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Technical Note

TN 073 : 2014

Issued date: 05 September 2014
Effective date: 05 September 2014

Subject: Withdrawal of SPC 411 Earthwork Materials

This technical note is issued by the Asset Standards Authority as a notification to remove from use RailCorp document SPC 411 *Earthwork Materials,* version 2.1.

SPC 411 is a legacy document and shall be used for reference purposes only. ASA standard T HR CI 12111 SP *Earthwork Materials,* version 1.0 supersedes this document.

Authorisation

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Technical Note

TN 016: 2013

Issued date 19 December 2013
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Subject: Interpretation guide to SPC 411 version 2.1

SPC 411 Earthworks Materials version 2.1 issued on June 1 2012 shall be read in conjunction with the interpretations listed in Table 1:

Table 1 Interpretation to SPC 411

Location	Reference role or title	Applied interpretation	Comment
2.2	RailCorp	RailCorp	As published on the ASA website

The above interpretations have been issued to contextualise the contents of SPC 411 version 2.1 to the organisational context post July 1 2013.

Further generic interpretation guidance, which are published on the ASA website are provided in the documents listed in Table 2:

Table 2 Interpretation guides

Reference No	Title	Version	Issue date
TS 10762	Legacy RailCorp Standards Interpretation – Management Overview	1.0	28/06/2013
TS 10760	Guide to interpretation of organisational role and process references in RailCorp standards	1.0	17/06/13
TS 10760 – SMS	Interpretation guide RailCorp SMS references within RailCorp engineering standards	1.0	17/06/2013

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Engineering Specification
Civil

SPC 411

EARTHWORK MATERIALS

Version 2.1

Issued June 2012

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Engineering Specification

NSW Transport RailCorp

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Document control

Version	Date	Summary of change
2.1	June, 2012	Changes detailed in Summary table below
2.0	July, 2010	Change of format for front page, change history and table of contents; 1 - minor editing; 2 - additional standards included; 3.1.1 – minimum frequency of testing included; 3.1.2 – new section; 3.1.3 – additional requirements for durability and strength; 3.1.4 – new section; 3.2.1 – additional requirements for dispersivity, free swell index and collapse index; 3.2.2 – plasticity index added; 3.2.3 – new section; 3.2.4 – new section; 3.3.1, 3.3.2, 3.3.3 - minimum frequency of testing included; 4.2.1, 4.2.2, 4.2.3 - minimum frequency of testing included; 5 – new section; 6 – new section; 7.3 – additional test requirements specified; 7.4 - additional test requirements specified; 7.6 – new section; 7.7 – new section
1.1	November, 2009	All – change of format; minor editing and formatting
1.0	October, 2006	First issue as a RailCorp document. Replaces TS 3422

Summary of changes from previous version

Summary of change	Section
Reformat in new template	All
Delete reference ASTM D720; add reference ASTM D4546	2.1
Delete ASTM D720 and replace with ASTM D4546	7.3

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1 Scope and Application

This specification details the material properties and testing requirements for soil and other materials used to construct the embankment and the capping layer for track formation.

Embankment and capping materials used for RailCorp tracks shall comply with the requirements of this specification.

2 Applicable Standards

2.1 Australian and International Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1726	Geotechnical Site Investigations
AS 3706	Methods for Testing Geotextiles
AS 4133	Methods for Testing Rocks for Engineering purposes
ASTM D4542	Standard Test Method for Pore Water Extraction and Determination of the Soluble Salt Content of Soils by Refractometer
ASTM 4546	Standard Test Methods for One-Dimensional Swell or Collapse of Cohesive Soils
ASTM D4647	Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D5333	Standard Test Method for Measurement of Collapse Potential of Soils

2.2 RailCorp Standards

ESC 410 Earthworks & Formation

2.3 Other

Nil

3 Embankment Materials

3.1 Free draining filter material

The free draining filter material used for construction of drainage blankets shall be clean crushed rock, river gravel or slag composed of hard, strong and durable particles to satisfy the requirements of this specification.

3.1.1 Particle size distribution

Particle size distribution of the material for drainage blankets should be in accordance with the following table:

Description	Criteria	Frequency of Testing
% passing 53.0mm sieve	100	One per 50 cubic metres of material. At least one test if less.
% passing 37.5mm sieve	90 - 100	
% passing 26.5mm sieve	20-55	
% passing 19.0mm sieve	0-5	

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% passing 75μm sieve	0	

3.1.2 Maximum deleterious material

The maximum deleterious substances in the material used for drainage blanket shall be limited to the figures given in the following table:

Description	Criteria	Frequency of Testing
Soft and Friable Particles Clay Lumps	5% 0.5%	One per 50 cubic metres of material. At least one test if less.

3.1.3 Durability, Strength and Abrasion Resistance

The wet/dry strength variation of the material shall be of maximum 35% and the Los Angeles Value (Grading A), tested according to AS 1141, Section 23, shall not be more than 30%. The point load strength index $I_{(s)}$ (50) of the material shall be of minimum 1MPa.

3.2 General Fill

General fill shall consist of material that can be compacted to not less than 95% Maximum Dry Density as determined by AS 1289 Tests 5.1.1 and 5.3.1.

Relative compaction specified must be achieved over the full depth of layer. Each compacted layer shall have a uniform thickness as recommended in the specifications. The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material in any lot is homogeneous. The material must be free of tree stumps, roots and refuse.

3.2.1 Unsuitable material

Unsuitable material shall not be used in construction of general fill.

Unsuitable material includes topsoil, peat and other highly organic soils, logs, stumps, material susceptible to spontaneous combustion, soluble material such as gypsum and salt rock, expansive soils, free draining materials susceptible to scouring, very fine sand, non-cohesive silt, organic clay and highly dispersive soils.

Dispersivity potential of soil shall be determined by either using a Pinhole Test apparatus, according to *ASTM* D 4647 (*Standard Test* Method for Identification and Classification of Dispersive Clay Soils by the *Pinhole Test) or Crumb Test in accordance with AS 1289, Test 3.8.1.* In using the Pinhole Test, any material classified other than ND1 or ND2 (non dispersive) will be considered as unsuitable. In using Crumb Test, soils classified as Emerson Class number 1, are considered as unsuitable.

Materials with a free swell index higher than 3%, soluble substances more than 3% and organic content more than 5% by weight of dry material are all considered as unsuitable and shall not be used for construction of embankment.

Collapsible soils in foundation are also considered as unsuitable material and shall be treated before construction of embankment. Collapse index is determined according to ASTM D5333 - 03 (Standard Test Method for Measurement of Collapse Potential of Soils).

3.2.2 Plasticity Index and Soaked CBR

The general fill material shall have a minimum plasticity index of 9 and a soaked CBR of at least 3%.

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3.2.3 Frequency of testing

All recommended tests, including Atterberg Limits, Soaked CBR, Dispersivity Potential, Free Swell Index and Soluble Content shall be carried out as one test per 1000 cubic metres of the material. If the volume of the material to be used is less, at least one set of test shall be carried out.

3.2.4 Specifications of subgrade material

All specifications and limitations provided for fill material, would apply to the subgrade as well.

3.3 Structural Zone Fill Material

The structural zone fill material shall have higher quality and comply with the specification requirements in this section.

3.3.1 Particle size distribution

The particle size distribution and minimum testing frequency of material for structural zone shall be in accordance with the following table:

Description	Criteria	Frequency of Testing
% passing 53.0mm sieve	80 - 100	One per 1000 cubic metres of material. At least one test if less
% passing 2.36mm sieve	15 - 100	
% passing 425μm sieve	5 - 70	
% passing 75μm sieve	0 - 30	

3.3.2 Atterberg Limits

The Atterberg Limits and minimum testing frequency of material for structural zone shall be in accordance with the following table:

Description	Criteria	Frequency of Testing
Liquid Limit	Maximum 40	Three per 1000 cubic metres of material. At least three tests if less.
Plasticity Index	Maximum 20	

3.3.3 Dry Density and Soaked CBR

The Maximum Dry Density, minimum Soaked CBR, and minimum testing frequency of material for structural zone shall be in accordance with the following table:

Description	Criteria	Frequency of Testing
Maximum Dry Density	Min.18kN/m^3	Three per 1000 cubic metres of material. At least three tests if less.
Minimum Soaked CBR (Standard Compaction)	Min. 8%	

4 Capping Material

4.1 Performance requirements

Material proposed for the capping layer shall be a well graded natural or artificially blended gravel/soil.

It shall have sufficient fines to permit it to be compacted to high densities by static or vibratory steel-tyred rollers or by ballasted pneumatic-tyred rollers.

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Finished capping material shall provide a semi-impermeable layer to the underlying formation.

Materials such as natural ridge gravel free from vegetable matter, ripped sandstones with low clay content and crushed and blended tough, durable rock or slag, have been found to meet the material properties of this specification.

4.2 Material properties

Natural gravels may be combined to provide material that conforms to this specification. Crushed rock shall include such added material as necessary for the combined material to satisfy the requirements of this specification.

The material shall have properties that conform to the following requirements.

4.2.1 Particle size distribution

Material shall be well graded with maximum nominal size of 20mm, and with typical particle size distribution as follows:

AS Sieve Size	Percentage Passing	Frequency of Testing
53mm	100	Three per 500 cubic metres of material. At least three tests if less.
37.5mm	100	
26.5mm	100	
19.0mm	95-100	
9.5mm	-	
4.75mm	-	
2.36mm	30-80	
0.075mm	6-10	

4.2.2 Atterberg Limits

Material for the capping layer shall comply with the following Atterberg Limits:

Description	Criteria	Frequency of Testing
Liquid Limit	Maximum 30 (35 for arid areas)	Three per 500 cubic metres of material. At least three tests if less.
Plastic Limit	Maximum 20	
Plasticity Index	4 to 15	
Linear Shrinkage	Maximum 4.5%	

4.2.3 Dry Density and Soaked CBR

The maximum Dry Density and minimum Soaked CBR of the material for the capping layer shall be in accordance with the following table:

Description	Criteria	Frequency of Testing
Maximum Dry Density	Minimum 20kN/m^3	Three per 1000 cubic metres of material. At least three tests if less.
Soaked CBR (95% Standard compaction with 9kg surcharge)	Minimum 50%	

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5 Rockfill Material

Rockfill material shall be made of strong, hard, durable, and clean pieces of sound rock, having the following requirements:

- Point Load Strength Index (I_{s50}) greater than 1 MPa
- Maximum Wet/Dry Strength variation of 35%
- Minimum dimensions are determined based on the application. A minimum dimension of 500 mm is required for rock facing. Smaller dimensions may be permitted for gabions and rock fills.

6 Geotextile and Geogrid

These materials may be used as separation, strengthening or filtration elements in earthworks. The most appropriate uses of geosynthetics in track formation are:

- Filtration and separation.
- Subgrade support.

6.1 General characteristics of geotextiles

The fibres of geotextile and thread used joining lengths shall consist of long chain synthetic polymers composed of at least 95% by mass of polyolefins or polyesters. The geotextile filaments must be rot proof, chemically stable and shall have low water absorbency. Filaments must resist delamination and maintain their relative dimensional stability in the geotextile.

Non-Woven geotextiles must have filaments bonded by needle punching, heat or chemical bonding process. Woven geotextiles must have filaments interlaced in two sets, mutually at right angles. One set must be parallel to the longitudinal direction of the geotextile.

Geotextiles shall be free of any flaws which may have an adverse effect on their physical and mechanical properties. Geotextiles must be stabilised against ultraviolet radiation such that when tested in accordance with AS 3706.11, shall have retained strength of at least 50% after 627 hours of test exposure.

6.2 General characteristics of geogrids

A geogrid is specifically designed to provide tensile reinforcement to the track substructure. Geogrids are superior to geotextiles in this function because of their higher modulus and tensile strength and their performance is not destroyed by coarse aggregate.

The geogrid selection should be on the basis of the grading of the material in contact with it. The grid opening size is related to the maximum size of the aggregate with which it interlocks.

The recommended minimum strength is 20 kN/m transverse and 20 kN/m longitudinal to the track. The interlocking with aggregates is important. A geogrid with a square web profile and high rigidity will perform well in interlocking with aggregate.

7 Validation Requirements

7.1 Sampling

Samples of materials for laboratory testing shall be taken and handled in accordance with AS 1726, and AS 1141, Section 3.

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Samples of material proposed for use shall be tested and the results considered in the final selection of material.

7.2 Test requirements for free draining filter material

The following tests shall be carried out on the free draining filter material to confirm compliance with the specified performance requirements:

Particle size distribution	AS 1289 Test 3.6.1
Soft and friable particles	AS1141. 32
Clay lumps	AS1141.30
Los Angeles Value	AS1141. 23
Particle density	AS1141.6

7.3 Test requirements for general fill material

The following test shall be carried out on the general fill material to confirm compliance with the specified performance requirements:

Soaked CBR (Standard compaction)	AS 1289 Test 6.1.1
Dispersion – Determination of Pin Hole Dispersivity Classification	ASTM D4647
Dispersion – Determination of Emerson Class Number of a soil	AS 1289 Test 3.8.1
Collapse Test	ASTM D5333 – 03
Free Swell Index	ASTM D4546 - 08
Soil Soluble Contents	ASTM D4542-95(2001)

7.4 Test requirements for structural zone fill material

The following tests shall be carried out on the structural zone fill material to confirm compliance with the specified performance requirements:

Particle Size Distribution	AS 1289 Test 3.6.1
Liquid Limit	AS 1289 Test 3.1.1
Plastic Limit	AS 1289 Test 3.2.1
Plasticity Index	AS 1289 Test 3.3.1
Maximum Dry Density	AS 1289 Test 5.1.1
Soaked CBR (Standard compaction)	AS 1289 Test 6.1.1

7.5 Test requirements for capping material

The following tests shall be carried out on the capping material to confirm compliance with the specified performance requirements:

Particle Size Distribution	AS 1289 Test 3.6.1 (Wet Sieve Procedure)
Liquid Limit	AS.1289 Test 3.1.1 or

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	AS 1289 Test 3.9
Plastic Limit	AS.1289 Test 3.2.1
Plasticity Index	AS.1289 Test 3.3.1 AS.1289 Test 3.3.2
Linear Shrinkage	AS.1289 Test 3.4.1
Maximum Dry Density	AS 1289 Test 5.2.1
Soaked CBR	AS 1289 Test 6.1.1* *Compacted to 95% (min) Maximum Dry Density obtained by AS 1289 5.2.1 & with 9kg surcharge.

7.6 Test requirements for rockfill materials

The following tests shall be carried out on the rock material to confirm compliance with the specified performance requirement:

Point Load Strength Index	AS 4133.4.1-2007
Wet/Dry Strength Variation	AS 4133.4.2

7.7 Test requirements for geotextiles and geogrids

The following tests shall be carried out on geotextiles and geogrids to confirm compliance with the specified performance requirements:

Elongation at Peak Strength	AS 3706.2
Tensile Strength, Wide Strip	AS 3706.2
Burst Strength, CBR Method	AS 3706.4
Puncture Resistance, Drop Cone	AS 3706.5
Pore Size Determination	AS 3706.7
Determination of Permittivity (ψ)	AS 3706.9