DELIVERING FOR QUEENSLAND

Technical Specification

Transport and Main Roads Specifications
MRTS06 Reinforced Soil Walls

November 2025

(ATS 5120 Construction of Reinforced Soil Structures, Ed 1.0 March 2023)

Queensland Government

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Purpose

This ancillary document outlines the adopted national Austroads Technical Specification ATS 3135 *Supply of Reclaimed Asphalt Pavement Materials* and modified Queensland-specific content with tracked changes.

The following table summarises the relationship between the Austroads Technical Specification ATS 3135 *Supply of Reclaimed Asphalt Pavement Materials* and this document:

Type of Content	**Display**
National content adopted	National content adopted
National content not adopted	National content not adopted
Queensland-specific content	Queensland-specific content

About this document

The document adopts and modifies Austroads Technical Specification ATS 5120 *Construction of Reinforced Soil Structures* as part of national harmonisation. It sets out the requirements for the construction of Reinforced Soil Structures (RSS), also referred to Reinforced Soil Walls (RSW). It also includes requirements for the supply of all materials associated with RSW.

How to use this document

This document includes the national guidance and Queensland-specific advice while following the structure established in Austroads Technical Specifications.

Queensland-specific advice includes practices which vary from national practice because of local environmental conditions (such as geography, soil types, climate); different funding practices; local research; local legislation requirements; and to expand instruction on particular issues.

This document:

- sets out how the Austroads Technical Specification ATS 5120 *Construction of Reinforced Soil Structures* applies in Queensland
- has precedence over the Austroads Technical Specification ATS 5120 *Construction of Reinforced Soil Structures* when applied in Queensland
- has the same clause numbering and headings as the Austroads Technical Specification ATS 5120 *Construction of Reinforced Soil Structures*.

Transport and Mains Roads provides an ancillary document which outlines adopted national and modified Queensland-specific content with tracked changes. To access a copy click on the below link: Ancillary documents for harmonised Technical Specifications.

Terminology

The following general amended definitions apply when reading this document.

Reference to...	Means
Shall	Denotes mandatory requirements.
Must	Denotes mandatory requirements.
Principal	The State of Queensland acting through the Department of Transport and Main Roads.

Reference to...	Means
Administrator	The Administrator will be responsible for the overall administration of this Contract.

Contents

1 Scope

1.1 ~~Austroads~~ This Technical Specification ~~ATS 5120~~ sets out the requirements for the construction of Reinforced Soil Walls (RSW), also known as Reinforced Soil Structures (RSS). It does not ~~cover~~ apply to reinforced slopes / foundations, soil nail walls or reinforced embankments.

1.2 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.

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

2 Referenced documents

2.1 ~~The following documents are referenced in this specification:~~The requirements of the referenced documents listed in Table 2.1 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced documents, the requirements in this Technical Specification shall take precedence.

Table 2.1 – Reference documents

Reference	Title
Australian / New Zealand Standards	
AS 1141.11.1	*Methods for sampling and testing aggregates Particle size distribution - Sieving method*
AS 1141.22	*Methods for sampling and testing aggregates Wet/dry strength variation*
AS 1214	*Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)*
AS 1237	*Plain washers for metric bolts, screws and nuts for general purposes*
~~AS 1289~~	~~*Methods of testing soils for engineering purposes*~~
AS 1379	*Specification and supply of concrete*
AS 1726	*Geotechnical site investigations*
AS 3610	*Formwork for Concrete*
AS 3700	*Masonry structures*
AS 5100	*Bridge Design*

Reference	Title
AS/NZS 3678	*Structural steel – Hot-rolled plates, floorplates and slabs*
AS/NZS 3679	*Structural steel – Hot-rolled bars and sections*
AS/NZS 4455	*Masonry units, pavers, flags and segmental retaining wall units*
AS/NZS 4680	*Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*
AS/NZS 4671	*Steel reinforcing materials*
AS 4969.1	*Analysis of acid sulfate soil - Dried samples - Methods of test - Pre-treatment of samples under Australian / New Zealand Standards*
AS 4969.12	*Analysis of acid sulfate soil - Dried samples - Methods of test Complete suspension peroxide oxidation combined acidity and sulfur (SPOCAS) method*
AS ISO/IEC 17025	*General requirements for the competence of testing and calibration laboratories*
Austroads	
ATM 710	*Chloride Content of Soil*
ATS 1120	*Quality Management Requirements*
ATS 2160	*Supply and Installation of Geotextiles (Separation and Filtration)*
ATS 5325	*Supply of Precast Concrete Members*
International Standards	
BS EN ISO 10319	*Geosynthetics. Wide-width tensile test*
American Public Health Association	
APHA 4500	*Standard Methods for the. Examination of Water and Wastewater*
Transport for New South Wales	
TfNSW R57	*QA Specification R57 - Design of Reinforced Soil Walls*
Queensland Department of Transport and Main Roads	
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
Q181C	*Effective angle of internal friction*

3 Definitions

3.1 ~~The following definitions applies to this Specification.~~ The terms defined in MRTS01 *Introduction to Technical Specifications* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 3.1 below.

Table 3.1 – Definition of terms

Term	Definition
Principal's Registration Scheme	Any scheme for the prequalification, registration or approval of products, manufacturers, suppliers and/or Professional Engineers which is in operation in the jurisdiction where the RSS is to be constructed.
Professional Engineer	A person who: a) has at least 5 years of experience in or structural engineering or geotechnical engineering (as appropriate) b) is registered on any scheme of registration of engineers prescribed by legislation in the applicable jurisdiction c) is appropriately registered or prequalified, if the Principal has implemented an applicable registration or prequalification scheme, and d) satisfies at least one of the following requirements: i. is a Chartered Professional Engineer; or ii. holds a 4 year civil engineering degree from a university that is accredited under the Washington Accord and is registered in a relevant area of practice on the National Engineering Register (in Australia) or the Register of Chartered Professional Engineers (in New Zealand).
Reinforced Soil Walls (also known as Reinforced Soil Structures)	An earth retaining structure comprising selected fill and soil reinforcement that is embedded at regular intervals in both vertical and horizontal directions within the fill to form a composite structure.
Reinforced Fill Material	The fill material, complying with Clause 8, in which the soil reinforcement is embedded to form the reinforced soil block. It extends from the rear of the facing to the end of the soil reinforcement.
RSS System	The reinforcing elements, wall facings and any associated components such as connections, joint fillers and sealants.
Soil Reinforcement	Metallic or synthetic components that are embedded in the select fill and which act through interface friction, bearing or other means to provide the required strength and stability of the RSS.

4 Quality System Requirements

4.1 The Contractor must prepare and implement a Quality Plan that includes the documentation in Table 4.1. Hold Point 1 Record

Table 4.1 – Quality Plan

Clause	Description of document
5	Design documentation, as specified in Clause 3 "Design Control" and Clause 4.9 "Design Output and Certification" of TfNSW R57 and supporting calculations (unless the Principal is providing the design);
7	Supplier details, type of proposed proprietary RSS system and evidence that the RSS System Components are approved under any applicable Principal's Registration Scheme
8.2	Details of the fill materials and the Sampling and Test Plan.

HOLD POINT 1	
Process Held	Manufacture of facing panels and/or preparation of the foundation for the RSS.
Submission Details	The Quality Plan must be submitted to the ~~Principal~~ Administrator at least 10 working days prior to the commencement of manufacture of the facing panels and/or preparation of the foundation for the RSS.

5 Design

5.1 Unless the Principal has provided a design of the RSS under the Contract, the design of the RSS must comply the technical requirements of TfNSW R57 and any other design requirements included in the Contract documents.

5.2 Unless specified otherwise, the Design Life of the RSS is 100 years.

Hydrostatic pressures in reinforced soil walls

5.3 All RSWs shall be designed for a default water table height equal to 2/3 the RSW height, to allow for the influence of groundwater conditions during the design life of the structure. For walls entirely in cut situations, the default water table height shall be taken as wall height. Facing height shall be taken as wall height.

5.4 The default water table height requirement may be relaxed and zero water pressure on the rear face of the RSW block can be adopted, if one of the following conditions is satisfied:

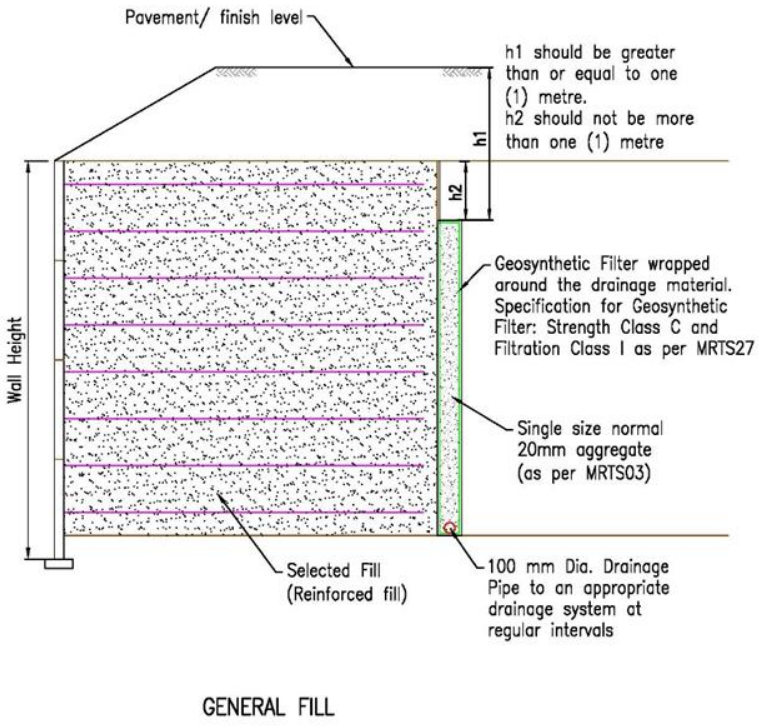
a) provision of a full height continuous granular drainage blanket, as shown in the following Figure 5.6, behind the reinforced fill RSW block (that is, interface between the reinforced fill block and general backfill). Alternatively, for RSWs with height less than 4 m, a prefabricated cellular material as per MRTS03 *Drainage Structures, Retaining Structures and Embankment Slope Protections*, wrapped with a geosynthetic filter fabric with equivalent design drainage and strength properties as per MRTS27 *Geotextiles Separation and Filtration* may be provided, or

b) provision of a free draining reinforced fill material, conforming to requirements of Clause 8 and the additional requirements in Clause 8.8). Permeability testing on compacted free draining reinforced fill material shall be performed to confirm the permeability. Constant head permeability testing, effective angle of friction at constant volume, particle size distribution, Wet Strength, Wet / Dry Strength Variation and Degradation Factor shall be performed from the same sample lot, preferably by the same laboratory. During construction, additional particle size distribution tests shall be conducted to verify that the percentage passing the 0.150 mm test sieve does not exceed 3% of the initial test results.

5.5 The testing frequencies for shear strength and other properties pertaining to the selected fill, shall conform to Clause 8.14. A geosynthetic filter, the properties of which are given in Figure 5.6, shall be installed between the reinforced fill material and general fill interface.

5.6 This does not address extreme events such as inundation, potential draw down due to flooding and so on. These requirements shall conform to TfNSW R57 and shall address a minimum 1% AEP flood event.

Figure 5.6 – Typical details of a drainage blanket behind RSW block



Global stability analysis

5.7 Notwithstanding the provisions of Clause 4.7.4 of TfNSW R57, the following minimum requirements shall apply to the assessment of global stability:

a) Geotechnical Model: Scaled cross-sections of the RSW with idealised sub soil models depicting the design material properties, pore water pressure conditions and their associated parameters shall be established.

b) Method of Analysis: Morgenstern and Price method of limit equilibrium analysis shall be the primary method of limit equilibrium analysis using Geo Slope SLOPE / W software.

c) Presentation of Stability Analysis: The Drawings shall include a report on the RSW global stability analysis. The report shall clearly indicate the geotechnical models and design strength parameters and pore water pressure conditions adopted, loading conditions considered, design standards complied with and shall be supported with design calculations where appropriate. The report shall also include cross-sections showing the centres of slip circles investigated and the locus of the most critical circle or non-circle surface for the design life.

Allowance for pile foundations

5.8 Where piles are to pass through the RSW, the following minimum provisions shall apply:

a) the Drawings shall coordinate the reinforcing strip and pile locations, allowing for all construction tolerances for both

b) where there is the possibility of disturbing a facing unit during pile driving, special provisions shall be made (for example, a compressible filler placed adjacent to the earth face of the unit at the pile location), and

c) if piles are to be driven after construction of the RSW, rigid liners shall be installed in the RSW block during construction. Alternatively, pre boring may be used where it is demonstrated that reinforcement will not be disturbed. Liners and/or pre boring shall be extended at least 500 mm below the underside of the RSW block.

Design documents

5.9 The Contractor's Design Documents shall include the following:

a) Design Calculations (including global stability analysis)

b) duly completed Design Checklist in Annexure MRTS06.1

c) Contractor's Construction Drawings

d) Contractor's Construction Specifications including RSW construction sequence

e) any particular requirements for ground and/or foundation improvement, and

f) arrangements for monitoring the performance of the RSW over the nominated period.

5.10 The Contractor shall include in the Design Documents for the RSW:

a) a certificate from the Contractor’s Designer which confirms that the design:

b) adequately allows for the site conditions, applied loadings, and relevant material properties for all components of the design, and

c) ensures the structural integrity and serviceability of the RSW for the nominated design life:

i. a statement that the specification for materials to be used in the Works complies with the Drawings, and this Technical Specification, including conformance with any minimum and/or maximum property requirements detailed therein. This statement shall be in a form which demonstrates and/or quotes the basis on which it is made, including reference to relevant test certificates for select fill, general fill, soil reinforcement, facing units, facing connections and associated components. All such test certificates shall be not more than 12 months old at the time of commencement of construction of the RSW and shall be made available for examination by the Administrator if required, and

ii. a report certified by the Contractor's RPEQ Geotechnical Engineer who carried out the geotechnical design.

5.11 The Contractor's Design Documents shall be submitted by the Contractor to the Administrator a minimum of 28 days prior to commencement of construction of the RSW. **Milestone**

5.12 Construction of the RSW shall not be started prior to the Contractor receiving notification from the Administrator as to the suitability of the design. **Hold Point 2**

HOLD POINT 2	
Process Held	Commencement of construction of the RSS.
Submission Details	Suitable design of RSW.

6 Site investigation

6.1 This Clause 6 only applies if the Contractor is responsible for undertaking the geotechnical site investigation or verifying the adequacy of a site investigation provided by the ~~Principal~~Administrator.

6.2 The Contractor must assess all available site information and carry out any further site investigation as necessary to determine the topography and properties of all relevant soil strata influencing the design of the RSS.

6.3 Unless specified otherwise in the Contract documents, the site investigation must be carried out in accordance with AS 1726. The assessment of the site investigation data must be carried out by a Professional Engineer with at least 5 years relevant experience in geotechnical engineering in conjunction with the designer of the RSS.

6.4 The extent and requirements of the site investigation must address the particular site conditions as well as the type and complexity of the project.

6.5 The site investigation must take at least the following issues into consideration:

a) surrounding ground as well as that underneath the structure

b) groundwater

c) aggressiveness of soil and groundwater including assessment of potential acid sulphate conditions likely to be associated with excavations

d) shear strength and compressibility characteristics of the subsurface strata likely to influence the behaviour of the structure

e) post-construction short and long term subsurface settlement, and

f) the aggressiveness of soil determined in accordance with the test methods AS 1289.4.3.1 and other relevant tests.

6.6 The shear strength parameters of the foundation soil under effective stress conditions must be determined in accordance with one or more of the test methods AS 1289.6.4.2 and AS 1289.6.2.2.

6.7 The undrained soil shear strength of foundation soil where relevant, must be determined by insitu and/or laboratory tests which must include at least one or more of the test methods AS 1289.6.2.1 and AS 1289.6.4.1 and AS 1289.6.5.1.

6.8 The compressibility characteristics of the foundation soil must be determined in accordance with Test Method AS 1289.6.6.1.

6.9 The above test methods do not apply where the foundation material is rock.

7 RSS System components

General

7.1 Where a Principal's Registration Scheme is in place for the supply of the RSS System, the RSS System must be approved under that scheme.

7.2 The contractor must submit test certificates of representative samples for the soil reinforcement, connections to the facing panels and associated components demonstrating compliance with this Technical Specification to the ~~Principal~~ Administrator. The test certificates must not be more than 12 months old.
Hold Point 3 Record

HOLD POINT ~~23~~	
Process Held	Commencement of construction of the RSS.
Submission Details	The test certificates must be provided at least 10 working days prior to the commencement of construction of the RSS.

Geosynthetic (extensible) reinforcement

7.3 If geosynthetic reinforcement is used, the short-term tensile strength of the geosynthetic reinforcement must be determined in accordance with BS EN ISO 10319. The minimum creep test duration for geosynthetic reinforcement is 10,000 hours. To ensure continuity of quality is being maintained, short term creep tests of minimum duration 1000 hours must be carried out and shown to be compatible with the long-term results.

7.4 Geosynthetic reinforcement must be demonstrated by testing as sufficiently strong, stable and durable to satisfy the performance and design requirements of this Technical Specification.

7.5 The Contractor must provide the following details and properties of any geosynthetic reinforcement:

a) dimensions including cross-sectional dimensions of strip and grid materials

b) characteristic ultimate tensile strength - longitudinal and transverse (where geogrid is used)

c) strain at both ultimate and nominated tensile strength, in both longitudinal and transverse directions where grid materials are to be used

d) creep-limited strength in the longitudinal axis at the specified design life

e) long-term tensile strength at 5% elongation (i.e. initial and creep strain)

f) minimum breaking load

g) Considerations of and allowance for strength reduction over the life of the structure due to creep deformation and rupture

h) allowance for strength reduction due to variations in manufacturing process

i) allowances for extrapolation of uncertainties where test duration is less than the design life, and

j) material strength and durability testing for the effects of exposure to:

   i. water

   ii. aggressive fluids

   iii. aggressive soils

   iv. UV radiation

   v. temperature effects

   vi. mechanical damage, and

   vii. contact with the fill material(s) intended for use with the RSS.

7.6 Testing must be carried out where appropriate to assess the influence of the following job specific environmental factors on the durability and performance of the geosynthetic reinforcement for the design life of the structure:

a) loading

b) water and installation induced damage

c) UV exposure

d) operational temperature

e) chemical / bacterial composition of Reinforced Fill Material, and

f) aggressive fluids.

7.7 All test certificates and test reports must be endorsed in accordance with the AS ISO/IEC 17025 accreditation for the testing laboratory. All test reports must be in English alphanumeric characters.

Steel (non-extensible) reinforcement

7.8 Steel reinforcing must comply with the grade, thickness and galvanized coating thickness specified on the Drawings.

Facing panels

7.9 Concrete facing panels must:

a) comply with the Drawings

b) be manufactured from reinforced concrete in accordance with ATS 5325

c) unless specified otherwise on the Drawings, be finished to Class 2 in accordance with AS 3610 and

d) not be lifted by connection points used to connect soil reinforcement to the facing panel unless connection points are certified and tested for this purpose.

7.10 Unless specified otherwise, the Contractor must produce a test panel comprising of at least one full facing panel and reinforcing anchor in accordance with ATS 5325.

7.11 The Contractor may submit to the ~~Principal~~ Administrator a proposal to consider facing panels from another project, which are of the same design and are manufactured under identical conditions, as the test panels. **Hold Point 4 Record**

HOLD POINT ~~34~~	
Process Held	Production of facing panels
Submission Details	The test panel must be provided to the ~~Principal~~ Administrator at least 10 working days prior to the commencement of production of the facing panels.

7.12 The accepted test panel must be preserved as a quality benchmark until completion of construction.

7.13 Any concrete blocks and masonry facing panels must comply with AS/NZS 4455 and AS 3700. Testing of specimens cut from facing panels for compressive strength is permissible.

Connections

7.14 Materials connecting the wall facing panels with the reinforcing elements must be electrolytically compatible to ensure that corrosion will not be promoted through the use of dissimilar metals.

7.15 Steel components must be hot dipped galvanized in accordance with AS 4680 (for steel) and AS 1214 (for hexagonal bolts, nuts and washers) with a minimum average coating thickness equivalent to an application rate of 600 grams per square metre of zinc.

7.16 The Contractor must provide a certificate of compliance certifying that the mass of zinc coating on galvanized steel components meets the specified requirements and that steel components have sufficient sacrificial steel thickness in combination with the galvanizing to achieve the specified design life.

Other materials

7.17 Bearing pads (ie the pad placed in the horizontal joint between panels to maintain the correct spacing between panels) must be:

a) either HDPE, neoprene or ethylene propylene diene monomer
b) durable and inert
c) resistant to creep rupture and environmental degradation, and
d) able to accommodate differential movements between adjacent panels, during construction as well as throughout their design life.

7.18 Geotextile material placed behind the joints must be Strength Class B or higher in accordance with ATS 2160.

7.19 Joint fillers and sealants must be composed of durable inert materials resistant to atmospheric degradation and must:

a) protect filter fabric from exposure to sunlight
b) maintain the degree of permeability assumed in the design, and
c) retain soil fines.

7.20 Sealants must be polysulphide or polyurethane based elastomeric compounds.

Component tolerances

7.21 Notwithstanding any other tolerances specified in ATS 5325, the following tolerances apply to concrete components in RSS:

Overall dimension:	± 5 mm
Thickness:	± 5 mm
Location of fasteners:	± 5 mm

7.22 The following tolerance apply to the dimensions of metallic and geosynthetic reinforcement

Length of reinforcement:	+ 50 mm, - 0 mm
Width of reinforcement:	+ 5 mm, - 0 mm
Thickness of reinforcement:	+ 1 mm, - 0 mm

Handling and storage

7.23 All prefabricated RSS components must be transported and stored carefully to minimise mechanical damage and deterioration, including protection of geosynthetic reinforcement elements from UV degradation.

8 Fill material

General

8.1 This Clause 8 applies to the Reinforced Fill Material and to material placed in the drainage layer (where applicable). Additional requirements for the fill material placed above and/or behind the reinforced soil block may be specified in the Contract documents.

8.2 The Quality Plan must include:

a) details of the type and source of the materials, and

b) a sampling and test plan for the materials that demonstrates compliance with the specified standards, including the shear strength and effective angle of internal friction for the select fill.

8.3 The Contactor must submit a report detailing the~~of~~ test results of representative samples for each ~~of the~~ material propert~~y~~~~ies~~ specified in ~~this~~ Clause 8.2. For each material type, a minimum of two~~At least 4 sample test~~ results must be provided for the angle of friction at constant volume, as well as ~~and 7 sample test results~~ for the other specified properties, in accordance with the frequency outlined in Table 8.14. In general, any variation in grading, visual characteristics, or rock type shall be considered a different material type unless otherwise approved by the Administrator~~must be submitted~~. **Hold Point 5 Record**

HOLD POINT 45	
Process Held	Placement of fill material
Submission Details	The report of test results must be submitted to the ~~Principal~~ Administrator at least 5 working days prior to the commencement of fill placement.

Reinforced Fill Material

8.4 The Reinforced Fill Material must:

a) be composed of inert, hard, durable granular material, with properties that will not cause deterioration of the RSS components

b) be capable of being compacted in accordance with the specified requirements to form a stable mass of fill

c) be free from organic or other deleterious material such as plastic, metal, rubber or other synthetic material, inorganic contaminants, dangerous or toxic material, or material susceptible to combustion

d) not be derived from argillaceous rock, such as shales and claystones or other materials which are susceptible to breakdown into a friable material, and

e) not be steel furnace slag.

8.5 If steel or polyester soil reinforcement is used, the Reinforced Fill Material must not contain recycled concrete or cement stabilised soil.

8.6 The Reinforced Fill Material must meet the physical properties requirements specified in the RSS design, including the angle of friction at constant volume and the design grading envelope, and must be compactable to a stable mass at the required density.

8.7 The characteristic value of the weight per unit volume of the Reinforced Fill Material must be within ± 5% of the value specified in the RSS design. If these limits are exceeded, the Contractor must consult the designer regarding the implications for the design and any necessary action to be taken. Data for this assessment may be obtained from relative compaction tests carried out on the Works.

8.8 If the Reinforced Fill Material is designed to be free draining, its permeability must be greater than 10-5 m/s when compacted to a dry density ratio not less than 97% (AS 1289.5.1.1) or 90% density index (AS 1289.5.6.1), whichever is applicable.

8.9 Unless specified otherwise in the RSS design, the Reinforced Fill Material must comply with the properties specified in Table 8.9.

Table 8.9 – Particle size distribution requirements for fill materials

Property	Test Method	Requirement
Maximum particle dimension prior to placement and compaction	-	150 mm for steel reinforcement and 75 mm for geosynthetic reinforcement. For all soil reinforcement, the maximum size prior to placement and compaction must not be greater than one third of lift thickness
Percentage Passing	AS 1289.3.6.1	
37.5 mm		80 -100
9.5 mm		25 – 100
600 µm		10 - 100
75 µm		0 – 10 (1)
Coefficient of Uniformity (2)	NA	≥ 5

Notes:

1. Unless specified otherwise, up to 15% is permitted for backfill comprised of crushed sandstone which has been approved by the ~~Principal~~ Administrator.

2. Coefficient of Uniformity = D60 / D10, where D60 and D10 are the equivalent sieve sizes in mm, as interpolated from particle size distribution curve and through which 60% and 10% of Reinforced Fill Material passes respectively.

8.10 Where geosynthetic soil reinforcement is used, the Reinforced Fill Material must meet the pH requirements shown in Table 8.10.

Table 8.10 – Allowable pH limits of reinforced fill materials for RSS System with geosynthetic components

Soil reinforcement material type	Allowable pH limits in fill material
Polyester	4 – 9
HDPE	3 – 12

8.11 Where steel components in the RSS System are used, the Reinforced Fill Material and water used in construction must meet the chemical and electrical properties requirements shown in Table 8.11.

Table 8.11 – Chemical and electrical properties for RSS System with steel components

Property	Test Method	Allowable limits of reinforced fill material		Water used in construction
		Dry land	Submerged (1)	
pH	AS 1289.4.3.1	5 – 10	5 – 10	6.5 – 8.5
Chloride ion content (2)	APHA 4500-CL			< 250 mg/L
Chloride ion content (2)	ATM-710	≤ 0.02	≤ 0.01	
Sulfate ion content (2)	APHA 4500-SO42			< 250 mg/L
Peroxide sulfur content (2, 3)	AS 4969.12	≤ 0.06	≤ 0.04	
Resistivity (saturated) (ohm metre)	AS 1289.4.4.1	≥ 10	≥ 30	-

Notes:

1. “Submerged” does not include marine environment, which is a case requiring investigation to determine allowable limits. Use “submerged” values where the structure is permanently or regularly submerged. Use “dry land” values otherwise.

2. % by mass.

3. Prepare samples in accordance with AS 4969.1.

Drainage Layer Material

8.12 Material in the drainage layer must:

a) be clean, graded, hard and durable crushed stone or river gravel

b) free of clay or perishable matter, and

c) conform to the requirements shown in Table 8.12. when tested in accordance with AS 1289.3.6.1.

Table 8.12 – Drainage zone material particle size distribution

Sieve size (mm)	% passing
37.5	100
9.5	< 5

8.13 A suitable synthetic filter and separation fabric as specified in the RSS design must be installed.

Testing frequencies

8.14 The frequency of testing of the Reinforced Fill Material must comply with Table 8.14 and the results must be submitted to the ~~Principal~~ Administrator.

Table 8.14 – Minimum frequency of testing for each lot

Material property	Test Method	Minimum frequency (1)
Wet Strength, Wet / Dry Strength Variation (2)	AS 1141.22	1 test per 2500 m³ with a minimum of 2 tests for each type of material.
Permeability (3)	AS 1289.6.7.1	2 tests per 2,500 m³, with a minimum of 2 tests for each type of material.
Compaction	AS 1289.5.4.1 or AS 1289.5.7.1. Density Index AS 1289.5.6.1	1 test per 100 m², with minimum of 1 test every two adjacent continuous layers compacted on the same day, provided that the material has uniform treatment and appearance
Angle of friction at constant volume under effective stress conditions	Q181C	Large shear Box (nominal 300 mm): 2 tests per 2,500 m³, with a minimum of 2 tests for each type of material. Small size shear box (nominal 100 mm): 1 test per 400 m³, with a minimum of 5 tests for each type of material.
Grading	AS 1289.3.6.1	1 sample per 200 m³ or part thereof, but not less than 1 sample per layer.

Material property	Test Method	Minimum frequency [1]
pH [4]	AS 1289.4.3.1 carried out at a temperature of 23 ± 2°C	1 sample per 400 m³ or part thereof but not less than 1 sample per layer
Electrical and chemical properties [3]	Refer Table 8.10	

Notes:

1. The default testing frequencies are given in the table. Reduced minimum testing frequencies are permitted for certain properties, as stated in the Transport and Main Roads Quarry Registration Certificate – Testing Frequency Schedule. A reduced testing frequency will only be considered if the supplier can demonstrate consistent process control and maintained quality For the Q181C test, ~~Where a Principal's Registration Scheme is in operation for the supply of the fill material, the Principal may approve a reduced rate of testing where the supplier can demonstrate consistent process control. t~~The reduction may be applied ~~up to 50% of the rate specified.~~as follows (Material type is defined in Clause 8.3):
   - For quarries classified under the "LOW" testing frequency level, adopt a rate of 1 test per 10,000t (with minimum 2 tests per material type).
   - For quarries under the "MEDIUM" frequency level, adopt a rate of 1 test per 5,000t (with minimum 2 tests per material type).
   - For quarries at the "DEFAULT" frequency level, adopt a rate of 1 test per 2,500t. (with minimum 2 tests per material type).
2. Where this testing is specified in the Contract documents.
3. Only required if the Reinforced Fill Material is designed to be free draining.
4. Steel reinforced systems only.

9 Construction

General

9.1 The Contractor must construct the RSS in accordance with:

a) any requirements specified in the design

b) any requirements specified by the manufacturer of the RSS System, and

c) Clause 9 and Clause 10.

In the event of an inconsistency, the above order of precedence will apply.

9.2 Site preparation, excavation (including removal of any unsuitable material) and placing of fill material must be carried out in accordance with the applicable general earthworks specification and any requirements for foundation improvement specified in the design.

9.3 Any over-excavation (ie excavation below or beyond the excavation the design levels or dimensions) must be backfilled and compacted with material that is compatible with the RSS design and the foundation design.

9.4 Unless specified otherwise, the Contractor must arrange for a Professional Engineer to inspect the foundation and submit a report confirming that either the foundation complies with the RSS design or that additional treatment is required. Upon completion of any additional treatment, Hold Pont 4 reapplies. **Hold Point 6 Record**

HOLD POINT ~~56~~	
Process Held	Construction of base strip footings
Submission Details	The report from a Professional Engineer must be submitted to the ~~Principal~~ Administrator at least 3 working days prior to the commencement of the construction of the footings and RSS.

Base strip footings

9.5 Base strip footings must be constructed to the lines levels and dimensions shown on the Drawings within the following tolerances:

Plan dimension:	- 5 mm
Thickness:	- 10 mm
Reduced level of top surface of footing:	± 5 mm
Maximum variation of top surface from a 3 m straight edge:	± 5 mm.

9.6 Unless another concrete grade is specified in the design, grade N32 to AS 1379 must be used in the base strip footing, which must be cured for a minimum of 24 hours before placement of wall panels.

Erection of facing panels

9.7 If steel soil reinforcement is used, the reinforcement must be thoroughly washed with water complying with Table 8.10. Washing of soil reinforcement made of other materials which are not susceptible to corrosion is not necessary, unless specified by the supplier. **Witness Point 1**

WITNESS POINT 1	
Process	Washing of soil reinforcement made of steel.
Notification	At least one working day (not less than 24 hours) prior to the commencement of the activity.

9.8 The degree of inclination of the facing panels towards the fill must be adjusted where necessary as placement and compaction of fill material proceeds, to ensure that the specified tolerances are not exceeded.

9.9 On completion of the first course of facing panels, the panels must be inspected and surveyed before construction of the second course of facing panels. **Hold Point 7 Record**

HOLD POINT ~~6~~7	
Process Held	Construction of the second course of facing panels
Submission Details	Survey records for the bottom course of facing panels must be provided to the ~~Principal~~ Administrator prior to placing the second course.

9.10 Prior to placement of each course of facing panels, the level and alignment of the preceding course must be measured to verify that all positions, levels and dimensions of the facing panels are in accordance with the Drawings.

9.11 Adequate support of the facing panels must be provided at each stage of erection. The supporting course of facing panels must be shored to control movement during the placement and compaction of fill material.

9.12 Bearing pads must be placed between precast concrete panels to prevent them from sitting directly on each other. Bearing pads must be placed within 5 mm of the positions shown on the Drawings. Unless shown otherwise on the Drawings, bearing pads are not inserted in vertical joints.

9.13 A strip of geotextile material, at least 500 mm wide, must be placed between the back of the facing panels and the fill material, equidistant across all joints. If shown on the Drawings, a vertical strip drain, at least 300 mm wide, must be placed behind each vertical joint and covered by a non-woven geotextile.

9.14 Sealants may only be used where shown on the Drawings or to protect the geotextile from UV degradation. Sealants (including primers) must be applied in accordance with the manufacturer's recommendations. Sealants must not be used in the following applications:

a) for joints which will be below finished ground level, or

b) where the RSS design requires the wall face to be free draining.

Placement of soil reinforcement and compaction of Reinforced Fill Material

9.15 Unless specified otherwise, the placement and compaction must be carried out in a direction parallel to the face of the structure and must be completed in stages to follow closely the erection of facing panels and placement of reinforcing elements.

9.16 Reinforcing elements and facing panels must not be damaged or displaced during placement and compaction of fill. Tracked machines or vehicles must not be operated directly on top of reinforcing elements which are not covered by at least 150 mm of fill material. No plant must be operated in a manner that would cause the displacement of soil reinforcement from the intended positions.

9.17 All vehicles and all construction equipment weighing more than 1500 kg must be kept at least 2 metres away from the facing panels (unless an alternative distance is specified in the design). Fill material within 2 metres of the facing panels must be compacted using one or more of the following methods:

a) a vibro-tamper

b) a vibrating plate compactor roller with mass not exceeding 1000 kg, or

c) a vibrating roller with a mass per metre of width of not more than 1300 kg and a total mass of not more than 1500 kg.

9.18 Where a compactor cannot reach the material behind the facing panel (eg inclined faces), alternative means such as stabilisation must be used to ensure the units are adequately supported.

9.19 RSS fill material must be placed and compacted with a moisture content not greater than the optimum moisture content. After compaction, the absolute value of density and / or the characteristic value of density ratio of the material must not be less than the values specified in the RSS design or elsewhere in the Contract documents.

9.20 Synthetic soil reinforcement must not be spliced or joined in the primary strength direction. Where connections are made of synthetic soil reinforcement such as geogrids, the geogrid layers must not be spliced or joined in the primary strength direction.

9.21 Soil reinforcement must be laid horizontally on the compacted fill at the location and levels specified in the Drawings. It must be connected securely to facing panels in accordance with the Drawings. Geosynthetic reinforcement must be pulled taut before placing the overlaying fill material. The method of fill placement and compaction must ensure that slack is not introduced into the soil reinforcement as fill is placed. The condition of the soil reinforcement and the connections to the facing panels at each level must be recorded just before covering. **Witness Point 2**

WITNESS POINT 2	
Process	Placement of fill over soil reinforcing
Notification	At least one working day (not less than 24 hours) prior to the placement of fill.

9.22 Where overlapping of soil reinforcement is required e.g. for curved walls, a minimum thickness of 75 mm of compacted fill must be provided between the overlapping soil reinforcement.

9.23 The fixing of the soil reinforcement and placement of reinforced fill must be carried out in one plane at a time.

9.24 During construction, the earthworks fill material behind the RSS block must be maintained at the same level as the RSS block. Where the material is an existing earthwork or material slope which requires temporary support by shoring, the shoring must be removed in such a manner that the stability of the adjacent ground is maintained, the compacted fill material is not disturbed and the formation of voids is prevented.

9.25 At the end of each day's operations, the top layer of fill must be shaped to permit drainage away from the face and the remainder of the RSS.

Capping, filter and drainage materials

9.26 Filter and drainage materials must be constructed in accordance with the Drawings and/or the manufacturer's instructions. Where granular material is used as a drainage material, the drainage material must be compacted to the same requirements as Reinforced Fill Material. It must be constructed progressively in layers matching the Reinforced Fill Material.

9.27 If the surface above the RSS block is unpaved, an impermeable layer of fill material must be placed above the reinforced soil zone which prevents water infiltration into the RSS block. The material must be placed and compacted in accordance with the applicable general earthworks specification and any requirements specified in the design.

10 Tolerances

10.1 Construction tolerances measured immediately after completion of the RSS and the application of all dead load surcharges, must comply with Table 10.1. Negative deviations are measured towards the RSS block. Where no other tolerance is given, a measurement (dimension, level, position) which falls within ± 6 mm of the required value must be deemed to be conforming. The Contractor must submit survey results, demonstrating compliance with Table 10.1, to the ~~Principal~~ Administrator. **Record**

Table 10.1 – Construction tolerances

Element	Tolerance
Reinforcing elements	within ± 100 mm of the design levels and locations specified in the Drawings.
Wall face	No point on the face of the completed RSS deviates from the specified position by more than ± 50 mm at bridge abutments, and + 50 mm to – 100 mm for walls outside a distance from bridge abutments equal to the height of the RSS wall.
	The vertical alignment of the face of the completed wall must not deviate from the specified vertical inclination by more than + 5 mm, – 10 mm per metre height
	The flatness of the wall must be such that the maximum deviation from a 4.5 metre straight-edge must not exceed ± 20 mm. In the case of walls curved in plan, the horizontal deviation must be measured from a 4.5 metre long reference, curved to the specified curvature.

Element	Tolerance
	The horizontal step between adjacent facing panels must not exceed 10 mm.
Top and bottom of wall	For walls adjacent to bridge abutments, the top and bottom of the wall must be within ± 15 mm of the design alignment specified in the Drawings.
	For walls outside a distance equal to the height of the RSS from bridge abutments, the top and bottom of the wall must be within ± 30 mm of the design alignment specified in the Drawings.
Level	The level of any point on the wall must not deviate from the specified level by more than ± 20 mm, except where the provision of such tolerances must not permit a neat join to adjacent structures.

11 Monitoring

11.1 As a minimum, the performance of RSS wall must be monitored through the measurement of the deflection of the RSS wall facings. The contractor must provide reference points (survey points) vertically on the facing at a cross-section of the wall. The top survey point must be at one metre down from the top of the wall. The bottom survey point must be at one metre up from the bottom of the wall. The rest of the survey points must be at no greater than two metre intervals between the top and bottom points in a cross-section avoiding two points on one facing panel.

11.2 The x, y and z co-ordinates of each survey points must be measured to an accuracy of 5 mm. Sufficient control points must be established so that vertical and horizontal movement can be measured to an accuracy of 1 mm.

11.3 The minimum monitoring cross-section requirements are as given in Table 11.3

Table 11.3 – Minimum monitoring cross-section requirements

Wall height	Minimum number of monitoring cross-sections
6 m – 8 m	For every 100 m length of wall section within the wall height between 6 m and 8 m, at least one cross-section. The maximum height within the wall section must be targeted
> 8 m – 10 m	For every 75 m length of wall section within the wall height between > 8 m and 10 m, at least one cross-section. The maximum height within the wall section must be targeted.
> 10 m	For every 50 m length of wall section within the wall height > 10 m, at least one cross-section. The maximum height within the wall section must be targeted.

11.4 In addition to the above, the contractor must provide additional monitoring cross-sections at high-risk areas such as follows:

a) wall curvature on plan – concave outwards (bowl facing backfill)

b) heavily loaded walls

c) walls that are located at a high-risk area for example, close to public or heavy traffic

d) walls that are located adjacent to other structures / utilities which may be affected by the wall movement

e) walls subject to abutment / bridge horizontal loadings, and

f) walls where there is some uncertainty in the design / construction.

11.5 Monitoring of vertical and horizontal movement at the survey points must start as soon as the wall reaches the maximum height. The monitoring frequency must be as follows:

a) initially every 2 weeks for 2 months

b) then monthly for another 2 months, and

c) then 3 monthly for a period of 2 years or any other period specified in the Contact.

11.6 After each measurement, the Contractor must plot the measurements on a log time scale plot and extrapolate these measurements in order to predict the position of the RSS at the end of its design life. The results of each measurement and the log time scale plot must be submitted to the ~~Principal~~ Administrator within 14 days of each measurement. **Record**

12 Certification of construction

12.1 Within 10 working days of the completion of construction of RSS block, the Contractor must forward the following documentation to the ~~Principal~~ Administrator: **Record**

a) Electronic files containing fully detailed “as-constructed” Drawings and specifications in a format acceptable to the ~~Principal~~ Administrator. The Drawings must also include the horizontal and vertical positions of the soil reinforcement within the RSS block, together with any necessary information which would enable any roadwork furniture (for example, posts) to be installed with minimal damage to the RSS. The locations of all monitoring points specified in Clause 11 must also be included.

b) A certificate from the Contractor which confirms that the RSS has been completed and constructed using construction materials and construction processes that are in accordance with the Drawings, Specifications and this Technical Specification.

c) A certificate from the Contractor's Designer (if applicable) which confirms that the as constructed Drawings and the construction specifications and the as constructed RSS fulfil the structural integrity and serviceability criteria stipulated under the design. This certificate must be signed by a ~~Principal~~ Professional Engineer of the Contractor's Designer, and

d) All guarantees and warranties required by the Contract.

~~Annexure~~Appendix A: Summary of Hold Points, Witness Points, Milestones and Records

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

The Hold Points, Witness Points, Milestones and Records~~following is a summary of the Witness Points / Hold Points that apply to this Specification and the Records~~ that the Contractor must ~~submit~~ supply to the ~~Principal~~ Administrator to demonstrate compliance with this Technical Specification, are summarised in Table A.

Table A – Hold Points, Witness Points, Milestones and Records

Clause	Hold point	Witness point	Milestone	Record
4.1	1. The manufacture of facing panels and the preparation of the foundation for the RSS			Quality Plan
5.6	2. Suitable Design RSW		Submission of design and Drawings (28 days)	
7.2	~~2.~~3. Commencement of construction of the RSS.			Test certificates for RSS components
7.11	~~3.~~4. Production of facing panels			Sample facing panel
8.2	~~4.~~5. Placement of fill material			Report of fill material test results
8.14				Construction materials test results
9.4	~~5.~~6. Construction of base strip footings			Foundation Inspection Report
9.7		1. Washing of soil reinforcement made of steel		

Clause	Hold point	Witness point	Milestone	Record
9.9	~~6.~~7. Construction of the second course of facing panels			Survey records for the bottom course of facing panels
9.19		2. Placement of fill over soil reinforcing		
10.1				Survey records
11.6				Monitoring results
12.1				As Constructed Drawings and certificates of completion