Structures

Master Specification

ST-RE-C1 Reinforced Soil Structures

Document Information	
K Net Number:	13523412
Document Version:	2
Document Date:	August 2020

DEPARTMENT FOR INFRASTRUCTURE AND TRANSPORT

Government of South Australia
Department for Infrastructure and Transport

Document Amendment Record

Version	Change Description	Date	Endorsement record (KNet ref.)
1	Initial issue (formerly S20)	28/06/19	
2	Formatting for publishing	August 2020	

Document Management

Contents

ST-RE-C1 Reinforced Soil Structures

1 General

1.1 This Part specifies the requirements for the supply of materials and the construction of Reinforced Soil Structures.

1.2 Reinforced Soil Structures must consist of a composite system of compacted select backfill and reinforcing material with precast concrete wall facing.

1.3 Reinforced Soil Structures must be installed in accordance with the manufacturer's instructions and the requirements of this Part. In the event an inconsistency, the higher standard shall apply.

1.4 Documents referenced in this Part are listed below:

a) AS 1289 Methods of Testing Soils for Engineering Purposes.

b) AS 1554 Structural Steel Welding Code.

c) AS 3678 Hot Rolled Structural Steel Plates, Floor Plates and Slabs.

d) AS 3679 Hot Rolled Structural Steel Bars and Section.

e) AS 4671 Steel Reinforcing Materials.

f) AS 4680 Hot dip Galvanized (Zinc) Coatings on Fabricated Ferrous Articles.

g) AS 5100 Bridge Design.

1.5 Design of the Reinforced Soil Structures must comply with ST-RE-D1 "Design of Reinforced Soil Structures".

2 Materials

General

2.1 Materials must comply with any specific requirements of the proprietary systems adopted.

Wall Facings

2.2 Wall facing panels must be of incremental height, precast reinforced concrete, manufactured in accordance with Division ST-SC "Concrete". The minimum concrete grade is S32.

2.3 Steel reinforcement must be a minimum of 450 mm^2 per metre in each of two directions at right angles to each other and located at mid-depth of the panel thickness.

2.4 Wall facing panels must be positively interconnected to prevent relative displacement normal to the wall face.

2.5 Incorporate anti-graffiti measures and aesthetics in the design.

2.6 A footing must be designed to accommodate the wall facing panels.

Joint Fillers

2.7 Joint fillers between wall facing panels must be composed of durable inert material resistant to attack from the soil material and the atmosphere.

2.8 Joint fillers must be provided to allow for joint rotation without spalling of concrete edges and to prevent loss of fines from the backfill material and staining of the panel faces.

Soil Reinforcing

2.9 Reinforcing strips or grids and their connections, which are attached to the wall facing panels and embedded in the fill, must be fabricated from approved reinforcing products.

2.10 The Contractor must provide all evidence necessary to verify that the soil reinforcing is sufficiently strong, stiff, stable and durable to satisfy the performance and design requirements of major reinforced soil structures and this Specification with a minimum of 10 years data from laboratory and site applications in representative conditions.

2.11 Steel reinforcing must comply with AS 3679 with a minimum base metal thickness of 5 mm and hot dip galvanized after fabrication in accordance with AS 4680 with a minimum average coating thickness equivalent to 600 grams per square metre.

2.12 Steel mesh must comply with AS 4671 and hot dip galvanized after fabrication with zinc to AS 4680 with a minimum average coating thickness equivalent to 600 grams per square metre.

2.13 Synthetic material must comply with a British Board of Agreement Certificate and demonstrated by testing in a NATA accredited laboratory to satisfy the performance and design requirements of this Specification.

Connections

2.14 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.

2.15 All materials forming connections must be adequately protected for the in-situ conditions, consistent with the protection provided for adjacent components and for the defined structure life.

Handling Transportation and Storage

2.16 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. All materials forming connections must be adequately protected for the in-situ conditions, consistent with the protection provided for adjacent components and for the defined structure life.

Backfill

2.17 Select backfill must comply with the specified requirements (refer Clause 7) and have a particle size distribution, shear strength and co-efficient of friction value to ensure the design parameters are achieved. Submitting conformity test results shall constitute a **Hold Point**.

2.18 Pulverised fuel ash must not be used as select backfill.

3 Construction

Levelling Pads

3.1 Levelling pads must be cast from Grade N20 concrete to the lines levels and dimensions shown on the drawings, within the following tolerances:

Table ST-RE-C1 3-1 Levelling pads tolerances

Name	Tolerance
Plan dimension	- 5 mm
Thickness	-10 mm
Reduced level of top surface of footing	- 5 mm to + 5 mm
Maximum variation of top surface from a 3 m straight edge	5 mm

3.2 The pads must be cured for a minimum of 24 hours before placement of wall panels.

Panel Erection

3.3 Panels must only be handled and lifted by a lifting device or other method specified by the designer. Each wall facing panel must be supported immediately after erection and until the abutting fill material has been placed and compacted. Panels must be erected without disturbance, damage or distortion of reinforcing strips or panels.

3.4 The Contractor must set out an offset line in front of and parallel to each Reinforced Earth wall levelling pad. On completion of each row of panels and before commencing the next row, the Contractor must submit details of the final position of the top and bottom of each panel. The tolerances for pile erection are given in Table ST-RE-C1 3-2.

Placement of Filling

3.5 Fill must be placed on to the reinforcing strips so that the toe of the fill pile is approximately 1.5 m from the panels. The material must be pushed parallel to the panels and spread toward the panels and toward the free end of the strips. Fill placement must follow the erection of each run of panels.

3.6 At each reinforcing strip level, fill must be compacted before placing and bolting strips. At the end of each days' operations, the Contractor must shape the top of fill so as to direct run off of rainwater away from the wall face.

3.7 Fill must be placed in layers of between 100 mm and 200 mm compacted thickness and the properties comply with those specified in Clause 7 "Verification Requirements". The location of tests must be selected by the Contractor for each lot on a stratified random basis. A **Hold Point** shall be constituted for submission of the results of these tests unless stated otherwise in the Contract Documents for the project.

3.8 The minimum frequency of compaction testing must be the greater of:

a) 6 tests per 500 mm thickness of fill placed, and

b) 6 tests per 50 cubic metres.

3.9 Heavy earthmoving and compaction equipment (in excess of 2 t Gross Vehicle Mass) must be kept at least 1.5 m away from the back of the wall. Tracked machines or vehicles must not be operated on top of reinforcing elements until the elements are covered by at least 150 mm of fill material. Sheepsfoot rollers must not be used for compaction of fill material.

Tolerances

3.10 The finished wall must comply with the tolerances in Table ST-RE-C1 3-2.

Table ST-RE-C1 3-2 Tolerances

Property	Acceptance limits
Departure from plan position shown on the Drawings at base of wall	< ± 15 mm
Relative displacement of adjoining smooth panel faces measured normal to face of wall	< ± 15 mm
Local deviation of the wall face measured at any location with a 3 m straight edge	< 15 mm
Overall vertical tolerance of the exposed wall face	< 5 mm per metre of wall height
Reduced levels on the wall	< ± 20 mm
Variation in exposed gap width between panels	< 5 mm per metre length.

3.11 The Contractor must provide a Survey Certificate; vide PC-SI1 "Site Survey", demonstrating that the wall complies with the tolerances specified by this Part.

3.12 Provision of the Survey Certificate shall constitute a **Hold Point**.

4 Miscellaneous

4.1 Spoon drains must be provided at the top of the walls to collect drainage from adjacent batter slopes and must discharge to collection pits with outlets to the drainage system.

4.2 Vertical drops greater than 1.0 m created by construction of the wall must be protected by safety fences along the top of the wall. The fence must be 1.2 m high with a top and bottom rail of galvanized steel tube and faced with steel chain mesh unless otherwise specified on the Drawings.

5 Hold points

5.1 The following is a summary of Hold Points referenced in this Part:

Document Ref.	Hold point	Response time
2.17	Submitting conformity test results	2-3 weeks
3.7	Submission of fill material test results	1 day
3.12	Survey Certificate	5 Working Days

6 Test Procedures

6.1 The Contractor must use the following test procedures in Table ST-RE-C1 6-1 (refer to https://www.dpti.sa.gov.au/contractor_documents) to verify conformance with the Specification.

Table ST-RE-C1 6-1 Test procedures

Test procedure	Test
TP 061	Site Selection by Stratified Random Technique
TP 320	Dry Density Ratio
AS 1289	Ph, Resistivity, SO4 Content

7 Verification Requirements

7.1 The Contractor must supply written verification that the following requirements (see Table ST-RE-C1 7-1) have been complied with and supply the verification with the lot package.

Table ST-RE-C1 7-1 Verification requirements

Document Ref.	Subject	Property	Test procedure	Test frequency	Acceptance limits
2.2	Concrete properties	Refer Division ST-SC	Refer Division ST-SC	Refer Division ST-SC	Refer Division ST-SC
2.3	Steel Soil Reinforcing	Refer AS 3679 or AS 4671	Refer AS 3679 or AS 4671	Refer AS 3679 or AS 4671	Refer AS 3679 or AS 4671
2.13	Synthetic Soil Reinforcing	Refer British Board of Agreement Certificate	Refer British Board of Agreement Certificate	Refer British Board of Agreement Certificate	Refer British Board of Agreement Certificate
2.17	Select backfill	Gradings and Soil Constants	Refer RD-EW-C1 or ST-SP-C1	Refer RD-EW-C1 or ST-SP-C1	Refer RD-EW-C1 or ST-SP-C1
		Shear Strength & Coefficient of Friction	As specified by designer	As specified by designer	As specified by designer
2.17	Select backfill in contact with steel when structure is not subject to inundation	pH	AS 1289.4.3.1	1 test per 400 cubic metres	between 5 - 10
		Resistivity	AS 1289.4.4.1	1 test per 400 cubic metres	> 5 000 (ohm.cm). If in range 1 000 to 5 000, it will be accepted if SO4 is satisfactory
		SO4 content (only required if resistivity in range 1 000 to 5 000)	AS 1289.4.2.1	1 test per 400 cubic metres	< 1 000 (mg/kg)
2.17	Select backfill in contact with steel when structure is	pH	AS 1289.4.3.1	1 test per 400 cubic metres	between 5 – 10
		Resistivity	AS 1289.4.4.1	1 test per 400 cubic metres	> 3 000 (ohm.cm).

Document Ref.	Subject	Property	Test procedure	Test frequency	Acceptance limits
	subject to inundation	SO4 content	AS 1289.4.2.1	1 test per 500 cubic metres	< 500 (mg/kg)
3	Wall Construction	Backfill Compaction	TP 320	Refer Clause 3.8	Not less than 95%.
		Position of Levelling Pads	Survey Certificate in accordance with PC-SI1 " Site Surveys"	Refer PC-SI1	Refer Clause 3.1 AND 3.2 "Levelling Pads"
		Panel Position at completion of each row	Survey Certificate in accordance with PC-SI1 "Site Surveys"	Refer PC-SI1	Refer Table ST-RE-C1 3-2
		Panel Position at completion of wall	Survey Certificate in accordance with PC-SI1 "Site Surveys"	Refer PC-SI1	Refer Table ST-RE-C1 3-2