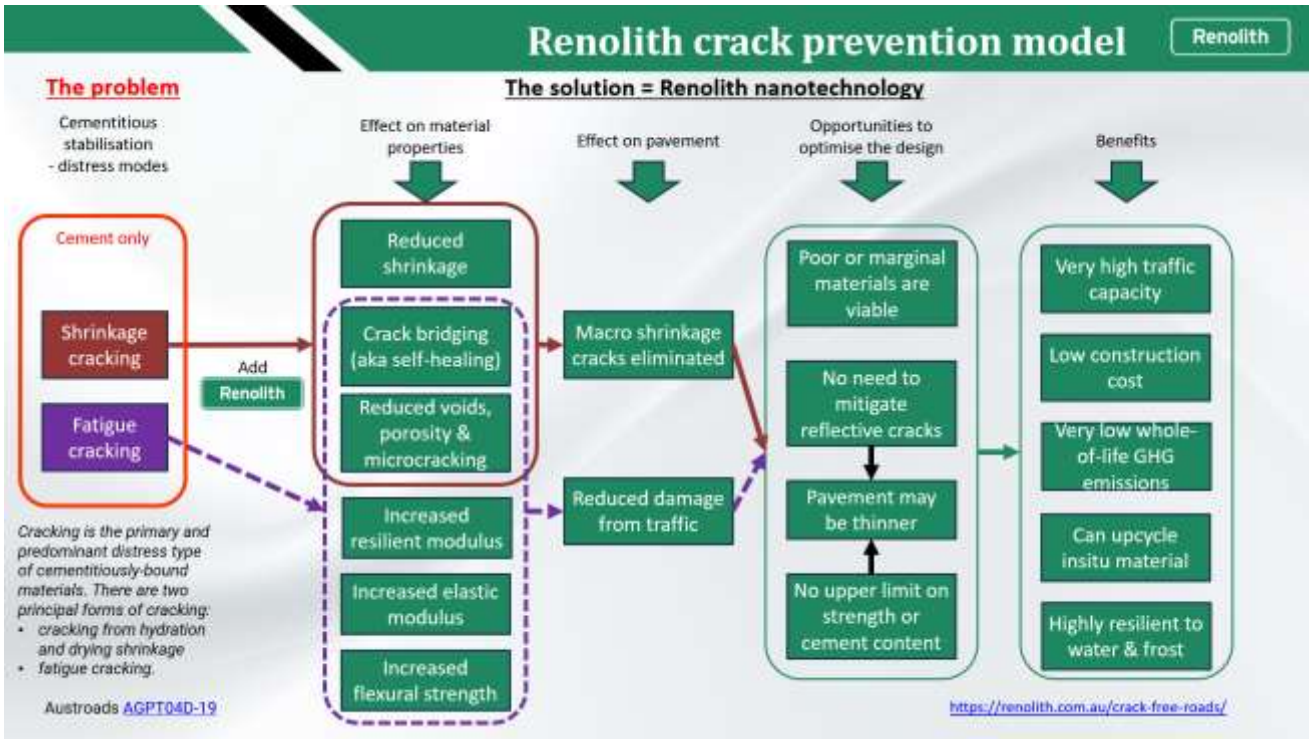


Figure 5: Renolith crack prevention model

Pavement design

Depth Quick Estimator

Pavement thickness is project specific; refer to Austroads guidance [3] & [4]. The AustStab *Pavement design guide for a cement stabilised base layer for light traffic* [5] provides the design thickness of stabilised local roads using an empirical approach, based on experience from a range of local government practices in Australia. Renolith improves the tensile strength, resilient modulus and elastic modulus of bound materials, thereby reducing pavement deflection and fatigue damage incurred. This means that the AustStab guide [5] will yield highly conservative designs. For most local roads, a 200-250mm Renolith-enhanced bound layer with spray seal wearing course is an economical solution. If the subgrade is very poor or higher fatigue life is required, pavement thickness and/or binder content can be increased. For high load (eg. mine haul) or high fatigue (eg. freeway) applications, a thicker layer may be required. For low load applications (eg. cycleway), a 120mm layer may suffice.

Life Estimator

Austroads Pavement Analysis Design Software AustPADS allows users to conduct advanced mechanistic analysis of the response-to-load of road pavements. Simple designs were modelled as shown, consisting of a new/rehabilitated base layer, a sub-base of residual granular material (if applicable) and various subgrades. Permutations of the following variables were modelled:

- New base thickness [200, 250, 300mm]
- New base modulus [350, 600, 800, 3600MPa]
- Extant pavement thickness [0, 300mm]
- Subgrade CBR [3,5,10,15%]



Base modulus values were modelled as follows:

1. Granular base: 350MPa Austroads AGPT02
2. Lightly bound: 600MPa [6]
3. Lightly bound+Renolith: 800MPa
4. Nanoengineered (Bound+Renolith): 3600MPa

The charts below show the outputs from the AustPADS modelling. These charts are intended to support a first-pass life estimate. They are not a substitute for pavement design.

Pavement model 1: New/rehabilitated base, no sub-base

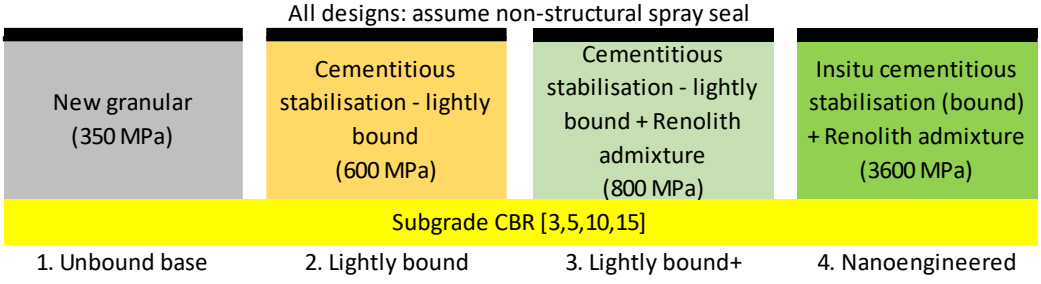


Figure 6: Pavement model 1 - New/rehabilitated base, no sub-base

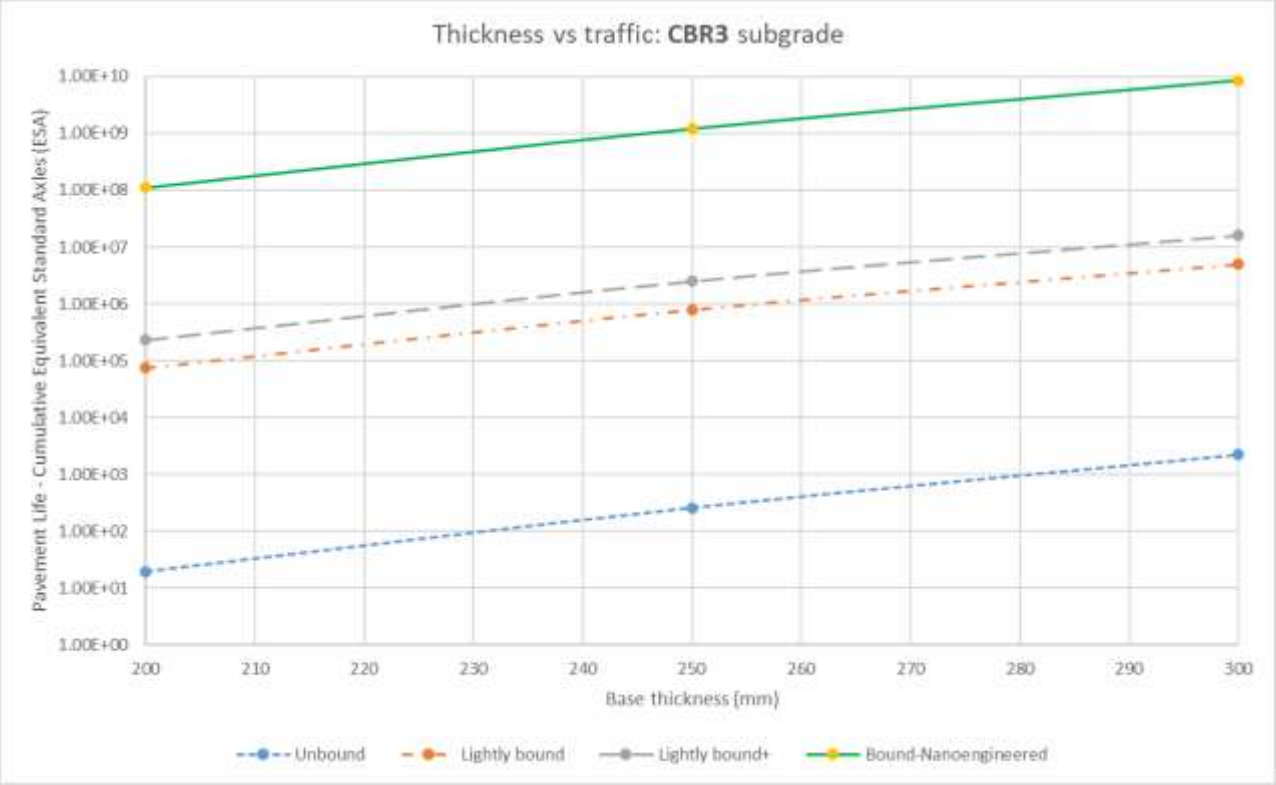


Figure 7: AustPADS outputs - New/rehabilitated base, no sub-base, CBR3 subgrade

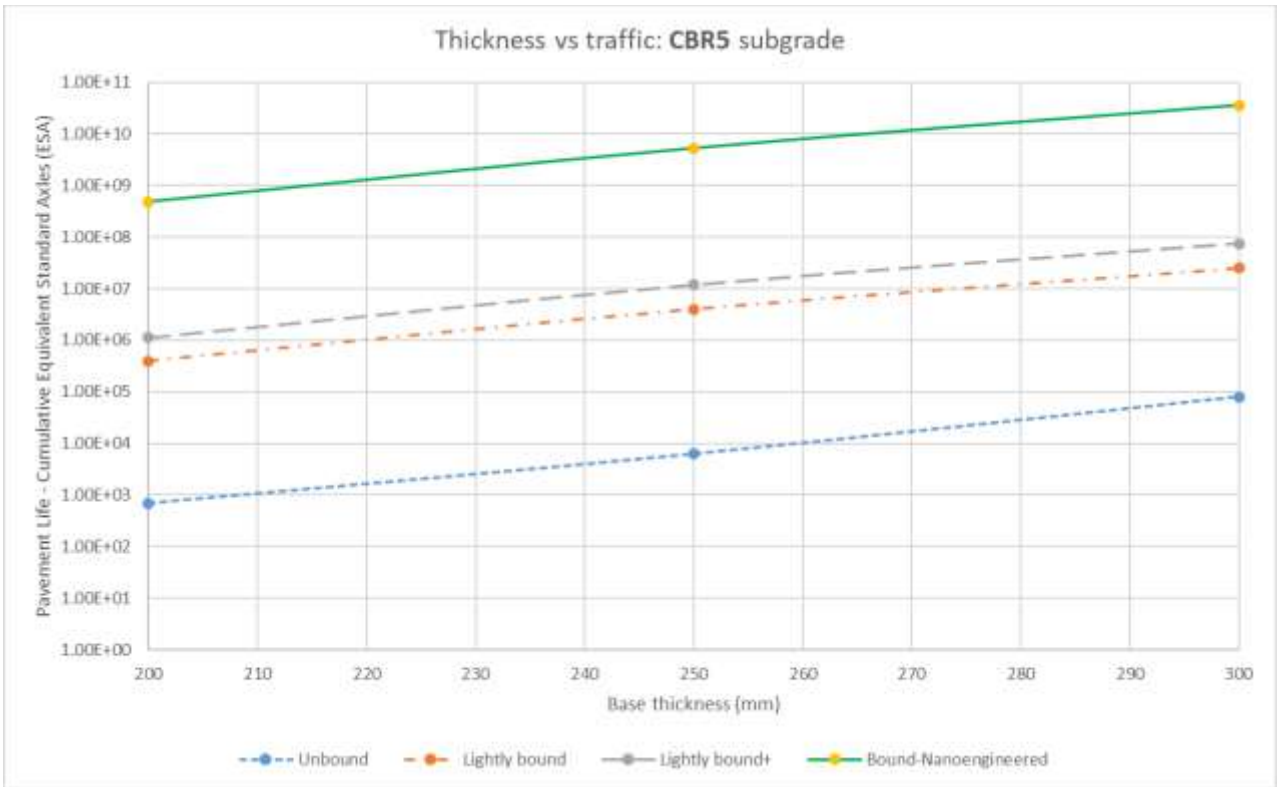


Figure 8: AustPADS outputs - New/rehabilitated base, no sub-base, CBR5 subgrade

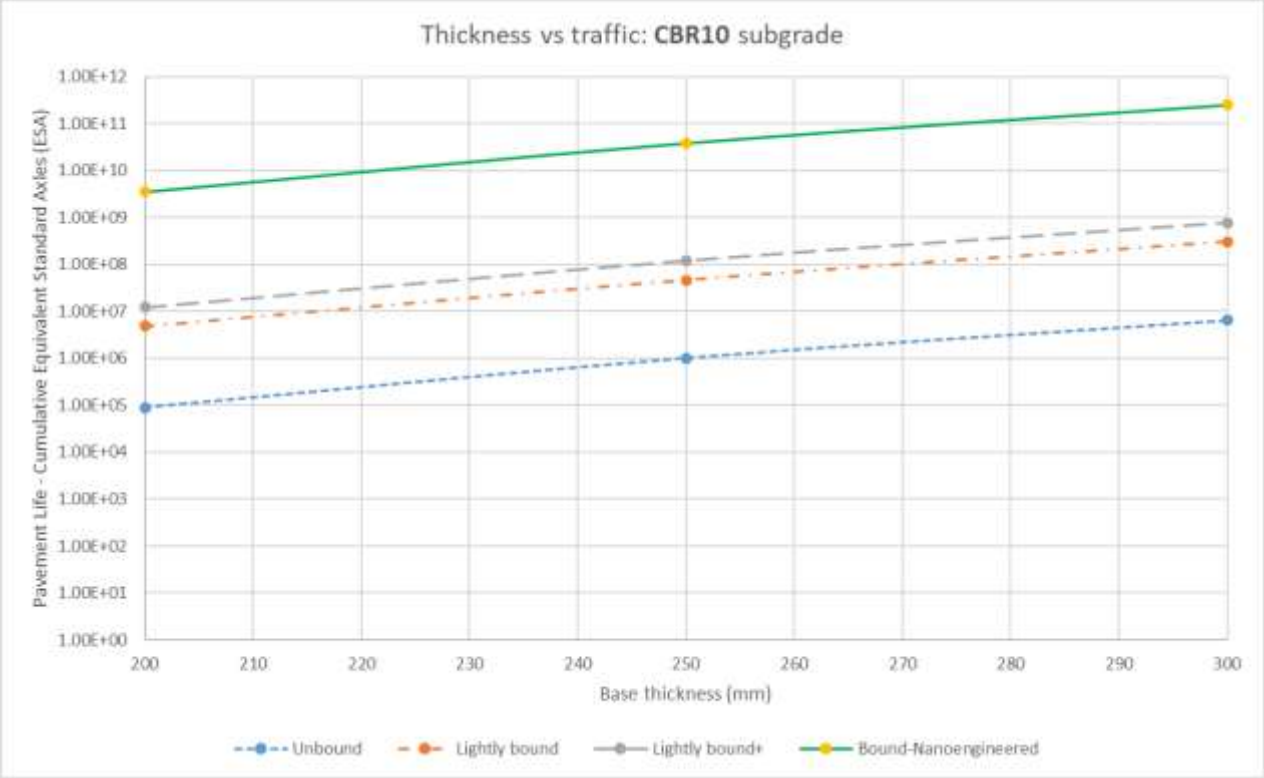


Figure 9: AustPADS outputs - New/rehabilitated base, no sub-base, CBR10 subgrade



Figure 10: AustPADS outputs - New/rehabilitated base, no sub-base, CBR15 subgrade

Pavement model 2: Rehabilitation of 300mm pavement

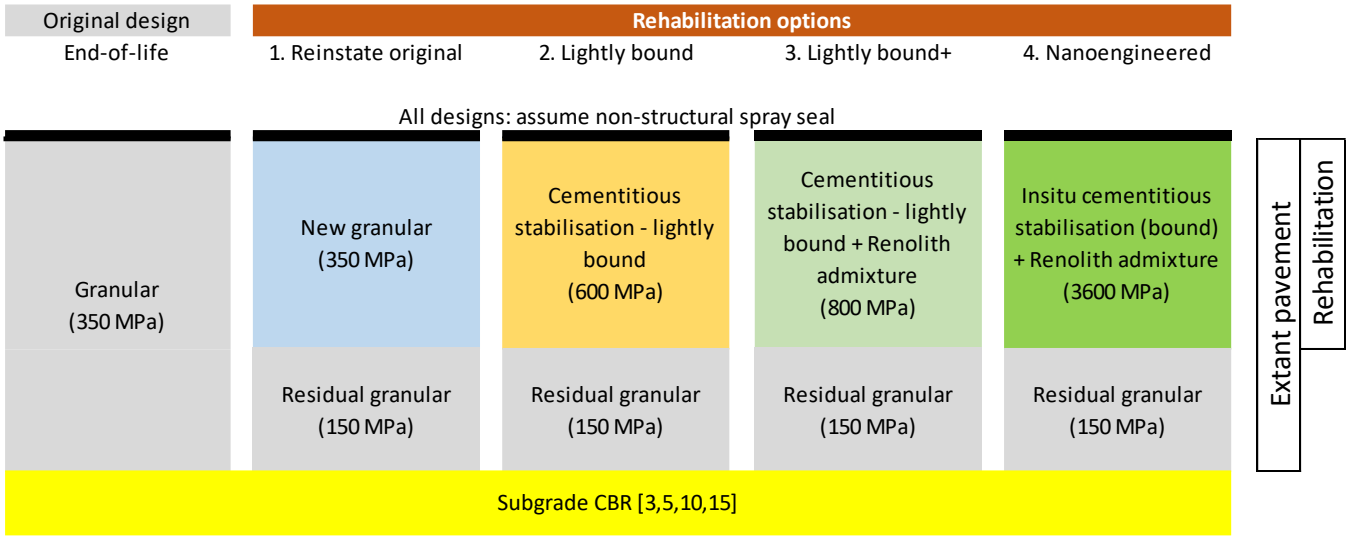


Figure 11: Pavement model 2: Rehabilitation of 300mm pavement

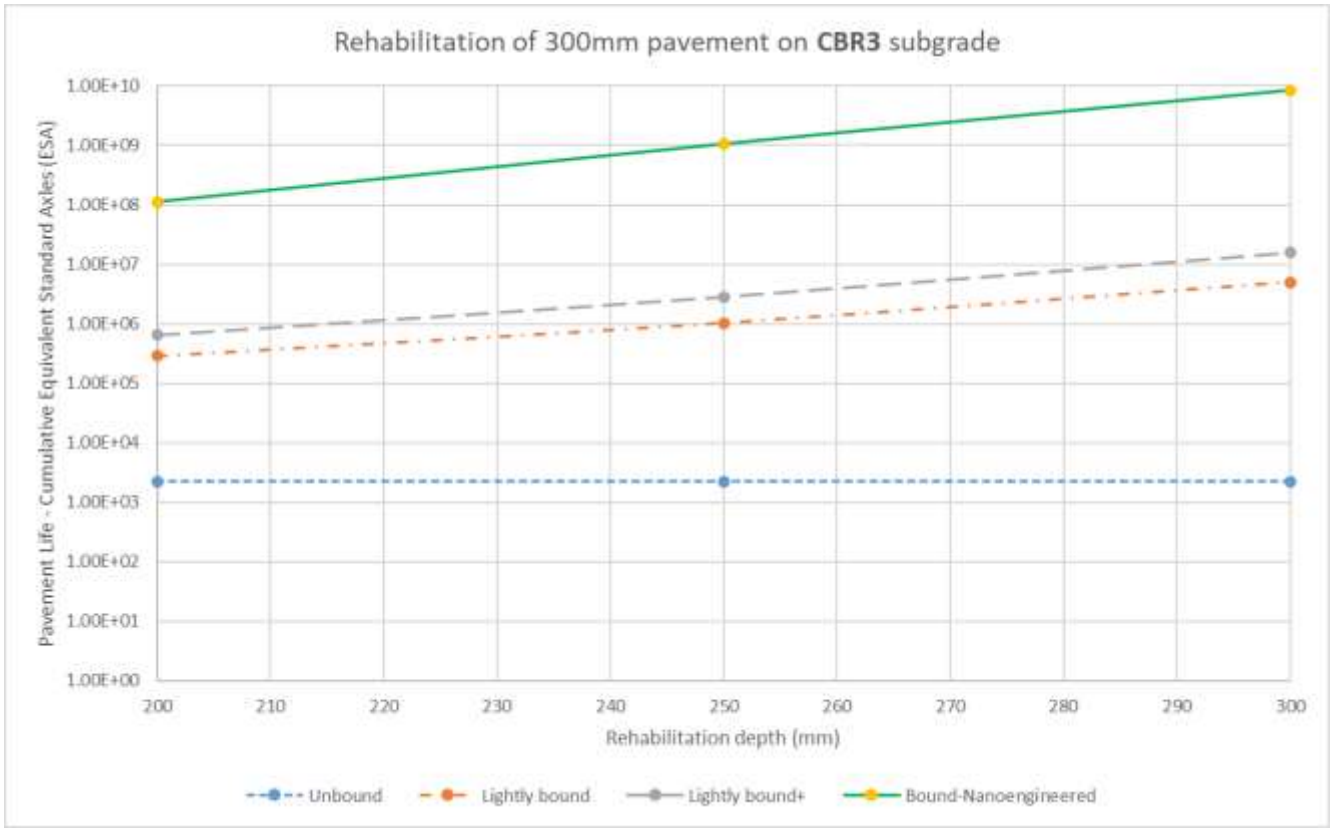


Figure 12: AustPADS outputs - Rehabilitation of 300mm pavement on CBR3 subgrade

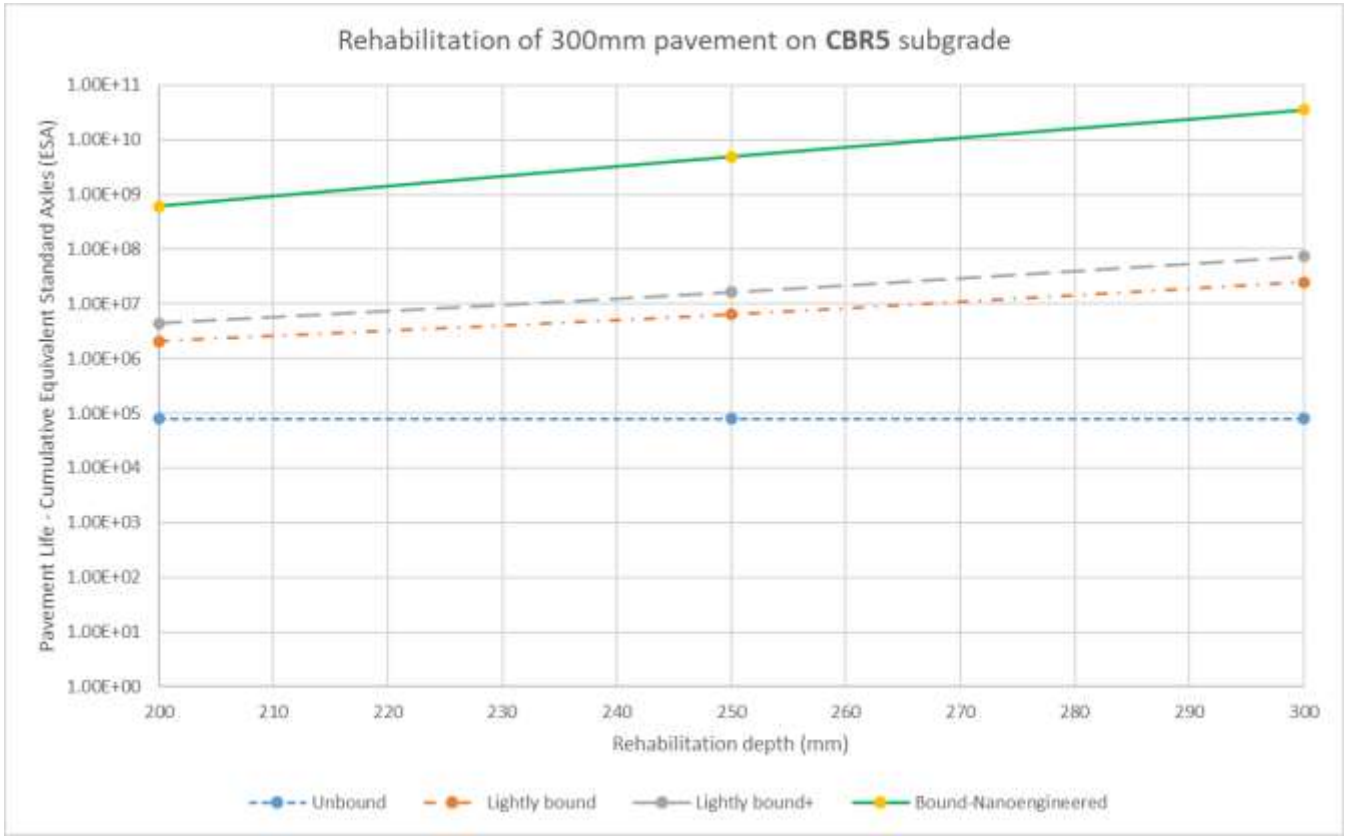


Figure 13: AustPADS outputs - Rehabilitation of 300mm pavement on CBR5 subgrade

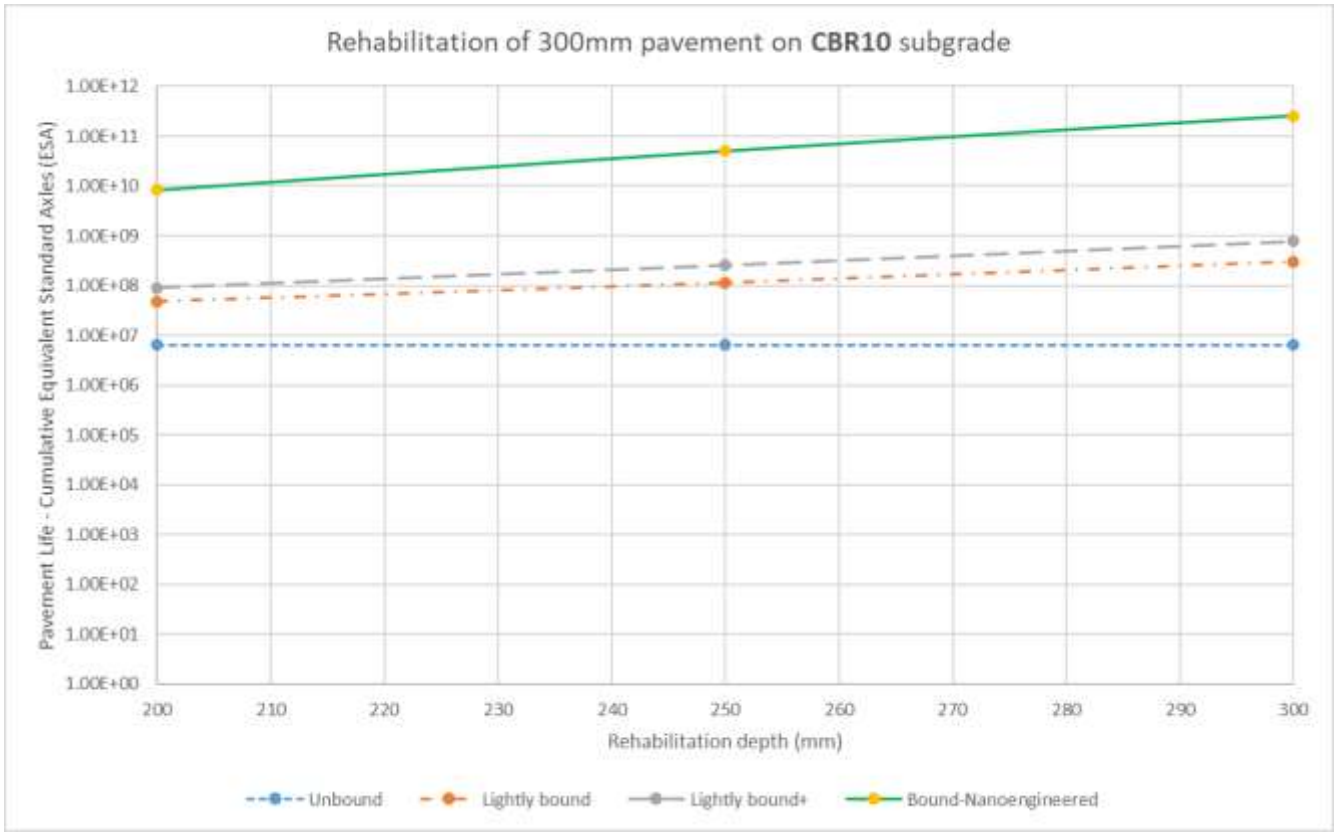


Figure 14: AustPADS outputs - Rehabilitation of 300mm pavement on CBR10 subgrade

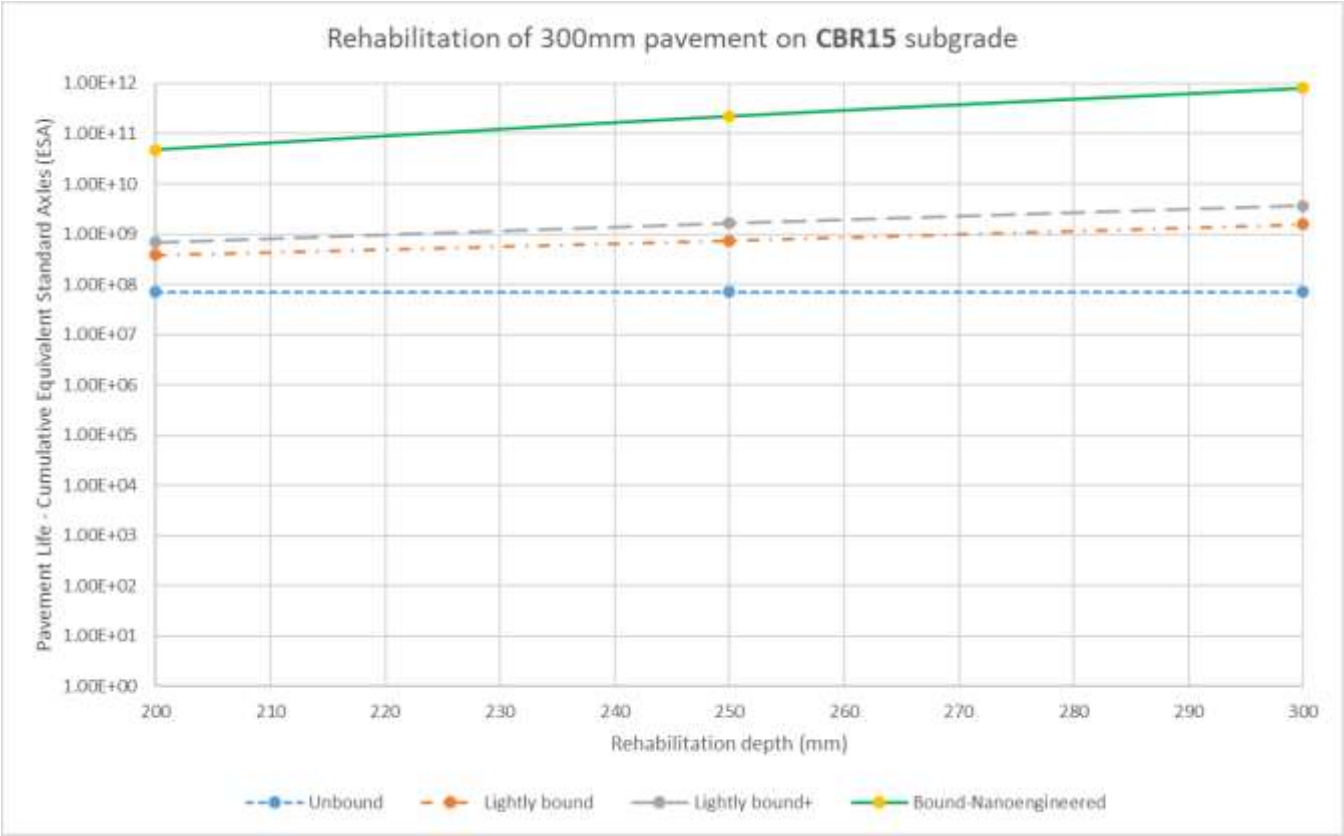


Figure 15: AustPADS outputs - Rehabilitation of 300mm pavement on CBR15 subgrade

Mix Design

Renolith 2.0 dose = 5% of binder

Renolith 2.0 is normally applied at 5% of the mass of cementitious binder. This is normally the economically optimum dosage to minimise cracking risks and improve material properties (strength, modulus etc).

Binder quantity

Cementitious binder ratio depends on the soil/aggregate type and desired strength. The addition of Renolith 2.0 admixture will increase the compressive strength, flexural strength, elastic modulus, resilient modulus and fatigue life whilst reducing permeability and shrinkage effects. Optimal use cases are:

- **1: Lightly bound+.** To mitigate the effects of shrinkage cracking, many stabilisation projects, such as rehabilitation of local government roads, specify a low quantity of binder (typically 2-3%) to achieve a lightly-bound (UCS 1-2MPa) material. With Renolith 2.0 admixture, the UCS will typically increase by 20%-80% and may become bound. Shrinkage cracking risks are reduced.

- **2: Bound/heavily bound.** Austroads AGPT02 [3] Table 6-7 (copy below) details the presumptive values for elastic characterisation of cemented granular materials.

Table 1 Presumptive values for elastic characterisation of cemented materials (from Austroads AGPT02)

Property	Base 4–5% cement[1]	Subbase quality crushed rock 3–4% cement[1]	Subbase quality natural gravel 4–5% cement[1]
Range of modulus (MPa)	3000–8000	3000–6000	3000–6000
Typical modulus (MPa)	5000	4000	3000
Degree of anisotropy[2]	1	1	1
Range of Poisson's ratio (vertical, horizontal and cross)	0.1–0.3	0.1–0.3	0.1–0.3
Typical value of Poisson's ratio	0.2	0.2	0.2

For materials not covered above, a high-performing heavily bound material (typical 28d UCS 3-15MPa) may be achieved using the mix ratios per Table 2. Problematic shrinkage cracking is unlikely when mixed thoroughly with Renolith 2.0 admixture at the recommended dose.

See *AustStab TN5* [7] and *Austroads AGPT04D-19* [8] for further guidance.

Table 2: Heavily-bound Mix Design for Various Soil Types

AASHTO soil classification	ASTM soil classification	Binder - as % of aggregate weight		AS2870-2011 Site class
	typical	Min	Max	typical
A-1-a / cold recycling	GW, GP, GM, SW, SP, SM	3%	8%	A
A-1-b	GM, GP, SM, SP	5%	9%	A
A-2	GM, GC, SM, SC	5%	10%	A-S
A-3	SP	7%	11%	A
A-4	CL, ML	7%	12%	S-M
A-5	ML, MH, CH	10%	14%	S-H1
A-6	CL, CH	10%	15%	M-H2
A-7	MH, CH	10%	16%	M-E

Notes:

- Table 2 mix design is adapted from laboratory testing of samples compacted in a mould (per AASHTO T180), 7 days curing, 2 hours soak in water, then Unconfined Compressive Strength (UCS) test (per AASHTO T208) exceeding 1.7MPa[1]. These mix

[1] *Austroads AGPT04D-19* [7] characterises the behaviour of lightly-bound cemented materials (1MPa < UCS < 2MPa, <3% binder) and bound cemented materials (UCS > 2MPa, >3% binder), with values determined from test specimens stabilised with General Purpose (GP) cement and prepared using 100% standard Proctor compactive effort at 100% standard optimum moisture content, normal curing for a minimum 28 days in moist condition without soaking in water. 7 day soaked UCS values are much lower than 28 day unsoaked UCS values. Renolith pavements using the recommended mix will behave like bound material, except with significantly reduced susceptibility to shrinkage cracking and premature fatigue cracking.

designs have been used successfully in various international projects, but tend to adopt a higher %cement than typically used in Australia.
- UCS values achieved with cement plus Renolith 2.0 is higher (typically approx. 20-80% higher) than those achieved with cement-only stabilisation.
- The binder application rate range shown in Table 2 assumes ordinary Portland cement (OPC). Binder application rates for slow and medium setting cementitious binder blends are likely to be similar, but check with the binder supplier to confirm comparable performance/strength.
- Highly organic soils are theoretically possible to use in pavement layers but are generally not viable or not permitted by stabilisation specifications.

Cement/Binder type

AustStab recommends that cement used for stabilisation should ideally conform to *AS 3972, 'Portland and Blended Cements' or NZS 3122 Specification for Portland and blended cements (general and special purpose)* [7]. Renolith is compatible with all cementitious binder blends listed in *Austroads Guide to Pavement Technology Part 4L: Stabilising Binders AGPT4L-25 Table 5.2* [9] (ie. slag/lime blends, cement/fly ash blends, slag/cement blends, fly ash/lime blends, triple blends).

Notes:

- Historically, General Purpose (GP) Portland cement Type I (per ASTM C150) has been most often used. General Purpose Blended Cements (GB) and cementitious binders are also suitable and may offer some advantages; see *Austroads AGPT4L-25* Sections 4&5 [9].
- In general, binder blends with reduced cement content cure more slowly, have slower strength onset and are less susceptible to shrinkage cracking than GP cement [10]. With Renolith 2.0 admixture:
  - Allowable working time is similar
  - strength onset is earlier
  - shrinkage cracking risks are further reduced
- See also applicable regional specifications[2] for guidance on suitable binders.

Design Tips

The following tips are suggested for achieving an optimal balance of whole-of-life costs, carbon footprint, durability, and pavement life:

- Avoid "upside down pavements"
  - TfNSW TS 10801 Supplement to Austroads Guide to Pavement Technology, Part 5: Pavement Evaluation and Treatment Design [11] states:

    > *7.5.3 Granular Overlay*
    >
    > *Avoid placing a granular pavement over a bound layer which forms part of the pavement. The granular material may be intended to bridge reflective cracking from the bound layer but results in an "upside down pavement". An upside down pavement is considered to be a high risk treatment in moderate to wet climates…*

  - Renolith admixture is highly effective at preventing cracking of the bound layer, hence granular overlays are superfluous and inappropriate. Eliminating the overlay allows the designer to reduce cost, increase pavement life and reduce the risk of potholes.

[2] e.g. Victorian Department of Transport and Planning (DTP) Section 307 - Insitu Stabilisation of Road Pavements with Cementitious Binders | Flexible Pavement Specifications (300 Series)

- Slow or medium setting cementitious binders
    - Blended cements consisting of GP cement, slag and fly ash have been used successfully in Australia since the 1990s. [1] These lower carbon binder blends can cut greenhouse gas emissions from construction considerably. Binders with less Portland cement tend to set slower, have reduced susceptibility to reflective cracking and [eventually] achieve comparable strengths.
    - The embodied carbon footprint of various blends can be estimated and compared using Austroads AGPT04-07 [12] data or a calculator such as: https://circularecology.com/concrete-embodied-carbon-footprint-calculator.html
    - Remember to consider the lifecycle emissions impact of mix design choices. A high strength pavement will typically have lower embodied carbon over the long term than a low strength (shorter life) mix.
- Material to be bound (MTBB)
    - Higher quality materials such as crushed rock will yield the best performance, but are not essential.
    - Fine poorly graded soils require much more binder (and Renolith 2.0) than coarse well graded soils, which means higher costs and carbon footprint. Aggregates can improve the soil grade and significantly reduce binder demand.
    - Site-won aggregates are typically the lowest cost and lowest carbon option. Recycled materials such as low grade recycled concrete aggregate (RCA) often work well.
    - Regional specifications may require fine, poorly graded and high plasticity soils to be improved for use in certain stabilisation applications (e.g. [10]). Consider blending local gravels and insitu materials to improve PSD and grading.
    - Refer to Austroads AGPT04D-19 [8] for guidance.
- Seal
    - Surface seals are critical over unbound granular bases to prevent water ingress. Cement stabilisation reduces permeability. Renolith 2.0 admixture reduces permeability by two orders of magnitude compared to cement-only stabilisation, typically yielding an impermeable base layer. Further, Renolith-enhanced materials retain significant strength when soaked. All-weather pavements without surface seal are possible.
    - Nanoengineered heavily-bound base layers from granular materials may provide adequate wear and skid resistance for many applications (eg. haul road, light traffic road, footpath, cycleway) without need for a separate wearing course.
    - A ‘semi-rigid’ pavement consisting of a bound (nanoengineered) base and non-structural spray seal is appropriate for many applications such as local roads and regional highways.
- Reflective cracking
    - Semi-rigid pavements are primarily designed to handle compressive loads at the surface and tensile loads at the bottom of the stabilized layer. However, specific localized conditions can cause the upper portion of the base to experience tensile stress. Tensile stress exceeding the capacity of the material may result in cracking:
        - High Horizontal Braking and Turning Forces: A spray seal is a very thin surfacing layer (typically only 10–20 mm thick). Heavy horizontal shear stresses from braking, accelerating, and turning vehicles are transmitted directly into the top of the stabilized base layer.
        - Localized Bending (Tyre Contact Pressure): High inflation pressures and heavy wheel loads create localized bending moments directly under the tyre footprint. Since the spray seal offers minimal load distribution, the top

of the base layer can experience localized flexing, leading to surface-zone tensile stresses.
        - Shrinkage: Cement-stabilized materials naturally undergo drying shrinkage. As the base tries to shrink, it is restrained by the lower layers or subgrade. This restraint induces tensile stresses throughout the base, including the upper portion, which often manifest as reflective cracks through the thin spray seal. [Note: This challenge is mitigated by Renolith admixture – see Renolith advantages]
        - Temperature Gradients: The top of the base layer is subjected to the most extreme temperature fluctuations. Severe gradients (e.g., a rapid drop in temperature at the surface) cause differential volume changes, inducing tensile stress in the upper zone.
    - Where surface tensile or shear stresses are excessive, consider an asphalt wearing course. Alternatively, instead of a standard spray seal, specialized interlayers can absorb or dissipate the high horizontal shear and localized bending before they stress the top of the base.
        - Strain Alleviating Membrane Interlayers (SAMI): Applying a heavy SAMI seal directly onto the stabilized base before the final surfacing is highly effective. This uses a highly elastomeric Polymer Modified Binder (PMB) sprayed at heavy rates. It acts as a flexible, rubbery cushion that absorbs horizontal movement and prevents shrinkage cracks in the base from tearing through the seal.
        - Geotextile Reinforced Seals (GRS): Incorporating a non-woven geotextile paving fabric into the spray seal creates a robust, waterproof membrane. The geotextile distributes localized wheel load stresses across a wider area and adds tensile reinforcement directly over the base surface.
        - Double/Double High-Stress Seals: Utilizing a two-coat spray seal (e.g., a 14/7 mm or 16/10 mm aggregate combination) bound with a high-performance PMB increases the shear resistance of the surfacing. This resists the high braking/turning forces that cause upper-base tearing.
- Subgrade
    - Austroads Guide to Pavement Technology Part 2 [3] and local road agency supplements (e.g., TMR, TfNSW) often require an improved subgrade layer, select fill, or lime/cement modification to create a stable construction platform before laying a heavily bound base or subbase.
    - Empirically, Renolith-enhanced bound layers are less sensitive to poor subgrade conditions than conventional bound layers. Nonetheless, poor support may make compaction challenging and reduce the pavement life. Consider interventions such as subgrade remediation where appropriate.

Water

Mix designs with water content at OMC[3] perform best. Refer to the relevant stabilisation specification for acceptable tolerances.

Field QC (heuristic): if you press the ready mix in the hand, it should form a cohesive ball. If it crumbles, add more water. If it sticks to the hand or moisture oozes out, use less water.

[3] The Optimum moisture content (OMC) is the moisture content at which the soil attains maximum dry density. This OMC value is with respect to the specific amount of compaction energy applied to the soil.

Renolith 2.0 admixture reduces evaporation losses. However, if high evaporation takes place in the field, add more water to prevent the pavement drying out during curing.

Constraints

Many regional standards and specifications impose constraints on soil stabilisation. Constraints may apply many aspects of the design, such as the application/layer (eg. base, subbase, subgrade), maximum binder content, binder set times, soil grade, maximum soil plasticity etc. These constraints exist to reduce the likelihood of failure (eg. cracking). The performance improvements achieved with the use of Renolith 2.0 admixture typically make these constraints technically redundant. Nonetheless, constraints imposed by any relevant specifications take precedence over information in this guide unless appropriate waivers/approvals have been obtained.

Example mix design

In-situ aggregate maximum dry density (MDD) = 2000kg/m^3
Pavement base layer thickness = 200mm
Cementitious binder application rate = 3%

- Binder spread rate = 2000kg/m^3 * 3% * 0.20m = 12kg/m^2
- Renolith 2.0 spread rate (@5% w/w binder) = 12kg * 5% = 0.6kg/m^2

Laboratory tests

The AustStab Pavement Recycling and Stabilisation Guide [13], NZ Transport Agency Best practice guide for pavement stabilisation [14] and AustRoads Guide to Pavement Technology Part 4D: Stabilised Materials [8] provide guidance on mix design and laboratory testing. AustStab Pavement Recycling and Stabilisation Guide [13] table 3.3 and Austroads AGPT04D-19 [8] table 8.1 list appropriate laboratory test methods for stabilised materials.

Basegrade Stabilisation

Local government roads in Australia often only have a flexible base layer sitting directly on the subgrade. When the thickness of the existing granular base layer is deemed too thin to satisfy rehabilitation design requirements, the base and subgrade layers may be insitu stabilised in a single process termed Basegrade Stabilisation. Young [15] proposes a mix design procedure for Basegrade Stabilisation which may be suitable for many local government roads. The procedure is outlined in Figure 16 below; the utility of this procedure may be further extended with Renolith 2.0 admixture according to
Table 3 below.

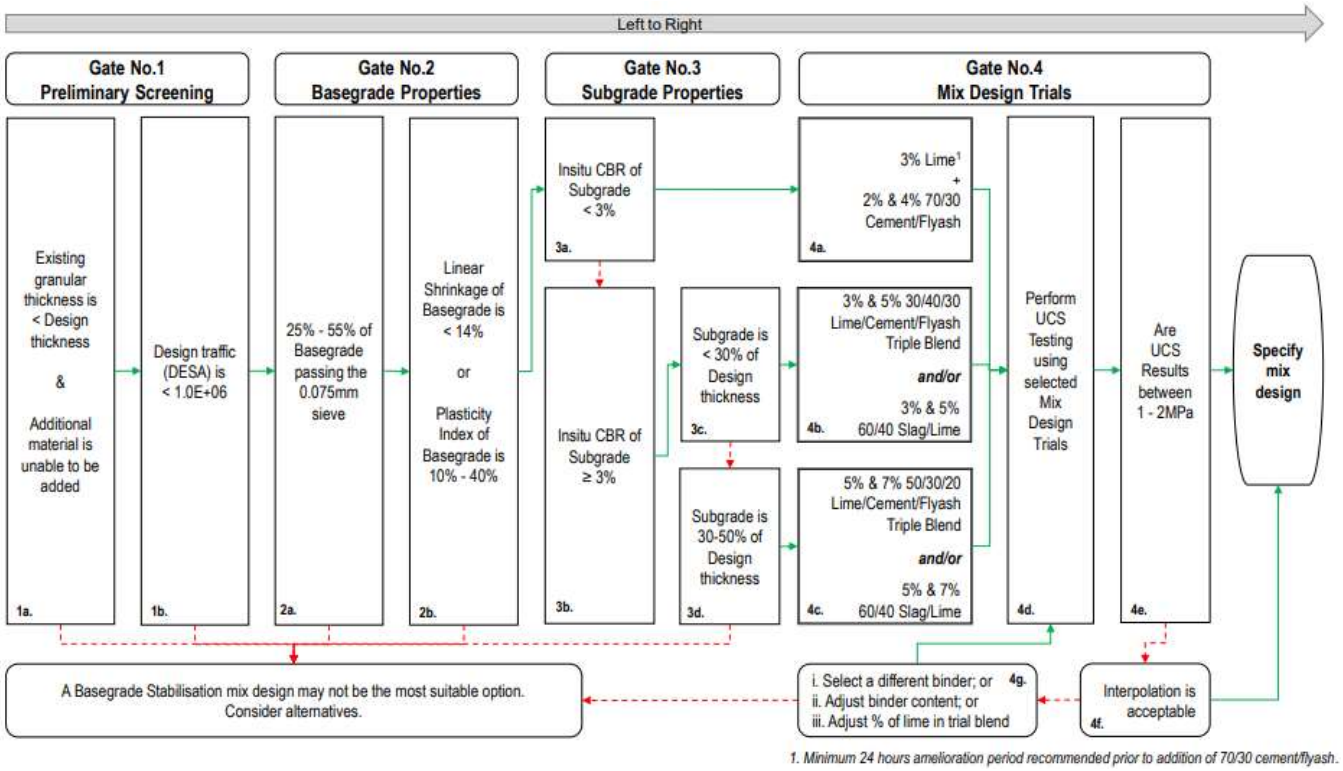


Figure 16 - Mix Design Procedure for Basegrade Stabilisation (from Young [15])

Table 3 Renolith enhancement to Basegrade Stabilisation Mix Design Procedure

Gate	Tips for using Renolith 2.0 admixture in Basegrade Stabilisation
1b	Medium or heavy design traffic can also be viable due to the significantly improved material fatigue performance. Traffic capacity may be modelled via Austroads Pavement Analysis Design Software AustPADS or similar tools.
2	PSD, shrinkage and plasticity index criteria may be relaxed. To improve material performance and minimise the risk of shrinkage cracking, consider increasing the Renolith 2.0 admixture dosage from 5% (normal dose) to 8% w/w binder (high dose) if the linear shrinkage is >14% and/or plasticity index >40%.
4e	UCS upper limit may be relaxed. A bound or heavily bound material with UCS >2MPa will yield a better pavement.

Labour and Equipment

The recommended equipment for pavement construction is summarised in Table 4 below, adapted from QLD TMR MRTS07B [16]. Actual equipment requirements may vary depending on project specifics and regional specifications.

Table 4: Plant and equipment

Major plant	Description
Reclaimer / stabiliser or Integrated spreader / reclaimer / stabiliser	Optimal Modern self-propelled machine with computerised liquid injection and the ability to mix to the design depth in a single pass (eg. Wirtgen, Bomag). Suggested specification a) Minimum power capacity of 155 kW/m of the drum width. b) Capable of mixing to the specified depth. c) Capable of supplying water such that incorporation rates can be varied across the full width of the stabilising box and incrementally across the box. d) Calibrated and capable of uniformly spreading stabilising agent to varying widths (if integrated spreader / reclaimer / stabiliser).
Cement spreader	Bulk cement spreader truck with flow control Eg. Calibrated with load cells and capable of uniformly spreading stabilising agent using a fixed bulk bin feeding a mechanical or hydraulic driven spreading rotor to varying widths. 15+ tonne recommended.
Water tankers	Two 6000L+ water trucks with spray bars and stabiliser coupling (one for water and one for Renolith 2.0 emulsion).
Grader	Caterpillar 140M or equivalent
Vibrating pad foot roller[4]	For layer thickness up to 200 mm: not required For layer thickness 200 - 300 mm: 21 tonnes
Vibrating smooth drum roller	12+ tonne, ideally with Intelligent Compaction (IC)
Multi-tyre roller	Minimum 12 tonnes
Miscellaneous equipment	
Forklift or mobile crane	For IBC/pallet and cement handling
Pump	For liquid transfers
Piping and connectors	To connect water tanker(s), stabiliser, and liquid storage

The recommended equipment in Table 4 is optimised for achieving a superior pavement quality at a high daily construction rate via in-situ stabilisation. Plant substitutions are possible, provided that accurate dosing, thorough mixing and full compaction is achieved. Mixing via mobile mixing plant has been specified and used successfully in the past; see [17]. See also Austroads [7] for further guidance.

[4] The latex in Renolith admixture reduces friction and compaction effort. Padfoot compaction is unlikely to be required for 200mm layers unless mandated by the applicable specification. Padfoot compaction is not recommended if a separate wearing course is out of scope because of the risk of incomplete trimming of the padfoot indentations.

4. Design Archetypes

Renolith nanotechnology has been proven in hundreds of projects around the world totalling more than 70,000,000m^2 of pavement base layers. Table 5 below shows cost-effective and empirically successful design archetypes that may be suitable for many typical Australian local government scenarios.

Table 5: Design archetypes

Australian local roads – rehabilitation and upgrade archetypes		
Extant pavement	Spray sealed	Unsealed
Extant construction	Spray seal over granular base. Rehabilitation required	Soil or gravel, unsealed. Any condition
Upgraded design		
Design type	Nanoengineered base with spray seal	Self-sealed nanoengineered base
Design example	New England Hwy Trial https://renolith.com.au/pinnarendi-trials/	QLD TMR Trial https://renolith.com.au/wonglepong-road/
Base	Nanoengineered – heavily bound	
Base construction	Insitu cementitious stabilisation	
Base thickness	200-250mm typical (traffic & subgrade dependent)	200mm typical
Binder type	Locally available cement or cementitious blend	
Binder rate	~3% typical	~3%-6% typical (material dependent)
Admixture	Renolith 2.0 @5% w/w cementitious binder	
Wearing course	Spray seal or asphalt	None (optional)

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7. Document control

Change History

Date	Version	Notes / changes
Oct 23	1.0	Key details summarised from Renolith 2.0 Design Guide v3.0.
Nov 25	1.1	Additional guidance on construction & mix design. Updated bibliography for revised Austroads publications. Added design archetypes section. Added basegrade stabilisation section.
Oct 26	1.2	Additional guidance on 'upside down pavements', specifications, design. Updated bibliography for revised Austroads publications. Various minor edits.
Oct 26	1.3	Added 'Life Estimator' section with AustPADS outputs
Nov26	1.4	Added guidance on mitigating reflective cracking

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8. Important Notice

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