Master Specification
Part ST-RE-D1

Design of Reinforced Soil Structures

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Contents

ST-RE-D1 Design of Reinforced Soil Structures

1 General

a) This Master Specification Part sets out the requirements for the design of Reinforced Soil Structures, including:

   i) the documentation requirements set out in section 2;

   ii) the design requirements, as set out in section 3;

   iii) material requirements, as set out in section 4; and

   iv) monitoring requirements, as set out in section 5.

b) The design of Reinforced Soil Structures must comply with the Reference Documents, including:

   i) AS 1100 Technical drawing;

   ii) AS 1726 Geotechnical site investigations;

   iii) AS/NZS 3679 Structural steel;

   iv) AS/NZS 4671 Steel for the reinforcement of concrete;

   v) AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;

   vi) AS 5100 Bridge design; and

   vii) Department Structures Group Drafting Guidelines for Consultants (available from: https://dit.sa.gov.au/standards/standards_and_guidelines).

c) This Master Specification Part excludes the design of Soil Nail Structures which must comply with ST-RE-C2 “Soil Nailing”.

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include:

a) anti-graffiti measures and aesthetics in accordance with section 4.2a);

b) evidence that footings have been designed to accommodate the wall facing panels in accordance with section 4.2b);

c) evidence to verify that soil reinforcing is sufficiently strong, stiff, stable and durable and otherwise satisfies the performance and design requirements of this Master Specification Part, in accordance with section 4.3; and

d) lines, levels and dimensions for levelling pads.

2.2 Design Report

In addition to the requirements of PC-EDM1 “Design Management”, the Design Report must include:

a) a full set of design calculations, incorporating calculations and determinations for all elements of the Reinforced Soil Structures, including appropriate sketches and details;

b) evidence of suitability of the proposed soil reinforcing products;

c) the Contractor's methodology for preventing erosion and maintaining stability of existing Reinforced Soil Structures that are impacted by the Works, in accordance with the requirements of section 3.1i);

d) all calculations for foundation stability, which demonstrates how the design meets the requirements of section 3.3b);

e) the details of any ground improvement measures, including supporting design calculations, where proposed by the Contractor in accordance with section 3.5b); and

f) the proposed details of the inspection and monitoring regime requirements and proposed instrumentation, including mounting details, locations, and monitoring frequency, which demonstrates how the requirements of section 5 and ST-RE-C1 "Reinforced Soil Structures" will be achieved.

2.3 Design Drawings

In addition to the requirements of PC-EDM1 "Design Management", the Design Drawings must include:

a) material parameters, particle-size distribution, shear strength and coefficient of friction;

b) details of the design loadings transferred from bridge approaches, crash barriers and loads from signs and sign support structures to the Reinforced Soil Structures, calculated in accordance with the requirements of section 3.1;

c) details of all drainage provisions used to satisfy the requirements of section 3.1h); and

d) a level of detail such that no further production of drawings is required once the IFC Design Documentation has been completed, including any Shop Drawings, but excluding any changes to IFC Design Documentation in accordance with PC-EDM1 "Design Management".

3 Design requirements

3.1 Design criteria

a) The design of Reinforced Soil Structures must be based on all site-specific geotechnical investigations carried out in accordance with PC-SI2 "Site Investigations".

b) Unless otherwise nominated in the Contract Documents, assets forming part of the Reinforced Soil Structures must have a Design Life of at least 100 years.

c) The design of Reinforced Soil Structures must accommodate live loading from bridge approaches and crash barriers, and the vertical and lateral loads arising from the earthworks.

d) Reinforced Soil Structures must satisfy the stability requirements for earth retaining structures set out in AS 5100.3 Bridge design, Part 3: Foundation and soil-supporting structures.

e) The reinforced soil blocks must consist of compacted fill and appropriate reinforcing elements.

f) The Contractor must undertake geotechnical investigations (carried out in accordance with PC-SI2 "Site Investigations") to determine the allowable bearing pressures and settlements on the founding material under the reinforced soil block.

g) Surface and subsoil drainage must:

   i) be provided where necessary to intercept or divert groundwater and surface water to prevent scour, the development of hydrostatic pressure behind facing panels, and the saturation of any fill; and

   ii) be provided as separate systems.

h) Where water or sewer mains are present:

   i) measures to prevent saturation of the backfill in the event of a leaking main must be provided;

ii) subsoil drainage must be designed to prevent blockage from silt deposition; and

iii) the Contractor must clearly show all drainage provisions used to satisfy the requirements of this section 3.1h) on the relevant Design Drawings.

i) Where the Works impact existing Reinforced Soil Structures, the Contractor must ensure that the design prevents erosion and maintains stability of the existing structures (including while such existing structures are being modified). Details of the Contractor's proposed methodology for preventing such erosion and maintaining stability must be included in the Design Report.

j) For straight walls, the design of Reinforced Soil Structures must provide for a 40V:1H maximum slope on the vertical wall face.

k) If a protective barrier is required at the face of a Reinforced Soil Structure, the position of the Reinforced Soil Structure must be shifted to accommodate the minimum clearance between the edge of the lane and the barrier.

l) Spoon drains must be provided at the top of the Reinforced Soil Structure walls to collect drainage from adjacent batter slopes and which must discharge to collection pits with outlets to the drainage system.

m) Vertical drops greater than 1.0 m created by construction of the Reinforced Soil Structure wall must be protected by safety fences along the top of the Reinforced Soil Structure wall.

n) All safety fences required in accordance with section 3.1m) must be 1.2 m high with a top and bottom rail of galvanized steel tube and faced with steel chain mesh.

o) The internal stability design of Reinforced Soil Structures must be in accordance with TfNSW Specification D&C R57 Design of Reinforced Soil Walls.

3.2 Settlement

a) The Contractor must ensure that the wall panel design for Reinforced Soil Structures, including panel jointing, accommodates design differential movement between adjacent panels both during and post construction.

b) The Contractor must ensure that at least 80% of the expected settlement occurs prior to the construction of the adjacent road pavements and associated structures.

c) The Contractor must ensure that the settlement of Reinforced Soil Structures does not exceed 10 mm at any point in time following completion of the structural backfill.

3.3 Foundation stability

a) Reinforced Soil Structures must be designed and constructed in such a manner that, at any point in time, the design geotechnical strength of the foundation exceeds the ultimate applied loading, in accordance with AS 5100.3 Bridge Design, Part 3: Foundation and soil-supporting structures.

b) The Design Report must include all calculations for foundation stability, demonstrating that the design meets the requirements of section 3.3a).

3.4 Slope stability

a) Reinforced Soil Structures must comply with the slope stability requirements set out in RD-EW-D1 "Design of Earthworks for Roads".

b) In addition to the requirements of RD-EW-D1 "Design of Earthworks for Roads", in assessing the potential instability of slopes above and behind a Reinforced Soil Structure, slopes with a potential failure surface encompassing part, or all, of a Reinforced Soil Structure must be considered.

3.5 Ground improvement

a) The Contractor may use ground improvement measures, including staged construction, preloading, surcharging, rigid ground inclusions of the Reinforced Soil Structure, to meet the requirements of this Master Specification Part for settlement and stability.

b) Where the Contractor proposes to use ground improvement measures in accordance with section 3.5a), the Design Report must include details of the ground improvement measures, including supporting design calculations.

4 Materials

4.1 General

All materials used in Reinforced Soil Structures must comply with requirements of ST-RE-C1 “Reinforced Soil Structures” and any specific requirements of the proprietary systems adopted.

4.2 Wall facings

a) Anti-graffiti measures and aesthetics for Reinforced Soil Structure wall facing panels must be incorporated into the Design Documentation.

b) Footings must be designed to accommodate the Reinforced Soil Structure wall facing panels, with evidence provided as part of the Design Documentation.

4.3 Soil reinforcing

a) The Contractor must provide evidence as part of the relevant Design Documentation to verify that the soil reinforcing is sufficiently strong, stiff, stable, and durable to satisfy the performance and design requirements of this Master Specification Part.

b) The evidence to be provided pursuant to section 4.3a) must include a minimum of 10 years of data from laboratory and site applications in representative conditions.

5 Monitoring

The design must:

a) allow the Contractor to implement a monitoring program:

   i) to ensure that the performance criteria in section 3 are met; and

   ii) in accordance with ST-RE-C1 “Reinforced Soil Structures”; and

b) include a minimum of 2 monitoring points on Reinforced Soil Structures for walls up to 5 m in height. An additional monitoring point is required for each 5 m increase or part thereof in wall height. Spacing between monitoring points must not exceed 50 m and must include at least one monitoring point placed at the highest point of the Reinforced Soil Structure wall facing.