Mauao Base Track – Stage 2 Works – Project Specification

This specification relates to the Mauao Base Track stage two works using soil nailing, with geosynthetic facing and installation of bored horizontal drains as shown on the drawings:

- C01 & C02 Revision A.

1 General

1.1 Setting Out

The Contractor shall be responsible for the correct set-out of all works based on coordinates supplied by the Engineer. The Engineer shall provide the Contractor with a reference point for set-out.

On completion of the set-out of the works at the site, the Contractor shall immediately advise the Engineer for the purposes of checking the set-out. No other works shall be carried out until this has been checked and approved by the Engineer.

If the set out is found to be incorrect, the works shall again be set out by the Contractor and re-checked by the Engineer.

1.2 Service Locate and Protection

The Contractor shall familiarise themselves with all underground services prior to start of any site works and adequately mark and identify underground services within the site works.

2 Soil Nail Requirements

2.1 Documents

The documents listed below and cited in the Clauses that follow are part of this specification. However, this specification takes precedence in the event of it being at variance with the cited document:

- NZS 3109:1997 Concrete construction
  NZS 3112.4:1986 Tests relating to grout
  NZS 3112.2:1986 Tests relating to determination of strength of concrete. FHWA0-IF-03-017 Pull-out tests
  AS/NZS 1477:2006 PVC pipes and fittings for pressure applications
  MacMat® and MacMat® R Installation Guidelines Int / IG / MMR / Rev: 02, Nov 2010

3 Materials

3.1 Soil Nail Reinforcing Bar

Soil nail bars shall be those stated in the design drawings or an equivalent as approved by the Engineer. Soil nail bars shall be properly labelled and shall be kept protected from dirt, rust and any deleterious substances prior to and during installation. Soil nail bars shall be rejected if damaged as a result of abrasion, cuts, nicks, welds, and weld splatter, handling, placing and

fabrication. Soil nail bars shall be galvanised (75µm) to the requirement stated in the design drawings.

3.2 Soil Nail Grout

The grout shall be neat cement grout or similar as approved by the Engineer. The grout shall achieve a minimum characteristic strength as stated in the design drawings after 28 days.

The Contractor shall engage an IANZ accredited laboratory to undertake two compressive strength tests for every batch of grout at 1, 7 and 28 days in accordance with NZS 3112.4. Grout test results shall be supplied to the Engineer within 24 hours of testing.

The grout water/cement ratio by weight shall be below 0.45 and bleed at 20˚C shall be less than 2% after 3 hours from mixing. No admixtures shall be permitted without the Engineer's prior approval. Standard flow cone tests for the grout shall be carried out in accordance with NZS 3112 at the Contractor's expense.

3.3 Soil Nail Hole Drilling

The inclination and spacing of drill holes shall be those as shown on the drawings. The Contractor may vary the inclination and spacing as approved by the Engineer to avoid conflicts such as tree roots or to suit the drilling rig. The soil nails in adjacent rows shall be offset in a staggered drill pattern as shown on the design drawings.

3.4 Soil Nail Bar Installation

Each soil nail bar shall be centralised in the drill hole using centralizers as shown on the drawings. The centralizers shall be installed at an approximate spacing as shown on the drawings.

If necessary, geotextile grout socks should be utilised to minimise loss of grout. Socks shall be pre-assembled prior to installation of soil nail bars.

The drill hole shall be checked to ensure that it is clear of debris prior to installation of the soil nail bar. The soil nail bar shall be inserted in the drill hole to the minimum design length but shall not be pushed beyond the drill hole length.

3.5 Soil Nail Grouting

Grout shall be injected through a grout pipe from the lowest point upwards. The grout shall flow continuously as the casing is withdrawn. The withdrawal rate shall be controlled to ensure that the end of the casing is always below the grout. The Contractor shall record the grout volume and grout consistency. The grout tube shall be removed from the drill hole after the grouting is completed.

3.6 Reinforced Mat Facing

The Contractor shall use MACMAT R (steel) or equivalent facing. If the Contractor proposes an alternative, the proposed alternative reinforced mat facing material should be submitted to the Engineer for approval before construction. The reinforced mat facing shall be installed in accordance with manufacturer's instructions and guidelines.

Prior to installing MACMAT R, coconut matting shall be installed below the MACMAT R to prevent migration of fines. Refer to drawings for details.

3.7 Soil Nail Head Installation

Bearing plates shall be placed firmly against the new slope/wall facing with bevelled washers. Nuts shall be tightened by using a large hand wrench.

3.8 Bored Horizontal Drains

The Contractor shall construct bored horizontal drains in the locations and at the grades shown on the Construction Drawings and to the requirements set out below.

The work shall be carried out by persons who have the equipment and a proven track record to carry out this type of work.

The outlet of the pipes shall be terminated a minimum distance of 500mm beyond the face of the slope. Details are given in the Construction Drawings. The bored diameter in the ground shall not exceed 50mm.

PVC pipes for bored drains shall be Class PN9 pressure pipes complying with AS/NZS 1477:2006. Circumferential slots, 2.0mm wide, shall be machine cut and have a length of at least 20mm each on the 40mm pipe. The slots shall be located in pairs in the upper half of the pipe on the same circumferential section. The pair of slots shall be spaced to give 10 pairs every 100mm length. The maximum length of pipe without slots shall be 100mm. The slots shall be machined and free of swarf or burred edges. Hacksaw slots are unacceptable. Pipes shall be unslotted from the discharge point to 1m into the bored hole. The outer anulus between the borehole and the drain pipe OD should be blocked with a grout plug at the slip face to prevent weeping at the face and ensure water drains to the end of the pipe.

The bored drains shall be inclined a minimum gradient above the horizontal of 1/100 to give drainage towards the outlet, as shown on the Construction Drawings.

The Contractor shall clean out the bored drains using low pressure water flushing within three months of completion.

4 Soil Nail Testing

4.1 General Requirements

The Contractor shall perform a minimum of one 'Verification' test for each different anchor length to be used in the design. Bare rods may be used for the sacrificial verification test anchors.

'Proof' tests shall be undertaken for at least 5% of the proposed soil nails. The Engineer may require extra tests based on the results of the testing results. Installation of additional soil nails may also be required if the testing results are unsatisfactory.

Soil nail testing shall not be performed until the grout has reached a minimum compressive strength of 70% of the design strength.

The Engineer shall be given a minimum of 24-hour notice prior to the first 'Verification' or 'Proof' test. The Engineer or his representative shall be present during the above tests. The Contractor shall be responsible for recording, analysing and interpreting all test results and reporting the data to the Engineer for review and approval.

4.2 Testing Equipment

The Contractor shall design the test frame and reaction system, which should be submitted to the Engineer for approval at least 48 hours before commencing the testing. All testing equipment shall be calibrated and checked to be in good working condition prior to each test.

The maximum jack force and pressure gauge shall not be less than 150% of the required test load with an accuracy of ±1% of the required test load. Dial gauges shall have an accuracy of ±0.02mm to measure deformation during creep test and shall have an accuracy of ±0.2mm to measure deformation during other load increments. The dial gauges shall have sufficient travel to allow the test to be completed without having to reset the gauges. The gauges shall be supported independently of the jack, reaction frame or wall local to the test site.

During testing, the jacking equipment shall be placed over the nail in such a manner that the jack, bearing plates, load cell, and jacking anchorage are all aligned. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test is not required.

4.3 Verification Test

The Verification Test shall be undertaken as per the load increments given in the following table in accordance with section 9.4 of FHWA-NHI-14-007, FHWA GEC 007, February 2015 or otherwise stated in this document.

The verification test anchors shall have a 4m bonded zone.

- The Verification Test Load is 33kN.

Verification test anchors shall be incrementally loaded as per the following schedule.

Load increment (Verification Test Load)	Hold Time (min)
Alignment load (AL)	1
0.13 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.25 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.38 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.50 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.63 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.75 VTL (Creep Test)	60 (recorded at 1, 2, 4, 5, 6, 10, 20, 30, 50, 60)
0.88 VTL	10
1.00 VTL	10
Alignment load (AL)	1

Notes: (1) AL = alignment load, which is commonly less than or equal to 0.025 VTL.

(2) Soil movement must be measured after each load increment has been achieved and at each time step.

(3) Permanent soil nail movement must also be recorded.

The Contractor must record soil nail movements at each load increment. As noted above, each load increment is held for at least 10 minutes. Creep tests are performed at 0.75 VTL. Test loads excess of this minimum and preferably to pullout failure are recommended.

Test acceptance criteria require that:

- Pullout does not occur at loads less than 1.00 VTL.
- The total movement (Δ_{VTL}) measured at VTL must exceed 80 percent of the theoretical elastic elongation of the unbonded length (L_{UB}), as defined below.
- The creep movement does not exceed the criteria presented in section 4.4.1.

4.4 Proof Test (Acceptance)

The Proof Test shall be undertaken as per the load increments given in the following table in accordance with section 9.4 of FHWA-NHI-14-007, FHWA GEC 007, February 2015.

The proof test Anchors shall have a 4m bonded zone.

- The Proof Test Load is 25kN.

Proof test anchors shall be incrementally loaded as per the following schedule.

Load increment (Proof Test Load)	Minimum period of observation (min)
Alignment load (AL)	1
0.17 PTL	Until Movement Stabilises
0.33 PTL	Until Movement Stabilises
0.50 PTL	Until Movement Stabilises
0.67 PTL	Until Movement Stabilises
0.83 PTL	Until Movement Stabilises
1.00 PTL (Creep Test)	10 recorded at 1, 2, 4, 5, 6 and 10
Alignment load (AL)	1

Notes: (1) AL = alignment load, which should be AL≤0.0025 PTL.

(2) If the soil nail movement measured between 1 and 10 minutes exceeds 0.04 in., PTL must be
maintained for 50 additional minutes and movements must be recorded at 20, 30, 50 and 60 minutes. The permanent soil movement must also be recorded.

(3) Times are measured after the target load had been achieved in each increment.

(4) If the soil reinforced with nails are relatively susceptible to deformation of creep, it is recommended to hold each load increment for 10 minutes and to record the soil nail movement at 1, 2, 5 and 10 minutes.

4.4.1 Details of Creep Tests

Creep test, which are part of the verification and proof tests are conducted at a specified, constant test load, with displacement recorded at specified time intervals. The deflection-versus-log-time results are plotted om a semi-log graph, and are compared with the acceptance criteria presented in the construction specifications.

Acceptance criteria for the creep movement require that:

Verification Tests

- The creep movement between the 1- and 10- minutes readings at 0.75 VTL is less than 1.016mm.
- The creep movement between the 6- and 60- minute readings at 0.75 VTL is less than 2.032mm.
- The creep rate is linear or decreasing throughout the creep test load-hold period.

Proof Tests

- The creep movement is less than 1.016mm. Between the 1- and 10- minute readings.
- If the movement is exceeded, PTL must be maintained for an additional 50 minutes with readings recorded at 20, 30, 50 and 60 minutes.
- If the creep test is extended, the creep movement between the 6- and 60- minute readings is less than 2.032mm.

4.5 Hydroseeding

All areas within the extent of works including the stage one batter shall be hydroseeded according to TNZ F/1, Clause 15.3 so that:

- 85% strike rate is achieved within one month of the Date of Practical Completion.
- 90% strike rate is achieved immediately before the end of the Defects Notification Period.

The seed mixture shall be certified free of all pests and diseases. The seed mixture and proportions of each variety to be used is as follows:

- Single native grass “Microlaena stipoides”.

At the time of sowing, a compound pre-emergence fertiliser such as 4:12:15 NPK shall be applied at a rate of 100kg/ha.

5 Construction Records

The contractor shall keep construction records for every nail and bored drain constructed. The construction records shall contain the following information as a minimum:

- Nail/drain number, location, and dimensions

- A drilling record showing date and time of drilling, the drilling method, the type of materials encountered and the location at which the materials were encountered, water loss/seepage during drilling, problems during drilling.
- Nominal and actual volumes of grout placed.
- Soil nail test records.c

6 Engineers Inspections

The Contractor shall give a minimum 24 hour notice to the Designer for the minimum inspection scheduled as follows:

- Setting out details.
- Inspection of slope.
- Installation of the first soil nail.
- First Verification and Acceptance Test.
- Installation of bored drains.
- Completion of soil nail slopes.