# Protection Works

DIPL Roadworks Master – May 2019

## Standards and Publications

Conform to the following Standards and Publication unless specified otherwise:

AS 1012(set) Methods of testing concrete.

AS 1141(set) Methods of sampling and testing aggregates.

AS 1141.25.1 Degradation factor – Source rock (Washington Degradation Test).

AS 1141.26 Secondary minerals content in basic igneous rocks

AS 1141.29 Accelerated soundness index by reflux. Basic igneous rocks

AS 1289 Methods of testing soils for engineering purposes.

AS 1725(set) Chain link fabric fencing.

AS 2001.2.3.2 Methods of test for textiles - Physical tests - Determination of maximum force using the grab method (ISO 13934-2:1999, MOD)

AS 2423 Coated steel wire fencing products for terrestrial, aquatic and general use.

AS 2758.1 Aggregates and rock for engineering purposes - Concrete aggregates.

AS 3706(set) Geotextiles - Methods of test.

AS 3972 General purpose and blended cements.

AS 4133(set) Methods of testing rocks for engineering purposes.

AS/NZS 4671 Steel reinforcing materials

AS /NZS 4680 Hot dip galvanized (zinc) coatings on fabricated ferrous articles.

NTMTM NT Materials Testing Manual accessible via <https://transport.nt.gov.au/infrastructure/technical-standards-guidelines-and-specifications/materials-testing-manual>

NTTM NT Test Methods

## Foundations

Excavate, fill and trim the site to the required shape prior to commencing the protection works.

Compact the top 150 mm of earthworks, on which protection works are to be laid to 90% maximum dry density ratio (modified).

## Geotextile Fabrics

### General

Supply and lay non‑woven polypropylene or polyester geotextile fabric, consisting 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 must have low water absorbency. Filaments must resist delamination and maintain their dimensional stability in the geotextile.

Non-woven geotextiles must have filaments bonded by needle punching, heat or chemical bonding processes.

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 must be free of any flaws which may have an adverse effect on the physical and mechanical properties of the geotextile.

Geotextiles must be stabilised against ultra-violet radiation such that, when tested in accordance with AS 3706.11, must have a retained strength of at least 50% after 500 hours of exposure.

### Storage, Packaging and Handling

Geotextiles must be stored under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid damage prior to installation.

Geotextiles must not be stored directly on the ground or in any manner in which they may be affected adversely by heat, water or soil. The method of storage must be in accordance with recommendations by the manufacturer.

The protected geotextile rolls must be clearly labelled showing manufacturer, type of geotextile, and batch identification number.

Handle rolls with forklifts or similar, using dedicated slings, free of sharp hooks or tongs. Rolls that are dropped, dragged or pushed around on the ground will be rejected.

### Delivery and Product Certification

Geotextile must be delivered to site at least 5 days prior to commencement of installation.

Provide a Certificate of Compliance that the geotextile complies with all the requirements as specified, together with test results reported on NATA endorsed test documents. The certificate must not be more than 12 months old.

The Certificate of Compliance to include: quality control documentation for the relevant batch/lots, physical properties sheet, and manufacturer’s letter of certification stating compliance.

### Construction

Prepare smooth surfaces for placement of the geotextile, free of sharp objects, large rocks and protruding vegetation.

Place geotextiles just ahead of the advancing face of construction work, with a maximum of 48 hours of placement prior to covering.

Repair punctures and tears.

Where used in trenches or other drainage configurations, place the geotextile to the shape of the prepared surface, folding and overlapping where required. Fully envelope drainage materials in trenches.

Unless specified elsewhere in the contract, the overlap must be minimum 300 mm. Overlap to be minimum 500 mm where large ground deformations are expected. Sewing may be permitted provided the seam strength exceeds the parent material grab strength.

Direct travel of machinery over geotextile not permitted.

Where required, conform to the following initial layer of material thicknesses:

|  |  |
| --- | --- |
| **Table - Minimum Initial Layer Thickness (mm)** | |
| **Nominal Maximum Particle Size D85 of Initial Fill Layer (mm)** | **Minimum Initial Layer Thickness (mm)** |
| < 150 | 300 |
| 150 - 300 | 400 |
| 300 - 500 | 500 |

Rock armour placed directly on geotextiles must be placed with a drop height of less than 1.5 m, and placed in such a manner so as not to damage, puncture or tear the geotextile.

Obtain Superintendent approval for use of vibratory compaction methods on the initial layer.

### Geotextile Grades

Unless specified elsewhere in the contract, use: non-woven, Strength Grade C.

All strength grades, where specified, based on a Characteristic Values (Q), to conform to the ***Table - Geotextile Strength Grade Properties***.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table – Geotextile Strength Grade Properties** | | | | |
| **Geotextile Strength Grade** | **Elongation (1)** | **Grab Strength (2) (N)(3)** | **Tear (2) (N) (3)** | **G Rating (2)** |
| **A** | >30%  <30% | 500  800 | 180  300 | 900  1350 |
| **B** | >30%  <30% | 700  1100 | 250  400 | 1350  2000 |
| **C** | >30%  <30% | 900  1400 | 350  500 | 2000  3000 |
| **D** | >30%  <30% | 1200  1900 | 450  700 | 3000  4500 |
| **E** | >30% | 1600 | 650 | 4500 |
| Notes:   1. % Elongation corresponding to max CBR burst strength as per AS 3706.4. Generally <30% for wovens, >30% for non-wovens. 2. Property value is 80th percentile characteristic value (mean strength – 0.83 x standard deviation), as per relevant AS test. 3. N = Newtons | | | | |

Filtration properties relevant to each grade to be certified as part of **Delivery and Product Certification** sub-clause requirements.

### Conformance Testing

Where project requirement is less than 15,000 m2, sampling and testing is not required.

Provide samples to independent, NATA accredited testing laboratory when project exceeds 15,000 m2, to the following test frequencies:

|  |  |  |  |
| --- | --- | --- | --- |
| **Table – Test Frequencies** | | | |
| **Description** | **Units** | **Test Method** | **Test Frequency** |
| Tensile Strength | kN/m | AS 3706.2 | 1 per 15,000 m2 |
| Tear Strength | N | AS 3706.3 | 1 per 15,000 m2 |
| CBR Burst Strength | N | AS 3706.4 | 1 per 15,000 m2 |
| Grade Tensile Strength | N | AS 2001.2.3.2 | 1 per 15,000 m2 |
| Flow Rate | l/m2/s | AS 3706.9 | 1 per 90,000 m2 |

Samples to be 15 m2 in size, cut across full width of the roll, not within 2 m of the end of a roll.

## Rock Properties

The rock properties specified in this clause apply to the rock, stone, aggregate and boulders specified in the following clauses in this section;

* Stone Pitching
* Dumped Rock
* Quarter Tonne Dumped Rock
* Rubble
* Gabion Rock
* Reno Mattresses

REQUIREMENTS; Clean, dry, durable crushed stone of uniform quality, free from weeds, vegetable matter and other deleterious materials.

Particles must have at least 2 crushed faces and comply with the following standards;

AS 1141.25.1 Degradation factor – Source rock (Washington Degradation Test). Basic igneous rocks, eg. Basalt aggregates, shall have a minimum value of 50.

AS 1141.26 Secondary minerals content in basic igneous rocks, eg. Basalt aggregates, shall not exceed 25%.

AS 1141.29 Accelerated soundness index by reflux. Basic igneous rocks, eg. Basalt aggregates, shall have a minimum value of 94.

[ Project Officers should ensure that consideration is given to the appropriate selection of rock quality for the site location, availability of local rock and the risks associated with that selection.]

## Stone Pitching

### Stone Pitching

The stone used is to be spalls of hard durable rock complying with the **Rock Properties** clause and with dimensions not less than 150 mm and not larger than 200 mm.

Hand place the stones so that they are firmly bedded interlocked.

Place the stones so that the exposed faces of the stones are between 50 mm and 100 mm above the finished surface being protected. The depth of the stone pitching is to be as shown on the drawings.

[Check and amend if no specified plane]

### Grouted Stone Pitching – Hold Point

Place stones as specified in the **Stone Pitching** sub-clause.

**Hold point** - Obtain Superintendent's approval before grouting.

Grout stone pitching with waterproof, high strength cement mortar.

Cement mortar to consist of one part cement to three parts of clean sand mixed with potable water to form a workable mixture.

Work the mortar into the gaps between the stones of the stone pitching to bind the stones.. Work from the lower end of the slope of the pitchingup the slope.

Cure the mortar for at least 48 hours.

Remove defective mortar and regrout any loose stones.

Provide 75 mm diameter uPVC pipe sections to form weep holes penetrating the full thickness of the stone pitching and grout, at the rate of one weep hole every 5 square metres of stone pitching.

## Dumped Rock Protection

Large spalls or boulders complying with the **Rock Properties** clause and having a least dimension of ***[enter data]***mm.

[Consider the availability of rock sizes and specify size]

Dump into the specified area.

Protect adjacent areas from damage due to dumping.

The average plane of the exposed rock face to be within 100 mm of the specified position.

## Quarter Tonne Class Dumped Rock Protection

Large spalls or boulders complying with the **Rock Properties** clause and having the following grading.

|  |  |
| --- | --- |
| **Table – Rock - Size and grading** | |
| **Rock Size (weight)** | **Minimum % Larger Than Specified Size** |
| 35kg | 90 |
| 250kg | 50 |
| 500kg | 0 |

[Consider the availability of rock sizes and specify size.]

Dump into the specified area.

Protect adjacent areas from damage due to dumping.

The average plane of the exposed rock face to be within 100 mm of the specified position.

## Rubble

Broken rock complying with the **Rock Properties** clause.

Maximum size of rubble to be 200 mm.

At least 30% by mass to have a nominal size of 100 mm or greater.

No more than 20% by mass to pass the 2.36 mm sieve.

Dump rubble without segregation onto the prepared area.

Compact rubble to a tight finish.

The average plane of the exposed face to be within 100 mm of that specified.

The exposed face to be within 100 mm of the average plane.

[Check and amend if no specified plane]

## Gabions

### General

A flexible, hexagonal woven steel wire mesh box, filled with packed stone, complying with the **Rock Properties** clause and securely laced with steel wire.

### Steel Wire Mesh for Gabions

Use galvanized steel wire, Grade W15Z380 to AS 2423.

Zinc coating; 250 g/sq.m Galvanization to be carried out prior to weaving of the mesh.

Minimum tensile strength of wire: 380 MPa

Mesh openings to be 80 mm x 100 mm maximum, hexagonal in shape with flexible joints consisting of not less than two full turns.

All wire to be coated with average thickness of 0.55 mm extruded grey PVC firmly attached to the wire. The minimum thickness of coating to be 0.40 mm in accordance with AS 2423.

[PVC coating can be deleted where abrasion of wire is not likely to be a problem. Additionally PVC coating may be deleted after due consideration of the likely long term deleterious effects on the wire of ground water, soil salinity, natural weather exposure and water immersion]

Conform to the following wire sizes and galvanizing weights:

|  |  |
| --- | --- |
| **Table – Wire properties - Gabions** | |
| **Wire Type** | **Minimum Diameter(mm)** |
| Body wire | 2.7 |
| Binding and lacing wire | 2.2 |
| Selvedge wire | 3.4 |

Selvedge wire shall be woven integrally along all edges of the mesh, in accordance with the manufacturer's instructions, and such that the mesh shall not unravel.

The steel wire mesh shall be sized so that it can be folded into regular boxes, complete with diaphragms, having dimensions specified. Diaphragms to be at 1,000 mm spacings.

[Delete if no dimensions are shown in the drawings]

### Construction of Gabions

Assemble and erect in accordance with the manufacturer's instructions.

Pretension the wire framework against a firm anchor or adjacent units.

Retain the shape of the wire framework with spreaders.

Fill with hard durable stone, complying with the **Rock Properties** clause and placed in stages to achieve the tightest packing of stone.

Maximum stone dimension: 250 mm.

Minimum stone dimension: 100 mm.

Overfill the framework by 20 mm to 50 mm to allow for subsequent movement of the stone.

Perform lacing operations using specified lacing wire. Wire to pass round the edges being joined using alternative single and double loops through each mesh in turn. Tightness of the mesh and wiring is essential.

Ensure a tightly packed, neat and uniform construction.

## Reno Mattresses

### General

A flexible, hexagonal woven steel wire mesh box, filled with packed stone, complying with the **Rock Properties** clause and securely laced with steel wire.

### Steel Wire Mesh for Reno Mattresses

Use galvanized steel wire, Grade W15Z380 to AS 2423

Zinc coating; 250 g/sq.m Galvanization to be carried out prior to the weaving of the mesh.

Minimum tensile strength of wire: 380 MPa.

Mesh openings to be 60 mm x 80 mm maximum, hexagonal in shape with flexible joints consisting of not less than two full turns.

All wire to be coated with average thickness of 0.55 mm extruded grey PVC firmly attached to the wire. The minimum thickness of coating to be 0.40 mm in accordance with AS 2423.

[PVC coating can be deleted where abrasion of wire is not likely to be a problem. Additionally PVC coating may be deleted after due consideration of the likely long term deleterious effects on the wire of ground water, soil salinity, natural weather exposure and water immersion]

Conform to the following wire sizes and galvanizing weights:

|  |  |
| --- | --- |
| **Table – Wire properties – Reno mattresses** | |
| **Wire Type** | **Minimum Diameter (mm)** |
| Body wire | 2.0 |
| Binding and lacing wire | 2.2 |
| Selvedge wire | 2.4 |

Selvedge wire to be woven integrally along all edges of the mesh, in accordance with the manufacturer's instructions.

Cut to shape where necessary.

MATTRESS PANELS

Bottom panel: Includes both sides and both end panels.

Top panel: Shall have the same dimension as the bottom, without the sides and ends, and be supplied separately.

Diaphragms: Extend over the full width of the mattress from top to bottom at maximum intervals of 1 m.

### Construction of Reno Mattresses

Assemble and erect in accordance with the manufacturer's instructions.

Align diaphragms perpendicular to the direction of flow unless otherwise specified.

Pretension the wire framework against a firm anchor or adjacent units.

Retain the shape of the wire framework with spreaders.

Fill with hard durable stone complying with the **Rock Properties** clause and placed in stages to achieve the tightest packing of stone.

Maximum stone dimension: 120 mm when mattress depth 170 mm.

150 mm when mattress depth 230 mm.

200 mm when mattress depth 300 mm or greater.

Minimum least stone dimension: 80 mm.

Overfill the framework by 20 mm to 50 mm to allow for subsequent movement of the stone.

Perform lacing operations using specified lacing wire. Wire to pass round the edges being joined using alternative single and double loops through each mesh in turn. Tightness of the mesh and wiring is essential.

Last panel on downstream side, or at base of slope, shall be a whole unit (i.e. not cut).

Ensure a tightly packed, neat and uniform construction.

## Revetment Mattresses

### General

A nylon fabric material filled with mortar with filter points for the relief of hydrostatic uplift pressure.

Conform to the manufacturer's instructions.

### Materials

Mortar mix proportions:

|  |  |  |  |
| --- | --- | --- | --- |
| **Table – Mortar Mix Proportions – Revetment Mattresses** | | | |
| **Cement Type GP or GB** | **Fine Sand** | **Coarse Sand** | **Water** |
| 1 (500 kg) | 1.2 (600 kg) | 2.2 (1,100 kg) | 450 l/m3 |

Adjust fine sand/coarse sand proportions if required to provide workable mix.

### Construction of Revetment Mattresses

Toe‑in to provide cut‑off walls minimum 300 mm deep and width not less than maximum thickness of mattress.

Lay, cut and stitch mattress on prepared surface. Make allowance for take up of fabric resulting from filling mattress with mortar.

All stitching and seams to be neat in appearance and strength to withstand filling pressure.

Ensure mattress is anchored prior to mortar pumping to prevent creep during placement of mortar.

Provide openings in fabric at a maximum of one every 50 m2 for placement of mortar. Opening to match size of pumping hose.

Make good openings on completion of mortar pumping.

All areas of mattress to be hard filled with mortar with smooth surface.

Do not permit any loading on the mattress until one hour after mortar pumping has been completed.

Remove spilt mortar from surface of mattress by hand only. Do not use water to wash spilt mortar.

Make good any defective areas.

## Embankment Protection - Concrete

Construct embankment protection from concrete reinforced with a single layer of centrally located SL62 mesh.

[Delete reinforcing if not required]

Overlap the mesh by 200 mm at joints.

Make construction joints in the vertical plane, at 2 m maximum spacing.

Continue reinforcement mesh across construction joints.

Construct the embankment protection and the margins as an integral unit.

[Delete when there are no margins]

Construct the toe of the embankment protection and the adjacent protection work as an integral unit.

[Delete when there is no adjacent protective work]

Drainage holes to be 75 mm diameter penetrating the full thickness of the protection works. Install the drainage holes at 3 m intervals just above the toe.

Install additional rows of drainage holes parallel to the first, and at 3 m intervals and spacings, where the scope of work requires it.

The exposed surface to be within 50 mm of the specified position.

## Margins

Construct margins with reinforced concrete. Conforming to the requirements of the MISCELLANEOUS CONCRETE WORKS Section.

Make construction joints at 3 m maximum spacing.

Form the top 75 mm of the vertical face nearer the pavement, and any exposed outer face, true to line and level.

Wood float and broom finish the upper surface of the margin. Finish flush with the top of the pavement.

Overlap the bituminous seal on the margins by not less than 100 mm.

[Delete when adjacent pavement is not sealed]

TOLERANCES

Width: Not less than specified.

Level: + or - 10 mm of top of adjacent pavement.