



Infrastructure Cook Islands

Section F: Technical Specifications

Civil Construction Specifications

Avatiu Punanganui Market Bridge Replacement

Contract No. CK192010 Date of Release: 4 September 2019

TABLE OF CONTENTS

100	CLEARING & DEMOLITION	7
100.1	General.....	7
100.2	Scope	7
100.3	Extent of Works	7
100.4	Bridges, Culvert's and Structures.....	7
100.5	Disposal of Materials	7
200	EARTHWORKS.....	8
200.1	General.....	8
200.2	Scope	8
200.3	Related Documents.....	8
200.4	Stripping of Topsoil.....	8
200.5	Unsuitable Material.....	9
200.6	Sediment Retention and Erosion Control.....	9
200.7	Management of Stormwater	9
200.7.1	Scope and Priority	9
200.7.2	Surface Profile	9
200.7.3	Contour Drains	9
200.7.4	Sediment Retention.....	10
200.8	Subsoil Drainage	10
200.9	Earthfilling.....	10
200.9.1	General.....	10
200.9.2	Classification of Materials	11
200.9.3	Materials for Earthworks	11
200.9.4	Bulk Earthmoving	12
200.9.5	Over-Excavation.....	12
200.9.6	Benching	12
200.9.7	Depth of Layers	13
200.9.8	Control of Water Content	13
200.9.9	Standards of Compaction Required.....	13
200.9.10	Rolling	13
200.9.11	Compaction Testing	14
200.9.12	Subgrade Formation	14
200.10	Re-spreading topsoil and grass establishment	15
200.11	Protection and maintenance	15
300	STORMWATER DRAINAGE	17
300.1	General.....	17
300.2	Scope of works.....	17
300.3	Related documents	17
300.4	MATERIALS.....	17
300.4.1	Pipes	17
300.4.2	Castings	17
300.4.3	Step Irons	18
300.4.4	Concrete.....	18
300.4.5	Granular Pipe Bedding.....	18
300.4.6	Hardfill	18
300.4.7	Sand	18
300.5	CONSTRUCTION	18
300.5.1	General.....	18
300.5.2	Salvage of Existing Pipes.....	18
300.5.3	Trench Excavation.....	18
300.5.4	Bedding	18
300.5.5	Pipe Laying and Jointing	19
300.5.6	Backfilling	19
300.5.7	Concrete Structures	20



300.5.8	Concrete Encasing and Capping	21
300.5.9	Boring and Jacking Installation	21
300.6	TESTING AND ACCEPTANCE	21
400	CONCRETE FOR MINOR WORKS.....	22
400.1	General.....	22
400.2	Scope	22
400.3	Related Documents.....	22
400.4	MATERIALS	22
400.4.1	Water and Aggregates	22
400.4.2	Cement.....	22
400.4.3	Concrete.....	22
400.4.4	Mortar	22
400.4.5	Reinforcing	23
400.4.6	Marine Grade Concrete.....	23
400.5	CONSTRUCTION	23
400.5.1	Excavation and Foundations.....	23
400.5.2	Formwork	23
400.5.3	Reinforcing	23
400.5.4	Concreting.....	23
400.5.5	Finish.....	23
400.5.6	Tolerances.....	23
400.5.7	Defective Concrete Finishes	23
400.5.8	Backfill to Concrete Structures.....	24
500	KERBS, CHANNELS, FOOTPATHS & VEHICLE CROSSINGS.....	25
500.1	General.....	25
500.2	Scope	25
500.3	Related Documents.....	25
500.4	MATERIALS	25
500.4.1	Mortar	25
500.4.2	Concrete.....	25
500.4.3	Precast Kerbs.....	25
500.5	CONSTRUCTION	25
500.5.1	General.....	25
500.5.2	Kerbs	26
500.5.3	Channels	26
500.5.4	Machine Laid Kerb and Channel.....	26
500.5.5	Concrete Footpaths.....	26
500.5.6	Vehicle Crossings.....	27
600	GRANULAR PAVEMENTS	28
600.1	General.....	28
600.2	Scope	28
600.3	Related Documents.....	28
600.4	General.....	28
600.4.1	Protection of existing kerbs, channels and services	28
600.4.2	Preparation of road subgrade	28
600.4.3	Trimming	29
600.4.4	Subgrade Drains	29
600.5	Material.....	29
600.5.1	GAP 65, GAP 40, GAP 20	29
600.5.2	NZTA M/4 AP40 & AP20.....	30
600.6	Construction	30
600.6.1	Preparing Underlying Course.....	31
600.6.2	Supply, Placing, Compaction and Testing	31
600.6.3	Surface Shape, Surface Finish, Construction Tolerance	31
600.6.4	Protection and Caring	31
600.6.5	Benkelman Beam Deflection Testing	31
600.6.6	Presealing	31
600.6.7	Testing.....	32



600.6.8	Acceptance Criteria	33
700	CEMENT AND LIME TREATED COURSE	34
700.1	General	34
700.2	Scope	34
700.3	Related Documents	34
700.4	MATERIALS	34
700.4.1	Cement	34
700.4.2	Lime	34
700.4.3	Water	34
700.4.4	Imported Aggregate	35
700.4.5	Existing Aggregate	35
700.5	CONSTRUCTION	35
700.5.1	Sampling of Representative Stabilising Materials	35
700.5.2	Mix Design Testing	35
700.5.3	Plant and Equipment	36
700.5.4	Weather and Time Limitation	36
700.5.5	Surface Preparation	36
700.5.6	Plant Mixed and/or Ex-situ Stabilisation	37
700.5.7	Compaction	37
700.5.8	Construction Tolerance	37
700.5.9	Testing	37
700.6	PROTECTION AND CURING	38
700.7	ACCEPTANCE CRITERIA	39
800	BITUMINOUS SEAL COAT	40
800.1	General	40
800.2	Scope	40
800.3	Related Documents	40
800.4	MATERIALS	40
800.4.1	Sealing Chips	40
800.4.2	Bituminous Binder	40
800.4.3	Diluents	41
800.4.4	Adhesion Agent	41
800.4.5	Polymer Additive	41
800.4.6	Blending	41
800.4.7	Sampling and Testing	41
800.5	PLANT	41
800.6	CONSTRUCTION	41
800.6.1	Sealing Period and Working Hours	41
800.6.2	Edge Definition	41
800.6.3	Surface Preparation	41
800.6.4	Weed Killer	41
800.6.5	Binder Temperatures	41
800.6.6	Rate of Application	41
800.6.7	Sealing Operations	42
800.6.8	Riding Surface	42
800.6.9	Testing	42
800.6.10	Protection and Repairs	43
800.6.11	Acceptance Criteria	43
900	ASPHALT (DENSE GRADED ASPHALT)	44
900.1	General	44
900.2	Scope	44
900.3	Related Documents	44
900.4	MATERIALS	45
900.4.1	Bituminous Materials	45
900.4.2	Mineral Aggregates For Asphalt	45
900.4.3	Adhesion Agent	45
900.4.4	Membrane Seal	45
900.4.5	Other Additives	46



900.5	ASPHALT MIX DESIGN.....	46
900.5.1	Job Mix Formula.....	46
900.5.2	Mix Design.....	46
900.5.3	Approval of Mix Design	47
900.6	CONSTRUCTION	48
900.6.1	Weather Limitations.....	48
900.6.2	Plant and Organisation.....	48
900.6.3	Preparation of the Area to be Paved.....	49
900.6.4	Tack Coat.....	49
900.6.5	Membrane Seal.....	49
900.6.6	Storage of Mix	49
900.6.7	Transportation of Mix	49
900.6.8	Mix Temperatures	49
900.6.9	Placing and Compaction	49
900.7	ACCEPTANCE SAMPLING AND TESTING.....	50
900.7.1	Plant-Produced Material.....	50
900.7.2	Field Placed Material.....	50
900.7.3	Testing Frequencies.....	51
900.8	ACCEPTANCE/REJECTION	53
900.9	REPAIR	53
1000	SERVICE INSTALLATION & DUCTING	54
1000.1	General.....	54
1000.2	Scope of work.....	54
1000.3	Related documents	54
1000.4	MATERIALS.....	54
1000.4.1	Pipes	54
1000.4.2	Sand	54
1000.4.3	Hardfill	54
1000.5	CONSTRUCTION	54
1000.5.1	General.....	54
1000.5.2	Backfilling	55
1000.5.3	Restoration	55
1000.5.4	As-Builting	56
1100	PAVEMENT MARKING.....	57
1100.1	General.....	57
1100.2	Scope of work.....	57
1100.3	Related documents	57
1100.4	MATERIALS.....	57
1100.4.1	Paint	57
1100.4.2	Glass Beads.....	57
1100.4.3	Raised Pavement Markers.....	57
1100.5	PREPARATION.....	58
1100.5.1	General.....	58
1100.5.2	Removal of Redundant Pavement Markings	58
1100.5.3	Removal of Redundant Raised Pavement Markers.....	58
1100.6	PAINT MARKING	58
1100.6.1	Setting Out	58
1100.6.2	Application.....	58
1100.7	RAISED PAVEMENT MARKERS	58
1100.8	REMOVAL OF NON-COMPLYING WORK	59
1100.8.1	Paint Pavement Marking	59
1100.8.2	Pavement Markers	59
1200	ROAD SIGNAGE	60
1200.1	General.....	60
1200.2	Scope of work.....	60
1200.3	Related documents	60
1200.4	Materials.....	60
1200.4.1	RETRO-REFLECTIVE SHEETING MATERIAL.....	60



1200.4.2	Sign Standard of Retro-reflection.....	60
1200.5	SIGN MANUFACTURE.....	61
1200.5.1	General.....	61
1200.5.2	Sheeting.....	61
1200.5.3	Horizontal Panel Joints.....	61
1200.5.4	Sign Shape.....	61
1200.5.5	Modular Sign Assembly Fitting.....	61
1200.5.6	Channel Stiffening Extrusions.....	62
1200.5.7	Sign Back Face.....	62
1200.5.8	Packing and Handling of New Signs.....	62
1200.6	POSTS AND POLES.....	62
1200.6.1	General.....	62
1200.6.2	Post Embedment.....	62
1200.6.3	Steel Posts.....	63
1200.6.4	Aluminium Poles.....	63
1200.6.5	Impact Resistant System Posts.....	63
1200.7	SIGN FIXINGS.....	63
1200.7.1	General.....	63
1200.7.2	Sign Face Penetration.....	63
1200.7.3	Brackets and Fittings.....	63
1200.7.4	Back-to-Back Sign Fixing.....	63
1200.8	SIGN INSTALLATION.....	63
1200.8.1	General.....	63
1200.8.2	Replacement Sign Erection.....	63
1200.8.3	Ground Mounted Signs.....	64
1200.9	EXISTING SIGNAGE AND HARDWARE.....	64
1200.9.1	General.....	64
1200.9.2	Redundant Signage and Hardware.....	64
1300	ROAD SAFETY BARRIERS.....	65
1300.1	General.....	65
1300.2	Scope of work.....	65
1300.3	Related documents.....	65
1300.4	GENERAL.....	65
1300.5	MATERIALS.....	65
1300.5.1	Concrete and Mortar.....	65
1300.5.2	Highway Guardrails.....	65
1300.5.3	Bridge Guardrails.....	66
1300.5.4	Posts.....	66
1300.5.5	Terminals and Anchors.....	66
1300.5.6	Proprietary Barrier Systems and Crash Cushions.....	66
1300.6	CONSTRUCTION.....	66
1300.6.1	General.....	66
1300.6.2	W-Section, Thrie-beam and Modified Thrie-beam Barrier.....	67
1300.6.3	W-section Terminals.....	67
1300.6.4	Proprietary Barrier and Crash Cushion Systems.....	67



100 CLEARING & DEMOLITION

100.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

100.2 Scope

This specification covers the removal from the Contract area of all redundant structures, fences, hedges, trees, weeds, scrub and similar growth (including grubbing up of all roots).

100.3 Extent of Works

Objects and vegetation shall be retained unless specifically required to be removed to complete the contract works.

Objects and vegetation shall not be removed from private property unless expressly authorised by the Engineer.

The clearing works within this contract shall include clearing and removal offsite of, shrubs, weeds, scrub, trees, rubbish, building slabs, foundations, debris, fences and any other material that the Engineer deems not required in the final works.

All vegetation and other materials shall be removed from the site. Materials considered by the Engineer to be of value to the Principal, such as fencing posts and wire, pipes, etc. shall be neatly stacked in the Contract area where directed, and shall remain the property of the Principal.

Tree and other structures shall be brought down in such a manner as to avoid danger to the public or damage to other vegetation or structures which are to remain.

Where vegetation is cleared the ground shall be grubbed clear of all vegetation, refuse and obstructions in the underlying ground. Roots and vegetation that have a diameter of 20mm or more shall be removed and confirmation from the Engineer that any remaining organic matter is acceptable to remain within the contract area.

Boundary fences, structures, or other objects or growths not scheduled for removal, but which are damaged or destroyed by the Contractor's operations, shall be repaired or re-erected by the Contractor at his own expense.

100.4 Bridges, Culvert's and Structures

Unless detailed otherwise or as directed by the Engineer trees and stumps and other vegetation where the drip line extends within 05m of any proposed bridges, culverts and structures shall be completely removed.

100.5 Disposal of Materials

The contractor shall note that the disposal of all clearing material must be to an approved disposal facility and shall provide evidence that this is the case. The Contractor may recover the salvageable value of cleared materials that the Principal has no further use for and which are removed from the site.

On-site burning of selective vegetation and timber shall only be permitted if the Contractor obtains the necessary permits from the appropriate authority and Fire Service, and providing the fire is controlled and does not create a nuisance.

During the clearing operations, the contractor shall ensure that any noxious weeds and plants that may be found onsite are removed from site in a manner that will not spread seeds. Noxious weeds must be sprayed and cleared at the commencement of work, and care taken to see that there is no re-establishment growth either on the original site or on stockpiles etc. prior to completion of the work.



200 EARTHWORKS

200.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

200.2 Scope

This specification covers the covers the; stripping of topsoil, excavation and disposal of unsuitable materials, erosion and sediment controls, subsoil drainage (for bulk earthworks dewatering), earthworks including excavation, placement, compaction, trimming of batters, surface drains, formation and the re-spreading of topsoil.

The extent of earthworks for this contact is detailed in the drawings and all earthworks shall comply with the standard specifications and Infrastructure Cook Islands requirements to the complete approval of the engineer. The geotechnical engineer supervising the earthworks will advise any additional standards of compaction and additional earthworks testing.

No works on adjoining properties or sites shall be undertaken without written authorisation from the Engineer.

The contractor shall ensure that sufficient and effective silt/sediment control works are in place at all times.

200.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender.

NZS4404	Land Development and Subdivision Infrastructure
TNZ F/1	SPECIFICATION FOR EARTHWORKS CONSTRUCTION
TNZ F/2	SPECIFICATION FOR PIPE SUBSOIL DRAIN CONSTRUCTION
TNZ T/01	Benkelman Beam Deflection Measurements
NZS 4402	Methods of Soil Testing for Civil Engineering Purposes
BS1377	Methods of Test for Soils for Civil Engineering Purposes
NZS 4404	Land Development & Subdivision Infrastructure
NZS 4407	Methods of Sampling and Testing Road Aggregates
NZS 4431	Code of Practice for Earth Fill for Residential Development.
ARC TP90	Erosion & Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region

200.4 Stripping of Topsoil

All topsoil (as defined by the Engineer) together with turf, on areas of cutting and filling shall be removed and stockpiled in a planned manner on approved sites within the Contract area. In areas of heavy turf vegetation, this material shall be laid on the bottom of the stockpiles if directed by the Engineer for clean topsoil to be stockpiled on top. No extra payment will be made to the Contractor for double handling.

Except where limited by boundaries, existing works or fences and trees to be preserved, stripping shall extend one metre beyond the limits of the areas subject to earthworks or as agreed with the Engineer.

On completion of cut and fill earthmoving operations to the satisfaction of the Engineer, the topsoil (except that quantity directed by the Engineer to be reserved in stockpile on site) shall be spread evenly over the reformed area to the minimum depth shown on drawings (excluding road areas).

The Contractor shall stockpile the scheduled volume only. Any additional topsoil that requires removal from areas under construction shall be removed from site. The best quality topsoil only shall be stockpiled for re-



spreading. If, in the opinion of the Engineer, inferior topsoil has been stockpiled for re-spreading, a deduction shall be made to cover the cost of its replacement.

No topsoil shall be removed from the site without the Engineer's approval, and all surplus topsoil remains the property of the Principal unless agreed otherwise.

200.5 Unsuitable Material

The Engineer shall determine which materials will be classified as "unsuitable" and will in general apply the term to material which, by virtue of its inherent properties of grain size, water content, or organic content, is considered unsuitable for inclusion in earthfills. Unsuitable material that can only be excavated as a special operation involving plant such as dragline, tracked excavator, or other specially adapted plant, shall be paid for at the scheduled rate under the description "unsuitable material". Other unsuitable material shall be paid for at the same schedule rate as topsoil.

Where any material has become wet due to insufficient drainage or other negligent operation of the Contractor, and would not otherwise have had to be excavated, the excavation and backfilling shall be carried out at the Contractor's expense.

All unsuitable material located beneath areas to be filled shall be removed as directed by the Engineer prior to the commencement of filling. This material shall be either carried to dump or stockpiled for further use in locations approved by the Engineer. The extent and measure-up of undercut areas will be confirmed on site by the Engineer.

The Contractor shall ensure that no unsuitable material is buried or deposited on any part of the Contract area other than as directed by the Engineer.

Care shall be taken that unsuitable material and material suitable for filling are not mixed during excavation. Material which is unsuitable purely because of high moisture content due to its location on site, shall be spread and dried for use as fill, as described in this Specification. Material which is unsuitable because of the presence of vegetable matter or its naturally wet colloidal nature shall be placed in regions of general reserve or other areas specified by the Engineer. Such material shall be spread, dried and mixed with suitable material to obtain the best practicable compaction.

200.6 Sediment Retention and Erosion Control

The Contractor shall not commence earthworks until satisfied that all conditions and requirements of the Consents can be met and that suitable sediment and erosion controls, etc., have been constructed. The Contractor shall maintain the control measures as required until no longer required.

200.7 Management of Stormwater

200.7.1 Scope and Priority

Before any earthworks begin, the Contractor shall take all necessary precautions to protect public and private property from possible damage by stormwater runoff from the Contract area and catchment below the Contract area. The Contractor shall continue to provide and maintain adequate stormwater control facilities as the work proceeds and until the end of the maintenance period.

The Engineer may order the Contractor to cease all other operations until he is satisfied that the stormwater control systems are adequate and to the complete approval of the relevant authority.

200.7.2 Surface Profile

During the progress of the work, the surface profile shall be maintained in such shape and condition that there is adequate controlled drainage at all times.

The formation surface within 3 metres of fill batters shall be graded away from the top of the batter and surface water led to suitable discharge positions by means of vee drains to prevent possible batter erosion.

200.7.3 Contour Drains

The Contractor shall allow for the provision and maintenance of effective temporary and permanent open intercepting and contour drains.



All upstream catchments flowing onto the site shall be adequately diverted (clean water diversion drains) away from the site construction zone.

Contour drains discharging on virgin ground shall be put in at intervals to suit the general ground slope after earthworks operations have ceased for the day. Contour drains gradients should not exceed 2% and be spaced at intervals, to suit the site slope.

Intercepting drains shall be dug at the toe of batters and uphill of private boundaries and connected to approved outlets.

Where these drains are required to be dug through soft material, the Engineer may direct that they are lined.

200.7.4 Sediment Retention

The Contractor shall provide silt traps/ponds to the Engineer's approval on all temporary and/or permanent open stormwater channels. The type and size of silt traps/ponds may vary according to location but shall generally consist of a stilling pond and mesh fence, generally in accordance with required standards.

The Contractor shall maintain silt traps/ponds and remove all trapped debris to locations where it will not be washed down into open or piped drains. He shall restore pond areas after all risk of soil contamination has been removed.

Where silt traps/ponds and other drainage work are of a nature that maybe a danger to the public, the Contractor shall take adequate protective measures by fencing off the dangerous areas and erecting clear effective warning signage. If the Contractor fails by virtue of inadequate performance, to prevent damage to private and public properties and utilities, the Contractor shall, at his own expense, clean up and repair all ensuing damage.

200.8 Subsoil Drainage

Where fill is to be constructed over wet areas, springs or areas where in the opinion of the Engineer, water is likely to emerge or seep, then adequate subsoil drains and/or scoria blankets shall be installed. The Engineer shall inspect and confirm the extent of such work before any pipes or metal are placed.

The Contractor shall abide by TNZ Specification F/2.

The perforated pipes shall conform to the requirements for the class, type of joints, diameter, and length, shown on the drawings and specification.

Trenches shall be backfilled to a minimum depth of 200mm above the pipes with filter material spilled over onto the surrounding ground surface.

Filter material shall consist of clean, durable stones and comply with the grading specified in TNZ F/2.

Care shall be taken when placing and compacting earthfilling over the drains to ensure that they are not damaged and open ends shall be protected by a 15mm mesh screen to prevent entry of debris or animals.

The Contractor shall keep a careful as-built record (surveyed position, level) of the location of all subsoil drains or drainage blankets.

200.9 Earthfilling

200.9.1 General

It is intended that all materials other than those classed as unsuitable by the Engineer, which are excavated after stripping, be conditioned as necessary and be compacted to the standards specified below. Furthermore, any area of ground which has been disturbed to such depth (e.g. by grubbing operations) that cannot be compacted to the required standards in conjunction with the first layer of fill, shall be worked and compacted to the required standards before routine fill operations begin.

All earthworks shall be carried out in accordance with TNZ F/1 SPECIFICATION FOR EARTHWORKS CONSTRUCTION.

All earthworks shall be carried out in the dry and before fill is placed in any area, the Engineer shall be notified so that he may inspect the stripping and/or removal of unsuitable materials to see that this prior work meets the specified requirements. No cut and fill shall be undertaken until inspection and approval by the Engineer.



200.9.2 Classification of Materials

The materials to be excavated shall be classified as one of the types listed below. Whenever the Contractor wishes material to be defined as other than "soil" he shall give adequate notice to the Engineer so that an appropriate classification may be determined.

a) Unsuitable Material

This is defined as material that due to grain size; excessive natural water content; and/or organic content is deemed, by the Engineer, to be unsuitable for use as compacted earth fill material.

b) Soils and Soft Rock

Soils suitable for use as compacted earth fill shall be defined as material which can be excavated with reasonable facility by modern excavating plant.

Soft rock shall be defined as material which requires loosening by means of ripping equipment or some means other than continuous drilling or blasting and which can be subsequently removed by excavating plant.

c) Hard Rock

Hard rock shall be defined as solid material which cannot be reasonably loosened and prepared for excavation by means of a heavy-duty ripper and which requires to be broken up by means of explosives or heavy duty rock breakers before it can be handled by mechanical equipment.

Where agreement cannot be reached on classification of soft rock and hard rock material, ripping trials shall be carried out using appropriate plant, to determine the classification as described above.

Where the appropriate plant is not available on site the Contractor will be reimbursed for the cost of transporting, if the classification claimed by the Contractor is proven.

d) Topsoil

Topsoil shall be defined as the layer of material, which may include vegetation, turf, humus and other organic matter immediately below the ground surface and which is unsuitable for use in compacted earthfills.

200.9.3 Materials for Earthworks

The Contractor shall be responsible for selecting material from their nominated source and for the monitoring of the quality of fill material by regular testing. The minimum amount of testing to determine grading and plasticity index shall be one of each test per 500m³ of material and per source.

200.9.3.1 Hardfill

Hardfill is defined as a well graded, durable, granular aggregate which meets specified grading, strength, and durability criteria as defined below.

Hardfill shall be GAP65 or GAP100 supplied from a quarry and shall consist of a well-graded granular aggregate. The aggregate shall be free from organic, calcareous or other deleterious materials.

Hardfill shall have a minimum crushing strength of 130kN (NZS 4407:1991 test 3.10) and weathering quality grade of AA, AB, AC, BA. (NZS 4407:1991 test 3.11). Maximum PI of the fines content is to be 10%.

The grading envelopes for GAP65 and GAP100 are shown on Tables below.

Table - GAP65 Hardfill Grading Envelope Requirements

Sieve Size	% Passing By Weight
63 mm	100
37.5 mm	80 – 90
19 mm	50 – 70
9.5 mm	30 – 55
4.75 mm	20 – 40
2.36mm	15 – 30



1.18 mm	10 – 22
0.6mm	6 – 18

Table GAP100 Hardfill Grading Envelope Requirements

Sieve Size	% Passing By Weight
100.0 mm	100
75.0 mm	80 - 95
37.5 mm	50 - 75
19.0 mm	40 - 60
9.5 mm	27 - 46
4.75 mm	20 - 34
2.36 mm	15- 25
0.6 m	6 - 13
0.075 m	0 - 5

200.9.3.2 Sand

Sand for backfill of undercut areas or elsewhere as directed shall be clean sharp sand, and shall be approved in advance by the Engineer.

200.9.4 Bulk Earthmoving

On-site fill material shall be brought to appropriate moisture content prior to compaction by drying and/or blending as necessary. Oversize material shall be broken up into lumps not greater than 100mm size, be spread uniformly in layers of not more than 200mm loose thickness, and be compacted to the specified minimum strength and density.

Crushing to the approved maximum size may be achieved on the fill or the oversized material may be disposed of within the Contract area as instructed by the Engineer.

Specialised rollers (e.g. "sheep-foot" type), shall be used for fill compaction. Equipment used in transportation and spreading will not be permitted as compaction equipment. Compaction plant shall cover the entire area and subject each layer to a uniform degree of compaction effort. Each layer shall receive at least 4 passes of the roller or as many as necessary to achieve the strength and density requirements. The thickness of each layer shall be limited to ensure that the specified compaction is achieved for the full depth of each layer. Filled areas shall be sealed off with appropriate plant when rain is impending. The Contractor shall carry out, control tests as required on the fill.

200.9.5 Over-Excavation

The Contractor shall direct his operations to avoid excavating beyond the designated profiles. Any over-excavation shall be made good to the direction of the Engineer with compacted fill meeting the requirements of the Specification, all at the Contractor's expense.

200.9.6 Benching

After clearing and stripping of topsoil in the fill area, the ground shall be inspected by the Engineer for any possible unstable areas or exposed unsuitable materials. All such identified materials shall be excavated and the cut areas backfilled and approved prior to the commencement of bulk filling.

Slopes with gradients steeper than 1 vertical to 3 horizontal (1v:3h) shall be benched prior to bulk filling.

Benches shall as far as possible be the width of a machine (but not less than 2.5 m); shall have a slight fall inwards to allow for the control of water, and shall have a longitudinal fall that will ensure adequate drainage and discharge of water.

The rate for bulk earthmoving shall, unless otherwise scheduled, include all such preparatory benching and the Contractor shall allow for such in his bulk earthworks rates.



200.9.7 Depth of Layers

Subgrades

Within 500mm of the finished carriageway subgrade profiles the layers shall be spread to a loose depth not exceeding 150mm.

Bulk Fill

Elsewhere the layers shall be spread to a loose depth not exceeding 200m.

200.9.8 Control of Water Content

At all times the fill material shall be compacted within the specified allowable variation of the optimum water content.

If the Engineer considers the fill material is too wet for efficient compaction, or finds after testing that the moisture content of placed fill is not within the tolerances specified below, he shall order compaction operations to cease and instruct the Contractor to disc the material and allow it to dry, or take other appropriate measures to achieve the required water content for efficient compaction.

If the material has become too dry, the Contractor will be instructed to apply sprinkled water to ensure a uniform distribution throughout to layer.

Whether drying, wetting or a blending operation has to be carried out, the Contractor shall ensure that the material is broken up into lumps not greater than 100mm in size.

When the material has regained its optimum water content after the moisture adjustment process, it shall be recompacted and reshaped as specified.

Before Tendering the Contractor shall familiarise himself with soil and moisture conditions from the geotechnical information provided and the site. No extra payment shall be made for drying wet material or wetting dry material unless agreed to by the Engineer before work is carried out.

200.9.9 Standards of Compaction Required

The standard of compaction and method of determination shall be as set out in NZS4431 and NZS4402. Where this is not applicable the requirements shall be specified by the Geotechnical Engineer.

Fill material shall be placed in layers not exceeding loose depth noted in 200.9.7 and compacted with a sufficient number of passes of approved compaction equipment throughout the whole area and depth of each layer to comply with the following criteria:

The insitu dry density of the fill shall average not less than 95% of the maximum dry density of the fill material; and no single measurement of insitu dry density shall be less than 93% of the maximum dry density so determined.

The Geotechnical Engineer may undertake further tests on the natural soils before and/or during earthworks to establish and/or confirm required compaction standards for the particular natural materials on site.

If standards are to be amended, these will be directed by the Engineer onsite. The Contractor shall ensure that he has made due allowance in his tender for variance of natural materials, moisture contents and associated compaction requirements.

200.9.10 Rolling

The Contractor shall submit to the Engineer the compaction method and compaction equipment proposed to be used. The number of passes of the machinery required to produce the compaction specified shall be determined by the Contractor and confirmed by the Engineer. This number of passes shall be a guide to the Contractor as to the minimum amount of rolling required to be carried out, but shall in no way exempt the Contractor from full compliance with the compaction specification. The movement of all construction vehicles and incidental traffic shall be evenly distributed to prevent the formation of distinct wheel tracks and to ensure that any compaction effected by those vehicles is uniform throughout the filling areas. All fill placement shall in general conform to NZS 4431 and NZS 4404.



200.9.11 Compaction Testing

The Contractor shall arrange for regular control tests to ensure that adequate compaction has been attained over the entire area where fill materials are placed. Frequency of testing shall conform with NZS 4431 and control testing in accordance with NZS 4402.

All costs associated with the retesting of any unsatisfactory fill areas shall be borne by the contractor.

The earthworks will not be passed nor certified, nor final payment made, until the Engineer/Geotechnical Engineer is satisfied with the standard of work.

200.9.12 Subgrade Formation

On completion of subgrade formation, to the satisfaction of the Engineer, a joint inspection shall be carried out to determine compliance for shape, grade, strength and uniformity.

Longitudinal and transverse shape and grade checking shall be determined by the use of:

- i. A 3m straight edge.
- ii. Taut string lines and steel tape offset measurements.
- iii. Electronic survey equipment.

In all cases the tolerance must be within the range of +0 and -30mm to the designed or nominated levels. No gradient or cross-fall shall vary more than 10mm in a 3 metre length when compared with the true gradient or cross-fall

The final subgrade formation shall not locally pond water.

200.9.12.1 Protection of the Subgrade

The Contractor shall be responsible for the protection and care of the subgrade at all times and particularly during wet weather. He shall construct at no extra cost all necessary temporary drains to provide such protection. The whole of the subgrade shall be kept graded at all times to ensure that no areas pond water. The Contractor shall protect the subgrade from damage by laying planks when directed and shall take other precautions as needed. In no case shall vehicles be allowed to travel in a single track. If ruts are formed, the subgrade shall be reshaped and recompacted. Storage or stockpiling of materials on top of the subgrade shall not be permitted.

Any areas found to lack the specified accuracy or to have suffered deterioration shall be scarified, reshaped by adding, removing or replacing material, dried, watered, recompacted or otherwise treated until the specified requirements for the sub-grade and its surface are obtained

200.9.12.2 Subgrade Testing

When the Contractor considers that the preparation of the subgrade is complete in accordance with the above criteria, and that the condition and strength of the subgrade is suitable for the construction thereon of the sub-basecourse and basecourse layers, he shall request that an inspection of the subgrade be carried out by the Engineer. The Contractor shall supply the results of all subgrade tests to the Engineer prior to the inspection, and shall carry out such further tests as the Engineer considers to be necessary to confirm the strength and condition of the subgrade. If so directed by the Engineer, the Contractor shall test roll the subgrade in the presence of the Engineer. This test rolling shall be by a 10 to 15 tonne rubber tyred roller, a fully loaded motor scraper, or similar plant item.

For each section of subgrade which has been prepared and completed, testing shall be carried out as follows:

The in-situ CBR shall be determined by testing with a dynamic cone (Scala) penetrometer to a depth of not less than 1 metre. Should any area fail to meet the design CBR the Engineer is to be notified and further works required to achieve the design requirements will be determined including the application of additional compactive effort to the top of the subgrade layer, stabilisation, undercutting etc. Following these works further testing with a dynamic cone Scala penetrometer as above will be undertaken.

Should any area still fail to meet the above deflection criteria, additional Scala penetrometer tests shall be carried out at closer intervals as directed by the Engineer to define areas of failure.



The Contractor shall not commence the construction of the subbasecourse layer until the Engineer's acceptance of the subgrade is given. If during pavement construction, sealing or maintenance period, failure of any portion of the carriageway occurs which is attributable to the failure of the sub-grade then the Contractor shall make good the carriageway at his own expense.

Should the Engineer consider that the Contractor has not fulfilled his obligations to the extent that softening of, damage to, or failure of the subgrade occurs and that, in the opinion of the Engineer, remedial measures are necessary to restore the subgrade and any subsequent work to their original condition, the Contractor shall carry out such remedial works at no cost to the Principal.

200.9.12.3 Testing

Testing of subgrade, fill etc. shall be carried out in accordance with the following tables. All testing shall be carried out by the Contractor.

Table: Soil Tests Before Compaction		
Soil Type	Test	Frequency
Cohesive	Maximum Dry Density	Once per material type
	Liquid Limit	
	Plastic Limit	
	Plasticity Index	
Cohesionless	Maximum Dry Density	Once per material type
	Liquid Limit	
	Plastic Limit	
	Plasticity Index	
All	Moisture content	As required

Table: Soil Tests After Compaction		
Location	Test	Frequency
Bulk Fill	Surface Levels	20m grid
	Density/Moisture Content	1 per 900m ³ per layer
	Scala Penetrometer	20m grid
Subgrade	Surface levels	20 metre intervals
	Straightedge	Continuous
	Proof Rolling	Continuous
	Density/Moisture Content	20m intervals/lane
	Scala penetrometer	20m intervals/lane
	CBR Test	as directed

200.10 Re-spreading topsoil and grass establishment

On completion of earthworks to the satisfaction of the Engineer, topsoil shall be re-spread from stockpiles to the depths shown on the drawings, or other such depths as the Engineer may direct.

The topsoil shall be prepared so that the top 20mm is free of clods and is open textured and ready for the application of the seed mixture. The remaining topsoil layer should be firmly compacted.

Grass establishment shall be timed to take advantage of the local optimum growth period.

Grass seed shall be of a type approved by the Engineer and shall be supplied by the Contractor.

It is the Contractors responsibility to ensure a satisfactory strike (not less than 75% coverage) and any unsuccessful coverage shall be made good at the Contractor's cost.

200.11 Protection and maintenance

The Contractor shall be responsible for the reinstatement of any damage within or outside the Contract area attributable to the operations of the Contractor. The Contractor shall at all times ensure that the works are



carried out in a way that prevents the deposition of material on land outside the Contract area by the action of water or causes attributable to the operations of the Contractor.

Any damage or deposition occurring during the Contract and period of maintenance, will be reinstated to the satisfaction of the Engineer at the Contractor's cost.

The Contractor shall be responsible for the stability of all cuttings and embankments until the end of the maintenance period and shall at his own cost, make good any subsidence or failure and replace any portions which have become displaced due to unsatisfactory workmanship, attrition by traffic, inadequate protective/stabilisation measures or any other reasons attributable to the negligent operations of the Contractor.



300 STORMWATER DRAINAGE

300.1 General

Refer to the General Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

300.2 Scope of works

The work comprises the construction complete of all drains, junctions, bends, special fittings, manholes and any ancillary work necessary for the completion of the works in accordance with the Contract Drawings, this Specification and the General and Special Conditions of Contract.

300.3 Related documents

This section makes reference to various standards or documents, which form part of this Specification unless otherwise qualified by this or other contract documents. It should be noted that these documents in turn require reference to other standards. In all cases the standards or other documents are to include the latest version and all amendments current at the time of tender.

Concrete Pipes

AS/NZS 3725 *Design for installation of buried (plus Supplement 1) concrete pipes.*

AS/NZS 4058 *Precast concrete pipes (pressure and non-pressure)*

Plastic Pipes

AS/NZS1254 *PVC pipes and fittings for stormwater and surface water applications.*

AS/NZS4058 *UPVC pipes and fittings for drain, waste, and vent applications)*

AS/NZS2032 *Installation of PVC pipe systems*

AS/NZS7643 *Code of practice for installation of unplasticised PVC pipe systems*

Other

NZS3109 (plus amendments 1 and 2) *Concrete construction*

BS7874 *Method of test for elastomeric seals and joints in pipework and pipelines.*

AS/NZS2566 (plus supplements 1 and 2) *Buried flexible pipelines — structural design and installation.*

NZS4404 *Land Development and Subdivision Infrastructure.*

300.4 MATERIALS

300.4.1 Pipes

Pipes shall be of the material, class and jointing type nominated on the Drawings and shall comply with the relevant specification listed in TNZ F/3, NZS 3725, NZS 2566, NZS 4452 and AS/NZS 5065.

It is noted that all drainage pipes shall include a suitable jointing system that is water tight and that will limit potential displacement between pipes to the satisfaction of the Engineer.

300.4.2 Castings

Castings shall be made from grey iron of a quality not less than that specified as grade ENGJL-150 in BS EN 1561 and shall be free from all defects. Castings shall be hot dipped in bitumen. Covers and grates shall not rock in their frames. Where shown in the Drawings castings shall be “Gatic Non-Roc”.



300.4.3 Step Irons

Step irons for manholes shall be of the type as detailed in NZS 4404 formed from 20mm diameter round Type 316 stainless steel rod.

300.4.4 Concrete

Concrete work shall be in accordance with this Specification. Unless stated otherwise, concrete shall have minimum 28 day strength (f'c) of 20MPa.

300.4.5 Granular Pipe Bedding

Granular pipe bedding shall be AP20 gravel or crushed stone complying with the grading requirements of NZS 4452. The compaction fraction shall be less than 0.1.

300.4.6 Hardfill

Hardfill shall be GAP65 satisfying the requirements of NZS 3725 and NZS 2566, unless specified otherwise on the Drawings. Crushed demolition material shall not be used as hardfill in trenches.

300.4.7 Sand

Sand for pipe bedding and backfilling shall be clean sharp sand.

300.5 CONSTRUCTION

300.5.1 General

Construction of pipe drains and culverts shall be carried out in accordance with TNZ F/3 and/or NZS 4452 as applicable.

Where required, all drainage work shall be carried out by a suitably experienced and competent drain layer using best trade practice. Works shall also meet the requirements of the Cook Islands Building Code as required.

Special consideration is to be given to the proper bedding out at the spigots of reinforced concrete pipes to ensure that the full length of each pipe barrel is completely supported by bedding material, and is not subjected to bending and possible circumferential cracking.

Additions and/or modifications to TNZ F/3 and NZS 4452 are set out below.

300.5.2 Salvage of Existing Pipes

Obsolete pipes shall be excavated and removed or grouted, as shown on the Drawings. All removed pipes shall be removed from site, becoming the property of the Contractor.

300.5.3 Trench Excavation

Concrete, asphalt or chip sealed pavements and footpaths shall be saw cut parallel to and 300 mm outside the edges of the proposed trench. The pavement surfacing shall be carefully removed prior to excavation.

The maximum trench width from the trench invert to a height of at least 150 mm above the top of the pipe shall not be greater than the external diameter of the pipe plus 400 mm for pipes up to 600 mm diameter and plus 600 mm for pipes over 600 mm.

The trench width for corrugated steel pipes shall be the external pipe diameter plus one metre or half the pipe diameter either side of the pipe, whichever is the smaller.

300.5.4 Bedding

Pipes shall be laid upon granular pipe bedding except where expressly detailed otherwise in the Drawings.



Corrugated polyethylene pipes shall be laid on compacted granular material of the following minimum thickness:

100 mm in sands and gravel

200 mm in silts and clays

300 mm in rock

Bedding material for corrugated polyethylene pipes shall be shaped to the curvature of the invert and shall be of sufficient width to permit effective compaction of backfill under the haunches of the pipe. A uniform blanket of sand 50 mm thick shall cover the shaped, compacted bedding material before setting the pipe in place.

300.5.5 Pipe Laying and Jointing

Pipes shall be laid to the lines, grades and invert levels indicated on the Drawings. The installed pipeline shall have a uniform gradient and the pipe invert level at any point shall not vary more than ± 10 mm from the specified design invert level, except that where the design gradient is 1% or flatter, the pipe invert level shall not vary more than ± 3 mm from the design invert level.

Pipes shall be clean and free from dirt or mud on the inside and, in the case of pipes requiring concrete surround, on the outside as well, before laying. Debris shall be prevented from entering the pipes during laying.

The method of lifting and installing of pipes shall prevent damage to the pipes and bedding material.

All pipes shall be laid by a suitably experienced and competent drain layer.

The jointing of pipes to a manhole or other structure shall be carried out in accordance with the requirements of NZS 4452 except that:

Stub connections shall be provided for all pipe connections to a manhole or other structure and shall project not more than 300 mm from the structure for pipes up to 350 mm bore diameter, and not more than 600 mm from the structure for pipes over 350 mm bore diameter. Connections shall be surrounded and haunched with concrete to a minimum distance of 200 mm from the manhole

Where there is likelihood of relative vertical movement in the case of RC pipes less than 350 mm bore diameter, the RC pipe joined to the stub pipe shall be no longer than one metre and shall be flexibly jointed at both ends

For flexible pipes into concrete structures the Contractor shall follow the written requirements of the pipe manufacturer

300.5.6 Backfilling

(a) General

No backfilling shall be done until laying and jointing of the line has been checked and certified, in accordance with Contractors QA system.

Backfilling of trenches and around manholes and other drainage structures, constructed outside of pavement areas, shall be completed with "selected fill" complying with and placed and compacted as specified in TNZ F/3, unless where shown otherwise on the Drawings.

Heavy construction equipment shall not be operated over or near such pipes, or within 1m of the trench, until a minimum cover of 0.6 metre compacted depth has been achieved.

Any pipe moved or damaged during compaction shall be replaced.

(b) Hardfill Backfill



In existing paved areas, or where shown on the Drawings for future paved areas, backfill for trenches and around manholes and other drainage structures shall be hardfill as specified. Hardfill backfill shall be placed in layers not exceeding 150 mm loose thickness. Each layer shall be compacted with approved mechanical compaction equipment before the next layer is placed.

Prior to pavement surfacing newly laid small diameter RC pipes (less than 450mm-dia) are to be inspected by CCTV to ensure pipe has not suffered circumferential cracking because of poor bedding or handling. If cracking is evident the defective pipes shall be replaced.

(c) Reinstatement in Existing Pavement Areas

Backfill material in existing pavement areas above subgrade level shall match that of the existing pavement. It shall be placed and compacted in accordance with TNZ B/2.

The surface of the trench shall be reinstated to a standard equivalent to the existing surface.

Any seal edge previously saw cut and subsequently damaged shall be resawn and made good prior to final surfacing works.

(d) Reinstatement in Existing Grassed Areas:

The final 150 mm of backfilling shall be clean topsoil, free from stones, and sown with grass.

300.5.7 Concrete Structures

(a) General

Concrete work shall be carried out in accordance with the CONCRETE FOR MINOR WORKS Specification, noting the additions and/or modifications set out below.

(b) Sumps (Catchpits)

Sumps shall be constructed as shown on the Drawings. Sumps shall be constructed in the positions and to the invert levels shown on the Drawings.

The quality of materials, formwork and workmanship shall be such that on completion, a smooth even surface is obtained without plastering. The shafts shall be carried up to such height that when cast iron frames are set in position the top of the frame shall be 50 mm below the finished surface of the adjacent channel, roadway or existing ground, as is appropriate, except where otherwise required. Walls shall not be poured directly against the ground.

Precast catchpits meeting the requirements of NZS4404 may be used. Pipe connections shall be haunched and surrounded with concrete to a distance of 150 mm from the catchpit wall.

(c) Cast in Place Manholes

Manholes shall be constructed as detailed in NZS4404 from 20 MPa concrete, unless shown otherwise on the Drawings. Manholes shall be constructed in the positions and to the invert levels shown on the Drawings.

Where practicable, manhole inverts shall be formed with a half pipe centrally bedded in concrete. In all other cases, the channels in the floor of the manholes shall be formed in concrete rendered with cement mortar and finished with a steel tool and neat cement. Leaks shall be carefully stopped and the manholes made watertight. Benching in manholes shall be rendered with cement mortar and finished as above. Pipe ends shall finish 13 mm short of the inside wall and be plastered with cement mortar. Pipes shall be haunched and surrounded with concrete to a minimum distance of 200 mm from the outside of the manhole. In manholes over 900 mm deep, step irons shall be built into the manhole wall in a line vertically above the outlet pipe.

Manhole roof slabs shall be set to levels to ensure the finished cast iron lid levels and slopes will coincide with the surrounding road, path or ground surface as the case may be. Roof slabs and lids shall be heavy duty unless expressly noted to the contrary.



Where shown on the Drawings, junctions shall be constructed into the manhole. Junctions which are not to be connected during the contract shall be sealed.

(d) Precast Manholes

Precast manhole components shall be assembled and jointed strictly in accordance with the manufacturer's written recommendations, and shall consist of centrifugally spun reinforced concrete flush-jointed pipes of the diameters shown on the Drawings. Holes for step irons shall be factory made with step irons bolted into the manhole wall and the outer end of the holes filled flush with mortar. The base benching and mortar shall be constructed in accordance with the detail shown in NZS 4404, unless shown otherwise on the Drawings. Connections shall be haunched as specified above.

Manholes 2.4 m and less to invert shall be constructed from one precast section. Manholes over 2.4 m deep shall have a bottom section of minimum length 1.8 m. Excepting at the base, all joints in the manholes shall be sealed with RB 200 sealant and held together with approved stainless steel replaceable tie bolts on the inside of the manholes.

All manholes shall be watertight.

(e) Inlet and Outlet Structures

Inlet and Outlet structures shall be constructed in accordance with the Drawings complete with concrete apron and flow-dissipation and riprap. (f) Junction and Branch Connections

Where shown on the Drawings, 'Y' Junctions shall be laid in the new drainage lines for future connections. All connections shall be fitted with factory sealed stoppers.

300.5.8 Concrete Encasing and Capping

Where concrete encasing or capping is required, 17.5 MPa concrete shall be used. Unless otherwise detailed, concrete encasing shall be discontinuous at each pipe joint.

300.5.9 Boring and Jacking Installation

Installation shall be carried out with an approved system by an experienced operator and so that no disruption to traffic or damage to the roadway occurs. Pipe shall be installed concurrent with the boring operations unless a jacking sleeve is used. Water shall be prevented from entering the excavation.

300.6 TESTING AND ACCEPTANCE

All pipelines shall be inspected both before backfilling the trench and after all backfilling and surface reinstatement is completed.

The following tests shall be undertaken:

All pipelines and associated sumps, catchpits and other elements shall be surveyed to confirm final position and grade

All pipelines shall be inspected for line and grade. Sighting through each line between manholes and/or outlets after backfilling shall show a full circle at the far end with all pipes concentric

Inspection before final surfacing of 450Ømm diameter or less RC pipe to check for possible cracking resulting from poor bedding or handling. Prior to inspection the pipelines shall be cleaned by flushing

Any elements not meeting the requirements shall be re-laid.



400 CONCRETE FOR MINOR WORKS

400.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

400.2 Scope

This specification covers supplying and placing portland cement concrete for minor structures and incidental construction, and includes reinforcing steel and formwork.

400.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender.

NZS 3104:2003	Concrete Production
NZS 3112:1986	Methods of Test for Concrete Part 1: Tests relating to fresh concrete Part 2: Tests relating to the determination of strength of concrete
NZS 3114:1987	Concrete surface finishes
NZS 3121:1986	Water and aggregate for concrete
NZS 3122:2009	Portland and blended cements
NZS 3124:1987	Concrete Construction for Minor Works
AS/NZS 4671:2001	Steel bars for reinforcement of concrete

400.4 MATERIALS

400.4.1 Water and Aggregates

Water and aggregates for concrete shall comply with NZS 3121.

400.4.2 Cement

Cement shall comply with NZS 3122, Type GP.

400.4.3 Concrete

All concrete except site concrete shall be manufactured by an approved readymix plant and shall be High or Special grade to NZS 3104.

Slump shall be in accordance with Table 4 of NZS 3124. The nominal maximum aggregate size shall be 19 mm.

Concrete for structures shall have a minimum crushing strength of 20 MPa at 28 days except where otherwise specified.

Weak concrete where required shall consist of 1 part of Portland cement to 6 parts of AP20 aggregate by volume.

400.4.4 Mortar

Mortar shall consist of two or three parts of fine, sharp, well graded sand to one part of cement measured by dry loose volume, well mixed by hand or in a suitable mechanical mixer with just sufficient water to make it



slightly moist. It shall be mixed in small quantities as required. Any mortar not used within 30 minutes of mixing shall be discarded.

400.4.5 Reinforcing

Reinforcing shall be grade 300 bars unless otherwise shown. Welded wire fabric shall comply with AS/NZS 4671.

400.4.6 Marine Grade Concrete

Where required on the Drawings, marine grade concrete shall be used, having the following properties:

Minimum Compressive Strength at 28 days (f'c)	30 MPa
Cement Content (minimum)	380 kg/m ³
Maximum Water Cement Ratio	0.45
Minimum Water Cement Ratio	0.40

400.5 CONSTRUCTION

400.5.1 Excavation and Foundations

Structures shall be constructed on foundations of equal or better strength than specified for subgrade. Excavation including undercut shall be in accordance with the EARTHWORKS specification and as directed by the Engineer. Undercuts shall be backfilled with compacted hardfill.

400.5.2 Formwork

Formwork shall be to the requirements of NZS 3124 as appropriate for this type of construction.

400.5.3 Reinforcing

Reinforcing steel shall be bent and placed in accordance with NZS 3124. Spacers and supports shall be either proprietary or purpose-made using 20 MPa concrete. Bricks, wood or concrete masonry shall not be used as spacers or supports.

400.5.4 Concreting

No concrete shall be placed until the formwork and reinforcing has been inspected and approved.

Concrete shall be placed in accordance with NZS 3124 and as near as possible to its final position. Vibrators shall not be used to move concrete along forms. Vibrators are to be of the immersion type unless otherwise approved.

400.5.5 Finish

Unless specified on the Drawings, surface finishes shall be of the following classes defined in NZS 3114:

- (a) Formed surfaces to be backfilled shall be Class F1.
- (b) Exposed formed surfaces shall be Class F3.
- (c) Unformed surfaces to be backfilled shall be Class U1.
- (d) Unformed surfaces exposed to weathering shall be Class U3.

400.5.6 Tolerances

Unless otherwise specified, tolerances shall be in accordance with Table 2 of NZS 3124.

400.5.7 Defective Concrete Finishes

Concrete that is damaged from any cause, and concrete that is honey-combed, fractured or otherwise defective, and concrete which has surface depressions outside the tolerances specified, shall be cut out and replaced. Minor bulges and abrupt irregularities beyond the specified limits shall be reduced by grinding to approved tolerances. Minor depressions and defects may be repaired by filling. All fillings shall be bonded tightly to the surface of the holes and shall be sound and free from shrinkage cracks and hollow areas after



the fillings have been cured and dried. The Engineer shall determine whether a bulge or depression can be repaired or cut out. Where the repair requires the concrete to be cut out, appropriate size repairs must be made as directed by the Engineer.

Repair of defective concrete finish other than that due to minor porosity of the surface shall be carried out by one or more of the following methods as accepted by the Engineer:

- Concrete removal and replacement
- Hand placed cement mortar
- Pneumatically placed cement mortar
- Epoxy mortar

A method statement for the repair of damaged or defective concrete shall be provided and approved prior to carrying out remedial works.

400.5.8 Backfill to Concrete Structures

All spaces which have been excavated, and the volumes of which are not occupied by the concrete structure, shall be backfilled with suitable material compacted in layers in accordance with the provisions of the specification, or as directed by the Engineer.



500 KERBS, CHANNELS, FOOTPATHS & VEHICLE CROSSINGS

500.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

500.2 Scope

This specification covers the construction of concrete kerbs, channels, footpaths, pram crossings and vehicle crossings.

500.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender.

NZS 3104:2003	Concrete production
NZS 3114: 1987	Concrete surface finishes
NZS 3124:1987	Concrete construction for minor works
NZS 4404:2010	Land Development and Subdivision Infrastructure

500.4 MATERIALS

500.4.1 Mortar

Mortar shall comply with the requirements of the CONCRETE FOR MINOR WORKS specification. Any mortar which is not used within 30 minutes of mixing shall be discarded.

500.4.2 Concrete

Unless otherwise specified, all concrete used in roading and street works shall comply with the requirements of NZS3109, and shall have a minimum compressive strength as indicated on the Contract drawings or specified elsewhere.

All materials used in concrete work including formwork, reinforcement, cement, aggregates, etc. shall be subject to the approval of the Engineer who may reject any materials which he considers will lead to an unsatisfactory finished structure.

500.4.3 Precast Kerbs

Precast kerb blocks shall be manufactured to the dimensions shown in and shall be of the type shown in the Drawings. They shall be precast in 20 MPa concrete and shall be sound and free of blemishes when ready for laying.

500.5 CONSTRUCTION

500.5.1 General

The construction of concrete kerbs, channels footpaths and vehicle crossings shall comply with the requirements of NZS 4404 which shall be deemed to form a part of this Specification except as modified herein.



500.5.2 Kerbs

Kerbs shall be laid accurately to the lines, gradients and levels shown in the Drawings. No kinks or flats will be permitted. String lines shall be inspected for line, gradient and level prior to laying kerb.

Precast kerb blocks shall be bedded on and backed with 10 MPa concrete to the minimum thickness detailed on the Drawings, and shall be flush pointed with mortar.

500.5.3 Channels

Channels shall be cast insitu from 20 MPa concrete in accordance with the details shown in NZS 4404 and to the lines and levels shown in the Drawings. Where shown channels shall be reinforced.

Formwork shall be straight and parallel to kerb lines and shall be sufficiently braced to ensure that no deflection occurs during construction. Concrete shall be poured continuously between stop ends.

Contraction joints in unreinforced channels shall be formed at 4 metre centres, at right angles to the kerb line, by insertion of "Malthoid" D.P.C or equivalent strip. The joint material shall be set flush with the surface and shall be a minimum of 25 mm deep. Contraction joints shall be coincident with joints in precast kerb blocks.

The top surface of channels shall be finished smooth and even with a steel trowel. Channels shall not pond water at any point.

500.5.4 Machine Laid Kerb and Channel

Kerb and channel may be cast insitu using 25 MPa concrete placed by an approved machine operated by skilled personnel. The profiles shall be in accordance with NZS 4404 except where specified otherwise.

Contraction joints shall be formed at 5 metre maximum centres, at right angles to the kerb line, by saw cutting or other approved method. Where a footpath adjoins the kerb, contraction joints shall be coincident with joints in the footpath.

500.5.5 Concrete Footpaths

(a) Preparation

The subgrade shall be excavated and trimmed to achieve a firm, uniform surface, and a layer of approved AP20 granular material shall be placed and compacted with a mechanical compactor to a minimum thickness of 25 mm. The granular layer shall be well wetted with water immediately prior to the placing of concrete.

(b) Setting Out

The line of the footpath shall be carefully set out in accordance with the Drawings. The line shall be straight between tangent points and shall sweep around any curves in a true arc without flats, kinks or angles. Levels, gradients and crossfalls shall be as shown on the Drawings, and the finished surface shall be free draining.

(c) Construction

Footpaths shall be constructed from 20 MPa concrete and shall be 100 mm thick or as shown on the Drawings.

The Contractor shall form contraction joints every 4 m by saw cutting or other approved method. The edges of the paths shall be neatly chamfered. Concrete shall be poured in one operation and without interruption between formed construction joints. The whole of the surface shall be screeded and after the initial set it shall be carefully broomed transversely to present a non-skid surface. The surface shall comply with NZS 3114 class U5. The finished work shall be kept continuously wet by approved means and shall be thoroughly protected from frost and from direct rays of the sun and from drying winds for at least seven days after pouring. The boxing supporting the vertical faces shall not be removed for at least 36 hours after the concrete is placed.



(d) Wheelchair Crossings

Wheelchair and pram crossings shall be constructed in accordance with NZS 4121 Code for the Disabled, or as detailed.

500.5.6 Vehicle Crossings

Concrete vehicle crossings shall be constructed from 20 MPa concrete in accordance with the Drawings and NZS 4404.



600 GRANULAR PAVEMENTS

600.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

600.2 Scope

This specification covers the construction of flexible road pavements using conventional metal sub-basecourse and basecourse material,

600.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender.

NZS4404	Land Development and Subdivision Infrastructure
NZS 4402	Methods of Testing Soils for Civil Engineering Purposes
NZS 4407	Methods of Sampling and Testing Road Aggregates
TNZ B/02 (+ Notes)	Construction of Unbound Granular Pavement Layer
TNZ M/3 Notes	Sub-base Aggregate
TNZ M/4 (+ Changes)	Basecourse Aggregate
TNZ T/1 (+ Notes)	Benkelman Beam Deflection Measurements
TNZ F/2 (+ Notes)	Pipe Subsoil Drain Construction

600.4 General

600.4.1 Protection of existing kerbs, channels and services

The Contractor shall avoid damage to all existing kerbs, channels, footpaths, sumps, manhole tops, pipes or any other services above, at, or below, ground level. Any damage occurring shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

The contractor should allow all costs to marry new work into existing pavements and shall ensure that Road Managers standards are complied with at all times.

600.4.2 Preparation of road subgrade

The construction of the subgrade for roads is described within the technical Specification.

Scala penetrometer tests of the subgrade will generally be required to determine/confirm the pavement design.

A joint inspection of the subgrade shall be carried to determine the extent of weak areas and the best method for their improvement. The responsibility for the cost of such work shall also be agreed at this time.

The Contractor shall then proceed to improve the soil in the weak areas and carry out the final trimming and rolling of the subgrade. Trimming, shaping and rolling shall be carried out using equipment suited to achieving the required profiles and compaction. Trimming and rolling shall be carried out under dry ground and weather conditions and care shall be taken not to over—compact or disturb sensitive soils. Any point on the final surface of the subgrade shall have a level within 30mm of its designated level.

Benkelman Beam tests of the subgrade if required by the Engineer shall be taken in strict accordance with TNZ Specification T1. Test readings shall be taken at 20m centres along the road at 1 and 3 metres from the



face of each kerb line or edgeline. The Contractor may take tests at any other points that he considers necessary. A copy of the results of the tests shall be supplied to the Engineer, and these shall be analysed to assess the adequacy of the subgrade formation.

On completion of any further subgrade improvement work in the areas showing high deflections, the subgrade shall be considered to be complete and the Contractor shall then assume entire responsibility for its maintenance and the subsequent construction of the pavement layers. Any weaknesses which develop in the pavement or subgrade shall be repaired in accordance with the Engineer's instructions at the Contractor's expense.

600.4.3 Trimming

The Contractor shall be responsible for the final trimming and compaction of the subgrade to a tolerance of no more than 30mm below and not above the required level. Surplus material from the trimming shall be disposed of on site as directed by the Engineer. If in the opinion of the Engineer any portions of the subgrade are unsound, the faulty material shall be removed and replaced with material approved by the Engineer and then compacted.

600.4.4 Subgrade Drains

Drains shall be laid where detailed on each side of the road carriageways or accessway as shown on the Contract Drawings and shall discharge into cesspits or other approved outlet. The drains shall be surrounded with clean scoria or drainage filter metal. Filter socks may also be specified.

600.4.4 Subgrade Protection

When the subgrade has been accepted by the Engineer, and all ancillary work has been completed, the sub-basecourse and basecourse metal shall be placed and compacted.

Under no circumstances shall the prepared and compacted subgrade be left uncovered to suffer damage by weather, construction traffic, or any other cause.

Should the Contractor fail to observe this provision, and damage to the subgrade does occur, the Contractor shall meet the full costs of restoring the subgrade to the specified standards immediately before metalling proceeds.

Despite the fact that the subgrade has been approved by the Engineer, should any subsequent weakness in the subgrade develop during metal placing which is attributable to weakness of the subgrade, then the Contractor shall remove the metal, make good the subgrade, and replace the metal and/or sealing to the satisfaction of the Engineer. If it is found during the course of the carrying out of this remedial work that the cause of the above weakness of the subgrade can be shown to have been due to failure on the part of the Contractor to adhere strictly to the terms of the Specification, then no extra payment for the work done or materials used in making good this failure will be allowed to the Contractor.

600.5 Material

600.5.1 GAP 65, GAP 40, GAP 20

The GAP aggregate shall comprise crushed aggregate and must be free of all non-mineral matter.

600.5.1.1 Crushing Resistance

Crushing Resistance shall be not less than 130 kN when the aggregate is tested according to NZS 4407:1991 Test 3.10 "The Crushing Resistance Test".

600.5.1.2 Weathering Resistance

The aggregate shall have a quality index of AA, AB, AC, BA, BB or CA when tested according to NZS 4407:1991 Test 3.11 "Weathering Quality Index test".

600.5.1.3 Sand Equivalent

The sand equivalent shall not be less than 25 for carriageway pavement metal when the aggregate is tested according to NZS 4407:1991 Test 3.6 "Sand Equivalent Test".



600.5.1.4 Permeability

The permeability shall be greater than 1×10^{-4} m/s when tested in accordance with Section 10.6 of Volume 2 of the “Manual of Soil Laboratory Testing” by K H Head. The test samples shall be compacted to the same density as specified for the completed in-situ sub-base.

600.5.1.5 Grading Limits

When tested according to NZS 4407:1991 Test 3.8.2 "Subsidiary Method by Dry Sieving", or Test 3.8.1 "Standard Method by Wet Sieving" where aggregates contain clay or other fine material causing aggregation of the particles, the grading of the aggregate shall fall within the respective envelope defined below.

Test Sieve Aperture	Percentage by Weight Passing		
	GAP 65	GAP 40	GAP 20
65.0 mm	100		
37.5 mm		100	
19.0 mm	40-65	63-81	100
9.5 mm		40-60	52-76
4.75 mm		25-45	33-57
2.36mm		16-35	20-44
1.18 mm		9-27	12-35
600 micron		5-20	7-25
300 micron	10 max	1-15	4-20
150 micron		10 max	12 max
75 micron		7 max	8 max

600.5.2 NZTA M/4 AP40 & AP20

Where specified on the drawings, all metal used for basecourse or running course construction shall comply with the standards/requirements of NZTA specification M/4 2006 and or subsequent issues.

600.6 Construction

No metalling shall start until the subgrade has been inspected and approved by the Engineer who will determine if testing is required to determine any bearing capacity issues.

Where a subbase is specified, it shall be placed as a separate layer and shall be compacted and trimmed to conform with the lines, grades and cross sections shown on the plans. The sub—base shall be inspected and approved by the Engineer before any basecourse metalling is carried out.

The depths of metal specified on the Contract Drawings for both the subbase and the basecourse may be subject to alteration. Following inspection or testing, the Engineer will advise the Contractor if any variations are required in the specified metal depths.



600.6.1 Preparing Underlying Course

The sub-base shall be constructed, shaped, compacted and finished in conformity with the provisions of this Specification before placing of basecourse is commenced.

Control of levels between the edges of the pavement shall be by stringing between level stakes or steel pins placed in lanes parallel to traffic routes at intervals not exceeding 20 metres or by means of laser levelling equipment.

600.6.2 Supply, Placing, Compaction and Testing

The supply, placing, compaction and testing of the Sub base and basecourse layers shall be carried out in strict accordance with TNZ B/2 specification.

Placing procedure shall be such that no damage to, or rutting of, the subgrade or sub-base occurs. Cartage shall be arranged such that trafficking of the subgrade is avoided, and trafficking of the subbasecourse is minimised. Particular care shall be taken that traffic is not concentrated in any area.

600.6.3 Surface Shape, Surface Finish, Construction Tolerance

Should the finished surface be loose or 'bony' the contractor shall undertake remedial actions as directed by the Engineer at no additional cost. Remedial actions, such as the ones detail below, shall be discussed and agreed with the Engineer on site.

Take up, replace and re-compact all "bony" areas.

Tighten up with the addition of small amount of approved binder fraction following by light watering to ensure optimum compaction is achieved. On no account shall a skin of fines be allowed to form on the basecourse surface.

Refer to TNZ B/2 specification for other surface shape, surface finish and construction tolerance requirements.

600.6.4 Protection and Caring

Where a running course is proposed, construction of the running course shall comply with TNZ B/2 specification, clause 10.

Cartage equipment may be routed over the basecourse provided no damage results, and provided that such equipment is routed over the full width of the basecourse to avoid rutting or uneven compaction. Where any damage is caused by cartage over the basecourse layer, the Constructor shall undertake remedial actions as directed by the Engineer at no additional cost.

600.6.5 Benkelman Beam Deflection Testing

Benkelman Beam testing shall be carried out on top of the basecourse in accordance with TNZ T/1 specification at 20m intervals in each lane in both wheelpaths. The acceptance criteria shall be agreed prior to the commencement of testing on site or as noted on the design drawings. The acceptance criteria may vary for different pavements with different subgrade types.

600.6.6 Presealing

Refer to TNZ B/2 specification, clause 12 for presealing requirements. Joint pre seal inspection shall be carried out by Engineer and Constructor prior to the commencement of surfacing or construction of the upper pavement layer(s).

The finished basecourse surface is expected to be smooth, even, tightly bound and free from sudden changes in profile that will affect the finished surfacing. The surface is to be free from slurry or excessive fines, the surface is to be broomed with a stiff bristled rotary broom and is to be a mosaic surface with larger aggregate bound by smaller aggregate.

Where in the opinion of the Engineer the surface is deemed not to meet these requirements the Contractor will at their cost undertaken remedial works as agreed with the Engineer to rectify the surface profile such as ripping and compacting, drag brooming etc.



600.6.7 Testing

Table 210.3 specifies the minimum acceptable testing frequency for each modified layer.

Table - Minimum Test Frequency

Test Property	Frequency
---------------	-----------

Source Property Testing including:

Particle Size Distribution Bearing Strength Crushing Resistance Weathering Resistance Sand Equivalent Clay Index Plasticity Index Broken Face Content Permeability	Prior to agreement of material source and 1 test for each 10,000m ³ of source material used.
Maximum Laboratory Dry Density and Optimum Moisture Content Solid Density (NZS 4407 Test 3.7 or ASTM C127/128)	Prior to agreement of material source and 1 test for each 5,000m ³ of source material used.
For running course material testing only: Crushing Resistance Particle Size Distribution	1 test per material source

Production Property Testing including:

Particle Size Distribution Sand Equivalent Clay Index Plasticity Index	2 tests per 1-400m ³ lots size 3 tests per 400-1500m ³ lots size 4 tests per 1500-4000m ³ lots size. Where the lot size exceeds 4000m ³ , additional testing at the rate of 1 test for every 1000m ³ .
Crushing Resistance Broken Face Content Weathering Resistance	2 tests per source 4 weeks before use on site.

In-situ Testing including:

Particle Size Distribution Sand Equivalent or Clay Index/Plasticity Index (Mat Test)	1 test per 1,000m ³ of material placed.
---	--



Compaction test including Degree of Saturation test immediately prior to surfacing	For each compacted layer. 1 set of test (5 random test points) per lot. If lot size exceeds 1000m ² , additional test at a rate of 1 set for every 1000m ²
Surface level, thickness, surface shape and crossfall	each 20m cross section
Visual Inspection prior to the commencement of the upper pavement layers or surfacing	entire site
Benkelman Beam Deflection	1 test per 20m interval staggered, in both wheelpaths of each lane.

600.6.8 Acceptance Criteria

In addition to compliance with TNZ B/02 Construction of Unbound Granular Pavement Layer the following acceptance criteria is to be utilised.

Table: Compaction testing

	Carriageway	Footpath	Berm
Basecourse	98% MDD or IV 40	IV 30	N/A
Sub-base	95% MDD or IV 30	IV 30	N/A
Deeper Fill	IV 25	IV 15	IV 10

IV = impact value

Compaction testing must be carried out:

- by a suitably qualified person;
- using equipment with a current calibration certificate;
- as specified in the Reasonable Conditions and Quality Plan; and
- as necessary to achieve the standards in the Table above at all depths of any backfill.

A lesser compaction for sand may be approved by the Road Manager if it can be clearly shown that the compaction is at least as much as the undisturbed sand in the adjoining ground.

In the case of low volume roads a minimum impact value of 35 for carriageway base course may be accepted by the Road Manager as an alternative to specifying a maximum dry density (MDD).

The above specifications do not remove the responsibility of the Contractor to ensure that no settlement occurs.

Also note that:

- The Clegg hammer may be used for testing of general fill and base layers of Carriageways;
- Clegg hammer tests only indicate the compaction of the lift last laid of any backfill layer. The impact tester method covers material of 37.5mm and down and may not be suitable for sub-base material with larger stone sizes.

The Contractor must retain the test records and make them available to the Engineer.

Any areas which do not comply with this specification shall be rejected, and reconstructed as agreed with the Engineer.



700 CEMENT AND LIME TREATED COURSE

700.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

700.2 Scope

This specification covers the construction of one or more courses of a mixture of granular pavement materials, cement, lime, a blend of cement and lime, and water in accordance with this specification, and in conformity with the lines, grades, thicknesses, and typical cross sections shown in the Drawings.

700.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender. All Materials and workmanship shall comply with these Standards unless expressly noted otherwise.

ASTM C25	Chemical Analysis of Limestone, Quicklime and Hydrated Lime
NZS 3121	Water Aggregate for Concrete
NZS 3122	Portland and Blended Cements
NZS 4402	Methods of testing soils for civil engineering purposes
NZS 4407	Methods of sampling and/or testing road aggregates
NZTA B/6	Specification for in situ Stabilisation of Bound Subbase Layers
NZTA T19	Draft Specification for Mix Design Testing of Modified and Bound Pavement Layers
NZTA B/7	Specification for the Manufacture and Construction of Plant Mixed Modified Pavement Layers
TNZ M/15	Lime for use in Soil Stabilisation NZS4404 Land Development and Subdivision Infrastructure
TNZ T/1 (+ Notes)	Benkelman Beam Deflection Measurements

700.4 MATERIALS

700.4.1 Cement

Cement shall comply with NZS 3122, Type GP.

700.4.2 Lime

Lime shall be calcium oxide (quicklime) in accordance with TNZ M/15.

700.4.3 Water

Section 5 of NZTA B/6 and NZTA B/7 are deleted from this specification.

Water shall comply with NZS 3121. Water from sources other than a public water supply shall be tested for compliance as described in section 3.4 of NZS 3121.



700.4.4 Imported Aggregate

All imported aggregate for stabilisation shall comply with the Sub-basecourse specification.

700.4.5 Existing Aggregate

All existing basecourse or subbase materials for in-situ stabilisation shall be uniform in quality and gradation. The selected aggregate material for stabilisation shall be free of roots, sod, weeds and shall have a maximum aggregate size no larger than 60mm.

700.5 CONSTRUCTION

700.5.1 Sampling of Representative Stabilising Materials

Prior to commencing stabilisation works, the Contractor shall obtain samples of the existing granular pavement materials for stabilisation from test pits located at regular intervals so that one set of testing covers less than or equal to 2000m² of carriageway areas. Where the granular pavement material varies within any lots, the Contractor shall increase testing intervals as agreed with the Designer. Test pits shall be excavated to the nominated depth and the layers of existing aggregates or soils shall be carefully logged.

Where imported aggregate materials are specified on the design drawing for in-situ stabilisation, the Contractor shall obtain representative aggregate samples from the stockpile or directly from the quarry supplying the aggregate for stabilisation for the purpose of mix design. One set of testing is required where all imported aggregate is uniform in quality, gradation and from a single consistent source. Where different aggregate suppliers are proposed, testing shall be repeated for every new supplier.

Test samples of the layer(s) to be stabilised shall be prepared from materials recovered from the test pits for stabilisation of existing granular pavement or from the stockpile or the quarry supplying the imported aggregate. Test samples shall be thoroughly mixed to replicate the action of in-situ mechanical stabilisation.

Where the layer to be stabilised incorporates some imported material then a sample of the imported material passing the 19mm sieve shall be added to the test sample in the proportion of the expected depth of imported material that will be required to attain the design levels. (Note that the proportion may vary between test pit locations).

Where existing asphalt layer(s) are present within the stabilising depth, and provided the total thickness of asphalt layers does not exceed 100mm, the Contractor can incorporate the correct portion of the pulverised asphalt material, with a maximum dimension of any piece of asphalt less than 19mm, into the stabilising mix for testing.

700.5.2 Mix Design Testing

Mix design testing shall be carried out to determine an agreed blend of additives, for modified and/or stabilised subbase as follows:



Table C0211.1 - Mix Design - Percentage of Stabilising Additives

Aggregate / Stabilisation Type/Test Criteria	Imported Aggregate for 4% cement stabilisation	Existing Aggregate or a blend of existing / imported aggregate for 4% cement stabilisation	Imported Aggregate for 2% cement modification
Trial cement / lime blends ^{1,2}	3% cement 4% cement 5% cement	4% cement, 1% lime; 4% cement, 2% lime; 5% cement, 1% lime	2% cement, 0% lime; 2% cement, 1% lime; 2% cement, 1.5% lime
MDD, OMC	Testing to NZS 4407 Test 4.1.3 (vibrating hammer) to determine maximum dry density and optimum moisture content is required. One test per aggregate blend shall be carried out.		
Aggregate / Stabilisation Type/Test Criteria	Imported Aggregate for 4% cement stabilisation	Existing Aggregate or a blend of existing / imported aggregate for 4% cement stabilisation	Imported Aggregate for 2% cement modification
Grading (wet) and PI	Testing to NZS 4407 Test 3.4 and 3.8.1 to determine the plasticity index and particle size distribution (wet) are required. One test per aggregate blend shall be carried out.		
UCS ³	Unconfined compression tests to NZS 4402 Test 6.3.1 shall be carried out with 3 cement/lime blends per aggregate blend. One test per cement/lime blend shall be undertaken. The cylinders shall be moist cured at 40°C for a minimum of three days and immersed in water for four days before testing.		
ITS ³	Indirect Tensile Test (ITS) tests to draft NZTA T19 specification shall be carried out with 3 cement/lime blends per aggregate blend. Two dry ITS tests per cement/lime blend shall be undertaken. Note that all ITS testing shall be undertaken with a strain rate of 1mm/min.		

Mix Design Acceptance Criteria

UCS	3.5MPa min	1MPa max
ITS Dry	1000kPa min	Within 150-350kPa
ITS Wet	-	Within 100-300kPa
TSR = ITS Wet/Dry	-	65% min

Note:

- Other cement/lime blends can be tested as agreed with the Engineer.
- Where plasticity index of the stabilising aggregate (tested in accordance with NZS 4407 Test 3.4) is less than 10, lime is not required in mix design.
- Compaction of the UCS and ITS samples shall be carried out in accordance with NZS 4407 Test 4.1.3.

700.5.3 Plant and Equipment

The equipment shall comply with Section 6 of NZTA B/6 and B/7 specifications.

700.5.4 Weather and Time Limitation

Refer to Section 7.1 of NZTA B/6 and B/7 for weather and time limitations.

700.5.5 Surface Preparation

Prior to stabilisation, the surface to be in-situ stabilised shall be brought to grade, compacted and shaped to conform to the typical sections, lines and grades shown in the Drawings.



Refer to Section 7.2 of NZTA B/6 and B/7 for other surface preparation requirements.

700.5.5.1 In-situ Stabilisation

a) Spreading of Stabilising Agent(s) and Addition of Water

Refer to section 7.3 of NZTA B/6 for the requirements of water and stabilising agent(s) addition or spreading.

b) In-situ Mixing

Refer to section 7.5 of NZTA B/6 for the requirements of in-situ mixing.

c) Addition requirements regarding lime stabilisation

Where quicklime is used for stabilisation, it shall be transported to the site on the day that it is to be used, and shall be protected from public access and exposure to dampness at all times. Any lime that has been exposed to moisture before use shall not be accepted. Unless otherwise authorised by the Designer, the quicklime shall be supplied in a granular or pelletized form.

Lime shall be spread only on that area where the mixing operations can be completed on the same working day. Refer to the design drawings for the rate of application of quick lime (or hydrated lime with an adjusted application rate as agreed with the designer). Where hydrated lime is preferred by the Contractor, it may be applied to the partially pulverised material as slurry or in a dry form. Quick lime shall not be applied by the slurry method.

Spreading equipment shall be capable of uniformly distributing the lime without excessive loss and only water trucks and equipment used for spreading and mixing shall be permitted to pass over the spread lime until mixing is completed. Any procedure that results in excessive loss or displacement of the lime shall be discontinued immediately.

700.5.6 Plant Mixed and/or Ex-situ Stabilisation

a) Plant Batching and Mixing

Handling and addition of aggregate and stabilising agent(s), adding of water, batching, mixing, control of grading and testing shall be undertaken in accordance with Section 7.3 of NZTA B/7 specification.

b) Loading, Transportation, Discharging and Construction of Modified Pavement Layers

Refer to Section 7.4 and 7.5 of NZTA B/7 specification for loading, transportation, discharging and other construction requirements.

700.5.7 Compaction

Immediately after in-situ stabilisation, the stabilised layer shall be compacted in accordance with Section 7.6 and 8.1 of NZTA B/6 specification.

Compaction of modified subbase shall conform to Section 7.6 and 8.1 of NZTA B/7 specification.

700.5.8 Construction Tolerance

a) Stabilising Width

All stabilising width shall comply with Section 8.2.1 of NZTA B/6 and B/7 specification.

b) Surface Shape, vertical thickness and Crossfall

The surface shape, thickness and crossfall of the compacted stabilised subbase shall comply with Section 8.2.2 and 8.2.3 of NZTA B/6 and B/7 specification.

700.5.9 Testing



Table C0211.2 - Minimum Test Frequency

Test Property	Frequency
For both in-situ and ex-situ stabilisation	
Subbase source properties, and production testing	Refer to Project Specification GRANULAR PAVEMENTS
Mix Design Testing as per Table 211.1	Once initially and every change in aggregate source and/or insitu stabilisation existing/imported material combination.
In-situ Stabilisation	
Water content before spreading of stabilising agent	One test per 250m ²
Spreading of stabilising agent	One test per 400m ²
Average usage test	Upon emptying the spreader and bulk tanker
ITS (using behind the hoe sample)	Two ITS tests per 5000m ² area or 250m linear metre construction lot, whichever is lesser.
Plant mixed/Ex-situ Stabilisation	
Aggregate, water, cement and/or lime application	Continuous by plant operator or upon emptying the bulk tanker, whichever is applicable
Solid Density (at Mixing Plant)	One test per 3000m ³
ITS (at mixing plant)	Two ITS tests per 1000m ³ area or 250m linear metre construction lot, whichever is lesser.
For both in-situ and ex-situ Stabilisation	
Visual inspection of stabilised material	First 20m run of each construction lot
Maximum Dry Density and Optimum Moisture Content (Laboratory)	One test per aggregate source and repeat at a minimum of one test per 5000 m ² area
Insitu Density / Compaction	Five random tests per 1000 m ² or per lot whichever is lesser. If lot exceeds 1000m ² additional test at a rate of 1 set for every 1000 m ²
Plateau Dry Density	One test per 5000m ² area or per homogeneous section of work completed within a construction shift, whichever is lesser.
Thickness	Once at both ends of the stabilising drum every 200m along the cut length
Surface level	10 x 10 m grid
Benkelman Beam deflection testing on top of stabilized or modified subbase (as noted on design drawings)	10m intervals in both wheelpaths, to be undertaken between 3 to 6 days after compaction of stabilised material.

700.6 PROTECTION AND CURING

Refer to Section 7.8 of NZTA B/6 specification and Section 8.4 of NZTA B/7 specification for protection and maintenance requirements.



700.7 ACCEPTANCE CRITERIA

Any areas which do not comply with this specification shall be reconstructed.



800 BITUMINOUS SEAL COAT

800.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

800.2 Scope

This specification covers the construction of one or more applications of bituminous material and cover aggregate to an existing basecourse, primed or sealed surface.

800.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender.

TNZ M/1 (+ Notes)	Roading Bitumens
TNZ M/6 (+ Notes)	Sealing Chips
TNZ M/13 (+ Notes)	Adhesion Agents
TNZ P/3 (+ Notes)	First Coat Sealing
TNZ P/4 (+ Notes)	Resealing
TNZ Q/1	Chipsealing
TNZ T/3	Measurement of Texture by the Sand Circle Method
TNZ T/5	Size, Shape and Grading of Grades 1-4 Sealing Chips
TNZ Bituminous Sealing Manual	
TNZ P/17	Performance Based Specification for Chip Seals
BCA 9904	Safe Handling of Bituminous Materials used in Roothing
ASTM D977	Specification for Emulsified Asphalt
ASTM D244	Testing Emulsified Asphalt
ASTM D2397	Specification for <i>Cationic Emulsified Asphalt</i>
TNZ (2005) Chipsealing in New Zealand	

800.4 MATERIALS

800.4.1 Sealing Chips

Sealing chips shall be of the graded specified on drawings and shall comply with the requirements of TNZ M/6, P/3 and P/4. All material shall be stockpiled in accordance with TNZ P/3, and sampled to ensure compliance with the specifications. The sampling and testing shall be undertaken by an IANZ accredited laboratory. No material shall be delivered to Site until approved by the Engineer, and all material delivered to the Site shall be from the approved stockpile.

800.4.2 Bituminous Binder

Bituminous binder shall comply with all aspects of TNZ M/1. The Constructor shall be responsible for selecting an appropriate bitumen grade and additives for the traffic, site and environmental conditions.



800.4.3 Diluents

Cutting and fluxing diluents shall comply with the requirements of TNZ M/1. The Constructor shall be responsible for determining the quantity of AGO (if any) and cutter, to be added. Total diluents shall not exceed the quantities specified in Table 1 of NZTA P/3 or P/4 as applicable.

800.4.4 Adhesion Agent

An adhesion agent approved and blended in accordance with the requirements of TNZ M/13 "Specification for Adhesion Agents" shall be incorporated in the sealing binder.

800.4.5 Polymer Additive

Where specified on drawings a polymer additive (minimum of 4% SBS) shall be incorporated into the binder. Other polymer additives can be used in lieu of SBS type as agreed with the Engineer.

Full technical details and Specifications for the Polymer additive shall be submitted to the Engineer for approval.

800.4.6 Blending

Blending of additives, fluxes and AGO shall be carried out by the Constructor in strict compliance with the manufacturers recommendations and all relevant safety regulations and procedures.

The total quantity of each component incorporated into the sealing binder shall be accurately measured by a certified volume metering or weighing device. The binder shall be thoroughly mixed before use.

The Engineer will not supervise this operation. The Constructor shall provide the blending certificates as specified in NZTA P/3 and P/4.

800.4.7 Sampling and Testing

All sampling and testing shall be carried out by the Constructor prior to the commencement of sealing and shall be in accordance with TNZ P/3 or P/4 or this specification as applicable. Sealing shall not proceed until compliance to the Specification is clearly demonstrated.

800.5 PLANT

Construction plant shall comply with the relevant requirements of TNZ P/3 and TNZ P/4.

800.6 CONSTRUCTION

800.6.1 Sealing Period and Working Hours

Refer to NZTA P/3 or P/4 as applicable. And as agreed with the Engineer.

800.6.2 Edge Definition

Refer to NZTA P/3 or P/4 as applicable.

800.6.3 Surface Preparation

Surface preparation for sealing or resealing shall be in accordance with NZTA P/3 or P/4 as applicable.

800.6.4 Weed Killer

A 600 mm wide strip along all edges to be sealed shall be treated with a long term soil sterilant for the purpose of total weed control with an effective period of not less than 12 months.

800.6.5 Binder Temperatures

Binder temperatures shall be in accordance with NZTA P/3 or P/4 as applicable.

800.6.6 Rate of Application

It shall be the Constructor's responsibility to determine the correct application rate for the sealing chips for the seal coat, and the correct application rate and diluent content for the binder, such that the chips are firmly held and bleeding or flushing does not occur. The following procedure shall be followed:



- (a) The Constructor shall calculate the rate of application of sealing chips and binder, using the guidelines in the NZTA document “Chipsealing in New Zealand” or other acceptable method, and shall submit the design to the Engineer, at least 5 working days, prior to application of the seal coat. As a minimum, the calculated application rate shall not be less than the design application rate specified on the design drawings. Sealing work shall not proceed until the design has been accepted by the Engineer.
- (b) The Constructor shall then construct a test strip using the application rate as determined by the Constructor. The test strip shall be checked to ensure that the binder application rate is correct. The binder application shall be adjusted as required.
- (c) Sealing may then proceed using the adjusted application rate, provided that the road surface is not significantly different to that used for the test strip.
- (d) If the surface texture changes significantly, the sealing rate shall be recalculated and adjusted if necessary.

800.6.7 Sealing Operations

Sealing operations shall be in accordance with TNZ P/3 or P/4 as applicable.

800.6.8 Riding Surface

A smooth and even ride, free of bumps and undulations, is required for the finished surface.

Where the surface does not meet this requirement in the opinion of the Engineer then remedial measure shall be undertaken by the Contractor at their own cost until a suitable surface finish and ride quality is achieved.

800.6.9 Testing

The following Table specifies the minimum acceptable testing frequency for bituminous seal surfacing.

Table - Minimum Test Frequency

Test Property	Frequency
Source Property Testing including: Crushing Resistance Weathering Resistance Weak Particles Test Polished Stone Value Size and Shape Cleanness Grading	1 test per 500 m ³
Production Property Testing Cleanness Size and shape Grading	1 test per 500 m ³
Test Property	Frequency
Bituminous Material All standard TNZ M/1	Once initially then as directed by the Engineer
Chipsealing mix design	Once initially per seal type then as directed by the Engineer



Binder application rate	Once upon completion of a sealing operation.
-------------------------	--

800.6.10 Protection and Repairs

Protection and repairs to the completed sealcoat(s) shall be in accordance with NZTA P/3 and NZTA P/4.

800.6.11 Acceptance Criteria

Any areas which do not comply with this specification will be rejected and all defects shall be reconstructed to the satisfaction of the Engineer.



900 ASPHALT (DENSE GRADED ASPHALT)

900.1 General

Refer to the general Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

900.2 Scope

This specification covers the construction of one or more layers of asphaltic mix layers or bitumen stabilised basecourse mix on bituminous emulsion tack coat, prime coat or chip seal(s), placed on a prepared surface. Each course shall be constructed to the depth, typical section or levels shown on the Drawings and shall be compacted, finished and approved before placement of the next course.

900.3 Related Documents

This section makes reference to various standards and TNZ Specifications; the main ones referred to are listed below, but it should be noted that these in turn require reference to other standards. In all cases the standards are to include all amendments current at the time of tender. All materials and workmanship shall comply with these standards unless expressly noted otherwise.

TNZ T/1	Standard Test Procedure for Benkelman Beam Deflection Measurements
TNZ M/6	Sealing Chip
TNZ M/1	Roading Bitumens
AAPA NAS	AAPA National Asphalt Specification
	TNZ New Zealand Supplement to NAS Specification
TNZ M/10	Asphaltic concrete
TNZ P/9P	Construction of asphaltic concrete paving
TNZ P/11	Open Graded Porous Asphalt
TNZ P/23	Performance Based Specification for Hotmix Asphalt Wearing Course Surfacing
BCA E/2	Performance of bitumen distributors
TNZ M/13	Adhesion Agents
	APRG Report No. 18 Selection and Design of Asphalt Mixes
	Asphalt Institute Mix design methods for asphalt concrete Manual Series No.2
NZS 4407	Methods of sampling and testing road aggregates
NZS 4402	Methods of testing soils for civil Engineering purposes
ASTM D2397	Cationic emulsified asphalt
ASTM D1188	Bulk specific gravity of compacted bituminous mixes using paraffin-coated specimens
ASTM D2726	Bulk specific gravity of compacted bituminous mixtures using saturated surface dry specimens
ASTM D2041	Theoretical Maximum specific gravity and density of bituminous paving mixtures
ASTM D3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D3549	Test for thickness or Height of Compacted Bituminous Paving Mixture Specimens
ASTM D4123	Method of Indirect Tensile Test for Resilient Modulus of Bituminous Mixtures
AS 1141	Methods of Sampling and Testing Aggregates
ASTM D2027	Liquid Asphalt (Medium Curing Type)



TNZ Q/2	Hot Mix Asphalt
BCA 9904	Safe Handling of Bituminous Materials used in Roading
AG:PT/T231	Austrroads Test Method: Deformation resistance of asphalt mixtures by the wheel tracking test
BS DD 229	Method for determination of the relative hydraulic conductivity of permeable surfacings
BS DD 232	Method for determination of the maximum binder content of bituminous mixtures without excessive binder drainage
AG:PT/T235	Asphalt Binder Drain-off
AG:PT/T236	Asphalt Particle Loss TNZ M/I (+ Notes) Roading Bitumens

900.4 MATERIALS

900.4.1 Bituminous Materials

Bituminous materials shall comply with TNZ M/1.

Tack coat shall comply with ASTM D2397.

The Contractor shall furnish certified test reports for all bituminous Materials that the Contractor proposes to use in the Works, together with a statement as to their source. The Contractor shall require the manufacturer or producer of the bituminous Materials to furnish Material subject to this and all other pertinent requirements of the Contract. Only those Materials which have been tested and approved for the intended use shall be acceptable.

900.4.2 Mineral Aggregates For Asphalt

Mineral aggregates for manufacturing of;

- Dense graded asphalt shall comply with the requirements of NAS 2004 and NZ Supplement to NAS 2006
- TNZ type mixes, such as Mix10, or Mix15, shall comply with TNZ M10 specification
- Stone mastic asphalt (SMA) shall comply with TNZ P/23
- Bitumen Stabilised Basecourse Mix (SBM) shall comply with the requirements of NAS 2004 and NZ Supplement to NAS 2006

The polished stone value (PSV) for wearing course aggregates shall not be less than that detailed in the Drawings for the various locations of the project. Where a specific wearing course aggregate source is specified on the design drawings, another substitute aggregate source cannot be used without prior written approval from the designer.

900.4.3 Adhesion Agent

An approved adhesion agent shall be incorporated in the mix. The procedures for testing and approval of the adhesion agent shall be in accordance with NZTA M/13.

900.4.4 Membrane Seal

Membrane seal shall comply with all requirements of TNZ P/3. All sealing chip, grade 4 or 5 as specified on the design drawings, shall comply with all requirements of TNZ M/6 specification. All approved sealing binder shall comply with all requirements of TNZ M/1.



900.4.5 Other Additives

Where specified on drawings, or deemed necessary by the Contractor, as part of the asphalt mix design, a polymer additive (minimum of 4% SBS) or sasobit additive (additive content to be nominated by the Contractor) shall be incorporated into the binder. Other polymer additive may be used by the Contractor, subjected to the acceptance of the Designer.

Full technical details and Specifications for the additives shall be submitted to the Designer for approval.

900.5 ASPHALT MIX DESIGN

900.5.1 Job Mix Formula

The Contractor shall be responsible for the design of the hot mix asphalt. The laboratory used to develop the job mix formulae shall be IANZ accredited for the design and testing procedures required.

Work shall not begin, nor shall any mixture be accepted, until the Contractor has established an approved Job Mix Formula for each mixture to be used. The approved Job Mix Formula for each mixture shall remain in effect until notified otherwise in writing by the Designer. The Job Mix Formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature at which the mixture is to be delivered at the point of discharge from the mixer.

900.5.2 Mix Design

All dense graded asphalt mixes shall be designed and tested in accordance with the procedures set forth in NAS 2004 and NZ Supplement to NAS 2006 using either gyratory compaction mix design methods or the Marshall mix design method.

All "TNZ" type mixes, such as Mix10 and Mi15, shall be designed and tested in accordance with TNZ M/10.

All stone mastic asphalt surfacing shall be designed and tested in accordance with TNZ P/23.

All bitumen stabilised basecourse mixes (SBM) shall be designed by the Contractor to NZTA P/23 specification and shall be based on APRG18 methodology. The AC28 grading envelope from NAS 2004 shall be used as a guide for the design of SBM mixes. The source material shall be AP40 basecourse material with no more than 30% of Recycled Aggregate Pavement (RAP or millings) incorporated into the mix. SBM mixes shall comply with the following criteria.

- The total binder content shall not be less than 3% by weight
- The design air void for the SBM mix shall be within 6-8% at 120 gyratory cycles
- VMA of the SBM shall not be less than 13%
- MATTA Resilient modulus of the SBM mixes shall be reported
- Wheel track test results (rut depth at 10,000 cycles) shall be reported

For structural asphalt pavements, the Designer has assumed minimum bitumen content and modulus for each layer. The Contractor shall design mixes to achieve the minimum "unadjusted" resilient modulus and total bitumen content.

Mix10 asphalt prelevelling mix shall be designed in accordance with TNZ M10 specification. Resilient modulus and wheel track tests are not required for Mix10 mix.

The design air void for all AC14, AC20 and AC28 asphalt mixes shall be 4% at 120 gyratory cycles. All AC14, AC20 and AC28 asphalt mixes shall achieve a minimum refusal density of 2% at 250 gyratory cycles.



AC14HB high fatigue resistance mixes shall be designed for “heavy” category. The design air void for AC14HB mixes shall be 3% at 120 gyratory cycles.

MATTA resilient modulus shall be reported for SMA, AC14, AC20, AC28 and AC14HB.

Wheel tracking test shall be carried out for all dense graded asphalt mixes and stone mastic asphalt surfacing mix, except for AC14HB layer. The reported wheel tracking depth, when tested in accordance with Austroad Test Method AG:PT/T231, at 10,000 cycles, shall be less than 6mm.

900.5.3 Approval of Mix Design

At least 10 working days prior to the start of paving operations a Job Mix Formula shall be prepared showing the following data:

(a) A statement detailing:

- The combined aggregate/filler grading and bitumen content of the designed mix, and the intended proportion of each constituent material which will be employed in the production mix
- Graphical plots of stability, flow (for Marshall design method), air voids, voids in the mineral aggregate, and unit weight versus bitumen content, and refusal density voids and wheel tracking results (as appropriate for level designed to in APRG 18 method).
- Bulk specific gravity and absorption of aggregate components
- Bitumen specific gravity at 25oC
- Bulk specific gravity of compacted paving mixture
- Maximum theoretical specific gravity of loose paving mixture • Tensile Strength Ratio (TSR).
- Anti-strip agent (if required).
- Temperature - viscosity relationship of the asphalt binder.
- Bitumen film thickness.
- % by mass of asphalt binder (total and effective) by mass and volume.
- Modulus of mix at standard test conditions.
- Wheel tracking test results
- Refusal air void
- Resilient modulus results
- Bitumen test reports
- Compaction method, including cycle/blow
- Other TNZ P/23 mix design and testing requirements for SMA mixes

(b) A statement detailing the test results obtained on a production run of the submitted mix. The statement shall include as a minimum:

- Date and total quantity of mix manufactured in the production run from which samples were taken.
- Point (quantity) in production run at which sample was taken.
- Percent passing each sieve size.
- Percent of asphalt binder (Total and effective).
- Bitumen viscosity or penetration grade.
- Number of blows of hammer compaction per side of moulded specimen for Marshall method or gyratory cycles for APRG 18 method.
- Temperature of mix when discharged from the mixer.
- Compaction temperature of specimens.
- Plot of the combined gradation.
- Air voids.
- VMA.
- Bulk Density.



- Maximum theoretical density

For all new asphalt and SBM mix designs, the Contractor shall organise an off-site laydown trial for mix design validation. The laydown trial shall be carried out in the presence of the Designer. Production tests in accordance with this specification shall be carried out by the Contractor. Field testing including coring, as required by this specification, shall be taken by the Contractor. All results from the off-site laydown trial shall be submitted to the Designer.

If the Contractor's production test results, and laydown trial results for new asphalt mixes, confirm compliance of the constituent materials and asphalt mix with this Specification the mix design will be provisionally approved by the Designer. All mix designs will then be submitted to the Engineer requesting approval. Work shall not start until written approval is granted from the Engineer.

Test Results from standard production runs will be acceptable provided they meet the requirements of this specification.

Refer to TNZ P/23 section 7 for additional production and laydown trial requirements for SMA mixes, where designed in accordance with TNZ P/23.

900.6 CONSTRUCTION

900.6.1 Weather Limitations

Asphalt and SBM shall not be placed when the weather is foggy or raining, or be placed on a wet surface, or when the surface temperature of the underlying course is less than specified in Table CO214.1 below.

Table C2014.1 - Base Temperature Limitations

Mat Thickness	Base Temperature (minimum)
75 mm or greater	4°C
Greater than 25 mm but less than 75 mm	7°C
25 mm or less	10°C

900.6.2 Plant and Organisation

All asphalt and SBM material shall be spread and struck off with an approved self-powered and propelled paving machine capable of spreading and finishing the asphalt or SBM layer true to line, grade, cross-section without the use of form or side supports. The paver screed shall be fitted with a compaction device capable of compacting the asphalt mixture to 80% of its specified final density.

The paver shall be equipped with an automatic screed control system. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors, or sensor-directed mechanisms or devices, which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1%.

The controls shall be capable of working in conjunction with any of the following attachments:

- Ski type device not less than 9 m in length.
- Short ski or shoe.
- Laser control.
- Wire control line
- An approved computerised "travelling stringline" e.g. "Paveset", or "Pavesmart"



900.6.3 Preparation of the Area to be Paved

The surface on which the paving is to be laid shall be dry, and any loose material, dust, clay or foreign matter shall be removed by sweeping. All sweepings must be collected and removed from site.

900.6.4 Tack Coat

Tack Coat shall be CRS-1 quick breaking cationic emulsion.

Tack Coat shall be applied to the prepared asphalt, basecourse, subbase and/or chipseal surface at a rate no less than the design application rate as specified on the design drawings. Tack coat application rates may be adjusted (increased) to suit the surface texture.

Following the application of the tack-coat, the surface shall be blinded out with a thin coating of fine mix. No trafficking, other than the essential construction traffic(s) for the construction of all upper asphalt layer(s), is permitted on the tack and blind surface. All tack and blind shall be constructed on the same day as asphalt paving.

Where a trackless tack coat is used, the fine mix (blind) can be omitted and the trackless tack coat surface may be trafficked by construction equipments subjected to the approval by the designer.

900.6.5 Membrane Seal

Membrane seal, where specified on the design drawings, shall be placed immediately prior to the construction of asphalt surfacing. All membrane seal shall be applied with a minimum residual binder application rate no less than the design rate as specified on the design drawings. Grade 4 or 5 sealing chip shall be used. Sealing binder shall be CQ-60 emulsion or other types nominated by the Contractor and accepted by the Designer prior to the commencement of Works.

The membrane seal shall be designed by the Contractor. All seal designs shall be submitted to the Designer at least 5 working days prior to the commencement of Works. Physical works shall not commence until the seal design is accepted by the Designer.

900.6.6 Storage of Mix

Storage of asphalt and SBM mix shall be in accordance with NAS 2004 and NZ Supplement to NAS 2006.

900.6.7 Transportation of Mix

The hot mixed asphalt and SBM shall be transported in accordance with TNZ P/9P cl. 6.1.

900.6.8 Mix Temperatures

Mixing, carting, placing and compaction temperatures shall comply with the maximums and minimums specified in NAS 2004 and TNZ Supplement to NAS 2006 for all dense graded asphalt mixes.

Mixing, carting, placing and compaction temperature requirements for SMA surfacing and SBM mixes shall comply with manufacturer's instruction.

900.6.9 Placing and Compaction

The spreading, finishing and compaction of all dense grade asphalt shall be carried out in accordance with NAS 2004 and TNZ Supplement to NAS 2006.

All SMA and TNZ type mixes shall be produced, placed, finished and compacted in accordance with TNZ P/23 and M/10 specifications respectively.

All SBM mixes shall be produced, placed, finished and compacted in accordance with NAS 2004 and TNZ Supplement to NAS 2006.

All mixes shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements.



Paving plan shall be carefully planned to minimise cold joints. All asphalt surfacing joints must be placed under lane or edge lines.

Cartage across freshly placed asphaltic concrete shall not be permitted. No construction trafficking over AC28 and AC14 high fatigue layer is permitted, except for the purpose of paving the upper layers.

Trafficking over SBM mixes shall not exceed 3 weeks unless otherwise agreed with the Designer.

The Contractor shall set out the design level on site. Where any pavement cut is evidenced and is not specified on the design drawing, the Contractor shall report to the Designer. The area of pavement cut shall be marked out and agreed on site with the Designer. The affected area shall be undercut and replaced with 160mm AC20, to be compacted in two layers. The pavement undercut shall be completed before proceeding with the construction of AC10 and OGPA surfacing.

900.7 ACCEPTANCE SAMPLING AND TESTING

All acceptance sampling and testing necessary to determine compliance with the requirements of NAS 2004 and NZ Supplement to NAS 2006 for dense graded asphalt mixes, TNZ P/23 for SMA mixes and TNZ P9/P for TNZ mixes. Testing organisations performing these tests shall meet the requirements of the NZ Code of Laboratory Management Practice. All laboratory equipment shall be calibrated by the testing organisation prior to the start of operations.

900.7.1 Plant-Produced Material

All production testing and compliance for all dense grade asphalt shall be carried out in accordance with the requirements of NAS 2004 and NZ Supplement to NAS 2006.

All production testing and compliance for all SMA surfacing asphalt, SBM mixes and TNZ type mixes shall be carried out in accordance with the requirements of TNZ P/23 and TNZ P9/P.

For SMA surfacing mixes, the critical sieve size to be monitored during production including the nominated grading tolerance shall be detailed in the Contractor's quality assurance plan.

The following production testing (individual results and rolling averages) shall be reported for each lot.

- Binder content
- Particle size distribution (grading)
- Maximum theoretical specific gravity (MTSG)

900.7.2 Field Placed Material

All testing and compliance shall be in accordance with the requirements of NAS 2004 and NZ Supplement to NAS 2006 for all dense graded asphalt, SBM mixes, TNZ P/23 for SMA surfacing asphalt and TNZ P9/P for TNZ type surfacing mixes.

(a) Thickness

Thickness shall be evaluated for compliance with the requirements shown on the drawings. Measurements of thickness shall be made using the cores taken.

The total asphalt layer thickness shall not be less than the design thickness in any area and shall not exceed the design thickness plus 20mm.

Individual asphalt layer shall comply with the following thickness tolerance.

- AC7 Prelevelling, -15mm and +15mm
- SMA, -0mm and +5mm
- TNZ Mix10 and Mix15, -0mm, and +5mm
- SBM, 0mm and +10mm
- AC14, AC20 and AC28, -0mm and +10mm
- AC14HB, -10mm and +10mm



(b) Ride Quality

The finished surface of the pavement shall not vary by more than ± 5 mm from design levels. The smoothness shall be evaluated with a 3 metre straight edge placed parallel to the centreline of the road, and any deviation from the straight edge is gradual. No depressions or hollows allowing ponding of surface water shall be accepted.

The finished final asphalt surfacing layer shall meet the roughness requirements detailed in NZTA CA3775 Te Atatu Interchange Appendices to Principal’s Requirements: A6 Pavement and Surfacing.

(c) In-situ Air Void

In-situ air voids (for SMA, AC14, AC20, AC28 and AC14HB mixes only) shall meet the requirements of NAS 2004 and NZ Supplement to NAS 2006.

In-situ air void for SBM shall be assessed in accordance with NAS 2004 and TNZ Supplement to NAS 2006. The upper and lower characteristic air void limit shall be 9% and 2% respectively.

In-situ air voids other TNZ type mixes shall meet the requirements of TNZ P/9P.

(d) Surface Shape and Rut Depth

Vertical tolerance (shape and rut depth) at the end of defects liability period must be less than 7mm. Surface shape must be such that:

- There are no obvious defects related to poorly constructed longitudinal or transverse joints
- No areas of the completed surface have any depression that will allow water to pond where the specified levels are such that the slope is greater than 1 in 50
- No visible cracking

(e) Skid Resistance and Texture Depth (wearing course only)

Surface texture and skid resistance shall comply with NZTA T/10 specification within the defects liability period.

900.7.3 Testing Frequencies

Table CO214.2 specifies the minimum acceptable testing frequency for asphalt layers.

Table C0214.2 - Minimum Test Frequency

Test Property	Frequency
Source Aggregate Property Testing	
Coarse Aggregate	
Wet Sieve	Daily or 1 test per 1000 tonnes
Crushing Resistance	One initially then as directed by the Designer
Weathering Resistance	One initially then as directed by the Designer
Cleanness	One initially then as directed by the Designer
Broken Faces	One initially then as directed by the Designer
Course Aggregate (SMA only)	
Los Angeles Abrasion Loss	One initially then as directed by the Designer
Wet/Dry Strength Variation	
Water Absorption	



Fine Aggregate Wet Sieve Crushing Resistance Sand Equivalent/Clay Index	Daily or 1 test per 1000 tonnes One initially then as directed by the Designer One initially then as directed by the Designer
Fine Aggregate (SMA only) Water Absorption Degradation Factor	One initially then as directed by the Designer
Filler Wet Sieve Clay Index	One initially then as directed by the Designer One initially then as directed by the Designer
Combined Aggregate Sand Equivalent	1 test per 1000 tonnes
Polished Stone Value (for wearing course only)	1 test per aggregate source
Asphalt Concrete Mix Design, JMF (ie. Marshall Testing or Gyrotory Compaction, Grading, Bitumen Content, Wheel Tracking Test etc)	1 per mix
Production Testing	
Grading	1 test sample per 200 tonnes or a max of 3 test samples per production lot
Binder Content	1 test sample per 200 tonnes or a max of 3 test samples per production lot
Maximum SG	1 test sample per 200 tonnes or a max of 3 test samples per production lot
Temperature	Each loaded truck
Binder Drain Down (SMA only)	1 test sample per 200 tonnes or a max of 3 test samples per production lot
Field Testing	
In-situ density (coring for air voids, where the design thickness is greater than 40mm)	1 test per 300m ² per layer (min 4/lot)
Thickness (where the design thickness is greater than 40mm)	Each core taken for density
Surface Shape and Level	Each 10m cross-section
Surface Finish Visual Inspection	Site walk-over
Roughness NAASRA Test (for wearing course only)	Each Lane at top of wearing course
Additional Testing for wearing course Field/core Permeability Test (SMA only) Texture Depth	1 test per 200m lot 1 test per 200m lot



900.8 ACCEPTANCE/REJECTION

Any lot which fails to meet the requirements of C0214 shall be rejected and made good to the satisfaction of the Designer.

In the event of non-compliance with the specified compaction requirements, additional samples shall be taken to determine the extent of areas of unsatisfactory compaction within a sub-lot.

Any sub-lot which does not comply shall be removed and reconstructed.

900.9 REPAIR

Patching of asphalt shall not be permitted. Should any sections fail to meet the requirements for density, thickness or surface tolerances, such sections shall be removed over the full width of the paver run and over such length required between sawcuts at right angles to the paver run. The exposed underlying surface shall be reinstated, sealed and new asphalt paving laid in full compliance with this Specification.



1000 SERVICE INSTALLATION & DUCTING

1000.1 General

Refer to General Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

1000.2 Scope of work

The work includes the supply and installation of services ducts as shown on the contract drawings, and shall include all trenching, backfilling, removal and restoration of paved areas, manholes, concrete encasement, installation of steel draw wires and duct markers. and in accordance with this specification and the General and Special Conditions of Contract.

1000.3 Related documents

This section makes reference to various standards or documents, which form part of this Specification unless otherwise qualified by this or other contract documents. It should be noted that these documents in turn require reference to other standards. In all cases the standards or other documents are to include the latest revision and all amendments current at the time of tender.

NZS4404	Land Development and Subdivision Infrastructure
AS/NZS1260	PVC-U Pipes and Fittings for Drain, Waste and Ventilation Applications
NZS7643	Code of Practice for Installation of Unplasticised PVC Pipe Systems

Ducts shall be laid to the requirements of the Road Manager and utility provider.

1000.4 MATERIALS

1000.4.1 Pipes

Duct pipes shall be of the size, material type and class nominated in the Drawings and/or by the utility provider.

1000.4.2 Sand

Sand, unless specified otherwise by utility providers, or on drawings, for pipe bedding and surround shall be clean AP5 material free from clay, stones or organic material. Sand shall be approved by the Engineer before use on Site.

1000.4.3 Hardfill

Hardfill shall be clean, well-graded subbasecourse material from an approved source

1000.5 CONSTRUCTION

Ducts shall be laid where indicated on the plans, in advance of carriageway and footpath construction.

The number of ducts per trench will be shown on the drawings and on completion 'as-built' location marked at the extremities of carriageway construction.

Communication Ducts: Unless shown otherwise these shall be 100mm diameter with an internal draw wire

Power Cable Ducts: These shall be in compliance with the utility provider's requirements

The depth and disposition of all ducting shall comply with the Road Manager and utility provider's requirements.

1000.5.1 General

The contractor shall liaise with utility providers for the installation of the required ducts or services by the appropriate party. The contractor is reminded that it is their responsibility to set out the required boundary



positions (using survey information from the Engineer) for all services installations and provide assistance and cooperation to the relevant utility providers.

Ducts for the later threading of communication and power cables shall be laid where indicated on the relevant utility provider's drawings, taking locations of existing utilities and features into account.

Ducts shall be laid in advance of road pavement and footpath construction.

Where turf is well established and the sod can be removed, it shall be carefully stripped prior to excavation and properly stored for reuse.

Prior to excavating in sealed areas, sawcuts shall be made back from the sides of the proposed trench, and the existing seal removed to a straight edge to facilitate a neat finish on restoration.

Trenches for ducts may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of the surface is disturbed.

Whenever practicable duct lines shall be laid so as to grade toward manholes and duct ends for drainage. On runs where it is not practicable to maintain the grade all in one direction, the duct lines shall be graded from the centre in both directions toward manholes, or duct ends. Pockets or traps where moisture may accumulate shall be avoided.

Ducts shall be constructed from uPVC, and when crossing carriageways shall have a minimum cover as specified by the Road Manager of 600mm. Ducts across paths and vehicle crossings shall have a minimum clearance of 100 mm below the underside of any concrete and not less than 400mm.

Ducts are to terminate as specified on both sides of the road, and protrude past other services and footpaths. Power ducts and telephone ducts shall have at least 450mm separation and shall be laid in a straight line in a properly graded trench with no angles or bends. The ends of ducts shall be capped to stop materials entering, and a draw wire (or approved nylon woven strap) left in each run or pipe and securely fastened to a stake or another identifiable surface object at each end. All ducts in carriageways shall be backfilled with basecourse or other fill as approved by the Engineer and the Contractor shall allow for the cost of this in his schedule rates for cable ducts.

The Contractor shall bear the cost of any work required to locate or relay ducts which have not been laid in the correct position or have not been recorded accurately.

Trenches shall be as narrow as possible to accommodate the ducts while enable suitable backfill and compaction.

1000.5.2 Backfilling

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

Ducts installed outside of the carriageway shall generally have a minimum of 100mm sand surround and carefully tamped with hand tampers. The remaining trench depth may be filled with regular excavated material and thoroughly compacted in 200mm layers to match the standard of the adjacent material. The trench shall be completely backfilled and compacted level with the adjacent surface, except that, when sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Ducts installed in existing pavement areas shall be backfilled approved basecourse aggregate mechanically compacted in maximum 150mm thick layers to give a tight and smooth finish which, when broomed, shall present a mosaic of large and small aggregate well bonded with fines. The depth of basecourse shall be 300mm or existing pavement depth whichever is greater.

The backfill to new paved areas shall be as specified on the Drawings, or where not specified, suitable hardfill. Hardfill backfill shall be placed in layers not exceeding 150 mm loose thickness and each layer shall be compacted with approved mechanical compaction equipment before the next layer is placed.

1000.5.3 Restoration

Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by trenching, storing of dirt, duct construction and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, seeding, or mulching.



The surface of the trench shall be sealed to the same standard as the existing seal. Surfacing of trenches in new paved areas shall be to the standard and details shown on the Drawings. Surfacing shall be undertaken in accordance with the relevant sections of this Specification.

1000.5.4 As-Builting

The Contractor shall furnish the Engineer and each utility provider with neat, detailed, accurately marked up drawings showing location of ducts, poles, chambers etc.

Deviations in duct lines shall be noted.



1100 PAVEMENT MARKING

1100.1 General

Refer to General Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

1100.2 Scope of work

The work includes the supply and application of all pavement marking including reflectorised and non-reflectorised paint pavement and raised pavement markers.

1100.3 Related documents

This section makes reference to various standards or documents, which form part of this Specification unless otherwise qualified by this or other contract documents. It should be noted that these documents in turn require reference to other standards. In all cases the standards or other documents are to include the latest revision and all amendments current at the time of tender.

- NZTA T12 Specification for Long-Life Pavement Marking Material Applicator Testing
- TNZ M/7 Road Marking Paints
- TNZ M/12 Raised Pavement Markers
- TNZ P/12 Pavement Marking
- TNZ P/30 High Performance Roadmarkings
- TNZ P/14 Installation of Raised Pavement Markers
- TNZ T/8 Roadmarking Paint Applicator Testing
- TNZ/LTSA Manual of Traffic Signs and Markings: Part 2 - Markings
- AS 2009 Glass Beads for Road-Marking Materials
- BS 1851 Specification for Titanium Dioxide Pigments for Paints
- BS 6088 Specification for Solid Glass Beads for Use with Road Marking Compounds and for other Industrial Uses

1100.4 MATERIALS

1100.4.1 Paint

Road marking paint shall comply with TNZ M/7-W or M/7-Y as appropriate, thinned and applied strictly in accordance with the manufacturer's written instructions.

Paint shall be supplied by an approved paint supplier.

Acrylic road marking paint shall not be used.

The applicator shall nominate the brand and type of paint to be used prior to application. The applicator shall submit on request the paint manufacturer's certificate of compliance for each paint consignment or batch.

1100.4.2 Glass Beads

All glass beads added to the paint for reflectorised line application shall be in accordance with AS/NZS 2009 "Glass Beads for Road-Marking Materials" and the current NZTA Policy and Testing Regime for Heavy Metals.

1100.4.3 Raised Pavement Markers

All raised pavement markers shall be in accordance with TNZ M/12 "Raised Pavement Markers".



1100.5 PREPARATION

1100.5.1 General

Clause 11.1(b) of TNZ P/12 and Clause 7(a) of TNZ/14P shall be amended by deleting the existing paragraph and substituting the following:

“Accumulations of surplus chip and other coarse material shall be removed prior to road marking”.

1100.5.2 Removal of Redundant Pavement Markings

All redundant paint pavement markings shall be permanently removed using either water blasting or milling off of the markings. The removal of all redundant pavement marking shall be such that:

- The shape of the marking cannot be distinguished.
- The final surface texture is similar to the surrounding pavement.
- No evidence of the paint remains.

Blacking out of markings is not a permanent removal method but may be used as a temporary measure until permanent removal can be completed. Blacking out of markings shall only be used with prior written approval.

1100.5.3 Removal of Redundant Raised Pavement Markers

All redundant pavement markers shall be uplifted and disposed off site. Where the uplifting of a redundant pavement marker results in the removal of the seal, the remaining hole shall be cleaned of all loose material and filled with the same adhesive used to fix the marker to the pavement. The amount of adhesive used shall be such that the surface the adhesive ties into the surrounding road surface.

1100.6 PAINT MARKING

1100.6.1 Setting Out

The painting of pavement surface markings shall be carried out in accordance with the drawings and TNZ P/12. Further to TNZ P/12 Clause 9.1, the applicator shall set out all pilot marks from plans and /or location points supplied by the Engineer.

All pilot marks shall be set out with string-lines to ensure that all lines appear by eye to be straight, or where designed as a curve, shall follow the true curve.

1100.6.2 Application

The portion of the pavement to be painted shall be clean and dry when the paint is applied.

The dry film thickness and line width tolerance shall be in accordance with TNZ P/30, Clause 6.3.4.

Where reflectorised markings are detailed the glass beads shall be applied to the painted lines in accordance with P/30.

The skid resistance of road markings shall be to Clause 6.3.4 of TNZ P/30.

1100.7 RAISED PAVEMENT MARKERS

(a) General

These shall be located as detailed on the drawings and installed in accordance with the requirements of TNZ P/14.

The types and pattern of new raised pavement markers being set out shall be as specified in the NZTA Manual of Traffic Signs and Markings or as directed by the Engineer.

The applicator shall ensure that the pavement surface is dry and free of all foreign material and loose chip, which would hinder the correct installation of the raised pavement markers.

(b) Spacings and Dimensional Tolerances

Main Road (Ara Tapu)



Unless noted otherwise on the drawings, provide one reflectorised Type A marker at 20m intervals, central in every second gap between centreline or lane line stripes.

The following dimensional tolerances shall apply in place of TNZ P/14 (Clause 3.2):

- Longitudinal Position: $\pm 100\text{mm}$
- Transverse position when placed between continuous double lines: $\pm 5\text{mm}$
- The reflective axis shall be within 5° of the line delineated.

1100.8 REMOVAL OF NON-COMPLYING WORK

1100.8.1 Paint Pavement Marking

The applicator shall permanently remove all pavement marking that has been applied outside the specified tolerances, including all run-ins and run-outs where instructed.

The removal of the pavement marking applied outside the specified tolerance shall be undertaken such that:

- The shape of the marking cannot be distinguished
- The final surface texture is similar to the surrounding pavement
- No evidence of the paint remains

Blacking out of markings is not a permanent removal method but may be used (with approval) as a temporary measure until permanent removal can be completed.

1100.8.2 Pavement Markers

The applicator shall permanently remove and reinstate all raised pavement markers that have been placed outside tolerance or deemed defective after twelve weeks of installation.

A Raised Pavement Marker is deemed defective when:

- It is missing, or
- It is out of tolerance as specified in TNZ P/14, or
- It is deemed ineffective.

In addition to the defects as listed in TNZ P/14 Clause 10.4(a), a raised pavement marker is deemed ineffective when:

- A Type A (retro-reflective Raised Pavement Marker) is not clearly visible at night from a distance of 160m with headlights on full beam

The applicator shall ensure that the removal of all non-complying pavement markers shall be such that the underlying seal surface is not damaged.



1200 ROAD SIGNAGE

1200.1 General

Refer to General Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

1200.2 Scope of work

The work includes the provision and installation of new signs, including all regulatory, permanent warning, and ground mounted signs. It also covers the installation of edge marker posts and relocation of existing signs.

1200.3 Related documents

This section makes reference to various standards or documents, which form part of this Specification unless otherwise qualified by this or other contract documents. It should be noted that these documents in turn require reference to other standards. In all cases the standards or other documents are to include the latest revision and all amendments current at the time of tender.

TNZ C/20 Erection and Maintenance of Traffic Signs, Chevrons, Markers and Sight Rails

NZTA Manual of Traffic Signs and Markings/Traffic Control Devices Manual

TNZ P/24 Performance Based Specification for Traffic Signs

RSMA Compliance Standard for Traffic Signs, Road Sign Manufacturers Association

AS/NZS 1906.1 Retroreflective materials and devices for road traffic control purposes Part 1: Retro-reflective materials

AS/NZS 1170 Structural Design Actions

NZS3910 General Conditions of Contract

Transit New Zealand State Highway Geometric Design Manual

1200.4 Materials

1200.4.1 RETRO-REFLECTIVE SHEETING MATERIAL

All retro-reflective sheeting must be approved for use in New Zealand and comply with the following requirements:

- a) Engineering Grade (Eng.), Class 1 High Intensity (HI) and Class 1A Prismatic material shall be in accordance with the requirements of AS/NZS 1906.1: 1993 Retro-reflective materials and devices for road traffic control purposes, Part 1 Retro-reflective materials.
- b) Class 1 Wide Observation Angle (WOA) material shall use trihedral cube corner prismatic sheeting that retains 70% of the specified minimum brightness for new sheeting including observation angles of up to 1.0° as detailed Table 220.1 below for a period of ten (10) years.
- c) Fluorescent signs shall be made using trihedral cube corner prismatic sheeting retroreflective sheeting as specified in (b) above, that in addition, is a visible-activated fluorescent reflector providing higher daytime brightness than ordinary coloured sheetings of similar chromaticity

1200.4.2 Sign Standard of Retro-reflection

The standard of retro-reflection for signs shall be as detailed in the Table below.



Table - Sign Standard of Retro-reflection

Sign Type	Standard of Retro-reflection
All signs with white or yellow backgrounds, such as the Regulatory Parking and Permanent Warning Signs	Class 1 High Intensity (HI)
All RG5 “Stop”, RG6 “Give Way” and RG-7 “Keep Left” signs	Class 1 Wide Observation Angle (WOA)
All Other Regulatory General signs	Class 1 High Intensity (HI)
All ground mounted information signs with a red, green, brown or blue background (Guide, Motorist Service and Tourist Signs)	Class 1 High Intensity (HI)
Chevron Sight boards and single chevrons	Class 1 High Intensity (HI)
All overhead signs.	Class 1 Wide Observation Angle (WOA)
Panels with white background for black on white signs with less than 30% black on the sign face.	Class 2 Engineering Grade
Panels with white background for black on white signs with more than 30% black on the sign face.	Class 1 High Intensity (HI)
Belisha Discs and red and white-banded railway	Class 1a Prismatic

1200.5 SIGN MANUFACTURE

1200.5.1 General

All guide signs shall be constructed to the dimensions shown on the drawings or relevant standards.

The supplier shall verify the dimensional layout of all multi-panel guide signs.

The supplier shall prepare shop drawings detailing the panel layout, positions of channel framing, and assembly systems prior to the manufacture of any no standard sign. The shop drawings shall be submitted for review and comment at least ten working days prior to manufacture of the sign.

Signs shall be fabricated using the minimum number of panels.

1200.5.2 Sheeting

All sign blanks shall be fabricated in aluminium Grade 5251-H34 or similar and shall be a minimum thickness of 2.5mm stiffened. Signs smaller than 0.2m² in area may be 2.5mm unstiffened.

Where possible, all signs shall be manufactured from a single size of aluminium.

1200.5.3 Horizontal Panel Joints

Horizontal panel joints shall not occur through any internal border, or through any word or numeral legend, other than the descender of any lower case legend.

1200.5.4 Sign Shape

All signs shall have rounded corners and comply with the shape requirements of Clause 7.1.4.4 of the TNZ Manual of Traffic Signs and Markings: Part I.

1200.5.5 Modular Sign Assembly Fitting

All modular signs that require horizontal joining shall be assembled using a suitable proprietary interlocking jointing system. The jointing system shall incorporate a channel to fit a LIP LOK bolt allowing for bracketing to the sign support at all joins.

All modular signs that require vertical joining shall be covered and supported on the rear of the sign by a joining strip covered on the inside face with the same reflective material as the face of the sign. The rear of the joining strip shall be the same colour and finish as the rear of the sign.



1200.5.6 Channel Stiffening Extrusions

All channel stiffening extrusions shall comply with Clause 4.7 of the RSMA 1995 Compliance Standards for Traffic Signs.

All stiffening channels shall be designed to accept an M8 LIP LOK bolt head. No bolts or rivets attaching the channel extrusion to the sign shall protrude into the sign face.

The maximum allowable distance between aluminium channel stiffening sections on modular signs shall be 600mm unless specified otherwise.

1200.5.7 Sign Back Face

The back face of all guide and tourist signs sign panels shall be primed and powder coated with a polyester powder coating system to the colour similar to Resene colour 14D4S. The coating shall be applied in accordance with the manufacturer's specification.

1200.5.8 Packing and Handling of New Signs

Signs shall be packaged and handled in accordance with the requirements in Section 6 of RSMA: Compliance Standard for Traffic Signs.

1200.6 POSTS AND POLES

1200.6.1 General

Unless otherwise shown on the drawings, the contractor shall design all proposed arrangements for posts, poles and other foundation elements as required.

All posts, poles and foundation details shall comply with the following:

- Section B "Strength and Rigidity" and Section 9 "Impact Performance Requirements for Sign Supports" of P/24 "Performance based Specification for Traffic Signs"
- The limitations that come into effect on 1 July 2005 as detailed in the RSMA Compliance Standard for Traffic Signs

Construction records shall be maintained for each sign that clearly show that all post, poles and foundation details comply with the requirements of this specification.

The design of foundations should, where required, take into account the very close proximity of services and not subject these services to any dead or live loadings from the sign support structures.

1200.6.2 Post Embedment

All post foundations shall comply with the requirements of P/24 Performance Based Specification for Traffic Signs and shall either be:

- Socketed using a purpose built socket, of not less than 5 mm wall thickness with a secure locking device
- Frangible slip-based
- Embedded directly into a concrete surround
- Any other embedment treatment as specified on the drawings or this specification

All posts shall be cased in a concrete foundation of 300 mm minimum diameter and have 100 mm cover to the base of the post unless specified otherwise.

All posts located within traffic islands and footpaths, excluding Impact Resistance System posts, shall be provided with ground sleeves. The ground sleeves shall be correctly sized for the post, be of a compatible material, include a locking bolt and pole stop, be cast in a concrete foundation of 300 mm minimum diameter and have 100 mm minimum cover to the base of the ground sleeve. The ground sleeve shall protrude 50 mm above ground level to prevent entry of surface water.

All reinstatement around poles or sleeves shall be with materials similar to those removed especially where coloured chip seal or coloured or textured concrete is used on traffic islands or footpaths.



1200.6.3 Steel Posts

Steel posts shall be of an approved frangible design. They shall be hot dip galvanised or similar approved and finished with white high gloss paint. The paint system shall be specified and applied in accordance with AS/NZS2312.

All poles shall be fitted with white PVC caps.

1200.6.4 Aluminium Poles

Aluminium poles shall be proprietary poles such as "Signfix" conforming to Alloy 6261 T5 or equivalent.

All poles shall be fitted with white PVC caps.

1200.6.5 Impact Resistant System Posts

All Impact Resistant System Posts shall be a heavy spring type that returns to its original position after being bent over. Flexible rubber jointed post shall not be used unless specified on the drawings.

1200.7 SIGN FIXINGS

1200.7.1 General

The supplier shall be responsible for the design of all sign fixings to suit the requirements of this specification, with all new or replacement signs being securely fixed to posts according to the manufacturer's specification.

1200.7.2 Sign Face Penetration

All signs shall be installed using approved sign support channel bracket fittings that do not penetrate the front face of the sign. No bolts, rivets or other fixings shall penetrate the front face of the sign.

The only exception shall be Regulatory Parking Signs less than 0.2 m² in area and medium mounted RG17 "Keep Left" signs. These may be fixed through the face using stainless steel fasteners. Nylon washers shall be used to protect the sign face.

1200.7.3 Brackets and Fittings

Brackets and fittings shall be approved proprietary items. Only stainless steel LIP LOK bolts shall be used.

All clamps for fluted aluminium poles shall have anti-rotational properties. Brackets and clamps shall be designed specifically for the size of pole or post used.

1200.7.4 Back-to-Back Sign Fixing

All back-to-back signs shall be installed using proprietary stainless steel back to back brackets.

The signs shall be installed so that the top of the signs is at the same level.

1200.8 SIGN INSTALLATION

1200.8.1 General

All signs shall be located and installed according to the requirements of TNZ P/24, or as shown otherwise on the drawings.

Sign locations are to be set out on site and approval from the Engineer sought prior to installation.

Signs shall be erected in accordance with the retro-reflective sheeting manufacturer's requirements.

The alignment and level of new, replacement or relocated items shall tie in with existing items and must appear by eye to be a straight or true curve, as appropriate.

1200.8.2 Replacement Sign Erection

Where signs replace existing signs, the replacement sign shall be erected in the same location, height and position as the original sign unless specified otherwise on the drawings.

If the replacement sign requires relocation to comply with TNZ Manual of Pavement Markings and Signs Part 1, prior approval shall be obtained for the new sign position.



The alignment and level of replacement signs shall tie in with existing items and shall appear by eye to be a straight or true curve as appropriate.

1200.8.3 Ground Mounted Signs

All ground mounted signs shall be orientated such that they are turned about 5 degrees away from the driver's line of sight or the normal to the road centreline as detailed in Clause 1.10 "Orientation" of the TNZ Manual of Pavement Markings and Signs Part 1.

1200.9 EXISTING SIGNAGE AND HARDWARE

1200.9.1 General

Existing signs and hardware may be reused where they are in good serviceable condition and meet current reflective standards.

1200.9.2 Redundant Signage and Hardware

Redundant sign equipment (including the sign panel and any associated frames, supports, posts, concrete foundations/footings and fittings) shall be uplifted and stored in a clean, weatherproof area, so that the equipment will not be prone to damage.

All redundant sign equipment shall be offered to the Road Manager, to be uplifted for possible future use. All redundant equipment not required by the Road Manager shall be uplifted, removed completely off site and disposed of in an appropriate manner.



1300 ROAD SAFETY BARRIERS

1300.1 General

Refer to General Conditions of Contract, which are equally binding on all trades. The requirements of the various sections of this Specification are inter-related. Therefore, it is necessary that this section of the Specification be read in conjunction with all other sections.

1300.2 Scope of work

The work includes the supply and installation of semi-rigid road safety barriers (w-section, Thrie-beam and modified Thrie-beam) barriers to be installed to the edge of the carriageways.

1300.3 Related documents

This section makes reference to various standards or documents, which form part of this Specification unless otherwise qualified by this or other contract documents. It should be noted that these documents in turn require reference to other standards. In all cases the standards or other documents are to include the latest revision and all amendments current at the time of tender.

- TNZ M/23 Guide for Road Safety Barrier Systems
- TNZ M/17P W-Section Bridge Guardrail
- AS/NZS3845 Road Safety Barrier Systems
- Austrroads Part 6: Roadside Design, Safety and Barriers
- Transit New Zealand State Highway Geometric Design Manual (SHGDM)
- Transit New Zealand Bridge Manual
- Transit New Zealand Manual of Traffic Signs and Markings (MOTSAM)

1300.4 GENERAL

Where this Specification refers to approved systems this is deemed to mean that the system in question:

Complies with NZTA M/23 and is listed in NZTA M/23 Appendix A, and complies with NCHRP 350 or MASH-1 (whichever is relevant in accordance with NZTA direction letter).

Prior to the supply of materials and construction of the barrier system, the Contractor shall provide documentation confirming the requirements noted above.

The barrier installation Contractor shall be experienced with and is deemed to understand the requirements of the barrier systems (s) required by this Specification and the construction drawings.

Where proprietary systems are detailed but specific products are not specified, the Contractor shall nominate an appropriate approved product and shall provide product specifications covering materials, assembly and on site construction. Specifications provided shall supplement the information detailed within this Specification.

1300.5 MATERIALS

1300.5.1 Concrete and Mortar

Concrete work and concrete supplied shall be in accordance with Project Specifications except as varied herein or noted otherwise on the construction drawings or the manufacturer/suppliers details and requirements.

Concrete for anchorage footings (concrete barrier or proprietary unit) shall have a minimum 28 day crushing strength of 30 MPa.

1300.5.2 Highway Guardrails

Galvanised steel W-Section highway guardrail (Test Level 3 compliant) including bolts washers and other ancillary equipment shall conform to the requirements of AS/NZS 3845 and NZTA specification M/23.



Galvanised steel thrie-beam highway guardrails (Test Level 3 or 4 compliant) including bolts washers and other ancillary equipment shall conform to the requirements of AS/NZS 3845 and NZTA specification M/23.

1300.5.3 Bridge Guardrails

Heavy duty galvanised steel W-Section bridge guardrails, bolts, washers and other ancillary equipment shall conform to the requirements set out in the NZTA Bridge Manual.

1300.5.4 Posts

Timber Posts where required for non-proprietary W-section and Thrie-beam guardrails, shall comply with AS/NZS 3845.

Steel posts for modified Thrie-beam barriers shall comply with AS/NZS 3845.

Steel posts for approved proprietary barrier systems shall conform to the manufacturers/suppliers specifications.

1300.5.5 Terminals and Anchors

Materials for approved W-section public domain terminals shall conform to the requirements of AS/NZS 3845 and NZTA M23.

Materials for approved proprietary terminals and anchors shall conform to the manufacturer/suppliers specifications.

Concrete transition units to which modified thrie-beam guardrail will be connected must include for sockets to be cast into the barrier. This will allow for bolts to connect the thrie-beam to the concrete unit and can be removed at a later date during maintenance operations. Under no circumstance will epoxy or grouting of bolts be permitted directly into the concrete unit.

1300.5.6 Proprietary Barrier Systems and Crash Cushions

Materials for approved proprietary barrier and crash cushion systems shall conform to the manufacturer/suppliers specifications. Details of the required systems are included within the drawing set. The manufacturer/supplier must confirm that the products supplied satisfactorily perform the functions required in the proposed location (i.e. design speeds, widths, Test Level, crossfall and the like).

All crash cushions utilised shall be non-gating systems.

1300.6 CONSTRUCTION

1300.6.1 General

Where approved by the Engineer, the Contractor may reuse sections of existing barrier which are found to be in good condition. Before dismantling, the Contractor and Engineer will inspect the barrier to determine which sections are reusable. The Contractor shall then dismantle the barrier, uplift posts and backfill the postholes with suitable material to the standard of the adjacent ground.

Reusable materials shall be stored on site. Damaged and unusable materials shall be removed from site to the Contractors dump.

Set out of all barrier installations shall be in accordance with the construction drawings. The Engineer shall be notified when set out of a section of barrier is complete for the opportunity to visually confirm the set out achieves the intention of the design.

Grading of the pavement or berm immediately adjacent to the barrier/terminal shall be in strict accordance with the construction drawings. Any change to the proposed layout and/or required grading shall be agreed with the Engineer prior to commencement of construction.

All barrier systems shall be constructed in accordance with the tolerances set out in AS/NZS 3845, or as amended by this specification or the specification of the proprietary system manufacturer/supplier. Where approved proprietary system tolerances conflict with those stated in AS/NZS 3845, tolerances stated by the proprietary system manufacturer/supplier shall govern.

All approved proprietary barrier systems shall be installed by persons approved by the barrier/terminal system supplier. The approved person shall be experienced with the installation of the specified barrier system(s) being installed.



1300.6.2 W-Section, Thrie-beam and Modified Thrie-beam Barrier

Installation of W-Section barrier shall be in accordance with AS/NZS 3845 and to the lines, levels and positions shown on the drawings.

Installation of Thrie-beam and Modified Thrie-beam barrier shall be in accordance with AS/NZS 3845 and to the lines, levels and positions shown on the drawings. The tolerance of post and system height shall be ± 20 mm unless otherwise specified by the manufacturer for a specific product (in accordance with AS/NZS 3845 Section 2.4.4).

Earthworks and pavement construction shall be completed prior to semi-rigid barrier installation to ensure correct relative levels and clearances are achieved.

1300.6.3 W-section Terminals

Public domain leading and trailing end terminals shall be constructed in accordance with AS/NZS 3845.

Proprietary leading and trailing end terminals shall be constructed in accordance with the manufacturers/suppliers specifications.

1300.6.4 Proprietary Barrier and Crash Cushion Systems

Proprietary barrier and crash cushion systems shall be installed in compliance with the manufacturers/suppliers installation specifications. The Contractor shall supply to the Engineer a detailed construction/installation methodology conforming to the specified installation process.

