TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R58

CONSTRUCTION OF REINFORCED SOIL WALLS (CONTRACTOR'S DESIGN)

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issued.	GM, PSP	20.08.96
Ed 1/Rev 1		Reformatted to standard template Minor changes to Hold Points.	GM, RNIC	01 03 97
Ed 1/Rev 2	4.3 (a) 8 Annexure 58/1 Annexure R58/2	Ban on use of argillaceous material. Pay Item R58P7 amended to define extent of reinforced fill. Clause 2 changed to Clause 3. New schedule listing Identified Records. Amended to include pretreatment of reinforced fill material prior to carrying out Q181C.	GM, RNIC	23.06.00
Ed 1/Rev 3	5.5 (c)	Inclination tolerances changed.	GM, RNIC	21.03.02
Ed 1/Rev 4	1.3.2	"parameter" deleted in text	GM, RNIC	21.02.03
Ed 2/Rev 0	Various Foreword 1.2 1.5, 2, 4, 5, 6, 7, 8 4.3	Clauses & annexures rearranged. Text revised to direct imperative style. "Superintendent" replaced by "Principal". Reformatting and minor editing. "Shall" replaced by "must". References to RTA R57 changed. References to RTA G40 and RTA R44 added. New clause after the Table of Contents. Clause 1.2 now introduces annexures. Referenced documents transferred to Annexure R57/M and revised. Clause numbers changed respectively to R58/D, 1.5, 2, 4, 5, 6 and R58/B. Reference to survey changed to RTA G71	GM, RNIC	16.05.05

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0		Former R58 now divided into 2 documents: R58 (this document) where design is provided by Contractor, and R59 where design is provided by Principal.	GM, IC	28.06.10
		Title changed to reflect changed requirements.		
	Guide Notes	Guide Notes revised to reflect changed requirements. Contact persons and phone numbers updated.		
	1.1	Scope reworded.		
	1.3.1	Definitions of “you”, “your” and “Foundation” added.		
	1.4	Notation “H” added.		
	1.5	Clause deleted – clause duplicated by clauses elsewhere.		
	2.1	Clause reworded to clarify intent.		
	2.5	Additional requirements for soil above and behind zone of reinforced fill material added.		
	2.6, 2.7	Clauses rearranged.		
	2.9	Material parameters specified in previous Clause 3(a)(ii) inserted in 3rd paragraph.		
	3	Clause reworded and simplified.		
	4.1	New clause no 4.1 and title inserted; subsequent clauses renumbered.		
	4.2	“for RSW” added to clause title.		
	4.3	Requirements for foundation preparation clarified, to cater for situation where design is provided by Contractor. Inserted - costs for inspection and report by Geotech Engineer to be included in rates generally.		
	4.4	Clause re-worded to clarify requirements.		
	4.5	1st paragraph deleted.		
	4.5.5	Clause re-worded to include relevant piling specifications as part of requirements.		
	4.6.1	New clause no and title inserted; subsequent clauses renumbered. Clauses re-worded to improve clarity.		
	Annex B	Payment for work items under R44 clarified.		
	Pay Item R58P7	Definition of reinforced fill material for payment purposes changed to end of reinforcement (from previously one meter beyond). Figure R58.1 amended.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	Pay Item R58P8	New pay item R58P8 added. Comment on use of this pay item added.		
	Annex C1	Clause references updated.		
	Annex C2	Schedule of Identified Records updated.		
	Annex D	Clause references updated.		
	Annex M	Referenced documents updated.		
Ed 3/Rev 1	2.5	Option to use either version of Qld test method added.	GM, IC	14.03.11
	Annex L	Test methods and frequencies revised.		
	Annex M	Referenced documents updated.		
Ed 3/Rev 2	Guide Notes, 1.3.1	Approved RSW Systems formerly listed in Annex R57/E now placed on RMS website. Reference to Annex R57/E replaced by url of document.	GM, IC	19.06.12
Ed 3/Rev 3	2.6	New clause prohibiting the use of recycled concrete and cement stabilised soil in zones affecting the soil reinforcement components if the components are made from galvanized steel or polyester. Subsequent clauses renumbered.	GM, CPS	15.07.14
Ed 3/Rev 4	Guide Notes	Contact person details updated.	GM, CPS	29.10.14
	Global	"Reinforced fill material zone" changed to "reinforced soil block".		
	1.4	Redundant notations deleted.		
	2.3	pH, chemical and electrical properties requirements of reinforced fill material, including Tables 1 and 2, moved here from spec R57. Sulfate ion content changed to peroxide sulfur content.		
	2.4	Requirements for drainage layer material consolidated with that in R57. Grading requirements for granular drainage material tabulated in new Table 3.		
	2.5	Chloride ion content, peroxide sulfur content, and pH added to required properties of soil above and behind reinforced soil block. All properties tabulated in new Table 4.		
	2.10	Sampling and testing requirements of representative materials clarified.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 4	4.3	Clause rewritten to clarify requirements.		
(cont'd)	4.5.3	Previous clauses requiring Contractor to divide reinforced soil block into 3 zones, etc and associated layer thickness and compaction requirements summarised in concise Table 5.		
	4.8	New clause added to clarify conformity testing requirements during construction.		
	Annex B	Pay item descriptions edited for clarity.		
	Annex L	Table on test methods and minimum frequency of testing edited.		
		Compaction testing requirements for the 3 zones within reinforced soil block moved here from clause 4.5.3.		
	Annex M	Referenced Documents updated.		
Ed 3/Rev 5	2.3	Steel furnace slag added to material prohibited from use as reinforced fill material.	GM, CPS	20.05.15
	2.3, 2.5	Notes to Tables 2 and 4 – "% by weight" changed to "% by mass".		
	2.6	Heading title changed.		
		Previous clause 2.6 becomes sub-clause 2.6.1.		
	2.6.2	New sub-clause on chemical property requirements of water used at reinforced soil block.		
	4.5.1	New clause on washing of steel soil reinforcement added. Subsequent clauses renumbered.		
		Witness Point on washing of steel soil reinforcement added.		
	Annex C1	Schedules amended.		
	Annex M	Referenced Documents updated.		
Ed 3/Rev 6	2.4	Table 3 – Maximum particle dimension of granular drainage material changed from "50 mm" to "53 mm".	MCQ	27.03.18
Ed 3/Rev 7	Guide Notes & 1.3.1	Link to RMS approved RSW systems updated.	MCQ	27.05.20
	2.1	Reference to previously clause 2.10 updated to clause 2.11.		
	2.4	Heading title changed to include filter fabric.		
		Clause reworded for clarity of drainage layer materials with steel furnace slag banned.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 7 (cont'd)		Strength and filtration requirements of geotextile and filter fabric to Specification RMS R63 added.		
	2.7	Heading title changed to include bearing pads.		
		Clause reworded. Term "concrete blocks and masonry units" changed to "concrete and masonry facing elements".		
		Bearing pads requirements added.		
	2.9	New clause on joint fillers and sealants, moved here from spec R57, and reworded.		
	2.10 & 2.11	Previously clauses 2.9 and 2.10.		
	4.5.3	Heading title changed to include bearing pads.		
		Clause rewritten. Old requirements of joint fillers and sealants deleted. New requirements introduced for placing bearing pads and joint fillers and sealants.		
	4.5.5	Heading title changed to include filter fabric and impermeable layer.		
		Clause reworded for drainage layer requirements including placing impermeable layer. New requirements for placing filter fabric across joints.		
	Annex B	Pay Item P5 revised to include impermeable layer.		
	Annex C1	Schedule of Hold Points updated.		
	Annex C2	Schedule of Identified Records updated.		
	Annex M	Reference to RMS R63 added.		
Ed 3/Rev 8	Global	References to "Roads and Maritime Services" or "RMS" changed to "Transport for NSW" or "TfNSW" respectively.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

Background to Specification R58

The former R58 specification sets out the requirements for the construction of Reinforced Soil Walls (RSW).

This R58 specification has now been divided into two specifications, R58 (this document) where the design of RSW is provided by the Contractor, and a companion specification R59 where the design is provided by the Principal.

The requirements for design of the RSW are set out in specification TfNSW R57. A list of TfNSW approved RSW systems, together with the names of the RSW system owners and conditions of their use can be obtained from:
https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/approved-products-materials/approved_rsw_systems_and_conditions_of_use.pdf

Use of Specification R58

Specification TfNSW R58 is intended for use when the design is to be provided by the Contractor, and hence must be used in conjunction with TfNSW R57.

Questions regarding the specifications may be referred to one of the following persons:

Manager Geotechnical Engineering (Ground Engineering)
Telephone: (02) 8837 0764 Facsimile: (02) 8837 0059

or

Contracts Quality Manager
Telephone: (02) 9462 6590

Transport for NSW

QA SPECIFICATION R58

CONSTRUCTION OF REINFORCED SOIL WALLS (CONTRACTOR'S DESIGN)

IC-QA-R58

VERSION FOR:
DATE:

CONTENTS

CLAUSE PAGE

FOREWORD

TFNSW COPYRIGHT AND USE OF THIS DOCUMENT

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R58 Edition 3 Revision 7.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R58

CONSTRUCTION OF REINFORCED SOIL WALLS (CONTRACTOR'S DESIGN)

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the construction of Reinforced Soil Walls (RSW) to a design provided by the Contractor.

The requirements for the design of the RSW are set out in Specification TfNSW R57 and must be complied with.

This Specification does not cover the requirements for construction of reinforced slopes or foundations.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Measurement and Payment

The method of measurement and payment is detailed in Annexure R58/B.

1.2.2 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure R58/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure R58/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.3 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R58/D and must be implemented.

1.2.4 Testing Procedures

The Inspection and Test Plan must nominate the proposed frequency of testing to verify conformity of the item and it must not be less than that specified in Annexure R58/L. Where a minimum frequency is not specified, nominate an appropriate frequency.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics. The Principal may vary or restore the specified minimum frequency of testing, either selectively or permanently, at any time.

1.2.5 Referenced Documents

Unless specified otherwise, the applicable issue of a referenced document, other than a TfNSW Specification, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R58/M.

1.3 DEFINITIONS

The terms "you" and "your" mean "the Contractor" and "the Contractor's" respectively.

The following definitions apply to this Specification:

1.3.1 General Definitions

Abutment	A structure or wall which extends beyond the bridge to retain the earth and support the ends of the bridge.
Capping	The element over the top course of facing elements to complete the RSW to specified finished levels.
Facing connections	Any connections, whether mechanical, frictional or other type, between facing elements and the soil reinforcement, designed to transfer loads between the soil reinforcement and facing elements.
Facing elements	Elements retaining the reinforced fill material, with provision for connection to the soil reinforcement.
Foundation	Portion of ground in contact with the RSW and supporting the loads from it.
Geosynthetic reinforcement	Soil reinforcement made of polymeric materials used in geotechnical engineering e.g. linear straps and geogrids.
Geotechnical Engineer	Engineer(s) with qualifications and experience in geotechnical engineering.
Reinforced fill material	Granular soil, decomposed rock or crushed rock fill material in a RSW in which the soil reinforcement is embedded.
Reinforced Soil Wall (RSW)	A retaining structure, with the face within 20° of vertical, which comprises soil reinforcement embedded in reinforced fill material, together with any facing elements, facing connections and footings.
RSW System	A system which has been pre-assessed and accepted by Transport for NSW as suitable for specific RSW applications, and which may be subject to certain conditions for use. For this purpose, a "system" includes the reinforcing elements, wall facings and any associated components such as connections, joint fillers and sealants.
RSW System Owner	A company whose RSW System has been accepted by Transport for NSW. The RSW System Owner certifies the design in accordance with TfNSW R57.

A list of the TfNSW approved RSW Systems, the respective System Owner, their applications and their Conditions of Use can be obtained from: https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/approved-products-materials/approved_rsw_systems_and_conditions_of_use.pdf

Soil reinforcement Components which are embedded in the reinforced fill material and act through interface friction, bearing or other means to improve the stability and structural adequacy of the RSW.

1.3.2 Design Definitions

Characteristic value The best estimates of values for material parameters for which the probability of a more adverse value occurring in the field is not greater than 5%.

The material and load factors in this Specification are calibrated using characteristic values. The designer must make safe estimates of the characteristic values for use in design.

Characteristic values must be based on a careful assessment of the range of values which could reasonably be expected to occur in the field. It is emphasised that a statistical analysis of a limited amount of measured data may be useful but will rarely lead directly to characteristic values.

The guaranteed minimum values for yield stress and tensile strength of steel may be used for the characteristic values.

Design value for material Characteristic value of material multiplied by the appropriate material factor. (See Clause 4.4 of TfNSW R57.)

Nominal Load The unfactored loads and load effects acting on the RSW.

1.4 NOTATION

H Mechanical height of the RSW

2 MATERIALS

2.1 GENERAL

The RSW System used must be in accordance with that specified in the RSW design. The materials used in the Works must be represented by the representative samples of the reinforced fill materials, and granular drainage material where appropriate (refer Clause 2.11).

2.2 SOIL REINFORCEMENT

The soil reinforcement used must be in accordance with that specified in the RSW design.

2.3 REINFORCED FILL MATERIAL

Notify the Principal of the source of reinforced fill material to be used in the Works.

The reinforced fill material must comply with the following requirements:

(a) The reinforced fill material must be inert, hard, durable granular material, without properties that would cause deterioration of the RSW components.

It must be either soil, decomposed rock or crushed rock fill material, 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.

Material derived from argillaceous rock, such as shales and claystones or other materials which are susceptible to breakdown into a friable material, and steel furnace slag must not be used as reinforced fill material.

(b) The reinforced fill material must meet the physical properties requirements specified in the RSW 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.

The characteristic value of the weight per unit volume of the reinforced fill material must be within ±5% of the value specified in the RSW design. If these limits are exceeded, 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.

(c) Reinforced fill material located within the Selected Material Zone of a road embankment must also meet the requirements for Selected Material as stated in Specification TfNSW R44.

(d) The reinforced fill material must meet the pH requirements shown in Table R58.1. Where the RSW system has steel components, the reinforced fill material must meet the chemical and electrical properties requirements shown in Table R58.2.

Table R58.1 – Allowable pH Limits of Reinforced Fill Materials

Soil Reinforcement Material Type	Allowable pH Limits in Fill Material (1)
Steel	5 – 10
Polyester	4 – 9
HDPE	3 – 12

Note:

(1) Determined using Test Method TfNSW T123 carried out at a temperature of 23 ± 2º C.

Table R58.2 - Chemical and Electrical Properties of Reinforced Fill Material for RSW System with Steel Components

Chemical and Electrical Property	Test Method	Allowable Limits	
		Dry Land	Submerged (1)
Chloride ion content (2)	TfNSW T1010	≤ 0.02	≤ 0.01
Peroxide sulfur content (2, 3)	AS 4969.12	≤ 0.06	≤ 0.04
Resistivity (saturated) (ohm metre)	TfNSW T185	≥ 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.

2.4 DRAINAGE LAYER AND FILTER FABRIC

Where granular material is used as a drainage layer, the granular material must be wrapped inside a nonwoven geotextile.

Granular material in the drainage layer must be inert, hard and durable, meeting the grading requirements stated in Table R58.3. It must not have properties that would cause deterioration of the RSW components, and must be free from organic or other deleterious material. Steel furnace slag must not be used as drainage layer.

Table R58.3 – Grading Requirements for Granular Drainage Material

Property	Requirement
Maximum particle dimension	53 mm
Percentage passing 9.5 mm AS sieve	≤ 5%

Nonwoven geotextile of drainage layer must comply with Specification TfNSW R63 (Strength Class B and Filtration Class 2).

Filter fabric must be nonwoven geotextile and comply with TfNSW R63 (Strength Class B and Filtration Class 2).

2.5 SOIL ABOVE AND BEHIND REINFORCED SOIL BLOCK

The soil above and behind the reinforced soil block within a distance of $H/_2$ from the reinforced soil block, must meet the physical properties requirements specified in the RSW design.

The characteristic value of the weight per unit volume of the soil above, and behind the reinforced soil block within a distance of $H/_2$ from the reinforced soil block, must be within ± 5% of the value specified in the RSW design. If these limits are exceeded, consult the designer regarding the implications for the design and any necessary action to be taken.

The soil above, and behind the reinforced soil block within a distance of $H/2$ from the reinforced soil block, must meet the pH, physical and chemical properties requirements shown in Table R58.4.

Table R58.4 – Physical and Chemical Properties of Soil Above and Behind Reinforced Soil Block

Soil Property	Test Method	Allowable Limits
pH	As for reinforced fill material	
Liquid Limit	TfNSW T108	≤ 30%
Plasticity Index	TfNSW T109	≤ 12
Chloride ion content (1)	TfNSW T1010	≤ 0.03% (3)
Peroxide sulfur content (1, 2)	AS 4969.12	≤ 0.08% (3)

Notes:

(1) % by mass.

(2) Prepare samples in accordance with AS 4969.1.

(3) Allowable limits apply only if RSW system has steel components.

2.6 ADDITIONAL REQUIREMENTS WHEN USING STEEL OR POLYESTER COMPONENTS

2.6.1 Steel or Polyester Components – Use of Recycled Concrete and Stabilised Soil

If any of the soil reinforcement components used in the RSW is made from either galvanized steel or polyester, do not use recycled concrete and stabilised soil with cementitious binders as:

(a) reinforced fill material (refer Clause 2.3);

(b) granular drainage layer material (refer Clause 2.4);

(c) fill material in the zone above and behind the reinforced soil block (refer Clause 2.5).

2.6.2 Steel Components Only – Chemical Properties of Water

If any of the soil reinforcement components used in the RSW is made from galvanized steel, water used to increase the moisture content of the reinforced fill material or for any other purposes at the reinforced soil block area must comply with the requirements in Table R58.5.

Table R58.5 – Chemical Properties of Water

Chemical Property	Test Method	Limits
pH	TfNSW T1002	6.5 – 8.5
Chloride ion content (mg/L)	TfNSW T1004	≤ 250
Sulfate ion content (mg/L)	TfNSW T1014	≤ 250

2.7 FACING ELEMENTS, CAPPING AND BEARING PADS

The finish of facing elements and capping must be as specified on the RSW Drawings.

Concrete and masonry facing elements must attain the minimum strengths specified for the RSW System.

Do not use any facing connections with defective coatings. Do not apply protective coatings in the field, except for minor repairs.

Bearing pads must be:

(a) either HDPE, neoprene or ethylene propylene diene monomer;

(b) durable and inert;

(c) resistant to creep rupture and environmental degradation;

(d) able to accommodate differential movements between adjacent panels, during construction as well as throughout their design life.

2.8 CONCRETE

Concrete, including concrete base footing and concrete facing elements, must meet the requirements specified in Specifications TfNSW B80 and TfNSW B115.

2.9 JOINT FILLERS AND SEALANTS

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;

(c) retain soil fines.

Sealants must be polysulphide or polyurethane based elastomeric compounds.

2.10 HANDLING AND STORAGE

Transport and store all prefabricated RSW components in accordance with the manufacturer's instructions to prevent damage and deterioration. Protect geosynthetic reinforcement and geotextile from degradation by ultra-violet radiation until its embedment within the RSW.

2.11 VERIFICATION OF MATERIAL PROPERTIES

Submit a report giving details of the construction materials to be used in the Works.

Include in the report test results of representative samples for each of the specified material properties for reinforced fill materials, granular drainage layer materials where applicable, and the soil material above and behind the reinforced soil block. Submit at least 4 sample test results for angle of friction at constant volume, and 7 sample test results for other properties.

Submit also test certificates of representative samples for the soil reinforcement, facing elements, facing connections, and associated components, which must not be more than 12 months old.

The material represented by the samples is considered to be nonconforming if any of the sample test result is less than the lower limit, or more than the upper limit as appropriate, of the characteristic value adopted in the design.

Include in the report a certification that the proposed materials, including all RSW system components supplied, conform to the specified material properties.

HOLD POINT	
Process Held:	Placement of reinforced fill material.
Submission Details:	At least 5 working days prior to commencement of placement of reinforced fill material, submit the details specified in Clause 2.11.
Release of Hold Point:	The Principal will consider the submitted documents, prior to authorising the release of the Hold Point.

3 CONSTRUCTION REQUIREMENTS SPECIFIC TO RSW DESIGN

At least 10 working days prior to the proposed commencement of manufacture of the facing elements, or the preparation of the foundation for the RSW, whichever occurs first, submit to the Principal the design output and certification detailed in TfNSW R57 Clause 4.9.

Submission of this design output and certification constitutes a Hold Point.

HOLD POINT	
Process Held:	Construction of the RSW.
Submission Details:	At least 10 working days prior to commencement of manufacture of the facing elements, or the preparation of the foundation for the RSW, whichever occurs first, submit to the Principal the design output and certification detailed in TfNSW R57 Clause 4.9.
Release of Hold Point:	The Principal will consider the submitted documents, prior to authorising the release of the Hold Point.

4 CONSTRUCTION

4.1 GENERAL

Construction of the RSW must comply with Clause 4, the RSW System specification, and any requirements specified in the RSW design.

The method of construction must make due allowance for any existing and planned future services and structures.

4.2 SITE PREPARATION AND EXCAVATION FOR RSW

Carry out site preparation and excavation for the RSW, including removal of any unsuitable material, placing of replacement fill and other site preparation and excavation work for the RSW in accordance with Specifications TfNSW G40 and TfNSW R44.

4.3 FOUNDATION PREPARATION

Prior to carrying out any foundation preparation, arrange for a Geotechnical Engineer to inspect the foundation area, validate and compare the characteristics of the foundation material and profile of the ground water with that assumed in the RSW design, and reassess any foundation treatment specified in the design.

If the Geotechnical Engineer identifies that the specified foundation treatment is inappropriate; or where no foundation treatment is specified, identifies that material exists in the foundation that is inadequate to meet the design values of foundation soil material parameters, advise the Principal promptly.

Provide the Principal with details of any revised RSW design or revised foundation treatment required.

Carry out any foundation treatment required.

If you excavate below the designed foundation level without being directed to do so by the Principal, backfill the over-excavation with material that is compatible with the RSW design, at your own cost.

On completion of the foundation preparation, arrange for the Geotechnical Engineer to inspect the foundation and submit a report confirming that the foundation complies with the RSW design.

The cost of the services of the Geotechnical Engineer will be deemed to be included in the rates and prices generally.

Submission of this report constitutes a Hold Point.

HOLD POINT

Process Held:	Construction of base/concrete strip footings, erection of facing elements, and placement of reinforced fill material.
Submission Details:	At least 5 working days prior to commencement of construction of base/concrete strip footings, submit to the Principal the report by the Geotechnical Engineer certifying that the foundation meets the design requirements.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

4.4 BASE STRIP FOOTINGS

Comply with the requirements of Specification TfNSW G71 for Survey Control.

Prepare the base strip footings supporting the bottom course of facing elements with sufficient accuracy to line and level such that facing elements can be placed within the specified tolerance with due allowance for the movement of footings which may occur due to placing of the fill.

The footing dimensions must comply with the specified tolerances in TfNSW B80.

4.5 ERECTION OF FACING ELEMENTS AND PLACEMENT OF REINFORCED FILL MATERIAL

4.5.1 Washing of Soil Reinforcement

Prior to installing soil reinforcement made of steel, wash the soil reinforcement thoroughly with water complying with Table R58.5. Washing of soil reinforcement made of other materials which are not susceptible to corrosion is not necessary, unless specified so by the supplier.

WITNESS POINT

Process Witnessed:	Washing of soil reinforcement made of steel.
Submission Details:	At least 24 hours notice prior to the commencement of the activity.

4.5.2 Erection of Facing Elements

Adjust the degree of inclination of the facing elements towards the fill, where necessary, as placement and compaction of fill material proceeds, to ensure that the specified tolerances are not exceeded.

HOLD POINT

Process Held:	Erection of second course of facing elements.
Submission Details:	Survey records for the bottom course of facing elements.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

Immediately check the level and alignment of each course of facing elements after placement of that course and prior to placement of the next course, if any.

Where capping is specified as part of the RSW System, finish the top course of facing elements such that capping is within tolerance of its design alignment.

4.5.3 Installation of Bearing Pads, Joint Fillers and Sealants

Place bearing pads 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 RSW drawings.

Where filter fabric may be exposed to sunlight through a joint, apply suitable joint fillers or sealants to protect the filter fabric from sunlight. Sealants (including primers) must be applied strictly in accordance with the manufacturer's recommendations.

4.5.4 Placement of Reinforced Fill Material

Construct the reinforced soil block as follows:

(a) Unless shown otherwise on the RSW drawings, deposit, spread, level and compact the fill material in layers of thickness appropriate to the compaction methods used, in a direction parallel to facing elements. Each layers of fill material must be horizontal and uniform in thickness over the area to be filled.

At the end of each day's operations, shape the surface of the fill to permit drainage away from the wall face and the retained embankment.

(b) Lay the soil reinforcement horizontally on the compacted fill at the locations and levels specified on the RSW drawings. Each soil reinforcement must rest fully on top of the compacted fill material without any voided space underneath the soil reinforcement. Connect it securely to the facing elements, in accordance with the requirements of the RSW System.

Pull any geosynthetic reinforcement 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.

Record the condition of soil reinforcement and facing connections just before placing the next layer of fill over it.

(c) Where overlapping of soil reinforcement is required (e.g. for curved walls), provide a minimum thickness of 75 mm of compacted fill between the overlapping soil reinforcement.

(d) Do not damage or displace soil reinforcement, facing connections and facing elements during placement and compaction. Do not allow tracked machines or vehicles to operate on top of soil reinforcement which are not covered by at least 150 mm of fill material. Rubber tyred equipment may be permitted to pass over soil reinforcement at slow speeds.

Prohibit any sudden braking and sharp turning of machines or vehicles which could displace soil reinforcement from its intended positions, even if there is fill material over the soil reinforcement.

(e) Keep all vehicles and construction equipment with a gross mass more than 1,000 kg at least 1.5 m away from the wall face.

Unless otherwise permitted by the Principal, compact the fill material within 1.5 m of the wall face with a vibrating tamper or vibrating plate compactor or a vibrating roller with a mass not exceeding 1,000 kg.

(f) Where filling is required in the zone behind (and outside) the reinforced soil block, place the fill in this zone progressively, keeping the level of fill the same as that within the reinforced soil block.

Where the existing material behind the reinforced soil block is retained by temporary supports such as shoring, remove the shoring progressively as the reinforced fill material is placed and compacted. Remove the shoring in such manner that the stability of the adjacent ground is maintained, the compacted fill material is not disturbed and the formation of voids is prevented.

The maximum layer thickness and required compaction for the 3 Zones within the reinforced soil block must be in accordance with Table R58.6.

Table R58.6 - Maximum Layer Thickness and Required Relative Compaction

Zone	Extent of Zone	Maximum Layer Thickness and Required Relative Compaction
1	Beyond 1.5 m from RSW facing elements and up to underside of Selected Material Zone.	As specified for "material placed in formations up to underside of Selected Material Zone" in TfNSW R44.
2	Beyond 1.5 m from RSW facing elements and within Selected Material Zone.	As specified for "Selected Material Zone" in TfNSW R44.
3	Within 1.5 m from RSW facing elements.	As specified for Zone 1, but with following exceptions: (a) Maximum compacted layer thickness of 150 mm, unless approved otherwise by the Principal. (b) Lower limit of relative compaction of 95% (1).

Note:
(1). When tested in accordance with TfNSW T166.

4.5.5 Provision of Drainage Layer, Filter Fabric and Impermeable Layer

Provide drainage layer as shown on the RSW drawings. Where granular material is used as a drainage material, compact the drainage material and reinforced soil fill with the same compactor and number of passes.

Provide impermeable layer where shown on the RSW drawings.

Place filter fabric to cover all joints to prevent loss of fill through the joints. Filter fabric across a joint must be continuous along any directions and must extend to a minimum of 200 mm to either side of the centre line of the joint.

4.5.6 Piling

Piling must be in accordance with the requirements specified in the bridge design, the RSW design, and the relevant piling specifications.

4.6 TOLERANCES

4.6.1 General

The dimensions, levels, and position immediately following the completion of the RSW and the application of all dead load surcharges, must be in accordance with the tolerances stated in the following clauses.

Where no tolerance is given, the default tolerance is ±6 mm.

Deviations outwards or away from the block of reinforced fill material are to be shown as positive deviations.

4.6.2 Clearances

Maintain any clearances required for the face at any point.

4.6.3 Soil Reinforcement

Soil reinforcement must be placed within ±100 mm of the design levels and locations specified on the RSW drawings.

4.6.4 Facing Elements

No point on the face of the RSW beneath bridge abutments must deviate from their design position by more than ±50 mm. No point on the face of the structure outside a distance corresponding to the height of the RSW from any bridge abutment must deviate from the design position by +50 mm, –100 mm.

The inclination of the face of the completed wall must not deviate from the specified inclination by more than +0, –5 mm per metre height for panel type walls or by more than +10 mm, –10 mm per metre of wall height for segmental block type walls.

The flatness of the face of the wall must be such that the maximum deviation from a 4.5 m straight edge must not exceed ±20 mm. In the case of walls curved to plan, measure the horizontal deviation from a 4.5 m long reference line curved to the specified curvature measured at panel joints.

4.6.5 Tolerances for Top and Bottom of Wall

The deviation from the design alignment for the top and the bottom of the walls must be:

(a) within ±15 mm for walls beneath bridge abutments;

(b) within ±30 mm for walls beyond the height of the RSW from bridge abutments.

The details at the junction of the wall and capping must be such that the finished capping is within the tolerance of its design alignment and the difference in tolerance for facing elements and capping can be accommodated.

4.6.6 Levels

The level of any point on the wall must not deviate from the specified level by more than ±20 mm, except where it is necessary to permit the tops to join neatly to adjacent structures or to result in a visually smooth alignment along the top surface.

4.7 MONITORING

Where monitoring is specified in the RSW design, install targets and probes in the RSW for monitoring of the RSW. The Principal will supply the targets and probes.

Installation must be in accordance with the requirements detailed on the RSW drawings.

Verify that the monitoring devices are in working order prior to covering up the devices.

4.8 CONFORMITY TESTING

Carry out sampling and testing of the reinforced fill material, drainage layer materials, and soil above and behind the reinforced soil block used in the Works in accordance with Annexure R58/L. Use statistical techniques in accordance with TfNSW Q as the basis for verifying conformity for each of the material properties in Annexure R58/L against the corresponding characteristic value adopted in the design.

For the purpose of this Clause, a Lot is taken as an area of work that is essentially homogeneous. occurs when the material origin and properties, general appearance, moisture condition during compaction, compaction technique, response to compactors, and state of underlying materials are substantially alike.

Submit all conformity test reports on any samples within 3 weeks after sampling.

Reject any Lot that does not conform to all design requirements.

5 CERTIFICATION OF CONSTRUCTION

On completion of construction of the RSW, submit to the Principal a certificate verifying that the construction materials used and the method of construction conform to design requirements and this Specification. Submission of this certificate constitutes a Hold Point.

HOLD POINT	
Process Held:	Imposition of surcharge loading above the zone of reinforced fill material.
Submission Details:	Submit a certificate verifying that the construction materials used and the method of construction comply with the design requirements and this Specification.
Release of Hold Point:	The Principal will consider the submitted documents, prior to authorising the release of the Hold Point.

6 WORK-AS-EXECUTED DRAWINGS

On completion of construction of the RSW, provide the Principal with a set of the work-as-executed drawings showing:

(a) vertical sections at 7.5 m centres, unless otherwise specified by the Principal;

(b) the horizontal and vertical positions of the soil reinforcement within the top 1.5 m of the block of reinforced fill material together with any other necessary information such that roadside furniture (e.g. posts) may be installed without causing damage to the RSW;

(c) the locations of all monitoring points referred to in Clause 4.7 of this Specification.

ANNEXURE R58/A – (NOT USED)

ANNEXURE R58/B – MEASUREMENT AND PAYMENT

Payment for clearing and grubbing will be made in accordance with TfNSW G40.

Payment for the removal and stockpiling of topsoil, excavation and disposal of surplus excavated material required under Clause 4.2, and removal and replacement of unsuitable material, will be made under the relevant pay items in TfNSW R44.

Supply and placement of fill material within the reinforced soil block will be paid under:

(a) Pay Item R44P2 (for site won material) or R44P3 (for imported material), as appropriate, for the portion of the reinforced soil block outside the Selected Material Zone;

Pay Item R44P5.1 (for site won material) or R44P5.2 (for imported material), as appropriate, for portion of the reinforced soil block within the Selected Material Zone;

and

(b) Pay Item R58P7 as an "extra over" item for the entire reinforced soil block.

Payment will be made for all costs associated with completing all other work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless specified otherwise, a lump sum price for any of these items will not be accepted.

Pay Item R58P1 - Supply of Components

This is a Lump Sum item.

This item covers all costs associated with the supply to site of all components for the RSW, including facing elements, soil reinforcement, facing connections, joint fillers and sealants and other required components.

Pay Item R58P2 - Preparation of Foundation

This is a Lump Sum item.

This item covers all costs required to meet the requirements of Clause 4.3, including the services of a Geotechnical Engineer.

Pay Item R58P3 - Base/Concrete Strip Footings

This is a Lump Sum item.

This item covers all costs associated with for the construction of base/concrete strip footings.

Pay Item R58P4 - Erection of RSW Panels

This is a Lump Sum item.

This item covers all costs associated with the erection of facing elements, including attachment of the soil reinforcement and associated components to the facing elements, and the placement of joint fillers and sealants.

Pay Item R58P5 - Drainage Layer

This is a Lump Sum item.

This item covers all costs associated with the supply and placement of geotextile and granular drainage materials in the drainage layer, including impermeable layer where required.

Pay Item R58P6 - Capping

This is a Lump Sum item.

This item covers all costs associated with the construction of any capping required over the top course of facing elements to complete the RSW to specified finished levels.

Pay Item R58P7 - Extra Over for Supply and Placing Reinforced Fill Material

This is a Lump Sum item.

For the purpose of this Clause, the reinforced fill material is deemed to commence from the rear of the facing and extend to the end of the soil reinforcement, as shown in Figure R58.1.

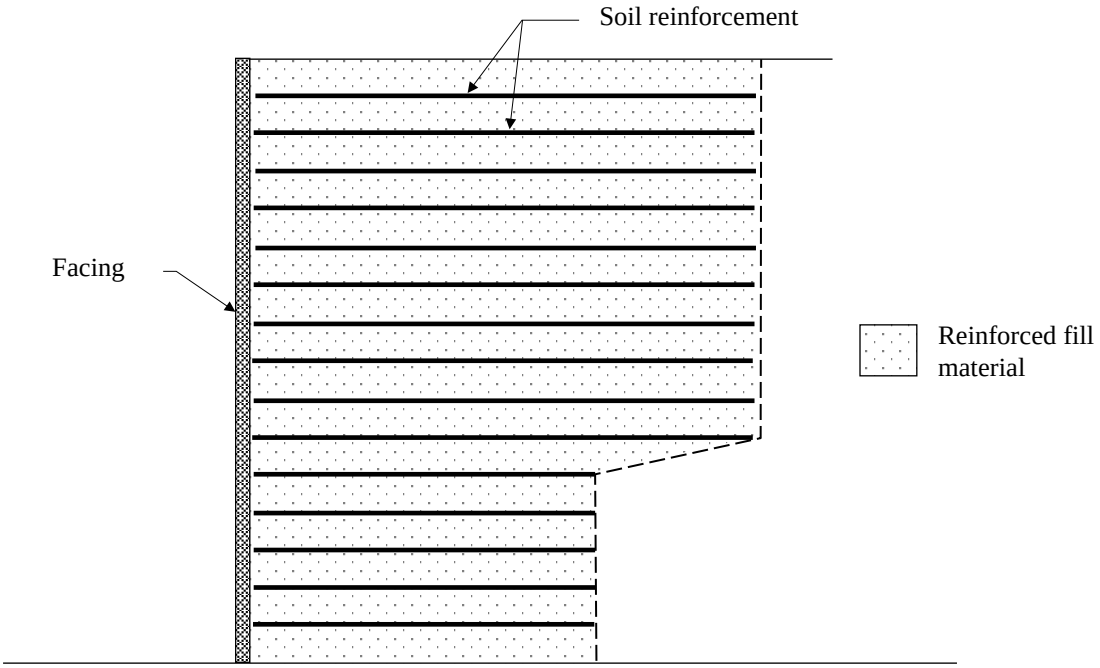

Figure R58.1 - Extent of Reinforced Fill Material for Payment Purpose

This item covers all additional costs associated with the supply and placing of reinforced fill material, over and above the costs allowed for under the relevant pay items in TfNSW R44.

Pay Item R58P8 - Extra Over for Supply and Placing Imported or Borrowed Material for Fill Above and Behind Reinforced Soil Block

Only use Pay Item R58P8 where it is likely that material from cuttings within the Site will not comply with the properties set out in Clause 2.5 for material above and behind the RSW block, and imported or borrowed material will be required.

Delete this note before issue of the Tender Documents.

The unit of measurement is the "cubic metre" of compacted volume of imported fill, measured in place. The volume is determined by calculation from the Drawings or by survey.

This item covers all additional costs associated with the supply and placing of borrowed or imported material conforming to the material requirements in Clause 2.5, for the soil above, and behind the reinforced soil block within a distance of $H/_2$ from the reinforced soil block, over and above that allowed for under Pay Items R44P3 and R44P5.2.

It includes the cost of opening up of the borrow site, excavation of material from the borrow site and the construction of embankments, the haulage of material and any pre-treatment such as breaking down or blending material or drying out material containing excess moisture, maintenance of the borrow site and restoration of the borrow site.

Payment will not be made for excess widening of embankments or wastage by you.

ANNEXURE R58/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.2.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.11	Hold	Submission of verification of design requirements
3	Hold	Construction of the RSW
4.3	Hold	Validation of foundation
4.5.1	Witness	Washing of soil reinforcement made of steel
4.5.2	Hold	Submission of survey record for the bottom course of facing elements
5	Hold	Submission of construction verification certificate

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.3	Source of reinforced fill material
2.11	Report giving details of all construction materials to be used in the Works together with test results and verifying that specified material properties have been met
3	Details of RSW design and certification
4.3	Report verifying that the site and foundations meet the design requirements
4.5.2	Survey of facing elements
5	Certificate that construction materials used and method of construction conform to design requirements and the Specification
6	Set of work-as-executed drawings

ANNEXURE R58/D – PLANNING DOCUMENTS

Refer to Clause 1.2.3.

The information to be supplied by you as part of your PROJECT QUALITY PLAN must include the following:

(a) Details of the construction materials to be used and their conformity with design requirements.

(b) Verification by the RSW System Owner that all components supplied for construction of the RSW meet the RSW System specifications.

(c) Details of the method of construction of RSW in accordance with Clause 4, together with a statement that the method of construction will comply with the design requirements.

(d) Details of the method of preparing the foundation in accordance with Clause 4.3.

(e) Details of the method of installing targets and probes for monitoring of the RSW in accordance with Clause 4.7.

ANNEXURES R58/E TO R58/K – (NOT USED)

ANNEXURE R58/L – FREQUENCY OF TESTING FOR EACH LOT

Clause	Material Property	Test Method	Minimum Frequency(1)
2.3, 2.5	Angle of friction at constant volume under effective stress conditions	Either: Q181C:Draft 1994 (2) or: Q181C:2008 (2)	1 test per 400 m^3, with a minimum of 5 tests for each type of material 2 tests per 2,500 m^3, with a minimum of 2 tests for each type of material
2.3, 2.4, 2.5	Grading	AS 1289.3.6.1 (refer also Table R57.10)	1 sample per 200 m^3 or part thereof, but not less than 1 sample per layer
2.3, 2.5	LL and PI	T108 and T109 (refer also Table R57.10)	1 sample per 200 m^3 or part thereof, but not less than 1 sample per layer.
2.3, 2.5	pH, electrical and chemical properties	As shown in Tables R58.1 and R58.2	1 sample per 400 m^3 or part thereof but not less than 1 sample per layer.
4.5.4	Relative compaction:		
	Zones 1 and 2	In accordance with TfNSW R44	In accordance with TfNSW R44 and TfNSW Q
	Zone 3	In accordance with TfNSW R44	1 test per 100 m^2, with minimum of 1 test every two adjacent continuous layers compacted on the same day, provided that the material has uniform treatment and appearance
	Moisture content	In accordance with TfNSW R44	In accordance with TfNSW R44

Notes:

(1) Take samples at the time of placement of the layer. If you place subsequent layers before obtaining test results of previous layers, you do so at your own risk.

(2) Prior to testing, pretreat the material in accordance with Test Method TfNSW T102 using 3 repeated compaction cycles.

ANNEXURE R58/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.5.

TfNSW Specifications

TfNSW G40	Clearing and Grubbing
TfNSW G71	Construction Surveys
TfNSW Q	Quality Management System
TfNSW B80	Concrete Work for Bridges
TfNSW B115	Precast Concrete Members (Not Pretensioned)
TfNSW R44	Earthworks
TfNSW R57	Design of Reinforced Soil Walls
TfNSW R63	Geotextiles (Separation and Filtration)

TfNSW Test Methods

TfNSW T102	Pretreatment of Road Construction Materials by Compaction
TfNSW T108	Liquid Limit of Road Materials
TfNSW T109	Plastic Limit and Plasticity Index of Road Construction Materials
TfNSW T123	pH Value of Soil (Electrometric Method)
TfNSW T166	Relative Compaction of Road Construction Materials
TfNSW T185	Resistivity of Sands and Granular Road Construction Material
TfNSW T1002	Determination of the pH Value of Water Using a pH Meter
TfNSW T1004	Quantitative Determination of Chloride Ion in Water
TfNSW T1010	Quantitative Determination of Chlorides in Soils
TfNSW T1014	Quantitative Determination of Sulfate Ion in Water

Queensland Department of Transport Test Methods

Q181C:Draft 1994	Determination of the Effective Angle of Friction at Constant Volume Conditions for Earthworks Materials
Q181C:2008	Effective Angle of Internal Friction at Constant Volume Conditions for Granular (Coarse Grained) Materials

Australian Standards

AS 1289.3.6.1	Methods of testing soils for engineering purposes – Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving
AS 4969	Analysis of acid sulfate soil – Dried samples – Methods of test
AS 4969.1	Pre-treatment of samples

AS 4969.12	Complete suspension peroxide oxidation combined acidity and sulfur (SPOCAS) method