

Superseded

**Technical Specification**

**Transport and Main Roads Specification  
MRTS35 Recycled Materials for Pavements**

**July 2017**

Superseded

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## 1 Introduction

### 1.1 Introduction to MRTS35

This Technical Specification applies to the use of recycled materials to be used in pavements for road construction, rehabilitation or maintenance.

Under the provisions of this Technical Specification, a recycled material may be used as a substitute for a new material specified for the Works where the requirements of this Technical Specification are supplementary to the respective parent Technical Specification, as follows:

- a) Nominated Recycled Material Blends (NRMBs) must comply with the following Technical Specifications:
  - i. MRTS05 *Unbound Pavements*: for utilising NRMB as an unbound granular pavement material
  - ii. MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*: for utilising NRMB to replace unsuitable material prior to stabilisation
  - iii. MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*: for utilising NRMB in pavements to replace unsuitable material prior to stabilisation, and
  - iv. in all cases, it must also comply with this Technical Specification.
- b) Bound Recycled Crushed Concrete (BRCC) types must comply with the following Technical Specifications:
  - i. MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*: for using Types BRCC1 and / or BRCC2 as relevant in place of plant-mixed pavement materials stabilised by using cement or cementitious blends
  - ii. MRTS09 *Plant-Mixed Pavements Layers Stabilised Using Foamed Bitumen*: for using RM001, RM002 and / or RCC as relevant in place of plant-mixed pavement materials stabilised by using foamed bitumen, and
  - iii. in all cases, it must also comply with this Technical Specification.

Type BRCC1 equates to 'Category 1' stabilised material as described in the Transport and Main Roads *Pavement Design Supplement* (PDS, viz. Section 6.4). Likewise, Type BRCC2 equates to 'Category 2' stabilised material.

This Technical Specification does not cover the use of recycled materials in lightly bound or cement modified pavement materials.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

## 1.2 Permissible use

This Technical Specification may be used for Contracts where the pavements are designed in accordance with the Transport and Main Roads *Pavement Design Supplement* and the following requirements are met:

- a) The overarching requirements for NRMB used as an unbound pavement material in accordance with MRTS05 *Unbound Pavements* are as follows:
  - i. For 'District Roads' as defined in the Transport and Main Roads *State Road Network of Queensland* map and where the NRMB pavement layer is immediately below an asphalt layer:
    - where the pavement design traffic load for a 20 year design life is less than  $10^6$  ESA, the asphalt (surfacing) layer shall be dense graded and/or stone mastic asphalt at least 25 mm thick, and
    - where the pavement design traffic load for a 20 year design life is equal to or greater than  $10^6$  ESA, the combined thickness of the dense graded and / or stone mastic asphalt layers above the recycled material pavement layer shall be a minimum of 100 mm.
  - ii. For 'National Network Roads', 'State Strategic Roads' or 'Regional Roads' as defined in the Transport and Main Roads *State Road Network of Queensland* map and where the NRMB pavement layer is immediately below an asphalt layer, the combined thickness of the dense graded and / or stone mastic asphalt layers above the recycled material pavement layer shall be a minimum of 100 mm.
  - iii. The NRMB shall not be used in:
    - any surfacing layer directly in contact with traffic, such as an unsealed shoulder or unsealed road
    - any pavement base layer below a spray sealed surfacing that is to be trafficked for longer than three months, including construction traffic and / or public traffic
    - any pavement base layer below a spray sealed surfacing that is to be trafficked where the maximum speed exceeds 60 kph
    - any pavement layer to be constructed with MRTS05 *Unbound Pavements* Type 1 material, and
    - any base or subbase pavement layer in a Heavy Duty pavement as defined in the department's *Pavement Design Supplement*.
- b) The requirements for NRMB when used as a 'new material to replace material not suitable for stabilisation' are as follows:
  - i. for MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*, the end product (that is, stabilised material) shall comprise not more than 50% (by mass) of NRMB, and the NRMB used shall be RM001, RM002, RM003 or RM004 material, and
  - ii. for MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*, the end product (that is, stabilised material) shall comprise not more than 50% (by mass) of NRMB and the NRMB used shall be RM001 and RM002 material.

- c) For MRTS09 *Plant-Mixed Pavement Layers Stabilised Using Foamed Bitumen*, the end product (that is, stabilised material) can comprise of up to 100% (by mass) of recycled materials where the recycled materials incorporated are limited to NRMB types RM001, RM002 and / or RCC.
- d) The requirements for BRCC when used as a 'Category 1' or 'Category 2' stabilised material are as follows:
- i. Where the pavement design traffic load for a 20 year design life is greater than  $10^6$  ESA, the BRCC material may be used for cementitiously stabilised layers in temporary pavements and / or service roads.
  - ii. Where the pavement design traffic load for a 20 year design life is greater than  $10^6$  ESA, the BRCC material may be used for cementitiously stabilised layers in the through / main carriageway and ramp pavements where:
    - BRCC compliance is demonstrated through a trial of at least three days' production prior to the start of works for the type of BRCC specified
    - successful use of the BRCC type specified / required must be demonstrated through prior use in a similar application, and
    - the material must be covered by a prime, SAMI and a minimum of 175 mm of dense graded and / or stone mastic asphalt.

## 2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* and the relevant parent Technical Specifications as given in Clause 1.1. Further definitions are as defined in Table 2.

**Table 2 – Definition of terms**

Term	Definition
Allowable Working Time	The time within which compaction and trimming of the stabilised layer shall be completed, measured from the commencement of incorporation of stabilising agent (that is, start of mixing of the stabilisation agent into the material) to completion of compaction and trimming
Binder	See <i>Stabilising Agent</i>
BL	Blended Lime (BL) stabilising agent is a blend of lime, fly ash and/or slag
BRCC	Bound Recycled Crushed Concrete (BRCC) is a mixture of RCC, water and approved granular additives that has been stabilised by cementitious stabilising agents to form a stabilised material, and produced at a controlled mixing plant to close tolerances of grading, moisture content and stabilising agent content for improved strength, stiffness, density and/or durability. It also meets the requirements of this Technical Specification.
Brick	A block of clay hardened by burning in a kiln and suitable for use under the Building Code of Australia as a building material in domestic housing or industrial building construction

Term	Definition
Ceramic	An inorganic, non-metallic solid prepared by the action of heat and subsequent cooling which have an inorganic crystalline or partly crystalline structure
Constituents	The recycled and, if applicable, quarry products that constitute the NRMB or RCC
Contaminant	A material that is not a specified material to be recycled as part of the NRMB; contaminants include debris and foreign material as specified in this Technical Specification, and materials that contravene environmental legislation and regulations
Crushed brick	Crushed material that principally consists of crushed brick and may also include some crushed concrete and concrete mortar
Crushed Recycled Materials	Recycled materials that are crushed into a product that conforms with the specified properties, and are produced in a controlled manner to close tolerances of grading, plasticity and maximum foreign material content, and are homogeneous
ERA	Environmentally Relevant Activity (ERA) as defined under Schedule 2 of the Environmental Protection Regulation 2008
ESA	Equivalent Standard Axle
Flyash	A pozzolanic by-product extracted from boilers of coal power generation that complies with AS 3582.1
GB cement	General Blended (GB) cement that complies with AS 3972 and is categorised
GGBFS	Ground Granulated Blast Furnace Slag (GGBFS) is pozzolanic by-product extracted from furnaces of steel manufacture that complies with AS 3582.2
Glass	Material formed by supercooling a molten mixture of sand (silicon dioxide), soda ash (sodium carbonate), and/or limestone to form a rigid physical state
Glass cullet	A product of mixed recycled glass sourced from manufacturing and post-consumer waste, is 100% crushed glass and is generally angular, flat and elongated in shape, this fragmented material comes in colour or colourless forms and its size varies depending on the chemical composition and method of production
GP cement	General Purpose (GP) cement that complies with AS 3972
Granular additive	A fine graded clayey sand and/or very fine clayey filler material that may be added to the crushed recycled material in a small quantity for improved workability, grading, plasticity, cohesion and/or permeability
Lime	Lime is produced by heating limestone in a lime kiln to temperatures above 900°C, resulting in carbon dioxide being driven off and Quick Lime (calcium oxide) being produced. Hydrated lime (calcium hydroxide) shall comply with AS 1672.1 and MRTS23 <i>Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation</i> .
NRMB	Nominated Recycled Material Blend (NRMB) is a RMB that complies with the requirements of this Technical Specification and has been accepted for use in the Works as an unbound granular pavement material
Ordered Stabilising Agent Content	The quantity of stabilising agent, as a percentage of dry mass of source material, designed to reach the specified strength of a stabilised material with allowable working time



Term	Definition
Parent Technical Specification	Parent Technical Specifications are MRTS05 <i>Unbound Pavements</i> , MRTS07B <i>In situ Stabilised Pavements using Cement or Cementitious Blends</i> , MRTS07C <i>In situ Stabilised Pavements using Foamed Bitumen</i> , MRTS08 <i>Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends</i> and/or MRTS09 <i>Plant-Mixed Pavement Layers Stabilised Using Foamed Bitumen</i> as relevant
Quarry product	Products from quarries that comply with this Technical Specification and MRTS05 <i>Unbound Pavements</i>
RAP	Reclaimed Asphalt Pavement (RAP) is purely asphalt material that has been milled or excavated from existing asphalt pavement layers, or unused asphalt returned from job sites
RCC	Recycled Crushed Concrete (RCC) is the main constituent of BRCC and consists of complying crushed concrete fragments, cementitious fines derived from cement / lime mortar and some quarry aggregate additives. The source material is typically reclaimed concrete from buildings and other large structures. RCC is the proposed blend to be submitted for approval prior to it being stabilised.
RMB	Recycled Material Blend (RMB) is a proposed blend submitted for approval and is made up of a combination of complying materials including crushed recycled material and with, if applicable, quarry products and/or approved additives, and meeting other requirements (for example, foreign materials limits). RMBs are produced at a controlled mixing plant to close tolerances of grading and moisture content, based on the optimum moisture content of the material.
Stabilising agent	The agent added to unbound material to increase the stiffness and modulus of the material. Types may include: <ul style="list-style-type: none"> <li>• bituminous – bitumen with or without polymers.</li> <li>• cement – GP or GB cement, and</li> <li>• cementitious blend – blends of cement and pozzolanic additive (for example, fly ash or slag) or blends of hydrated lime and pozzolanic additive.</li> </ul> (A Stabilising Agent is also referred to as 'Additive' in MRTS08 <i>Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends</i> .)
Tile	A manufactured piece of ceramic or stone
Type of recycled material	For the purpose of this Technical Specification, the types of materials that may be recycled into RMBs include complying reclaimed concrete, glass cullet, brick and asphalt
UCS Strength Gain	The difference between the UCS values measured at seven days and 28 days under normal curing when tested in accordance with Test Method RMS T131
Weighted Linear Shrinkage	Linear shrinkage multiplied by the percentage of material passing the AS 0.425 mm sieve
Weighted Plasticity Index	Plasticity index multiplied by the percentage of material passing the AS 0.425 mm sieve

### 3 Referenced documents

Reference	Title
MRTS01	<i>Introduction to Technical Specifications</i>

Reference	Title
MRTS05	<i>Unbound Pavements</i>
MRTS07B	<i>Insitu Stabilised Pavements using Cement or Cementitious Blends</i>
MRTS07C	<i>Insitu Stabilised Pavements using Foamed Bitumen</i>
MRTS08	<i>Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends</i>
MRTS09	<i>Plant-Mixed Pavements Layers Stabilised Using Foamed Bitumen</i>
MRTS23	<i>Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS51	<i>Environmental Management</i>
	<i>ANZECC Water Quality Guidelines and the Queensland Water Quality Guidelines. Prescribed water contaminants are listed in Schedule 9 of the Environmental Protection Regulation 1998</i>
–	<i>Dangerous Goods Safety Management Act 2001 and Dangerous Goods Safety Management Regulation 2001</i>
–	<i>Draft Guidelines for the Management of Contaminated Land in Australia 1998</i>
–	<i>Environmental Protection Act 1994 and Environmental Protection Regulation 1998</i>
–	<i>Environmental Protection (Waste Management) Regulation 2000</i>
–	<i>Land Protection (Pest and Stock Route Management) Act 2002 and Land Protection (Pest and Stock Route Management) Regulation 2003</i>
–	<i>Pest Management Act 2001 and Pest Management Regulation 2003</i>
–	<i>Transport and Main Roads Pavement Design Supplement</i>
–	<i>Transport and Main Roads State Road Network of Queensland</i>

#### 4 Standard test methods

##### 4.1 Standard test methods

The following test methods apply to this Technical Specification:

- a) test methods listed in Table 4.1, and
- b) test methods listed in the parent Technical Specifications.

Further reference to test numbers and test descriptions is provided in Clause 4 of MRTS01 *Introduction to Technical Specifications*.

For all test methods, except Particle Size Distribution (PSD) testing, asphalt shall be removed from the sample prior to sample preparation, and discarded. For PSD testing, the asphalt shall be conducted as noted in Table 4.1.

**Table 4.1 – Standard test methods**

Property to be Tested	Method No.
Preparation of Disturbed Samples	Q101
California Bearing Ratio (CBR)	Q113A
Chlorides	Q130A

Property to be Tested	Method No.
Flakiness Index	Q201
Linear Shrinkage	Q106
Liquid Limit	Q104A
Moisture Content	Q102A, Q102B, Q102D
Particle Size Distribution (PSD) <sup>1</sup>	Q103A
Permeability	AS 1289.6.7.1
Plastic Limit and Plasticity Index	Q105
Sulfate Content	AS 1289.4.2.1
Ten Percent Fines Value (wet)	Q205B
Wet / Dry Strength Variation	Q205C
Unconfined Compressive Strength (UCS)	Q115
Relative Compaction	Q140A, Q141A, Q141B, Q142A, Q144A, Q102A
Stabilising Agent Content	Q134
Nominated Working Time Limit	Q136
Foreign Material Content of Recycled Crushed Concrete <sup>1</sup>	Q477
Free Lime or Cement Content	RMS T134
pH Value	AS 1289.4.3.1
Degradation Factor (fine aggregate)	AS 1141.25.3
Degradation Factor (coarse aggregate)	Q208B
Water Absorption (%)	Q214B
Weak Particles	Q217
UCS Strength Gain	RMS T131

Note:

<sup>1</sup> Where the recycled material / blend contains asphalt, the asphalt shall be removed from the sample prior to sample preparation and sieved separately using the sieve sizes for the test method. The asphalt masses retained on each sieve shall be recorded and added to the cumulative masses for the equivalent sieve in testing the balance of the material. This shall be reported.

## 5 Quality system requirements

### 5.1 General

The Contractor shall comply with all statutory requirements, contract requirements, parent Technical Specification requirements and requirements of this Technical Specification.

In addition to the requirements of MRTS51 *Environmental Management*, all recycling and stabilising activities including sourcing, transporting, processing and placing of recycled materials shall meet the requirements of all statutory and regulatory requirements.

## 5.2 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable in this Technical Specification are summarised in Table 5.2. There are no Witness Points defined.

**Table 5.2 – Hold Points and Milestones**

Clause	Hold Point	Witness Point	Milestone
5.3.1	1. Contractor Offer Document Noted		Submission of Contractor's Offer Document

## 5.3 Contractor's offer document

### 5.3.1 General

The Contractor's Offer Document shall:

- a) include Construction and Handling Procedures in accordance with the requirements of Clauses 5.3.2 and 5.3.3, and
- b) be submitted by the Contractor to the Administrator **Milestone** not less than:
  - i. 28 days prior to their order for NRMB materials to be used in the Works in accordance with MRTS05 *Unbound Pavements*
  - ii. 56 days prior to their order for NRMB materials to be used in the Works in accordance with MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*, and MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*
  - iii. 56 days prior to their order for BRCC materials to be stabilised in accordance with MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*, and
  - iv. 21 days prior to their order for NRMB materials to be stabilised with foamed bitumen in accordance with MRTS09 *Plant-Mixed Pavement Layers Stabilised Using Foamed Bitumen*.

The Contractor shall not place the order for material until after the Administrator notes the Contractor's Offer Document. **Hold Point 1**

### 5.3.2 Receiving source material and processing the recycled product

The Contractor's Offer Document shall include construction and handling procedures for the production and placement of all pavement material(s), including:

- a) procedures that detail:
  - i. the company producing the NRMB, RCC to be bound and / or BRCC
  - ii. the proposed date of commencement of supply
  - iii. that the production facilities retain relevant licensing requirements under the *Environmental Protection Act 1994*, federal regulations and local government requirements

- iv. that all recycling activities including sourcing, transporting and processing of recycled materials satisfy the requirements for control of Red Imported Fire Ants under the requirements of the Queensland Department of Agriculture and Fisheries
  - v. that the production plant is licensed under Department of Environment and Heritage Protection ERA-62 (Waste Transfer Station Operation) and / or ERA-60 (Waste Disposal), and
  - vi. that the production plant is licensed under the provisions of Department of Environment and Heritage Protection ERA-33 (Crushing Milling, Grinding or Screening where crushing, milling, grinding and/or screening activities occurs at a plant)
- b) procedures used to control the source material including:
- i. records of source materials contained in each truck coming to the plant / site
  - ii. the source by general region of each type of recycled material
  - iii. inspection of materials at the entry gate of the plant / site
  - iv. inspection of materials at the point of tipping
  - v. record system for meeting regulatory requirements for fire ant control, and
  - vi. detection and management of contaminants and excess foreign materials
- c) procedures for manufacture of the NRMB, RCC to be bound and / or BRCC including:
- i. selection of source materials used
  - ii. sorting and stockpiling of raw materials
  - iii. method for dust control
  - iv. handling, crushing and processing procedures
  - v. plant details including plant type, proposed location, output capacity, and
  - vi. identification and removal of foreign materials/contaminates including the method of metal extraction, and
- d) procedures for production control including:
- i. statistical control processes to assure quality and satisfy the Contract
  - ii. calibration methods and frequencies, including a minimum of daily calculations to ensure compliance with the mix requirements
  - iii. method for addition of water and controlling moisture content of the mix
  - iv. methods for handling of materials including loading of mixture, control of segregation from production to placement and transferring NRMB / BRCC to trucks and the Works, and
  - v. stockpiling and storage of crushed materials, but not BRCCs.
- e) If a quarry product is used in the blend, detail:
- i. the source of the quarry product, including its current Transport and Main Roads Quarry Registration Certificate (where one is required), and
  - ii. the nominated type and subtype of the quarry product in accordance with MRTS05.

- f) For each NRMB and BRCC:
- i. nominate a unique identifying name for the mix
  - ii. for BRCC, confirmation that either RM001 or RCC shall be solely used as the main constituent material
  - iii. for NRMB mixes, nominate the RMB type in Table 6.2.2(a) with which the NRMB complies
  - iv. detail each of the constituents of NRMB / BRCC including, as applicable:
    - crushed concrete
    - crushed brick
    - RAP
    - granular additives
    - glass cullet, and
    - blend proportions
  - v. if used in the material, detail compliance results for each granular additive, and
  - vi. demonstrate that the NRMB or BRCC material complies with the requirements of Clause 5.3.2 including a recent certificate (no older than three months) signed by the Manufacturer of the NRMB or BRCC that certifies that the materials meet the requirements of this Technical Specification.
- g) For BRCC mixes also detail:
- i. the stabilising agent type(s), source(s) and demonstrated compliance of each additive / constituent
  - ii. admixture type(s), brand(s) and source(s), and certificates demonstrating the compliance of each admixture with AS 1478
  - iii. proposed stabilising agent application rate to meet the required UCS as per Clause 6.3.2
  - iv. blend proportions for constituent of the nominated stabilising agent
  - v. method for handling of stabilising agents, their constituents and admixtures
  - vi. method for blending cementitious additives / constituents for producing the nominated stabilising agents
  - vii. method for sampling the stabilising agent(s), admixture(s)/constituent(s) and water from the storage silos
  - viii. method for uniformly incorporating stabilising agent(s), admixture(s) and water into a central pugmill including doing this within the tolerance limits
  - ix. method for controlling moisture content including a work method and target moisture content that will ensure adequate, uniform moisture to achieve uniform distribution, hydration and specified level of compaction
  - x. Nominated Working Time Limit (as determined in accordance with Test Method Q136)
  - xi. the UCS achieved by the mix at 28 days under normal curing when tested in accordance with Test Method Q115 using standard compaction, and

- xii. for BRCC1 material with slow setting stabilising agents, test results that confirm of a UCS Strength Gain of at least 1.0 MPa and a minimum UCS at seven days of 1.0 MPa. If the UCS Strength Gain is less than 1.0 MPa, additional curing and testing needs to be carried out to show the increase in strength after 28 days.

### **5.3.3 Construction**

The Contractor's Offer Document shall include construction and handling procedures sufficient to assure quality in the placement and construction of all materials including:

- a) for BRCC, procedures for transporting BRCC that include the following:
  - i. number, type and capacity of transport vehicles
  - ii. measures to prevent loss of moisture during transit
  - iii. time between completion of mixing and discharge into the spreading equipment, and
  - iv. method of discharge into the spreading equipment / for spreading.
- b) a procedure to ensure that, after trimming, the finished surface of the pavement provides a tightly bound matrix of coarse and fine material without a slurry of fines, a pavement free from lenses and a surface free from roller marks after trimming
- c) the method of disposal of the trimmed material to waste, and
- d) methods for survey / level control adequate to ensure that the pavement course thickness is compliant.

## **6 Materials**

### **6.1 General**

Materials and their manufacture, delivery, placement and use shall comply with all the requirements of all relevant legislation and regulations.

### **6.2 NRMB material requirements**

#### **6.2.1 General**

The NRMB material shall be mixed thoroughly to ensure that there is an even and homogenous distribution of constituents.

Where Clause 3 of Annexure MRTS35.1 nominates that the RMB is to be in direct contact with galvanized or aluminium pipes / fittings, the pH value of the NRMB shall not exceed 11. Alternatively, the pipes and fittings shall be covered with a suitable fabric liner. The permeability of the mix shall be as given in Clause 3 of MRTS35.1, if specified.

Any additional testing required shall be in accordance with Clause 1 of Annexure MRTS35.1.

#### **6.2.2 Percentage limits of constituent recycled material types**

Each NRMB shall comply with:

- a) the requirements of Table 6.2.2(a) which specifies the percentage limits of constituents for RMBs, and
- b) Tables 6.2.2(b) and 6.2.2(c) which specify the PSD requirements.

A NRMB blend may contain quarry products conforming to the requirements of MRTS05 *Unbound Pavements*.

The NRMB may contain conforming granular additives, provided any clay component conforms to the requirements of Clause 6.4.6 and it does not exceed 2% of the total dry mass of the NRMB. Granular additives shall ensure increased mechanical interlock, increased inter-particle friction, increased resistance to water ingress and decreased aggregate breakdown.

The constituents and proportions of them within each NRMB shall not be adjusted from the nominated proportions and shall be consistent across all samples greater than 10 kg.

**Table 6.2.2(a) – Percentage limits of constituent recycled material types in RMBs**

RMB Type <sup>2</sup>	Parent Technical Specification	New Material to Replace Old Material <sup>1</sup>	Material Sub-type for Parent Technical Specification	Maximum Limit of each Constituent <sup>3</sup> (percentage by mass of final mix)			
				Reclaimed Concrete	RAP	Brick	Glass Cullet
RM001	MRTS05	Yes	Sub-type 2.1	100	0	0	0
RM002	MRTS05	Yes	Sub-type 2.2	100	15	0	0
RM003	MRTS05	Yes	Sub-type 2.3	100	15	15	0
RM004	MRTS05	Yes	Sub-type 2.4	100	15	15	0
RM005	MRTS05	No	Sub-type 2.5	100	15	45	5
RM006	MRTS05	No	Sub-type 3.5	100	15	45	5

Notes:

- For new materials to replace unsuitable materials, when used in works as per MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*, selection of the recycled materials shall be selected from RM001 to RM004 and at least match the quality of the existing pavement material.
- For new materials to replace unsuitable materials, when used in works as per MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*, selection of the recycled materials shall be from RM001 to RM002.
- For plant-mixed foamed bitumen stabilisation as per MRTS09 *Plant-Mixed Pavement Layers Stabilised Using Foamed Bitumen*, selection of the recycled materials shall be from RM001 to RM002.
- In all blends, a higher order type can be used as a lower order type (for example, a RM003 can be used where a RM004, RM005 or RM006 is required).
- The maximum limit of each constituent includes all materials whether included as primary mix design material, additive or foreign material.

**Table 6.2.2(b) – Particle size distribution for RMB types RM001, RM002, RM003 and RM004**

AS Sieve Size (mm)	Percentage Passing by Mass for each Nominal Size			
	RM001 and RM002		RM003 and RM004	
	Target	Limits	Target	Limits
26.5	100	100	100	100
19.0	100	95 – 100	100	95 – 100
13.2	85	78 – 92	85	75 – 95
9.50	73	63 – 83	75	60 – 90
4.75	54	44 – 64	59	42 – 76



AS Sieve Size (mm)	Percentage Passing by Mass for each Nominal Size			
	RM001 and RM002		RM003 and RM004	
	Target	Limits	Target	Limits
2.36	39	30 – 48	44	28 – 60
0.425	17	13 – 21	19	10 – 28
0.075	7	5 - 9	7	3 – 11

**Table 6.2.2(c) – Particle size distribution for RMB types RM005 and RM006**

AS Sieve Size (mm)	Percentage Passing by Mass for each Nominal Size	
	Nominal 20 mm Size	
	Target	Limits
26.5	100	100
19.0	92	84 – 100
13.2	82	69 – 95
9.50	73	56 – 90
4.75	57	37 – 77
2.36	43	23 – 63
0.425	19	8 – 30
0.075	8	2 – 14

### 6.2.3 Tolerances of constituent proportions

Table 6.2.3 details the tolerance limits of the total proportions by mass of the constituents of the NRMB from the RMB proportions stated in Table 6.2.2(a).

**Table 6.2.3 – Tolerances of the constituents**

Constituent	Tolerance (%) from Nominated Blend Percentages (by mass)
<b>Recycled products</b>	
Crushed concrete	± 5
Crushed brick and nonceramic tile	± 2
RAP	± 2
Glass cullet	± 1
<b>Quarry products</b>	
Nominated subtype	± 5
Granular additive	± 1
<b>Other</b>	
Moisture content	-1.0% and +0.5%

#### 6.2.4 Property limits

NRMB materials shall comply with the requirements of Table 6.2.4. In addition, controlling free lime (see Clause 6.2.5) in recycled materials shall be assured through stockpile management as specified in Clauses 6 of Annexure MRTS35.1.

Where an option is given in Table 6.2.4, the Contractor shall, before the Works commence, choose either the Plasticity Index and Weighted Plasticity Index (WPI) limits or Linear Shrinkage and Weighted Linear Shrinkage (WLS limits) as compliance requirements and provide written advice to the Administrator about the option chosen. This shall then not change during the Works.

NRMB materials to be stabilised (for example, to replace material unsuitable for insitu stabilisation) shall:

- a) have a water soluble sulfate content not exceeding 1.9 grams of Sulfate (expressed as SO<sub>3</sub> per litre), and
- b) have a Weighted Plasticity Index (WPI) of between 2200 and 3200.

**Table 6.2.4 – Property limits for RMBs**

Property	Limit	RMB Type					
		RM001	RM002	RM003	RM004	RM005	RM006
Flakiness Index (%)	Maximum	35	35	40	40	40	40
Wet/dry Strength Variation (%)	Maximum	35	40	45	45	45	45
Degradation Factor (coarse/fine aggregate) <sup>1</sup>	Minimum	-	-	-	-	-	-
California Bearing Ratio (%)	Minimum	80	60	45	35	15	15
Ten Percent Fines Value (wet) (kN)	Minimum	85	85	70	70	-	-
Liquid Limit (%)	Maximum	35	35	35	35	40	40
Plasticity Index or Linear Shrinkage	Maximum	6 3.5	8 3.5	8 4.5	12 6.5	14 7.5	14 7.5
Weighted Plasticity Index or Weighted Linear Shrinkage	Maximum	150 85	150 85	200 110	360 195	- -	WPI only – range: 2200 to 3200
Unconfined Compressive Strength (UCS) at seven days <sup>2</sup>	Maximum	0.7	0.7	0.7	0.7	0.7	0.7

Notes:

1. Any quarry product used in the NRMB shall comply with the requirements of MRTS05 *Unbound Pavements*.
2. The UCS limit is for the average UCS of compacted materials using standard compactive effort, for triplicate test specimens.

### 6.2.5 Contamination limits

Foreign materials types (as prescribed in Test Method Q477) in that fraction of the product retained on a 4.75 mm sieve shall not exceed the percentages by mass in Table 6.2.5.

Asbestos shall not be incorporated.

The free lime content shall not exceed 0.6% when tested in accordance with RMS T134.

**Table 6.2.5 – Limits of foreign materials in NRMBs**

Foreign Material Type	Constituents of Foreign Material Type	RMB Type (Refer Table 6.2.2(a))	Maximum Percentage in Mix (% by mass), when tested in accordance with Q477
1	Brick	RM001, RM002	1
	Asphalt	RM001	1
	Metal, ceramics and slag (other than blast furnace slag)	RM001, RM002, RM003, RM004, RM005, RM006	3
2	Plaster, clay lumps and other friable material	RM001, RM002, RM003, RM004, RM005, RM006	1
3	Rubber, plastic, bitumen not part of asphalt, paper, cloth, paint, wood and other vegetable matter	RM001, RM002, RM003, RM004, RM005, RM006	0.2

### 6.2.6 Additional aggregate requirements

Coarse aggregates shall consist of crushed fragments that are clean, sound, hard, durable, and angular. The crushed fragment shall be free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

All quarry-produced components of the RMB shall comply with the requirements of MRTS05 *Unbound Pavements* and this Technical Specification.

## 6.3 BRCC material requirements

### 6.3.1 General

Processing and stockpiling operations shall control the required quality of the constituent materials to meet the requirements of this Technical Specification and the relevant parent Technical Specification(s). Any additional testing required under specific contract requirements shall be in accordance with Clause 2 of Annexure MRTS35.1.

The following material shall be stabilised to produce BRCC:

- a) RCC only shall be used for BRCC1, and
- b) RCC or RM001 only shall be used for BRCC2.

### 6.3.2 Stabilising agent content, allowable working time limit and strength requirements

Notwithstanding the requirements of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*, the Contractor shall select one of the stabilising agent types as per Clause 6.4.7 to meet the following requirements:

- a) For determining Stabilising Agent Content, the following requirements apply:
  - i. The Ordered Stabilising Agent Content to be used in the Contract will be confirmed by the Administrator in accordance with Clause 8.2.1.1 of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*.
  - ii. The Target Stabilising Agent Content is the stabilising agent content to be used in manufacturing and shall be determined by adjusting the Ordered Stabilising Agent Content to account for the plant variability as specified in Clause 8.2.1.2 of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*. The resulting Target Stabilising Agent Content, stabilising agent type(s) and blend proportions of cementitious additives shall be such that the specified UCS requirements are met where the UCS test result shall be the mean 28-day UCS of triplicate test specimens determined in accordance with the test Q115 and compacted using standard compactive effort at optimum moisture content. Where samples for dry density-moisture relationship (Test Method Q142A) or UCS (Test Method Q115) are to be taken, they must be removed immediately after completion of plant mixing. The compaction of these samples must be completed within the Allowable Working Time.
- b) Notwithstanding the requirements of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*, the Allowable Working Time for BRCC shall be determined in accordance with Clause 6.4.7.
- c) Strength requirements:
  - i. Table 6.3.2 details the UCS requirements for BRCC.
  - ii. Slow setting stabilising agents, where the 28-day UCS test results are slightly less than the specified values, may be used, provided the minimum UCS Strength Gain is 1 MPa between seven-day UCS and 28-days' UCS. If the UCS Strength Gain is less than 1 MPa, additional curing and testing should be carried out to show the increase in strength after another 28 days.
  - iii. The seven-day UCS shall not be less than 1 MPa.

**Table 6.3.2 – UCS requirements for the BRCC**

BRCC Type	Pavement Material Type <sup>1</sup>	Minimum 7 Day (Mean) UCS (MPa)	Minimum 28 Day (Mean) UCS (MPa)	Maximum 28 Day (Mean) UCS (MPa)
BRCC1	Category 1	1.0	3.5	4.5
BRCC2	Category 2	1.0	2.5	3.5

Note:

<sup>1</sup> Refer to the Transport and Main Roads *Pavement Design Supplement*.

### 6.3.3 RCC material requirements

RCC material is an unbound material for cementitious stabilisation that meets the requirements of this Technical Specification. Requirements include:

- a) Property limits (other than PSD, UCS, PI, LS, WPI and WLS) for an RCC material shall be in accordance with Table 6.2.4 for NRMB – Type RM001.
- b) Property limits for PI and LS shall be in accordance with Clause 10 of Annexure MRTS08.1.
- c) Foreign materials limits for an RCC material shall be in accordance with Table 6.2.5 for NRMB – Type RM001.
- d) The water soluble sulfate content shall not exceed 1.9 grams of sulfate (expressed as SO<sub>3</sub> per litre) and the Weighted Plasticity Index (WPI) shall be between 2200 and 3200.
- e) The PSD for RCC shall comply with Table 6.3.3. The PSD curve shall also be smooth and not vary from one outer third of the total limits range between the minimum and maximum limits for one sieve to the opposite outer third of the total limits range for the next lower sieve.

**Table 6.3.3 – PSD for RCC**

AS Sieve Size (mm)	Percentage Passing by Mass for each Nominal Size	
	RCC <sup>1</sup>	
	Target PSD	PSD Limits
26.5	100	100
19.0	100	95–100
13.2	85	70–90
9.50	73	60–80
4.75	54	–
2.36	39	30–50
0.425	17	10–25
0.075	8	4–12

Note:

1. RCC is a special blend of recycled crushed concrete and granular additives (crushed rock) for use in plant-mixed cementitious stabilisation.

## 6.4 Constituent material properties

### 6.4.1 General

Each recycled material shall comply with the requirements of the applicable parent Technical Specifications. Notwithstanding this, for both NRMB and BRCC, the requirements of this Technical Specification are in addition to and override the requirements of the parent Technical Specifications.

Each NRMB material sub-type applicable to the RMB type is stated in Table 6.2.2(a) except that, for each recycled material type, the source rock requirements in MRTS05 *Unbound Pavements* do not apply.

Recycled materials with chemical substances, as evidenced by alkali-silica reaction and rust stains, shall not be used in producing RCC.

Constituents shall be free of contaminants such as clay, organic matter and any other deleterious material.

#### **6.4.2 Crushed concrete**

For producing NRMB, crushed concrete that contains appreciable unhydrated cement or free lime shall not be used.

Limiting unhydrated cement or free lime in NRMB will help stop or limit tufa precipitate formation in pavement drainage structures.

Crushed concrete is the main constituent of RCC. It may also contain granular additives (crushed rock).

#### **6.4.3 Reclaimed asphalt pavement (RAP) material**

RAP material included in the NRMB shall be purely asphalt and processed to a well-graded, free-flowing and consistent state. Minimum processing shall involve crushing and screening operations to ensure a maximum size not greater than the maximum aggregate size of the recycled material blend is being produced.

RAP, including the binder in it, shall not contain tar.

#### **6.4.4 Crushed brick**

Brick walls typically have significantly higher lime content due to the mortar attached to the brick, which shall be managed in material production. Crushed brick included in the NRMB shall be tested in accordance with Q205C and the wet strength and wet / dry strength shall be reported.

#### **6.4.5 Glass cullet**

The following requirements shall apply to any NRMB utilising recycled glass cullet:

a) Recycled glass source:

Glass shall be sourced only from food and beverage containers or building or window glass. Other glass shall not be used. Such other glass includes recycled glass classified as hazardous waste, light bulbs, laboratory equipment, televisions, computers, cathode ray tubes, porcelain products, cook tops, automobile and vehicle glass including windscreens, and fluorescent tubes.

b) Contaminants:

Cullet shall contain no more than 5.0% by mass of contaminants such as paper, foil, cardboard, metal, organics, plastic wrappers and bottle tops.

c) Cleanliness:

The cullet shall be cleaned to ensure that undesirable odours are eliminated.

d) Crushing:

Cullet crushing operations shall include crushing by a shaping crushing plant and shall produce a well-graded product.

e) PSD:

The cullet grading shall comply with Table 6.4.5.

f) The plus 4.75 mm component of the cullet shall not contain more than 1% of particles with a maximum dimension to minimum dimension ratio greater than 5:1.

**Table 6.4.5 – Cullet PSD**

AS Sieve Size	Percent Passing
9.5 mm	100
4.75 mm	70 – 100
2.36 mm	35 – 88
1.18 mm	15 – 45
0.30 mm	4 – 12
0.075 mm	0 – 5

#### 6.4.6 Granular additives

A granular additive is an imported aggregate or crushed rock which may be incorporated into the pavement material to improve its grading and cohesion and / or reduce its permeability. A granular additive alters the intrinsic properties of the parent material (for example, PSD, plasticity and stone hardness whereby load bearing capacity performance attributes are improved through increased mechanical interlock, increased inter-particle friction, decreased aggregate breakdown and increased resistance to weakening by water ingress).

Where the Contractor elects to use a granular additive component in the NRMB or RCC blend, the additive shall:

- a) for sources, materials or constituents covered by the Transport and Main Roads Quarry Registration System, be from a registered quarry
- b) be 100% passing the 2.36 mm sieve
- c) not be cementitious in nature
- d) be free of organic matter, lumps and balls of clay, oversize particles of rock and other deleterious material
- e) be of a size that means it can be effectively and uniformly distributed throughout the crushed recycled material
- f) be durable and resistant to in-service breakdown
- g) be delivered and stored to ensure that it is free-flowing when incorporated into the blend
- h) have a Weighted Plasticity Index  $\leq 1200$
- i) be dried and kept dry to ensure that free-flowing additive is incorporated evenly into the mixture
- j) be fully crushed and screened to the maximum aggregate size permitted in the product prior to blending

- k) be sized such that it can be effectively and uniformly distributed throughout the crushed rock via the continuous even addition to the crushed rock conveyor from the conveyor(s) containing the additive(s)
- l) NRMBs shall not contain crusher fines produced from crushed concrete but may contain fines be produced from crushed rock
- m) be produced from an igneous or metamorphic rock source, and
- n) have a Degradation Factor – Fine Aggregate of not less than 60.

#### **6.4.7 Stabilising agents**

All of the components of the stabilising agent shall be homogeneously and accurately blended / mixed by a dedicated blending plant prior to incorporation into the unbound material. At the time of incorporation, each component of the stabilising agent shall:

- a) comply with the relevant Specification(s), Standard(s) and Technical Specification(s), and
- b) be not more than three months old, measured from its date of manufacture to the time of its incorporation.

Notwithstanding the requirements of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*, the Contractor shall nominate as per Clause 5.3, the Stabilising Agent, proposed dosage, cementitious additives and blend ratios to be used. The Contractor select from and use one of the following Stabilising Agent types:

- a) Rapid Setting Stabilising Agent shall be General Purpose Cement (GP) that complies with AS 3972.
- b) Medium Setting Stabilising Agent shall be General Blended Cement (GB) consisting of GP Cement and Ground Granulated Blast Furnace Slag (GGBFS) and / or fly ash that comply with AS 3582.2 and AS 3582.1 respectively, and
- c) Slow Setting Stabilising Agent shall be a Blended Lime (BLB) consisting of hydrated lime (in accordance with AS 1672.1) and slag and/or fly ash that comply with AS 3582.2 and AS 3582.1 respectively. Hydrated lime shall comply with MRTS23 *Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation*.

In addition:

- a) The Allowable Working Time shall not be more than the Nominated Working Time Limit determined in accordance with Test Method Q136, unless otherwise determined by the Administrator.
- b) The Stabilising Agent used in the Works shall be the same in all respects as the Stabilising Agent used in the laboratory mix design upon which the Contractor's submission is based (see Clause 5.3).
- c) The Stabilising Agent shall be uniformly mixed into RCC materials to ensure a homogenous distribution and the proper / required binding of the particles.



Example Allowable Working Times for various stabilising agents are:

- GP Cement 2 hours
- GB Cement 4 hours
- Lime 8 hours
- Lime / Slag 12 hours, and
- Lime / Flyash 24 hours.

#### **6.4.8 Water**

Water sources shall be tested prior to use, for electrical conductivity and pH, in accordance with the current Australian Standards. The electrical conductivity shall not be more than 3500 S/cm and pH within the range of 6 to 10.

Water quality shall also be in accordance with Clause 6.5 of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*.

#### **6.4.9 Admixture(s)**

The type of admixture(s) shall be as approved by the Administrator as specified in Clause 6.2 of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*.

### **7 Material manufacture**

#### **7.1 General**

Materials and their manufacture, delivery, placement and use shall comply with all the requirements of all relevant legislation and regulation.

NRMB and RCC (to be bound) shall be manufactured at a controlled, dedicated mixing plant to achieve the tolerances for PSD and moisture content. The constituents and proportions of each NRMB and BRCC shall not be adjusted from the nominated proportions and shall be consistent across all samples greater than 10 kg.

The constituent material distribution, consistency and workability of the NRMB and BRCC shall be such that it can be handled and transported without segregation and can be placed, worked and compacted so that resulting pavement layer is homogeneous and complying.

For BRCC, the cementitious additives and / or stabilising agents must be transported to the mixing plant in watertight containers and must be protected from moisture until use. Nonconforming wet or lumpy stabilising agents or cementitious additives shall not be used in the Works.

Where the mixing plant does not include a separate silo for each cementitious additive, and / or does not have the capability to blend within the specified tolerance, the cementitious additives may be blended prior to delivery to the mixing plant. The blending tolerance of each cementitious additive to make up the nominated stabilising agent must be within  $\pm 3\%$  of the nominated blend proportions, and documentation demonstrating this, and the conformance of all constituents, must be provided for each delivery of the stabilising agent and cementitious additive.

Any spilled stabilising agent or cementitious additive shall not be incorporated into the material to be bound.

## **7.2 Manufacture of NRMB**

### **7.2.1 Blending**

The constituent materials within the NRMB shall be added, combined and blended using procedures that:

- a) are controlled to ensure uniformity and homogeneity of the NRMB
- b) ensure that the NRMB is processed to a well-graded, free-flowing and consistent state, and
- c) comply with the blending / mixing / production requirements specified in the parent Technical Specifications.

### **7.2.2 Moisture content**

Unless otherwise stated in Clause 5 of Annexure MRTS35.1, during manufacture of the NRMB material, water shall be added, provided:

- a) the amount of water is not less than 5% by mass
- b) water is incorporated using a controlled, measured process
- c) it is done not more than 48 hours prior to placement of the material in the pavement, and
- d) so that it is uniformly distributed throughout the material by using a pug mill or equivalent mechanical process.

## **7.3 Manufacture of RCC**

For the manufacture of RCC to be bound, in addition to the requirements in Clause 7.2, when the crushed concrete is blended with granular additives (crushed rock) to meet the PSD requirements in Table 6.3.3, concrete fragments shall be pre-wetted so that they can be blended consistently with the granular additives.

## **7.4 Manufacture of Plant-mixed BRCC**

### **7.4.1 Mixing Plant**

In addition to the requirements of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*, a dedicated mixing plant (pug-mill) shall be used that must be capable of:

- a) mixing the RCC, stabilising agent, admixture and water, so as to produce a moist and homogeneous material suitable for compaction, without the addition of further water after the material leaves the mixing plant
- b) providing measurements of the (stabilising agent) incorporated into the mix for each 200 tonnes produced to within 0.3% of the dry mass of the RCC, and
- c) operating in accordance with the manufacturer's recommendations.

### **7.4.2 Moisture content**

The moisture content of the material shall be controlled until it is within the target moisture content envelope as specified in Clause 5.3.3.

### 7.4.3 Stabilising agents and admixtures

At the time of incorporation, each component of the stabilising agent and each admixture shall:

- a) comply with the relevant Specification(s), Standard(s) and Technical Specification(s), and
- b) be not more than three months old, measured from its date of manufacture to the time of placement of the BRCC.

Stabilising agent and admixture types, blend proportions and application rates shall be selected by the Contractor to achieve the requirements of this Technical Specification.

Stabilising Agent type: to reduce shrinkage issues and to achieve a higher-strength slow-setting stabilising agents are recommended for producing BRCC1 whereas slow- or medium-setting stabilising agents are recommended for BRCC2.

Cementitious additives blend proportions and Stabilising Agent application rate: limited laboratory test results have demonstrated that only a BL slow-setting Stabilising Agent consisting of 4% lime / slag 15:85 blend and 5% lime / slag 25:75 blend achieved satisfactory outcomes for Category 1 (BRCC1). Both the BL and GB Stabilising Agent types demonstrated satisfactory results for Category 2 (BRCC2).

### 7.5 Process control requirements

Production of each nominated BRCC mix shall be such that:

- a) the stabilising agent content incorporated shall not be less than the Ordered Stabilising Agent Content
- b) the actual stabilising agent content used in production shall compensate for the product variability ( $\sigma$ ) of the plant, and
- c) the contractor's proposed Target Stabilising Agent Content, which has been estimated based on the actual production plant variability, shall be submitted to the Administrator at least 14 days before commencing manufacture, and shall be used in the Works thereafter.

Mixing of material shall be continued until the stabilising agent and all constituent materials are thoroughly and evenly distributed through the mass and a uniform mixture of homogeneous appearance is obtained. Sufficient mixing capacity shall be provided so that the rate of placement of complying mix is no less than 150 tonnes per hour or the Contractor's placing rate on the road bed per hour whichever is the higher.

At the completion of each batch, the Contractor shall calculate the average percentage of stabilising agent added as a percentage of the dry mass of the material being bound, to the nearest 0.05%, from the amount of stabilising agent used (determined from delivery dockets, silo dippings and so on) and the quantity of material mixed and placed in the works (determined by appropriate measurement). The Contractor shall submit all results to the Administrator at the end of each day's production.

## **7.6 Supply and delivery of BRCC**

BRCC shall be discharged from the mixer to a timed discharge hopper or alternatively to a storage bin. No material shall be discharged directly from conveyor belts into trucks or onto the ground. The drop from the conveyor to the minimum level of material in the timed discharge hopper or the storage bin must not exceed 4 m.

BRCC shall be stored in containers and delivered in vehicles so constructed that loss of material does not occur. Vehicles shall be fitted with suitable waterproof covers to prevent loss of moisture and the ingress of water during transport. The delivery vehicles shall not be allowed, either loaded or unloaded, to travel over any bound pavement layer without the approval of the Administrator.

Vehicles used for the delivery to the hopper of a spreading machine or to a spreader box must have bodies or discharge equipment which enable the load to be discharged directly into the hopper or spreader box without spillage onto the road or segregation of material. The number of delivery vehicles provided must be sufficient to ensure BRCC is delivered at a uniform rate that is compatible with the capacity of the spreading and compaction equipment in order to minimise stoppages of paving operations.

Handling, including discharging from the mixing plant and the loading of trucks, shall minimise segregation of BRCC. Any material delivered to the spreading machine which is unsuitable for reasons such as segregation or contamination is deemed to be nonconforming. BRCC shall be delivered to the site in such a way that it is spread, compacted, and trimmed / shaped to the final levels / shape within the allowable working time.

## **8 Stockpile requirements**

In addition to the stockpile requirements of the parent Technical Specifications:

- a) the Contractor's Environmental Management Plan (Construction) to be prepared in accordance with MRTS51 *Environmental Management* shall include provisions that the location of and clearances to a stockpile shall suitably protect ground water and water bodies from any deleterious leachates
- b) the Contractor's Stockpile Management Plan shall include the control of PSD and Foreign Material Content for each product, as specified in Clause 5
- c) where processed NRMB material has been stockpiled for some time and is no longer in a free-flowing condition, it shall be reprocessed to ensure it is in a free-flowing condition at the time of use
- d) the stockpile site shall be clear, clean, even firm, adequately paved, and well-drained
- e) if a stockpile is constructed in more than one layer, each layer shall be fully contained within the area occupied by the upper surface of the preceding layer
- f) there shall be a separate stockpile for each material of the same standard
- g) all stockpiles shall be separated from other stockpiles by at least two metres
- h) glass cullet shall be in a separate discrete stockpile prior to blending
- i) the surface of the stockpile shall be kept damp to prevent a net loss of moisture and to minimise the generation of airborne dust

- j) for RCC, the reclaimed concrete blocks prior to crushing and also the manufactured RCC prior to stabilising shall be stockpiled separately to exclude other recycled materials, and
- k) any other additional overriding requirements as stated in Clause 6 of Annexure MRTS35.1 shall be met.

For the purpose of testing, each individual stockpile lot shall be clearly delineated by one of the alternative methods below:

- a) a separate stockpile shall be formed for each stockpile lot, or
- b) material meeting the same requirements shall be added to a single stockpile incrementally such that a portion representing a stockpile lot is added, tested and found to be conforming before the next portion, representing the next stockpile lot, is added. Nonconforming stockpile lots shall be removed from the stockpile prior to the addition of further portions.

No stockpile which, in the opinion of the Administrator, is excessively wet, shall be used in the stabilisation works.

BRCC shall not be stockpiled.

## **9 Construction**

### **9.1 General**

Materials and their manufacture, delivery, placement, construction and use shall comply with all the requirements of the applicable parent Technical Specifications and all relevant legislation and regulation.

The recycled pavement material type and layer locations shall be in accordance with Clause 4 of Annexure MRTS35.1.

### **9.2 Supply of material to the Works**

#### **9.2.1 General**

Unless otherwise specified in Clause 7 of Annexure MRTS35.1, NRMB and BRCC shall be supplied in trucks covered with a waterproof covering.

If the Contractor elects, or is required to supply any material to a stockpile prior to delivery to the roadbed, the product after recovery from the stockpile shall comply with this Technical Specification.

Material shall be handled, stored and supplied in accordance with the requirements of the parent Technical Specifications.

#### **9.2.2 Delivery dockets**

Delivery to the Site shall be accompanied by a delivery docket that states the following minimum information:

- a) name of the NRMB or BRCC material and mix identifier
- b) name and address of Manufacturer of the NRMB or BRCC
- c) date of manufacture of the NRMB or BRCC
- d) production lot number and stockpile number

- e) certification that the NRMB or BRCC material has been sampled and tested and that it complies with the requirements of this Technical Specification, and
- f) batching time of plant-mixed cementitious stabilised BRCC.

Delivery dockets shall be made available for inspection by, and copies of them submitted to, the Administrator.

### **9.3 Construction of unbound pavement layers**

#### **9.3.1 Layer thicknesses**

Unless otherwise specified in Clause 8 of Annexure MRTS35.1, individual compacted layer thicknesses for the purpose of construction shall be chosen to suit the construction process within the following limits:

- a) 100 mm to 200 mm for NRMB layers other than base or subbase, and
- b) 100 mm to 150 mm for NRMB base or subbase.

### **9.4 Construction of bound pavement layers**

Construction requirements for BRCC shall be as per those in Clause 8 of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends* and this Technical Specification.

#### **9.4.1 Layer thicknesses**

Unless otherwise specified in Clause 8 of Annexure MRTS35.1, individual compacted layer thicknesses shall be:

- a) according to MRTS08 Table 8.1.9 for BRCC base or subbase, and
- b) placed in one layer for a layer thickness of up to 250 mm.

#### **9.4.2 Allowable working time**

The maximum period between the commencement of mixing and the completion of compaction and trimming shall not be more than the Allowable Working Time determined in accordance with Clause 6.4.7.

#### **9.4.3 Compaction**

The Contractor shall ensure that appropriate compaction / placing techniques are employed to avoid breakdown of weaker constituents during construction, together with proper pavement preservation techniques to control the distress mechanism in the bound base layer (where, for example, tensile fatigue manifests as shrinkage or block cracking), to overcome potential maintainability issues within the design life.

#### **9.4.4 Finishing/trimming**

No trimmed materials shall be incorporated into the Works.

#### **9.4.5 Curing**

Curing shall ensure that hydration of the cementitious stabilising agent takes place in a stabilised pavement. The requirements of MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends* shall apply.

## **10 Compliance testing**

### **10.1 General**

Acceptance shall be undertaken on a lot basis and the total quantity of material in the lot shall be subject to acceptance or rejection in accordance with the parent Technical Specifications.

The Contractor is responsible for carrying out sufficient sampling and testing to ensure NRMBs and BRCCs and their constituents comply with the requirements of this Technical Specification and their parent Technical Specifications.

The Contractor's sampling and testing program for the NRMBs and BRCCS and their constituents shall also be in accordance with the Contractor's quality control and compliance testing procedures.

### **10.2 Lots**

A lot shall be produced under uniform conditions from the same source materials and / or constituents and be essentially homogeneous.

Samples for materials compliance testing shall be taken from the stockpile(s) used for the Works. Lots and compliance testing shall be fully traceable by the Contractor's written records to the stockpile(s) tested.

### **10.3 Material compliance testing**

#### **10.3.1 General**

The frequency of compliance testing shall start at the Normal Level. This may change in accordance with the following criteria:

- a) after no nonconformances have occurred in four consecutive lots, the frequency of compliance testing can be at the Reduced Level, and
- b) where the frequency of compliance testing is at the Reduced Level and two nonconformances have occurred over two consecutive lots, the frequency of compliance testing shall immediately change to the Normal Level.

#### **10.3.2 Material compliance for NRMB**

##### **10.3.2.1 Compliance testing requirements when greater than 1000 tonnes of NRMB is used in the Works**

Where 1000 or more tonnes of an NRMB material is used in the Works, unless otherwise stated in Clause 9 of Annexure MRTS35.1, the Contractor's testing program for the NRMB shall be such that lot sizes and the frequency of testing are in accordance with Table 10.3.2.1(a) and Table 10.3.2.1(b), except that there must be a minimum of one test for the Works for each property.

**Table 10.3.2.1(a) – Minimum testing frequencies and maximum lot size for compliance testing of NRMBs when 1000 tonnes or more of NRMB is used in the Works**

Property	Test Procedures	Minimum Test Frequency		Maximum Lot Size for Testing (tonnes)
		Normal Level	Reduced Level	
Foreign Materials Content	Q477	2	1	2,500 or one day's production, whichever is lesser
Particle Size Distribution	Q103A	2	1	
Particle Size Distribution (of cullet)	Q103A	1	1	
Moisture Content	Q102A Q102B Q102D	2	1	
Linear Shrinkage and Weighted Linear Shrinkage	Q105	2	1	
Plasticity Index and Weighted Plasticity Index	Q105	2	1	

**Table 10.3.2.1(b) - Minimum testing frequencies and maximum lot sizes for additional compliance testing of NRMBs**

Property	Test Procedures	Minimum Test Frequency		Maximum Lot Size for Testing (tonnes)
		Normal Level	Reduced Level	
Ten Percent Fines Value (wet)	Q205B	2	1	5000
Wet/Dry Strength Variation	Q205C	2	1	5000
Flakiness Index	Q201	2	1	5000
California Bearing Ratio	Q113A	2	1	10000
Liquid Limit	Q104A	2	1	10000
UCS at 7 days	Q115	1	1	10000
Permeability	AS 1289.6.7.1	1	1	10000
Sulfate content	AS 1289.4.2.1	1	1	10000
pH	AS 1289.4.3.1	1	1	10000



### **10.3.2.2 Testing requirements for NRMB when less than 1000 tonnes of NRMB is used in the Works**

Where less than a total of 1000 tonnes of any NRMB material is used in the Works, for each property of that NRMB:

- a) The Contractor shall demonstrate compliance with the requirements of the property limits and test frequencies of Table 10.3.2.1(a).
- b) Unless otherwise specified in Clause 10 of Annexure MRTS35.1, the Contractor shall demonstrate compliance with each property limit and its associated test frequency for all properties detailed in Table 10.3.2.1(b) by either:
  - i. testing NRMB material used within the Works, or
  - ii. testing NRMB material used outside the Works where the property compliance:
    - is demonstrated for the NRMB material that is the same NRMB material that is used in the Works and the Contractor provides the Administrator with details of where the NRMB material used outside the Works has been used (location and date of supply) and the associated test results
    - is demonstrated to the minimum test frequency and lot size of Table 10.3.2.1(b)
    - the testing is continuous and is for all the NRMB supplied by the Manufacturer (that is, 'continuous' testing with no test results excluded), and
    - is demonstrated through Contractor submission to the Administrator of:
      1. all test results and charts of these for a minimum of 30 tests for each property
      2. calculations and charts of the rolling averages and standard deviations for the last 10 results for each property, where the rolling average shall conform with the respective property limit, and
      3. all test results and charts are legible.

### **10.3.3 Material compliance testing for BRCC and RCC**

#### **10.3.3.1 General**

The Contractor shall demonstrate compliance of the materials in accordance with MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends* and this Technical Specification.

#### **10.3.3.2 Compliance requirement when greater than 1000 tonnes of BRCC is used in the Works**

Where 1000 or more tonnes of a BRCC are used in the Works, unless otherwise stated in Clause 11 of Annexure MRTS35.1, the Contractor's testing program for the BRCC and its constituent parent material to be bound (RCC), shall be such that lot sizes and the frequency of testing are in accordance with Table 10.3.3.2(a) and Table 10.3.3.2(b), except that there shall be a minimum of one test for the Works for each property.

**Table 10.3.3.2(a) – Minimum testing frequency and maximum lot sizes for compliance testing for BRCC and RCC to be bound**

Material to be tested	Property	Test Procedure	Minimum Testing Frequency		Maximum Lot Size for Testing (tonnes)
			Normal Level	Reduced Level	
RCC	PSD	Q103A	2	1	1000 or one day's production, whichever is lessor
RCC	Foreign material content	Q477	2	1	
RCC	Moisture content	Q102A A102B Q102D	2	1	
RCC	Plasticity index and Weighted Plasticity Index	Q105	2	1	As per Annexure MRTS08.1
RCC	Linear Shrinkage and Weighted Linear Shrinkage	Q106	2	1	
RCC	Degradation Factor (fine aggregate)	Q208B	2	1	One day's production
RCC	Degradation Factor (fine aggregate)	AS 1141.25.3	2	1	
BRCC	Unconfined Compressive Strength (UCS) at 28 days	Q115	2	1	1000 or one day's production, whichever is lesser or as per Clause 11 of Annexure MRTS35.1
BRCC	Stabilising agent content (heat of neutralisation)	Q134	2	1	1000 or one day's production, whichever is lesser or as per Clause 11 of Annexure MRTS35.1
BRCC	Stabilising agent content (reconciliation of deliveries)	Q134	2	1	One day's production (for quality controlling only)
BRCC	UCS Strength Gain (only for slow-setting stabilising agents)	T131	2	1	10,000 or as per Clause 11 of Annexure MRTS35.1
BRCC	Nominated Working Time	Q136	2	1	10,000 or as per Clause 11 of Annexure MRTS35.1

**Table 10.3.3.2(b) – Minimum testing frequencies and maximum lot sizes for additional compliance testing for RCC to be bound**

Property	Test Procedure	Minimum Test Frequency		Maximum Lot Size for Testing (tonnes)
		Normal Level	Reduced Level	
Ten Percent Fines Value (wet)	Q205B	2	1	One per month or at any time when, in the opinion of the Administrator, the nature of the material has changed
Wet/Dry Strength Variation	Q205C	2	1	
Flakiness Index	Q201	2	1	As per Annexure MRTS08.1
California Bearing Ratio	Q113A	2	1	As per Annexure MRTS08.1
Liquid Limit	Q104A	2	1	10,000
Plastic Limit	Q105	2	1	10,000
Permeability	AS 1289.6.7.1	2	1	10,000
Sulfate content	AS 1289.4.2.1	2	1	10,000
pH	AS 1289.4.3.1	2	1	10,000
Water Absorption (%)	Q214B	2	1	10,000
Weak Particles	Q217	2	1	10,000
Free Lime or Cement content	RMS T134	2	1	10,000

### 10.3.3.3 Compliance requirements when less than 1000 tonnes of BRCC is used in the Works

Where less than a total of 1000 tonnes of any BRCC is used in the Works, for each property of that BRCC and its constituent parent material RCC:

- a) The Contractor shall demonstrate compliance with the requirements of the property limits and test frequencies of Table 10.3.3.2(a), and
- b) unless otherwise specified in Clause 12 of Annexure MRTS35.1, the Contractor shall demonstrate compliance with each property limit and its associated test frequency for all properties detailed in Table 10.3.3.2(b) by either:
  - i. testing the BRCC and RCC material used in the Works, or
  - ii. testing BRCC and RCC material used outside the Works where the property compliance:
    - is demonstrated for BRCC and RCC materials that is the same BRCC and RCC material that is used in the Works and the Contractor provides the Administrator with details of where these material used outside the Works has been used (location and date of supply)
    - is demonstrated to the minimum test frequency and lot size of Table 10.3.3.2(b)

- testing shall be completed for all the BRCC and RCC supplied by the Manufacturer (that is, continuous testing with no test results excluded)
- is demonstrated through Contractor submission to the Administrator of:
  1. test results and charts of test results for all of the past tests for the BRCC and RCC up to 30 tests
  2. calculations and charts of the rolling averages and standard deviations for the last 10 results for each property, where the rolling average shall conform with the respective property limit, and
  3. test results and charts are legible.

#### 10.3.3.4 Proportions of the blended stabilising agent

The components of a blended stabilising agent must not vary by more than  $\pm 3\%$  from stabilising agent blend proportions specified in Clauses 6.4.7 and 7. Each component shall be tested at the respective minimum frequencies stated in Clause 11 of Annexure MRTS35.1. A reduced testing frequency may be permitted in accordance with the parent Technical Specifications.

#### 10.3.4 Material testing for reporting only

##### 10.3.4.1 Testing NRMB and RCC for reporting

The testing detailed in Table 10.3.4.1 shall be completed and:

- a) the Contractor's testing program for the NRMB, BRCC and RCC to be bound shall be such that lot sizes are not greater than 10,000 tonnes and the number of tests is not less than those stated in Table 10.3.4.1, and
- b) test results shall be submitted to the Administrator are for reporting purposes only and do not form part of the compliance requirements.

**Table 10.3.4.1 - Minimum testing for testing NRMB, RCC and BRCC for reporting only**

Material to be Tested	Property	Test Procedure	Minimum Testing Frequency		Maximum Lot Size for Testing (tonnes)
			Normal Level	Reduced Level	
NRMB	Water absorption (%)	Q214B	2	1	10000
NRMB	Weak particles	Q217	2	1	10000
NRMB/RCC	Chlorides	Q130A	2	1	10000
BRCC	Modulus of Rupture	AS 1012.11	2	1	10000
BRCC	Capillary Rise Test	Q125D	2	1	10000
BRCC	Modified Texas Triaxial Test	RMS T171	2	1	10000

## **10.4 Construction Compliance Testing**

### **10.4.1 NRMB**

Construction compliance for NRMB unbound layers shall be carried out as specified in the relevant parent Technical Specifications.

### **10.4.2 BRCC**

Construction compliance for BRCC layers shall be carried out as specified in MRTS08 *Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends* and this Technical Specification.

#### **10.4.2.1 Density**

Moisture shall be uniformly distributed throughout the depth of the layer immediately prior to compaction. The full depth of the stabilised pavement shall be compacted. Compaction shall be a continuous operation and be commenced immediately after spreading of the BRCC. Compliance testing for compaction shall be completed within the Allowable Working Time.

For each sampling location, the insitu density shall be tested and samples shall be taken for determining the field moisture content and the maximum wet density in the laboratory.

A summary of test results shall be submitted to the Administrator including daily moisture content and relative density test results.

#### **10.4.2.2 Trimming**

Trimming shall be completed within the Allowable Working Time.

Final trimming shall provide:

- a) an acceptable surface for the application of the next pavement course or bituminous surfacing
- b) pavement layer free from lenses, and
- c) for the top BRCC / stabilised layer, a surface free from the imprints of any rollers used.

No trimmed material shall be incorporated into the works.

#### **10.4.2.3 Curing and strength check**

Each finished layer shall be sufficiently cured and prepared for the placement of the overlying layers. Additionally, tests such as visual deflection may be carried out after curing the top stabilised layer to identify 'soft' spots or test areas of unexplained failure.

Where any soft spot is identified, rectification work shall be carried out at the Contractor's cost prior to the next layer being placed.

Superseded