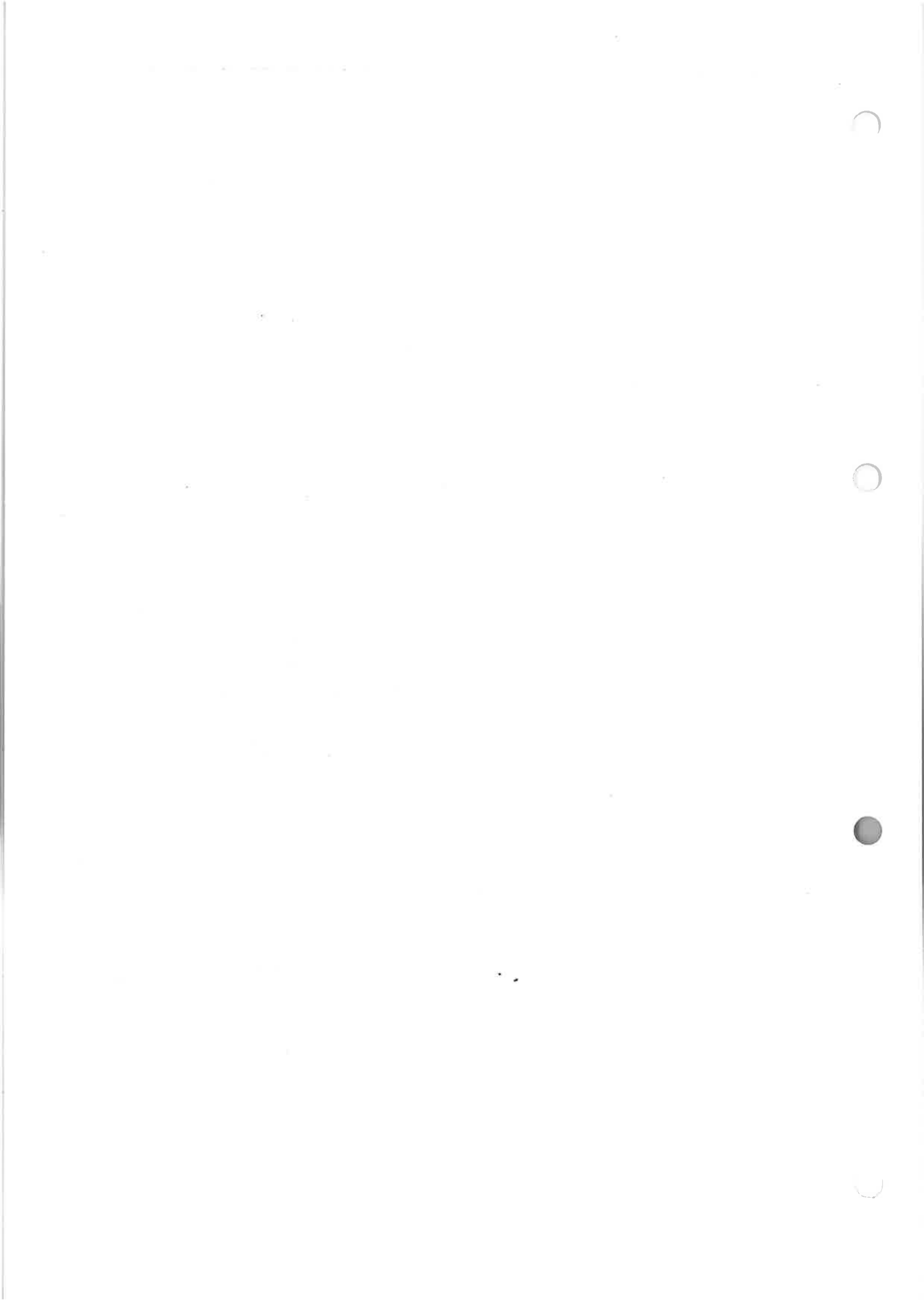


DEVELOPMENT
CONSTRUCTION
SPECIFICATION

C213

EARTHWORKS



SPECIFICATION C213 - EARTHWORKS

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SPECIFICATION C213 : EARTHWORKS

GENERAL

C213.01 SCOPE

1. The work to be executed under this Specification consists of:- **Scope**
- (a) Removal of topsoil
 - (b) All activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the Drawings and Specification.
 - (c) Removal and replacement of any unsuitable material,
 - (d) Any spoil or borrow activities associated with earthworks, and
 - (e) Any additional processing of selected material for the selected material zone.

C213.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents
Standards Test
Methods**
- (a) **Council Specifications**
- C201 - Control of Traffic
 - C211 - Control of Erosion and Sedimentation
 - C212 - Clearing and Grubbing
 - C220 - Stormwater Drainage - General
 - C273 - Landscaping
- (b) **Australian Standards**
- AS 1289.F1.1 - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
 - AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
 - AS 1289.5.1.1 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
 - AS 1289.5.7.1 - Compaction Control Test (Rapid Method).
 - AS 2187 Explosives - Storage, transport and use (SAA Explosive Code)
 - Part 1 Storage and land transport
 - Part 2 Use of explosives
- (c) **RTA Test Methods**
- T166 - Determination of Relative Compaction.
- (d) **Other**
- AUSTROADS - Explosives in Roadworks, Users Guide 1982.
 - EPA - Environmental Noise Control Manual
 - Resource NSW - Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage June 2003.

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C213.03 NATURAL SURFACE AND EARTHWORKS MATERIALS

(a) Earthworks Materials

1. The Developer shall be responsible for any assumptions made by their Contractor(s) in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

Material Characteristics

C213.04 PROTECTION OF EARTHWORKS

1. The Developer's responsibility for care of the Works shall include the protection of earthworks.

Developer's Responsibility

2. The Developer shall install effective erosion and sedimentation control measures in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION, prior to commencing earthworks, and shall maintain these control measures for the duration of the contract and defects liability or maintenance period.

Erosion and Sedimentation Control

3. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

Drainage of Working Areas

4. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off with a smooth roller.

Wet Weather Precautions

5. Should insitu or stockpiled material become over wet as a result of not providing adequate protection of earthworks, the material shall not be incorporated into the works until it is dried out.

Wet Material

C213.05 STOCKPILE SITES

1. The Developer shall obtain the written consent of the Council's Development Engineer to the use of any stockpile site that is not shown on the Drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile and identify all erosion and sediment controls to be implemented and maintained for this work.

Additional Stockpile Sites

2. Any clearing and grubbing required for these sites shall be carried out in accordance with Specification C212 - CLEARING AND GRUBBING. Temporary erosion and sedimentation control measures shall be taken in accordance with Specification C211 - CONTROL OF EROSION AND SEDIMENTATION.

Clearing and Grubbing

3. Restoration of stockpile sites following completion of the work shall be carried out in accordance with Specification C273 - LANDSCAPING.

Restoration

REMOVAL OF TOPSOIL

C213.06 SCOPE

1. Topsoil is surface soil, which is reasonably free from subsoil, refuse, clay lumps and stones.

Definition

2. No topsoil is to be removed from the site unless approved in writing by Council's Development Engineer.

Topsoil Removal Prohibited

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3. Removal of topsoil on any section of the Works shall only commence after erosion and sedimentation controls have been implemented and after clearing, grubbing and disposal of materials have been completed on that section of the Works. Topsoil throughout the length of the work shall be removed and stockpiled separately clear of the work.

Prerequisites

4. The work shall include the following:-

Extent of Work

(a) Cuttings

Removal of the topsoil to a depth quoted in Annexure C213A or as directed by the Council's Development Engineer.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in Annexure C213A, or as directed by the Council's Development Engineer. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in Annexure C213A shall be removed to its full depth as directed by the Council's Development Engineer.

(c) Other Locations

Removal of topsoil as directed by the Council's Development Engineer.

C213.07 TOPSOIL STOCKPILES

1. The maximum height of stockpiles shall not exceed 2.5 m and the maximum batter slope shall not exceed 2:1.

Height and Batter

2. Topsoil stockpiles shall not contain any timber, stones, clay lumps or other rubbish.

Stockpiles to be Clean

3. To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Council's Development Engineer as soon as practically possible.

Erosion Control

4. Where seeding of stockpiles to encourage vegetation cover is undertaken, such work shall be carried out in accordance with Specification C273 - LANDSCAPING.

Seeding Stockpile

CUTTINGS

C213.8 SCOPE

1. Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

Extent of Work

C213.9 EXCAVATION

1. Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Developer's attention is drawn to Clauses C213.23, C213.26, C213.28, C213.29, C213.30 and C213.31.

2. Cuttings shall have batter slopes as shown on the Drawings or as redetermined by the Council's Development Engineer on the basis of site inspection and investigation during the excavation.

Batter Slopes

3. The tops of all cuttings shall be neatly "rounded" so as the area may be maintained and to inhibit erosion and scouring.

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| <p>4. In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters will generally require progressive flattening at the ends of cuttings due to the presence of less stable material.</p> | <p>Batters to be Even</p> |
| <p>5. Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds.</p> | <p>Unstable Material</p> |
| <p>6. Where, after the removal of Topsoil as specified in Clause C213.07, material of variable quality or moisture content is encountered, the Developer shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of Clause C213.23.</p> | <p>Blending Material</p> |
| <p>7. Where the Council's Development Engineer redetermines the batter slope of any section of a cutting after it has been completed in accordance with this Clause, the Developer shall have no claim upon the Council or its agents as a result of the redetermination of the batter slope.</p> | <p>Variation for Batter Slopes</p> |

C213.10 BATTER TOLERANCES

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| <p>1. The tolerances for the excavation of batters, measured at right angles to the design grade line, shall be $\pm 300\text{mm}$.</p> | <p>Batter Tolerances</p> |
|--|---------------------------------|

C213.11 BENCHING IN CUTTINGS

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|---|----------------------------------|
| <p>1. Cut batters shall be benched as shown on the Drawings to provide drainage and erosion control on cut batters. Notwithstanding the tolerances permitted under Clause C213.12, bench widths shall not be less than those shown on the Drawings.</p> | <p>Bench Construction</p> |
| <p>2. Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Development.</p> | <p>Bench Maintenance</p> |

C213.12 TRANSITION FROM CUT TO FILL

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| <p>1. Following excavation to the cutting floor, a terrace shall be excavated for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 600mm below and parallel to the cutting floor, as shown in Figure C213.1.</p> | <p>Terrace Construction</p> |
| <p>2. The terrace shall extend into the cut to the point where the cutting floor is 600mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.</p> | <p>Extent of Terrace</p> |

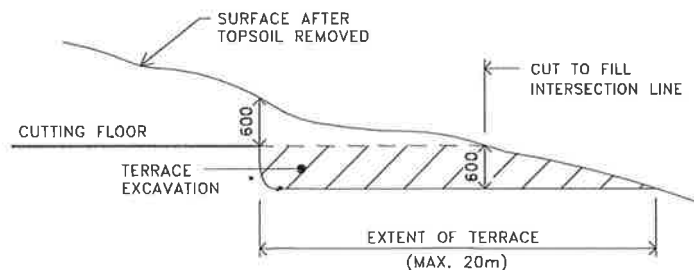


Figure C213.1 - Transition from Cut to Fill

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| <p>3. The material placed above the terrace shall satisfy the requirements of Clause C213.20 and shall be compacted in accordance with Clause C213.32.</p> | <p>Quality and Compaction</p> |
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BLASTING

C213.13 GENERAL

1. Blasting is not permitted within areas zoned for urban development (residential, commercial or industrial) where any dwelling is within one kilometre of the proposed site of blasting. When explosives are permitted to be used, the Developer shall obtain all necessary licences from the appropriate authorities, and shall comply with all Government regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187, Parts 1 and 2. The requirements of the Environment Protection Authority (EPA) shall be complied with. Copies of all permits and consents shall be made available to Council's Development Engineer on request.

Prohibited Locations

Contractor to Obtain Licences

2. The Developer shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Contractor's Responsibility

3. A minimum of seven (7) days prior to each blasting operation, the Contractor shall submit to the Council's Development Engineer written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and vibration. Monitoring details shall also be provided.

Proposed Blasting Procedure

4. Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table C213.1:

Ground Vibration

Point of Potential Damage (within 1km of blasting site)	Peak Particle Velocity
Completed and cured bridge structures or sub-structures (eg completed abutment)	25 mm/sec
Bridgeworks and structural retaining walls under construction.	20 mm/sec
Residential premises, schools, hospitals and other buildings	5 mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance	2 mm/sec

Table C213.1 - Limiting Peak Particle Velocity

5. Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.

Time Limits

6. When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with Specification C201 - CONTROL OF TRAFFIC. A standard warning procedure such as that given in the AUSTRoads Explosives in Roadworks, Users Guide 1982 shall be established and observed at all times.

Safety Precautions

C213.14 PRESPLITTING

1. Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre.

Presplitting

C213.15 BLASTING RECORDS

1. The Developer shall maintain accurate records of each blast showing the details listed below: -

Records to be Kept

Date and time of blast

Location, number and diameter of holes loaded

Depth of each hole loaded

Inclination of holes

Maximum and minimum burden

Types of explosives used

Charge distribution in each hole

Maximum instantaneous charge

Delay periods and sequence

Total amount of charges in the blast

Length and type of stemming in each hole

Name of Powderman & registered Business Name of his employer

2. The records shall be prepared as holes are loaded and signed by the Powderman. A copy shall be provided to the Council's Development Engineer on the day of the blast.

Record Preparation

C213.16 CONTROL OF AIR BLAST OVER-PRESSURE

1. This Clause shall apply only where a noise sensitive location exists within 1km of the blasting site.

Incidence

2. The Developer's attention is drawn to the recommendations given in the EPA Noise Control Manual for the reduction of air blast over-pressure.

Noise Control Manual

3. The noise emanating from blasting operations shall not exceed an over-pressure level of 115 decibels (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time.

Noise Limitations

4. The Developer shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. Personnel possessing current NATA registration for such monitoring shall carry out all monitoring. All test results shall be reported on NATA endorsed test certificates, which shall include a clear statement as to compliance or non-compliance with the requirements of this Specification. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Council's Development Engineer.

Monitoring of Air Blast Over-Pressure

5. In the event that the measured air blast over-pressure exceeds the specified limits, all further blasting work shall be suspended until details of proposed additional steps to be taken to eliminate future exceedences are submitted to the Council's Development Engineer. Blasting shall not resume until such proposals have been submitted.

Excessive Air Blast Over-Pressure

C213.17 CONTROL OF GROUND VIBRATION

1. The Developer shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table C213.1. Personnel possessing current NATA registration for such monitoring shall carry out all monitoring. All test results shall be reported on NATA endorsed test certificates, which shall include a clear statement as to compliance or non-compliance with the requirements of this Part of the Specification. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. A copy of the monitoring record is to be submitted to the Council's Development Engineer.

Monitoring Vibrations

2. To minimise the risk of peak particle velocity limits being exceeded, the Developer shall develop a blasting site relationship between peak particle velocity, distance and blasting charge as set out below.

Blasting Site Relationship

3. For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

Maximum Instantaneous Charge

$$MIC = 0.5 \left[\frac{D}{\left[\frac{p.p.v.}{1140} \right]^{-0.625}} \right]^2$$

- where MIC = Maximum Instantaneous Charge in kilograms
- D = Distance in metres from charge to the point of potential damage
- PPV = limiting peak particle velocity from Table C213.1

4. A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

5. For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Developer shall make the regression line plots available to the Council's Development Engineer, if so requested.

Adjustment of Blast Design

UNSUITABLE MATERIAL

C213.18 GENERAL

1. Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Council's Development Engineer deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings, which the Council's Development Engineer deems to be unsuitable for embankment construction.

Definition

2. Such material shall be excavated to the extent directed by the Council's

Extent of

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Development Engineer. Material removed as unsuitable shall, as directed by the Council's Development Engineer, be incorporated in embankments in accordance with Clause C213.20.

Excavation

3. After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Council's Development Engineer for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with Clause C213.32.

***Floor
Inspection***

4. The unsuitable material, which has been removed, shall be replaced with material from cuttings, or with material borrowed in accordance with Clause C213.31, of the quality specified in Clause C213.20. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with Clause C213.23 and compacted in accordance with Clause C213.32.

***Replacement
Material***

EMBANKMENT CONSTRUCTION

C213.19 SCOPE

1. Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with Clause C213.18, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified and to the alignment, grading and dimensions shown on the Drawings. It also includes any pretreatment such as breaking down or blending material or drying out material containing excess moisture.

Extent of Work

C213.20 EMBANKMENT MATERIAL

1. Material for embankment construction shall be obtained from the cuttings within the Works, supplemented by borrow in accordance with Clause C213.31 if necessary. The material may be imported to the site. The material shall be free of tree stumps and roots and shall be capable of being compacted in accordance with Clause C213.32.

***Location and
Quality***

2. The work shall be programmed so that material of the quality specified in Clause C213.23 and C213.27 for the upper zones of the formation is available when required.

***Selection of
Material***

C213.21 FOUNDATIONS FOR EMBANKMENTS

1. Following removal of topsoil in accordance with Clause C213.06, the embankment foundation area shall be made available for inspection by the Council's Development Engineer.

Inspection

2. Where the Council's Development Engineer considers that any underlying material is unsuitable, he may direct that it be removed and replaced in accordance with Clause C213.18.

***Unsuitable
Material***

a) Foundations for Shallow Embankments

***Shallow
Embankments***

1. Shallow embankments are those embankments of a depth less than 1.0 metre from the top of pavement to natural surface. After removal of topsoil, the area of shallow embankments shall be calculated.

2. Material in the foundations for shallow embankments that does not meet the requirements specified in Annexure C213A shall be deemed unsuitable in accordance with Clause C213.18 and shall be replaced by material of the specified quality.

***Unsuitable
Material***

3. Foundations for shallow embankments shall be prepared for embankment

Preparation of

EARTHWORKS

construction after removing topsoil and unsuitable, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in Clause C213.32. Equipment and techniques to minimise surface heaving or other foundation damage shall be used.

Foundations

b) Other Embankments

1. For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in Clause C213.32.

Preparation

2. Where a bridging layer has been specified as a foundation treatment in the Contract documents, it shall be supplied and placed as part of General Earthworks. The bridging layer shall consist of free-draining granular material, which shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of Clause C213.32 shall not apply to the bridging layer

Bridging Layer

3. A bridging layer may also be employed, subject to the approval of the Council's Development Engineer, where ground water or seepage is encountered in the foundation area or where it is demonstrated that it is impracticable to achieve the degree of compaction specified for the foundation in Clause C213.32. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design.

Seepage from Foundations

C213.22 HILLSIDE EMBANKMENTS

1. Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1 metre in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

Horizontal Terraces

C213.23 PLACING FILL FOR EMBANKMENT CONSTRUCTION

1. The fill material for embankment construction shall be obtained from the cuttings within the work in accordance with Clause C213.09, supplemented by borrow when authorised by the Council's Development Engineer in accordance with Clause C213.31.

Source of Material

2. The methods of excavation transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.

Uniformity of Material

3. The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of Clause C213.32.

Embankment Stability

4. Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with Clause C213.32. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25 per cent by volume of the filling consists of rock with any dimension larger than 150mm, the Council's Development Engineer may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in Clause C213.32 is attained.

Layer Thickness

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| <p>5. The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.</p> | <p>Maximum Size
Rock Pieces</p> |
| <p>6. Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Council's Development Engineer considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.</p> | <p>Grading of Fill
Material</p> |
| <p>7. Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer.</p> | <p>Reworking
Stony Patches</p> |
| <p>8. In placing embankment layers, equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers shall be used.</p> | <p>Equipment
Selection for
Placement</p> |
| <p>9. After compaction, embankment material in the zone(s) below the selected material zone (or sub-base layer, where no selected material zone) shall have a CBR value not less than that quoted in Annexure C213A for the depth(s) specified in Annexure C213A.</p> | <p>CBR Value</p> |
| <p>10. For the purpose of this Clause, the CBR value of the material shall be determined by Test Method AS 1289.F1.1.</p> | <p>Test Methods</p> |
| <p>11. The Developer shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements.</p> | <p>Contractor's
Responsibility</p> |

C213.24 EMBANKMENT BATTERS

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| <p>1. The batter slopes shown on the Drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Council's Development Engineer according to the Council's Development Engineer's assessment of the materials encountered.</p> | <p>Batter Slopes</p> |
| <p>2. When completed, the average planes of the batters of embankments shall conform to those shown on the Drawings or as determined by the Council's Development Engineer. No point on the completed batter shall vary from the specified slope line by more than $\pm 300\text{mm}$ when measured at right angles to the grade line. However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the Drawings.</p> | <p>Slope
Tolerances</p> |
| <p>3. Undulations in the general plane of the batter shall not be permitted.</p> | <p>Slope
Undulations</p> |

C213.25 ROCK FACING-OF EMBANKMENTS

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| <p>1. Where shown on the Drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.</p> | <p>Extent</p> |
| <p>2. The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced.</p> | <p>Mechanical
Interlock</p> |
| <p>3. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overflow the voids between larger rocks, or cause the larger rocks to lose</p> | <p>Graded Filter</p> |

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contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter.

4. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage and /or large rock dislodgment down the batter

Caution in Placement

C213.26 TRIMMING TOPS OF EMBANKMENTS

1. The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

Levels

2. The tops of embankments at these levels shall be compacted to meet the requirements of Clause C213.32 and trimmed so that they do not vary more than 0 mm above or 50 mm below the levels as calculated above.

Tolerances

C213.27 SELECTED MATERIAL ZONE

1. A selected material zone shall be provided as indicated on the Drawings and in accordance with the following quality requirements:

Dimension and Quality

- (a) It shall be free from stone larger than 100mm maximum dimension
- (b) The fraction passing a 19.0mm AS sieve shall have a CBR value of not less than that quoted in Annexure C213A.

2. The selected material shall be obtained from cuttings excavated or from borrow areas as specified in Clause C213.31. If necessary, the Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this Clause.

Winning Material

3. Any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled, until at least sufficient material is reserved to complete the selected material zone over the whole work.

Selection of Material

4. The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. Compaction shall be as specified in Clause C213.32.

Layer Thickness

5. After placement the selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material, which does not comply with the specified requirements of this Clause.

Homogeneous Layers

6. The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in Annexure C213A.

Tolerances

C213.28 FILL ADJACENT TO STRUCTURES

1. For the purpose of this Clause, structures shall include bridges, precast and cast-in-place box culverts and retaining walls. Fill adjacent to other culverts and drainage structures shall be provided in accordance with the particular Specifications for STORMWATER DRAINAGE as appropriate.

Structure Types

2. No filling shall be placed against structures within 21 days after placing concrete in these structures, unless approved in writing by the Council's Development Engineer.

C213.29 TREATMENT AT WEEPHOLES

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

Grading

- (a) The maximum particle dimension shall not exceed 50mm
- (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.

2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.

Extent

3. Alternatively the use of a synthetic membrane of equivalent drainage characteristics may be used. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Council's Development Engineer's approval.

Synthetic Membrane

C213.30 SELECTED BACKFILL

1. Selected backfill shall be placed adjacent to structures in accordance with Table C213.2. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS 1289.3.3.1, neither less than 2 nor more than 12. Material conforming to Class S Select Fill Material in accordance with the Resource NSW Specification may also be used.

Quality

Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-place Box Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining walls	H/3	H
(Where H = height of structure)		

Table C213.2 - Selected Backfill, Width and Height

2. The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of Clause C213.32.

Placement in Layers

3. The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 metre in width, and the selected backfill shall be placed in accordance with Clause C213.23.

Horizontal Terraces

4. No filling shall be placed against structures within twenty-one days after placing concrete in these structures, unless approved by the Council's Development Engineer.

Time of Placement

5. Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within twenty-one days after placing concrete in the bridge

Adjacent to Concrete Deck

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deck, unless approved by the Council's Development Engineer.

6. In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by hand placing around or against such structures.

**Spill through
Abutments**

7. In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm.

**Framed
Structures**

C213.31 BORROW

1. Where borrow material is required to complete the Works, the location of borrow sites shall be as approved by the Council's Development Engineer, and the quality of material shall be acceptable to the Council's Development Engineer in accordance with Clauses C213.20, C213.25 or C213.28 as appropriate. The edges of borrow sites shall be no closer than 3 metres from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Council's Development Engineer, cut batter slopes not steeper than 4 to 1, and shall be left by the Contractor in a tidy and safe condition.

**Borrow Site
Characteristics**

2. For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with Specification C212 - CLEARING AND GRUBBING and Clause C213.06. Restoration of borrow sites shall be carried out in accordance with Specification C273 - LANDSCAPING.

**Site
Preparation
and
Restoration**

3. If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses C213.09 & C213.10 as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

**Widening of
Cutting**

4. If borrow has to be obtained from locations outside the specified working area for the Works, such work shall be treated as imported fill. The Developer shall be responsible for obtaining any permits required for removal of the imported material from its origin. The Developer shall also comply with any requirements of the Environmental Planning and Assessment Act, the Local Council, land owners, the Rural Lands Protection Board and the NSW Soil Conservation Service, as appropriate.

Imported Fill

COMPACTION AND QUALITY CONTROL

C213.32 COMPACTION AND MOISTURE REQUIREMENTS

1. In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

**Trimming and
Compaction**

2. The following areas shall be compacted to provide a relative compaction, determined by AS 1289.5.7.1 for standard compactive effort, of not less than 95 per cent.

**95%
Compaction
Requirements**

- Each layer of material replacing unsuitable material as detailed in Clause C213.18.
- Each layer of material placed in embankments, up to 0.5 metres from the top of the pavement.
- The whole area on the floors of cuttings.
- Fill placed adjacent to structures up to 1.0 metre from the top of pavement.
- Material in unsealed verges and within medians up to the level at which

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topsoil is placed.

- Spoil (excluding unsuitable material)
- All other areas except those where other compaction requirements are specified.

3. Unsuitable material shall be stockpiled and compacted by track rolling.

**Unsuitable
Material**

4. The following areas shall be compacted to provide a relative compaction of not less than 98 per cent as determined by AS 1289.5.7.1 for standard compactive effort:

**98%
Compaction
Requirements**

- Foundations for shallow embankments.
- Foundations other than shallow embankments.
- Each layer of the embankment within 0.5 metres from the top of pavement.
- Each layer of the selected material zone as specified in Clause C213.27.
- Any areas of material of specified quality, which may be shown on the Drawings, specified elsewhere behind kerbs and/or gutters, or adjacent to rigid pavements.
- The fill material placed adjacent to structures as specified in Clauses C213.28 and C213.30 in each layer within 1.0 metre from the top of the pavement.

5. At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Council's Development Engineer, is within the range set out in Annexure C213A of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1. Material that becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Council's Development Engineer, by the use of hydrated or quick lime. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained.

**Moisture
Content**

6. Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

**Prompt
Compaction**

7. Any material that has been placed that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS 1289.5.7.1, shall be dried out and uniformly re-compacted to the required relative compaction in accordance with this Clause before the next layer of material is placed.

**Moisture
Content above
Optimum**

C213.33 TEST LOCATIONS

1. The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the area shall be worked to ensure uniform moisture content and compaction of all material within the lot.

**Contractor to
Prepare Area**

2. The tests then taken shall be considered to represent the total volume of material placed within the lot.

**Test
Representation**

3. Where the Council's Development Engineer considers that the material that is present has not achieved uniformity required by this Clause or Clause C213.23, he may direct further testing. The Council's Development Engineer shall nominate the area represented by the additional testing.

Further Testing

C213.34 DEFLECTION MONITORING OR PROOF ROLLING

1. Following completion of the formation to the underside of the selected material zone in accordance with Clause C213.21 and C213.23, and completion of the selected material zone in accordance with Clause C213.27, the work shall be made available in lots, for the Council's Development Engineer to carry out deflection monitoring or proof rolling. This action constitutes a **HOLD POINT**. The Council Development Engineer's approval to the completed formation following deflection monitoring or proof rolling is required prior to release of the hold point.

**Timing of
Deflection
Monitoring**

HP

2. A lot for deflection testing shall consist of a continuous length of formation, and a single carriageway width, which is generally homogeneous with respect to material and appearance. The boundaries of each lot shall be clearly identified with stakes clearly labelled to the satisfaction of the Council's Development Engineer.

Lot Size

C213.35 WIDENING OF FORMATION

1. Road shoulders and formation shall be widened to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the Drawings.

**Provision for
Services**

LIMITS AND TOLERANCES

C213.36 SUMMARY OF TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in the Table below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	Batter Slopes	$\pm 300\text{mm}$	C213.10
	a) Excavation		
	b) Embankment	$\pm 300\text{mm}$	C213.24
2.	Tops of Embankments		
	Trimming tops of Embankments	Parallel to the designed grade line, +0mm or -50mm of the levels specified	C213.26
3.	Selected Material	Annexure C213A	C213.27

NOTE: Plus (+) is towards the roadway/surface and minus (-) is away from the roadway/surface. Tolerances are measured at right angles to design surfaces.

Table C213.3 - Limits and Tolerances

ANNEXURE C213.A

EARTHWORKS - SUPPLEMENTARY INFORMATION

CLAUSE	DESCRIPTION	VALUE
C213.21	Requirements of material in foundations for shallow embankments: <ul style="list-style-type: none">• Moisture Content - within the range of +/- 2% of optimum.	
C213.27	Construction tolerances for Selected Material Zone are + <u>0</u> mm or - <u>50</u> mm of the designed grade and crossfall.	
C213.32	Moisture Content of material placed in embankments: <ul style="list-style-type: none">(a) Material in upper zones of formation: - within the range of +/- 2% of optimum.(b) All other embankment material: - within the range of +/- 2% of optimum.	

