Auckland Transport
An Auckland Council Organisation

16 Road Pavements and Surfacings

16.1 Scope and Intent

16.1.1 Auckland Transport Guidelines

It is essential that the following Auckland Transport Guidelines are read before reading the rest of this chapter.

Reseal Guidelines (PDF 61KB):

Seal Extension Guidelines (PDF 183KB):

Sustainability and Environmental Guidelines:

These Guidelines are currently under compilation and the link to these will provided upon completion.

16.1.2 Road Pavement

The scope and intent of these works is to design and construct pavement renewal works on the road network (including pavement rehabilitation, seal extension, pavement widening, new pavement construction and pavement reconstruction works) in a safe, efficient and timely manner that will provide the best whole of life cost option to return the pavement serviceability life in accordance with the relevant standards and industry guidelines whilst minimising any inconvenience to road users and other stakeholders.

The work covers the design and construction of road reconstruction and rehabilitation works on all roads, intersections, service lanes, park and ride facilities, carparks and town centres.

The work includes pavement reconstruction and rehabilitation, investigation, preparation of programmes, design, testing, reporting, estimate preparation, economic evaluation, road rehabilitation, road reconstruction, seal extension, seal widening and new road pavement construction and includes but is not limited to:

- All associated earthworks, subgrade preparation, protection of utility services, undercut and replacement works, supply and construction of all pavement granular and asphalt layers, pre-treatment of existing granular pavement layers, stabilisation of existing layers (lime, cement, KOBM, foamed bitumen or emulsion), construction of structural asphaltic pavement layers, kerb and channel, construction of interlocking paving, associated drainage of pavement reconstruction, construction of concrete pavements and construction of unsealed granular pavements.

The sections of this chapter of the ATCOP are deemed to be mutually inclusive, not exclusive of one another. For example, if the proposed pavement design/construction requires a combination of asphalt milling, pavement excavation, granular pavement construction and structural asphalt layers then the various sections of the ATCOP (and associated industry specifications, standards

and guidelines) must be followed and not be deemed to be exclusive to the specification grouping or heading.

Physical works may involve any or a combination of the following:

- Construction of granular pavement layers;
- Construction of premixed stabilised basecourse/subbasecourse layers;
- Stabilisation of the existing pavement with lime, cement and/or KOBM;
- Stabilisation of the existing pavement with foamed bitumen or emulsion;
- Construction of structural asphalt pavement layers.
- Construction of interlocking block paver roads

Works at each site may include some of the following:

- Development of an inspection and test plan for each site to demonstrate conformance with the pavement design and any relevant industry or project specifications.
- Digging, logging and reinstatement of test pits (up to 1m2 and up to 0.7m in depth).
- Undertake all necessary site investigations, desk top studies and walk overs of each pavement renewal site.
- Undertake a topographical survey of sites as instructed by the Auckland Transport representative.
- Prepare pavement design calculations, A3 drawings and a preliminary design report recommending a preferred pavement renewal option.
- Prepare estimates for the various pavement renewal options and prepare economic analyses suitable for lodging with NZTA as part of the funding application for the projects.
- Prepare A3 drawings for construction purposes and a final design report.
- Construction management and monitoring of all pavement renewal works.
- Earthworks and subgrade preparation and improvement
- Undercut unsuitable material and subgrade, backfill and compact with approved filling material
- Construction of subsoil drainage systems and connection to the nearest catchpit
- Disposal of milled and excavated material
- Location and protection of existing underground services and installation of new services and ducts.
- Construction of granular layers
- Construction of asphalt surfacing including membrane seal
- Placing of Tensar ARG Geogrid (or approved equivalent)/Geotextile including tack coat where necessary
- Construction of a first coat seal
- Construction of kerb and channel, traffic islands and medians
- Road marking and signage
- Raising or altering of utility service covers. All service covers must be raised during new surfacing or resurfacing operations to be flush with the adjacent finished pavement surface level.

- Site reinstatement
- As-built plans and RAMM information

16.1.3 Road Surfacings

The scope and intent of these works is to construct chipseal, asphalt concrete (AC) , and slurry seal pavement surfacing works on the road network in a safe, efficient and timely manner in accordance with the relevant standards and industry best practice guidelines whilst minimising any inconvenience to road users and other stakeholders.

The work covers all resurfacing on roads, intersections, service lanes, on road cycle lanes, park and ride facilities, carparks and town centres.

The road resurfacing work includes, AC mix and chip seal designs, manufacture, supply and laying of asphaltic concrete, slurry and chip seal surfacing on road carriageways, shoulders, services lanes, special vehicle lanes, cycle lanes, intersections, park and ride facilities and carparks and includes but is not limited to:

- All investigation, (including FWD and skid resistance testing), inspection and condition rating inputs, and design and quality assurance required to produce and implement annual programmes for all types of resurfacing works required across the road networks. The differing types of resurfacing works may include asphaltic concrete (AC), chip seal, slurry seal, SMA, OGPA, emulsion seal, membrane seals and any other specialist road surfacing material required. The works include all associated preparatory works, milling, sweeping and repairs necessary to achieve successful resurfacing.

16.2 Performance Criteria

16.2.1 Chip Seal Surfacing

Chip Retention

The sealed area must have a uniform retained layer of chip. The requirement for acceptance must be such that the area covered by chip in close shoulder to shoulder contact must be not less than 98% of the total area considered. The minimum area to be considered must be 300 mm x 300 mm.

Surface Texture

When measured in accordance with the procedures specified in NZTA T/3, the surface texture of the completed reseal must be such that the reseal can be expected to perform acceptably for a period of not less than the design life.

Remedial Work

Any remedial work undertaken on the resealed surface must have an equal standard of safety, durability, waterproofing, roughness and texture within + 15% of the sand circle of the surrounding surface to that of an undamaged resealed surface and must be virtually indistinguishable from the adjacent surface.

Construction

No obvious defects resulting from poorly constructed longitudinal or transverse joints, blocked or inappropriate spray nozzles, or incorrect chip spreading must be visible.

The quality of resealing must comply with the ATCOP.

All maintenance and renewal works to be carried out and programmed in accordance with the Auckland Transport “Road Resurfacing Governing Principle” (Draft)

All maintenance and renewal works to be carried out and programmed in accordance with the Auckland Transport “Reseal Governing Principle” (Draft)

Safety

Procedures for heating, blending, spraying and transferring binder materials have complied with "A Guide to Safe Practices for the Handling, Transportation and Storage of Bitumen" produced by the New Zealand Bitumen Contractor’s' Association (Inc).

Timeliness

Within a period of 48 hours from the time of completion of sealing, the road must be swept of surplus chip and have pavement marking reinstated as existing. This period may be extended for roads carrying particularly low traffic volumes that would benefit from or require a longer ‘bedding in’ time prior to sweeping.

Sealing records including daily site sheets and forms are submitted by the due date.

Quality Assurance records and test results being submitted by the due date.

Acceptance inspections must be performed on the initial completion of the work, and 12 months after completion of the work.

16.2.2 Asphalt (AC) Surfacing

The completed asphalt paving must meet the following performance criteria:

The design life for all AC surfacing must be a minimum of 10 years.

Surface Ride for new, rehabilitated or reconstructed pavements

The new pavement must have an average dynamic roughness, when measured over a length of 100m, of less than 60 NAASRA counts/km for any three consecutive results and no individual value greater than 70 within the extent of the re-surfacing area unless it can be clearly attributable to a permanent feature such as a bridge joint.

Surface Ride for Resurfacing Sites

The pre-resurfacing site roughness measure must be obtained from RAMM database – high speed roughness count. Where these measures do not exist, testing must be performed. The average roughness count must be used to benchmark the resurfacing works, as described below.

The roughness measurements of all new surfacing must be carried out on completion of the surfacing. All results must be submitted to the Auckland Transport representative within 2 working days.

The new surface when measured over a length of 100m must achieve an average NAASRA roughness less than the value calculated using the formula below. No two consecutive counts must exceed 70 and no individual count greater than 80 within the extent of the resurfacing are permitted unless this can be clearly attributable to a permanent feature such as a bridge joint.

NAASRA Count Criteria = 0.7D + 5 (D = average NAASRA roughness measure determined before the commencement of asphalt resurfacing.)

Where the roughness improvement criteria is not satisfied, remedial works must be undertaken to bring the roughness to the acceptable limit at no additional cost to Auckland Transport.

Surface Irregularities

The new pavement must be free from depressions or areas that pond water, any abrupt surface level, including service covers and irregularities exceeding 6 mm when measured with a 5m straight edge.

All service covers must be raised during new surfacing or resurfacing operations to be flush with the adjacent finished pavement surface level.

Density

The density requirements for the compacted mat are as defined in the NZTA P/9 P specification or as stated in the specific contract requirements.

Flushing, Shoving, Segregation and other Defects

The asphalt surfacing must not exhibit any signs of flushing, shoving or segregation following completion of the works and at completion of the defect liability period. Water cutting is not an acceptable remedy for flushed surfaces.

Texture

At the end of the defect liability period, the surface texture of the finished road surface must comply with the following requirements:

Table 51: Finished Road Surface Requirements

Surface Treatment	Minimum Texture Depth Requirement
NZTA Mix 15/20/40	0.45 mm
AC14	0.5 mm

Surface Treatment	Minimum Texture Depth Requirement
SMA10/14/15	1.0 mm

Any paving that does not meet the performance criteria must be rectified at no additional expense to Auckland Transport. Flushed SMA type surfaces are not acceptable and must be replaced. Water cutting is not an acceptable solution for treating flushed SMA type mixes.

Skid Resistance

The finished surface must comply with the surface resistance requirements as set out in NZTA T/10.

Construction

No obvious defects resulting from poorly constructed surfacing, including longitudinal or transverse joints.

Completion of Quality Control Sheets/As-Built/RAMM forms showing date and details of AC surfacing.

All utility lids and covers are lifted and pavement markings completed before temporary traffic management is removed

All service covers must be raised during new surfacing or resurfacing operations to be flush with the adjacent finished pavement surface level.

The quality of AC surfacing complies with the ATCOP.

All maintenance and renewal works to be carried out and programmed in accordance with the Auckland Transport "Road Resurfacing Governing Principle" (Draft)

All maintenance and renewal works to be carried out and programmed in accordance with the Auckland Transport "Reseal Governing Principle" (Draft)

Safety

Procedures for manufacturing and constructing the asphalt concrete surface have been followed.

Traffic management at the work site must comply with *ATCOP Chapter 26*.

Timeliness

Within a period of 24 hours from the time of completion of AC surfacing sealing, the road must have pavement marking reinstated as existing.

Surfacing records including daily site sheets and forms must be submitted by the due date.

Quality Assurance records and test results must be submitted by the due date.

Acceptance inspections must be performed on the initial completion of the work, and 12 months after completion of the work.

16.2.3 Slurry Surfacing

Acceptance inspections must be performed on the initial completion of the work and 12 months after completion of the work. For the purposes of this clause, a lot may be a day's production, 100 tonnes of dry mass aggregate, a residential street or a cul-de-sac whichever is the smaller.

Slurry, Capeseal, and Rut-filling are used for different purposes and so have different acceptance criteria as follows.

Acceptance Criteria for Slurry

The acceptance criteria for slurry include those for aesthetics, surface texture and aggregate loss as stated in the clauses below.

Acceptance Criteria for Capeseals

The acceptance criteria for capeseals include those for aesthetics, surface texture and aggregate loss as stated in the clauses below. Capeseal surfacings, while very different from those of normal slurry, should also display a uniform finish.

Acceptance Criteria for Rut-filling

The acceptance criteria for rut-filling include those for aesthetics, surface texture and aggregate loss as stated in the clauses below.

The surface of the rut-fill slurry is much coarser than that of normal or standard slurry, but the finished surface should display uniformity. The method of application into ruts requires that the coarser aggregate is pushed into the centre of the rut leaving fine aggregate to feather out at the edge, creating an acceptable but segregated surface.

Rut-fill slurry is the only slurry product that is laid at depths much greater than the maximum aggregate size and deformation and depressions may be possible within the slurry.

Aesthetics

The finished slurry must provide a smooth surface with uniform colour and texture. There must be no bare patches, gaps and/or missed areas, or areas with obvious segregation, track marks, drag marks, indentations or other permanent blemishes. There must be smooth transitions onto other surfacings at the ends with finished edges following parallel to the existing margins of the road surface.

Surface Texture

The surface texture at the end of the defects liability period must equal or exceed the minimum value specified. Using random sampling, the longitudinal positions should be chosen for each measurement location within each lot. The measurements should be taken at the following locations as defined by NZTA T/4 - Outer wheel-path, between wheel-path, centreline, inner wheel-path, and outer wheel-path. The frequency and location of testing must be stated in the Quality Plan.

Remedial work must be required if, within 12 months of completion of work, more than 10% of a lot has a finished surface with a texture depth less than the specified value.

Abrasion Loss

Remedial work must be required if, within 12 months of completion of the work or within the maintenance period, the effects of normal use and environmental conditions cause abrasion or loss of the slurry surface to reveal more than 0.5 m2 of the underlying surface, within any lot.

Skid Resistance

The finished surface must comply with the surface resistance requirements as set out in NZTA T/10.

Deformation and Depressions

Remedial work must be required if deformations or depressions exceeding 10 mm occur within the slurry surfacing, within 12 months of completion of work, when measured under a 2.0 metre straightedge.

Construction

No obvious defects resulting from poorly constructed surfacing, including longitudinal or transverse joints.

Completion of Quality Control Sheets/As-Built/RAMM forms showing date and details of slurry surfacing.

All utility lids and covers are lifted and pavement markings completed before temporary traffic management is removed

Safety

Procedures for manufacturing and constructing the slurry surface have been followed.

Timeliness

Within a period of 24 hours from the time of completion of slurry surfacing, the road must have pavement marking reinstated as existing.

Surfacing records including daily site sheets and forms are submitted by the due date.

Quality Assurance records and test results being submitted by the due date.

16.3 Sustainability

Consideration of existing and potential means of promoting sustainability in pavement design, materials, pavement and drainage maintenance activities and construction should be given by designers and others involved in determining what materials and processes go into these activities.

The pavement design, materials, pavement and drainage maintenance activities and construction approaches for all maintenance and renewals works should align with the following sustainability outcomes

- Target zero waste through waste minimisation and/or recycling/re-use maximisation;
- Energy savings;
- Reduction in contribution to greenhouse gases production;
- Contribution to whole of life cost reductions for maintenance of road transport assets;
- Usage of bio fuels and other similar fuel derivatives.

Given the numerous existing and potential sustainable inputs into road pavements, this might include consideration of some of the following:

- The use of recycled materials in road construction, such as:
- Asphalt, in the production of recycled asphalt pavement (RAP) mixes as is already permitted by existing NZTA specifications.
- Aggregates, with the use of recycled crushed concrete, the re-processing of waste aggregates and the use of industrial by-products (such as slag in asphalt).
- The use of various materials in construction, such as subgrade undercut situations where a variety of suitable materials could be made available.
- For example glass sand, millings (where environmental concerns may need to be addressed) or other recycled materials may be suitable.
- The sourcing of locally available materials in order to reduce the transport distance for the materials.
- The use of stabilisation/modification of pavement aggregate is promoted within the provisions of NZTA specifications such as NZTA M/4 in order to make locally available aggregates suitable for use as basecourse material.
- The use of slightly lesser grades of pavement aggregate is suitable for use in some applications where the use of premium aggregate is unnecessary. Some provisions have been made in this document to allow this.
- The stabilisation of existing road materials, including:
- In situ stabilisation which incorporates the current use of some recycled materials or by-products as additives.
- Designing pavements in order to allow future in situ stabilisation.
- Processing and treating of pavement aggregates using pug mills.
- The provision of incentives, where opportunities arise, for the use of sustainable materials or construction.

16.4 Contaminated Materials

Sites will be checked against the criteria for activity type and contamination thresholds established by the Ministry for the Environment in National Environmental Standard (NES) and their guideline documents and also in the Auckland Council “Auckland Regional Plan for Air Land and Water” (ALW).

In particular the contaminants that may be present in some of the existing pavement materials are;

- Polycyclic aromatic hydrocarbons (PAH)
- Total petroleum hydrocarbons (TPH)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Heavy metals

If a site is identified as having potential contamination issues a sampling plan must be developed and submitted to the Auckland Transport representative for approval.

All agreed sampling, contaminant testing and analysis are to be carried out by an approved IANZ (International Accredited New Zealand) certified laboratory.

All results must be checked against the contaminant criteria in the NES to see if the specific contaminant levels have been exceeded. If the levels are exceeded, then it must be established if resource consent is required for the pavement renewal works.

In any required design process it must be clearly demonstrated that all options have been considered for mitigating the presence of contaminated materials within the requirements of the NES the Ministry guidelines and the ALW. The first preference is to maintain and use the materials on site with the excavation and removal of the contaminated materials to landfills as the least preferred option.

If material is to be removed from site, then the materials must be classified using the following system;

- Contaminated Fill – contains contaminants above the maximum admissible concentrations for fill at local landfill sites;
- Managed Fill - contains contaminants below the maximum admissible concentrations for fill at local landfill sites;
- Cleanfill – material defined as cleanfill under the ALW and the Ministry “Guide for the Management of Cleanfills”.

Where resource consent is required for the pavement renewal works, a Remedial Action Plan (RAP) must be provided along with all reports and testing data required.

16.5 Noise and Vibration Management

All activities must comply with the noise requirements of the Resource Management Act (RMA) and the relevant operative District of Unitary plan requirements.

Where construction noise is likely to be an issue, a plan must be prepared and submitted to the Auckland Transport representative for review and approval. The plan must outline the nature of the intended works and the methodology required to comply with the RMA and District/Unitary Plan requirements and work within the limits prescribed in NZS 6803:1999 – Acoustics, Construction Noise (unless these limits have been superseded by any District/Unitary Plan requirements).

The plan should outline the following as a minimum:

- How construction noise management will be addressed in planning the works;
- That the construction noise management is in accordance with accepted industry best practice guidelines;
- How unreasonable noise will be mitigated, especially when working outside normal working hours or at night;
- An assessment of any sensitive buildings or utility services that may be affected by the vibration of construction plant;

- Methods to measure vibration and noise during construction;

16.6 Working In and Around Trees

Prior to undertaking any works in the road corridor, a Corridor Access Request (CAR) must be lodged with the Auckland Transport Corridor Manager. The CAR must provide information on the works to be undertaken on or near trees.

As part of the CAR application a plan must be provided outlining how the works in and around the trees are to be undertaken. The plan must identify any scheduled or protected trees under the operational district, city or unitary plans and separate resource consents must be obtained for any works that may directly or indirectly impact on any of these identified trees.

Works in and around trees include works undertaken within the drip line of any tree.

In general all works are to be undertaken in accordance with accepted industry best practice guidelines detailed in the documents produced by the New Zealand Arboricultural Association that set out currently accepted arboricultural practices for Amenity Tree Pruning, Tree Protection Fencing on Development Sites and Safety Requirements for New Zealand Arboricultural Operations.

The nature of the effects of the proposed works on any tree (i.e pruning, root cutting or tree removal) must be discussed with the Auckland Transport representative. The impact of the works may require the works to be carried out under the supervision of a qualified arborist and this must be identified and allowed for in the work plan.

Where practicable, the works should be planned to avoid damage to the live root structure or above ground structure of any tree.

All personnel that undertake works within the drip line of trees are to be trained in accordance with the accepted industry best practice guidelines detailed in the documents produced by the New Zealand Arboricultural Association.

The developer/contractor must ensure that all personnel carrying out any works within the drip line of any tree are suitably qualified and informed of any conditions of an approved plan and/or resource consent and act in full accordance with these conditions.

Where the input of a qualified arborist is identified the arborist is to be commissioned by the developer/contractor and agreed with the Auckland Transport representative. Prior to any works commencing within the drip line of trees within the road corridor, a site induction meeting is to be convened by the developer/contractor and must include the Auckland Transport representative. At the induction, the developer/contractor must have the arborist explain in detail the tree protection matters that are relevant to the specific sites and work methodologies to all certified personnel who will be implementing the works.

When working in the drip line of trees and where directed by the arborist, work areas must be excavated and/or probed prior to excavation to check for the presence of roots.

If it is necessary to remove part of the live root structure of any tree then this should only occur once the full extent of the roots within the excavation have been exposed. The affected roots must be neatly trimmed back to the edge of the excavation with a sharp pruning tool.

The cut face of the root(s) is to be protected from drying out and kept damp until the excavated area can be backfilled.

Where roots have encroached into pipes, chambers, manholes, meter boxes and other network utility infrastructure, they may be cut to ensure the effective functioning of the infrastructure, but this must be undertaken in accordance with the accepted industry best practice guidelines detailed in the documents produced by the New Zealand Arboricultural Association and instructions given by the arborist.

The arborist is to advise the Auckland Transport representative within 24 hours if any work affecting a tree will have long term significant adverse effects on the tree structure, including loss of visual amenity of the tree.

The preferred method of excavation within the drip line of trees is to be by way of hand digging. Hand digging must be carried out with care to allow tree roots to be identified before they are damaged. The retained roots should be protected by root protection measures as soon as they are exposed.

When operating in the drip line of trees the compaction method around root structures must be by hand-operated plate compactors only.

Where the pruning of any tree is required, this work is to be undertaken by a qualified arborist. The pruning must be undertaken in accordance with accepted industry best practice guidelines detailed in the documents produced by the New Zealand Arboricultural Association's "Amenity Tree Pruning" guideline.

Pruning involves the removal of up to 20% of the living canopy of a tree, or that involve cutting of limbs up to 100mm in diameter.

All excavation machinery is to operate from outside the drip line of trees unless the machinery used for excavation can operate from and remain fully on top of existing impermeable hard surfaces or appropriate ground protection measures specified by the arborist are followed.

All machinery must be operated with care to avoid contact with the branches, limbs and trunks of trees. Branches that overhang the works area and come in contact with machinery should be pruned or tied back.

No vehicles, machinery, equipment, spoil and/or materials must be positioned, operated, delivered, stored, wheeled or driven within the drip line of trees unless it can be kept within the bounds of an existing hard impermeable surface and does not conflict with any above ground structure of trees.

For all resurfacing activities, the site must be inspected before work commences and all road surfacing plant must be available and suitable for surfacing works under the canopy of any

overhanging trees. When working within the canopy or drip line of large trees, appropriate care is to be taken to ensure that there is no damage to the trees root or above ground structure.

All sites where protected trees are identified must be inspected in advance of work commencing with Council's Arborist. If it is considered that the overhanging trees will prevent work from reasonably being undertaken then the Auckland Transport Representative is to be immediately advised.

Care must be taken to avoid damage to roadside trees. If any damage, the Auckland Transport representative is to be immediately notified. For street trees the Auckland Council Parks Department must also be immediately notified of any that remedial work that may be required.

No tree damaged as a result of the surfacing operations is left in a condition that could pose a risk to the public. Any broken branches or other debris must be removed from the site and disposed of in an appropriate manner.

The installation of emulsion, bitumen, Rugasol and all other manufactured products which can cause harm to trees must be undertaken in a manner that ensures that no direct spray or spray drift comes in contact with any portion of any tree. The arborist is to advise on how works using such products are to be undertaken when in close proximity to any tree.

Any washing off of these, or similar, products must be undertaken in a manner that ensures that no water or resulting slurry or waste comes in contact with any portion of any tree.

Where a tree requires removal to facilitate the planned works, the arborist must advise if a specific plan is required for the tree removal. All removal of trees must be carried out in accordance with accepted industry best practice guidelines detailed in the documents produced by the New Zealand Arboricultural Association. Auckland Transport may require a replacement tree to be planted to mitigate the effects of removing the tree. This replacement planting is to be carried out to the satisfaction of Auckland Transport.

16.7 Publications and Standards

In addition to the requirements of this document, the following publications and standard specifications also form part of, but are not reproduced in ATCOP. In the event of any ambiguity or contradiction between ATCOP and any publication or standard specification, ATCOP takes precedence.

The intent is to ensure that all works undertaken are in accordance with best practices and industry standard. The list shown below is indicative but not necessarily complete. Auckland Transport reserves the right to add to or remove publications and standards from this list.

The ATCOP must be read in conjunction with the following:

16.7.1 Road Pavements

- NZTA B/2 Construction of Unbound Granular Pavement Layers
- NZTA B/3 Structural Design and Construction of Flexible Unbound Pavements

- NZTA B/5 In-situ Stabilisation of Modified Pavement Layers
- NZTA B/6 In-situ Stabilisation of Bound Sub-Base Layers
- NZTA B/7 Manufacture and Construction of Plant Mixed Modified Pavement Layers
- NZTA B/8 Manufacture and Construction of Plant Mixed Bound Sub-Base Pavement Layers
- NZTA F/1 Earthworks Construction
- NZTA F/2 Pipe Subsoil Drain Construction
- NZTA F/3 Pipe Culvert Construction
- NZTA F/5 Corrugated Plastic Pipe Subsoil Drain Construction
- NZTA F/6 Fabric Wrapped Aggregate Subsoil Drain
- NZTA F/7 Geotextiles
- NZTA M/1 Roading Bitumen
- NZTA M/3 Notes Sub-Base Aggregate
- NZTA M/4 Basecourse Aggregate
- NZTA M/4 Notes Crushed Basecourse Aggregate
- NZTA M/10 Asphaltic Concrete
- NZTA M/15 Lime for use in Soil Stabilisation
- NZTA P/9 Construction of Asphaltic Concrete
- NZTA P/9P (Auckland) Construction of Asphaltic Concrete Paving
- NZTA P/11 Open Graded Porous Asphalt
- NZTA Quality Standard TQS1: 1995 for High QA Level Contracts
- NZTA QG Notes Guideline on Role in Quality Assurance
- NZTA Q/2 Hot Mix Asphalt
- Q/2 Notes Chipsealing and Hot Mix Asphalt
- Q/4 High QA Level Contracts
- NZTA T/1 Benkelmen Beam Deflection Measurements
- Austroads Pavement Technology Series: Pavement Design - A Guide to the Structural Design of Road Pavements, 2004
- New Zealand Supplement to the document, Pavement Design – A Guide to the Structural Design of Road Pavements, 2007
- NZTA Economic Evaluation Manual Volume (EEM) 1, 2010
- Cement Stabilisation of New Zealand Roads – Formerly NRB & RRU
- Design and Construction of Concrete Road Pavements – Formerly NRB & RRU
- Austroads Materials for Concrete Road Pavements (2009)
- Interlocking Concrete Block Paving – Formerly NRB & RRU
- Lime Stabilisation of New Zealand Roads – Formerly NRB & RRU
- Geomechanics for New Zealand Roads – Formerly NRB & RRU
- Auckland Council (formerly Auckland Regional Council's) "Auckland Regional Plan for Air Land and Water"
- Ministry for the Environment "National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health" (2011)

- Ministry for the Environment “Contaminated Land Management Guidelines No.1 – Reporting on Contaminated Sites in New Zealand” (2011)
- Ministry for the Environment “Contaminated Land Management Guidelines No.2 – Hierarchy and application in New Zealand of Environmental Guideline Values” (2011)
- Ministry for the Environment “Contaminated Land Management Guidelines No.3 – Risk Screening System” (2004)
- Ministry for the Environment “Contaminated Land Management Guidelines No.4 – Classification and Information Management Protocols” (2006)
- Ministry for the Environment “Contaminated Land Management Guidelines No.5 – Site Investigation and Analysis of Soils (2011)
- Ministry for the Environment “Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand” (2011)
- Ministry for the Environment “Checklist of Reporting Requirements for Contaminated Sites” (2011)
- Ministry for the Environment “Toxilogical Intake Values for Priority Contaminants in Soil” (2011)
- Ministry for the Environment “Draft Sampling Protocols and Analytical Methods for Determining Petroleum Products in Soil and Water” (1999)
- Ministry for the Environment “Guide for the Management of Cleanfills” (2002)

16.7.2 Road Surfacing

- A Guide to the Safe Handling of Bituminous Materials – Department of Labour/Roading, Roading New Zealand
- NZTA P/3 Specification for First Coat Sealing
- NZTA P/05P Rubber Latex in Reseal Binders
- BCA (now Roading New Zealand) E/2 Specification for the Performance of Bitumen Distributors
- BS 812 Part 114 Polished Stone Value Test
- NZTA M/01 Specification for Roading Bitumens
- NZTA M/11 Specification for Pre-coated Chip
- NZTA M/06 Specification for Sealing Chip
- NZTA M/10 Asphaltic Concrete
- NZTA M/13 Specification for Adhesion Agents
- NZTA P/04 Specification for Resealing
- NZTA P/9 P (Auckland) Construction of Asphaltic Concrete
- NZTA P/11 Open Grade Porous Asphalt
- NZTA P/17 Specification for Performance-Based Bituminous Reseals
- NZTA P/23 Performance Based Specification For Hotmix Asphalt Wearing Course Surfacing
- NZTA T/3 Specification for standard test procedure for measurement of texture by the sand circle method
- NZTA T/4 Standard Procedure for Description of Test Locations on State Highways

- NZTA T/10 Specification for Skid Resistance Investigation and Treatment Selection
- NZTA, RCA Roading NZ "Chipsealing in New Zealand", (NZTA 2005) ISBN 0-478-10562-2
- NZTA Maintenance Guidelines for Local Roads
- Asphalt Institute Publication MS No. 2 'Mix Design Methods for Hot Mix Asphalt'.
- AAPA National Asphalt Specification (NAS) 2nd Edition and NZTA Supplement.
- NZTA MS2 Asphalt Institute Mix Design Methods for Asphalt Concrete and other Mix Types
- Austroads "Guide to Pavement Technology Part 4b: Asphalt"
- Austroads "Guide to Pavement Technology Part 4k: Seals"
- BCA (now Roading New Zealand) E/2 Specification for Performance of Bitumen Distributors
- Roading New Zealand (RNZ) 9806: Specification for Slurry Surfacing's
- ISSA A105 Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal.
- ISSA A143 Recommended Performance Guidelines for Microsurfacing.
- AP – T26 Guidelines and Specifications for Bituminous Slurry Surfacing
- Auckland Transport "Reseal Governing Principle" (Draft)

16.8 Design Requirements

16.8.1 Road Pavements

Site Investigation and Survey

Professional judgement must be used to identify all site features, which would affect the design and construction, and to provide the best overall value to the Auckland Transport.

Desk Top Study

All RAMM information and Vehicle Counts must be obtained by request through Auckland Transport prior to the design commencing and must be reviewed. Discussions can be held with the Auckland Transport Representative to identify road pavement history, performance, and other issues, which may affect the works.

Liaise with the Auckland Transport representative Transport Planners, and reviewing all applicable standards applicable to location/type of road. A GIS Plan must be obtained and any aerial photographs of each site. A check should also be taken with the Call Centre of any known complaints associated with the investigated section.

The information and outputs from the desk top study is to be included with the design report.

Liaise with utility service operators to gather information regarding other works which may be affected by the project. These works may include, but not limited to, drainage, sewage, under-ground power, ultra-fast broadband, and other utility services upgrades.

Detailed Site Walk Over

A detailed walk-over inspection of the site must be undertaken and must include:

- Measuring the site with reference to RAMM chainages - widths of full carriageway RAMM cross-sections every 20m
- Verifying RAMM information and noting approximate location of all defects eg failures, discrepancy in levels, cross falls, kerb and channelling, street furniture, service covers, drip lines, drainage features, depths of subsoil drainage within cesspits etc. Visual inspection to record all pavement features, defects and condition etc as per the RAMM database and the relevant Austroads Guidelines.
- Taking digital photographs at 100m minimum intervals in each direction noting RAMM chainage.
- Sketching a neat A3 base plan using the above information (scale to be 1:250 or 1:500), this must include all road features, cesspits, subsoil drain inlets, road marking, signage, all defects, RAMM chainages and cross-sections every 20m. (Note it is intended that this base plan be used throughout the design phase and implementation phase and for as-builting purposes).

The information and outputs from the detailed site walk over is to be included with the design report.

Location of Utility Services

All utility plans and written permits for proposed works at each site are to be obtained by the designer ie advise all utility operators of proposed works and to sketch all services on a copy of the base plan. Significant services must be clearly noted e.g. high pressure gas, water, high voltage power, fibre-optic cables, Watercare mains etc.

The designer must arrange for each utility service authority as part of the design process, to attend the site and mark out the location of their services prior to verification by either the use of ground penetrating radar or utility pilot trenches, or a combination of both methods.

The information and outputs regarding the location of utility services is to be included with the design report.

Topographical Survey and Preliminary Design Drawings

Topographical survey must be carried out as approved by the Auckland Transport representative if it is necessary to ensure adequate longitudinal and cross section shape and gradient on road and adequate drainage. The topographical survey must record details including road and kerb levels, street furniture, service covers, drainage features, drip lines, legal boundary, vertical profile at vehicle crossings, and other significant information.

Survey accuracy must be ±10 mm for reduced levels and ±20 mm for horizontal locations. The survey must be presented in AutoCAD format and must compromise a layout plan showing all existing features, longitudinal sections, along the road centrelines and kerb lines, and cross sections at no more than 10m intervals. The topographical survey plan must include contours at

0.20m intervals. Appropriate Traffic Control for the topographical survey work complying with the requirements of *ATCOP Chapter 26* must be supplied.

The preliminary geometric design drawings are to be included with the design report.

Ground Penetrating Radar (GPR)

The designer is to arrange for longitudinal radar scan down the left wheel track of the lane carrying the highest volume of traffic in each direction. The radar equipment to be used is to be new generation type equipment less than 5 years old. Two Antennas must be used during the survey to highlight the following zones beneath the surface (depth 0m-0.9m approximately and depth 1.0m-2m). Electronic scanning information is to be provided with specific information noted on the base plan-correlated to the RAMM chainages. Pavement depths are to be reported on at a minimum of 30m intervals. Services are to be replotted as necessary with actual cover depths noted on the base plan. The radar professional must write a brief technical report with a brief commentary on services, pavement depths, consistency of the pavement and any other information, which may affect the road design.

Temporary Traffic Management for the ground penetrating radar work must comply with the requirements of *ATCOP Chapter 26*.

The output of the ground penetrating radar study is to be included with the design report.

Test Pits and Utility Pilot Trenching

The designer is to arrange for test pits and utility pilot trenching over critical services in strategic positions highlighted on the base plan and agreed with the client. The test pit/utility pilot trenching is to be logged by the designer to NZ Geotechnical Standards and the test pit photos provided within the report must be in colour.

Liaison and necessary permits are the responsibility of the designer and are to be obtained and held on-site as required (i.e. Corridor Access Request and Utilities Approval).

Sufficient and representative samples must be obtained from each site for determination of natural soaked subgrade CBRs and natural soaked pavement CBRs and two modified pavement soaked CBR's. Other testing such as Atterberg Limit test, particle size distribution test, unconfined compressive test and indirect tensile test may be carried out as required with prior approval from the Auckland Transport representative. Each test pit must be saw cut square prior to excavation. The excavated depth is to subgrade or until a depth of 800mm is reached. A digital photograph must be undertaken with a tape measure in the hole indicating depth and the samples adjacent. All test pits must be professionally logged and reported in the design report. Other subgrade testing, such as shear vane testing, and in-situ moisture content (laboratory) testing must be carried out and reported in the test pit logs.

A Scala penetrometer test must be undertaken to a depth of 1.5m below subgrade. Testing to be carried out by IANZ certified staff. Reinstatement of the test pits must be as specified in the Utility Operators Code of Practice.

Traffic Control for the test pits and utility pilot trenching and reinstatement works are to comply with the requirements of *ATCOP Chapter 26*.

The designer is responsible for the collection of all data, documentation and interpretation of the test data for design purposes.

The outputs of all test pit logs and scala penetrometer results and the outputs of the utility pilot trenching are to be included with the design report.

Laboratory Testing

All Laboratory Testing is to be carried out by an approved IANZ (International Accredited New Zealand) certified Civil Engineering Laboratory.

All testing must be the responsibility of the designer to determine and undertake and must be sufficient to establish the condition of the various existing pavement layers and materials and sufficient to support and justify any design option chosen.

Sufficient testing is required to determine material properties including:

- **Soaked CBR Test of Natural Subgrade** - A remoulded soaked CBR of the subgrade must be carried out as recommended by the designer. Test and report to NZ Standards.
- **CBR Test-Natural Test-Pavement Sample** - A remoulded soaked CBR of the pavement must be carried out as recommended by the designer. Test and report to NZ Standards.
- **Modified Soaked CBR** - A modified soaked CBR using stabilising agents, (ie lime, cement, durabind, KOBM) must be carried out as recommended by the designer. Test and report to NZ Standards.
- **Particle Size Distribution (Wet) Test** – grading of the basecourse and/or subbasecourse must be determined as recommended by the designer. Test and report to NZ Standards.
- Unconfined Compressive Strength (UCS) test – soaked or dry UCS using stabilising agents, (ie lime, cement, durabind, KOBM) must be carried out as recommended by the designer in accordance with relevant NZ standard.
- **Indirect Tensile Strength (ITS) test** – soaked or dry ITS using stabilising agents, (i.e. lime, cement, durabind, KOBM, emulsion and foamed bitumen) must be carried out as recommended by the designer in accordance with NZTA or other relevant industry standards.
- **Atterberg Limit** – plasticity index, plastic limit and liquid limit must be determined in accordance with relevant NZ standard.

The outputs of all laboratory test results are to be included with the design report.

Utility Pilot Trenching

The designer is to arrange for utility pilot trenching over critical services as highlighted on the base plan and agreed with the Auckland Transport representative. Liaison and necessary permits are to be obtained and on-site as required (ie Road Opening Notice and Utilities Approval).

Traffic Control for the utility pilot trenching and reinstatement works is to comply with the requirements of *ATCOP Chapter 26*.

The designer is responsible for the collection of all data, documentation and interpretation of the data for design purposes. As a minimum, the location of the utility service, in terms of RAMM chainage and offset from existing edge of seal or channel and GPS coordinates, and the depth of utility services must be reported. All information must be clearly marked on the base plan for later reference.

The outputs of the utility pilot trenching is to be included with the design report.

Falling Weight Deflectometer (FWD) Testing

The designer must prepare a programme of FWD test sites and arrange for all testing, and analysis of data.

Testing must be carried out at 20m intervals of each lane. All lanes in both directions must be tested unless otherwise agreed prior with the Auckland Transport representative. All FWD testing must be carried out in accordance with D ASTM 4695-96-Standard Guide for General Pavement Deflection Measurements.

Traffic Control for the FWD testing is to comply with the requirements of *ATCOP Chapter 26*.

The designer is responsible for the collection of all dates, documentation and interpretation of the data for design purposes.

All road sections must have preliminary FWD results. The designer is to allow for all remodelling and calibration with actual test pit information or ground penetration radar and conversion to RAMM chainages as required. It must be noted that the FWD and engineering analysis of other information must be used as a tool for identifying mode of failure and the correct pavement treatment. All results are to be analysed and commented on.

Minimum information required in FWD report is:

- Resilient Modulus and deflections must be obtained for each pavement layer and modelled using pavement design ESA for 30-year design period.
- Tensile strain at bottom of bound pavement layers – ELMOD 6.0 or similar
- Compressive strain to subgrade - ELMOD 6.0 or similar
- ESA to failure.
- Critical Strain layer identified.
- GMP Granular Overlay from ELMOD or similar.
- Austroads Simplified Mechanistic Asphalt Overlay (ASMOL).
- Stabilisation Depth /Graphical Analysis.

The outputs of the FWD testing are to be included with the design report.

Sustainability

The sustainability principles detailed in *ATCOP Section 16.4* must be considered in all pavement renewal designs.

Contaminated Materials

Any contaminated materials discovered in any pavement renewals sites or new pavement construction areas must be addressed during the design process as per the requirements detailed in *ATCOP Section 16.5*.

Preliminary Design Report

The designer must carry out mechanistic pavement rehabilitation design procedure using Austroads "Pavement Design - A Guide to the Structural Design of Road Pavements (APDG), 2004" and the NZ Supplement (2007).

The pavement design must be carried out using multi-layer elastic computer program 'CIRCLY".

Pavements must have a minimum design life of 25 years. Where certain projects require a longer design life they will be defined in the NZTA Economic Evaluation Manual (EEM) and may have a design life of 30 years.

The designer must propose various rehabilitation options for each section of road and recommend the preferred option based on whole of life cycle cost analysis in accordance with NZTA Economic Evaluation Manual. The following options are to be investigated.

- Structural Asphalt
- Unbound Granular Pavement with/without modified subbase and/or modified subgrade
- Mill and replace with geosynthetic reinforcement
- Foamed Bitumen Stabilisation
- Cement/lime/KOBM Stabilisation
- Premixed Cement/Lime/Foamed Bitumen/Emulsion Stabilised Pavement
- Concrete Subbase with Structural Asphalt Overlay
- Concrete Pavement – new or replacement

With all options the designer must consider and report the following issues in the design report as a minimum.

- Effects on the road users,
- Protecting or altering utility services
- Ease and speed of construction
- Sustainability
- Effect on any contaminated materials
- Effect of traffic and key stakeholders
- Durability
- Construction risk
- Ease of future rehabilitation of the pavement. (To be considered as part of whole of life cycle cost analysis.)

The options must also consider the other improvements to the road sections including drainage (both surface and sub-surface), footpath, kerb and channel and vehicle crossings.

The designer may propose any other rehabilitation methods in addition to the above. Innovative new products will be encouraged, but need to be supported with appropriate test results and any previous performance results to enable the Auckland Transport representative to adequately evaluate the inclusion of the product(s) in the final approved construction.

The designer must prepare cost estimates for all options in accordance with the NZTA Economic Evaluation Manual (EEM) "PAC" orders of accuracy.

The designer must also identify contingency plans to deal with any risks associated with unforeseen ground conditions. This should be based on past experience in similar work and also on the knowledge of the local ground conditions. Contingency plans to include remedial work required for substandard subgrade / pavement strength, excessive sub-grade moisture, bridging over utility service trenches etc.

The designer must prepare a Preliminary Design Report. The Preliminary Design Report must include the following:

- Project Objective and Scope of Works
- Record and analysis of all investigations gathered/undertaken
- Topographical survey and geometric design
- Geotechnical investigation and reporting
- Ground/Pavement Contamination Assessment
- Record of all consultation, consent assessment and relative issues, discussions and approvals
- Design calculation, plans and details
- Assessment of options with a recommended option
- Cost Estimate
- Economic Analysis (as noted in clause 5360 below)

Preliminary Economic Evaluations

The designer must prepare Economic Evaluations for all options considered based on the preliminary design of the road sections as per the NZTA Economic Evaluation Manual (EEM).

Benefit Cost Ratio (BCR) for all road reconstruction pavement options and Net Present Value (NPV) for all pavement rehabilitation options must be calculated and reported in the design report.

Final Design Report

After approval from the Auckland Transport representative of the preliminary design and an independent review if required, the designer must prepare the final detailed design, report and construction drawings, quantities, cost estimates, contingency plans for remedial works and details.

The final design report must be submitted to the Auckland Transport representative for approval prior to construction.

Detailed Design Drawings

Layout plans; drawings and cross sections of proposed works must be based on the Base Plans showing all the required recommended treatments within each site. Various treatments must be highlighted on an excel spreadsheet using RAMM chainages for detailing areas of various treatments and determining quantities.

All original sheets must be A3 Size. Plan scales must be 1:250/ 1:500. The drawing set is to include cross sections at a minimum spacing of 20m centres along the centreline of the carriageway and a longsection along the road carriageway centreline showing both the existing and proposed centreline levels.

Design Phase Independent Safety Audit

The designer must arrange for the completion of a Stage III Safety Audit, in accordance with the NZTA publication "Safety Audit Policy and Procedures" (August 1993), unless directed otherwise by the Auckland Transport representative. The Auckland Transport representative

The designer's management of the Audit process will include making available all the information necessary for the Audit, providing comments on the Audit Report when requested and implementing such changes to the Contract's Deliverables as are directed by the Auckland Transport representative, as an outcome of the Audit. The comments must include economic viability, as appropriate.

Construction Cost Estimate

The designer must prepare a construction cost estimate with an accuracy of +10% to – 5% as per NZTA EEM-Firm Estimate of Costs‘ FEC’ accuracy based on a schedule of prices and including allowances for, the cost of utility service relocations, contingencies etc. The estimate must be based on relevant contract rates as applicable.

Economic Evaluation

The designer must revise the Economic Evaluations based on the final design review and update the BCRs and/or NPV's of the road sections as required in the NZTA EEM Manual as required.

Independent Review

The designer must provide all design documentation, reports and liaise with any separate Consultant appointed by Auckland Transport to carry out an independent peer review.

The designer must review the Peer Reviewers report and provide a response and amend the design if required and approved by the Auckland Transport representative.

16.8.2 Chip Seal

The detailed seal design must be undertaken by the designer generally in accordance with the requirements of the ATCOP and the methods outlined in the NZTA publication "Chipsealing in New Zealand".

The seal design for sites with insufficient skid resistance must be undertaken in accordance with Appendix 14 NZTA Maintenance Guidelines for Local Roads. The designer must undertake surface skid resistance testing using Griptester or British Pendulum where required to determine the skid resistance of the surface.

The seal designs must have a minimum design life of 10 years.

These designs are to be submitted to the Auckland Transport representative for review and must include the following:

a) Design Summary Sheet outlining:
   - Method and Formulae used
   - Traffic counts
   - Sand Circle Information obtained in accordance with the procedures outlined in NZTA T/3 specification
   - Design residual binder application rates
   - Proposed additives and their related volume
   - Heating factors
   - Final spray rates (if these vary from the design application rate, then the field spray docket or work sheets must detail the reasons for deviation from design)
   - At the time of undertaking the design process, the seal designer, when visiting each site, must look for any tree canopy issues that may hamper chip sealing operations. They will then provide a methodology to prevent damage to tree canopies.

b) Site sketches showing existing pavement features (existing patches/flushed areas/services) areas of traffic stress, location of sand circle tests and large trees.
   - If the designer proposes an alternative treatment selection, they may forward a written proposal to the Auckland Transport representative. This proposal is to be documented with reasons for the alternative and its benefits to the network.

- The Auckland Transport representative will assess the alternative treatment selection proposed by the designer and will provide recommendations and comments to approval prior to commencement of work.
- The designer must obtain traffic count data records from the RAMM database; however, it is the responsibility of the designer to confirm the actual traffic counts for use in the seal design. The designer may carry out traffic counts for sites where no traffic data is available from Auckland Transport. All new traffic count information must be uploaded into RAMM.
- The Auckland Transport representative must have 15 working days to evaluate the seal designs. Work must not commence until the seal designs and treatment selection proposals have been reviewed and comments provided by the Auckland Transport representative.

16.8.3 Asphalt (AC) Surfacing and Structural Layers

Job Mix Formula (JMF)

The designer must supply details of the mix designs together with the JMF, the Marmust properties for the NZTA M/10 asphalt mix types and other performance tests, such as resilient modulus testing and/or wheeltrack testing for NAS asphalt mix designs to the Auckland Transport representative for approval, all in accordance with NZTA M/10 or the National Asphalt Specification and its NZTA Supplement.

All asphaltic surfacing designs are to have a minimum design life of 10 years.

JMF details and supporting test information, including re-validation data, will be submitted at the start of the contract and then annually for approval.

Design of Mix

The surfacing design seal design for sites with insufficient skid resistance must be undertaken in accordance with NZTA Specification T10 and Appendix 14 NZTA Maintenance Guidelines for Local Roads. The designer must undertake surface skid resistance testing using Griptester or British Pendulum where required to determine the skid resistance of the surface.

The designer must design the AC surfacing to suit the pavement strength and stiffness, and traffic loading in order to achieve the minimum design life of 10 years.

(i) NZTA Mix 10, Mix 15 and Mix 20

Laboratory test specimens of paving mixes, combined in the proportions of the job mix formula, must be prepared and tested by the designer in accordance with the procedures set of the Marmust Method of Mix Design in the latest edition of the Asphalt Institute publication "Mix Design Methods for Hot Mix Asphalt ", Manual Series No. 2, using 75 blow compaction.

The Auckland Transport representative may specify a lower level of design compaction to suit specific sites or locations.

(ii) AC 14

The design process for the AC 14 and other mixes utilised in heavy to very heavy traffic categories (as defined in NAS and / or APRG 18) must be as defined above except that the mixes must be further qualified via refusal density at 250 cycles as defined in the APRG Report No 18. (not less than 2.0% air voids at refusal).

(iii) SMA 7, 10 and 14

The mix design for SMA 7, 10 and 14 must be in accordance with the requirements of the National Asphalt Specification and its NZTA Supplement.

(iv) Durability

For all mixes, a minimum binder film thickness of 7.5 micron is required, when calculated in accordance with the procedures set out in APRG 18.

NB. Design air voids must be in the range 4% to 5% for AC14 and must be in the range of 3% to 4% for NZTA Mix 15.

(v) Polished Stone Value (PSV)

The PSV of the aggregate for each JMF must be determined by the designer as part of the seal design in accordance with the requirements of NZTA T10 Specification for State Highway Skid Resistance Management and / or Appendix A of the NZTA Maintenance Guidelines for Local Roads.

PSV must be measured in accordance with BS 1097-8:2009.

Aggregate for each JMF must have a minimum PSV of 52 and be in the range of 52 to 57.

Where higher PSV aggregate is requested the minimum polished stone value must be 64 as directed by the Auckland Transport representative. The stone source must be advised to the Auckland Transport representative for approval before use.

Falling Weight Deflectometer (FWD) Testing

Testing must be carried out at 20m intervals of each lane in accordance with D ASTM 4695-96-Standard Guide for General Pavement Deflection Measurements.

The FWD test results must also include the curvature function of the existing pavement at each test point. These results are to be used to determine a suitable AC surfacing to match the design loading for the pavement and surfacing in accordance with the Austroads guidelines.

Traffic control for the FWD testing is to comply with the requirements of *ATCOP Chapter 26*.

The designer is responsible for the collection of all data, documentation and interpretation of the data for design purposes.

16.8.4 Slurry Surfacing

The designer must design the slurry in accordance with ISSA A105 or ISSA A143 mix design procedures and the requirements of the ATCOP.

The surfacing design seal design for sites with insufficient skid resistance must be undertaken in accordance with NZTA Specification T10 and Appendix A NZTA Maintenance Guidelines for Local Roads. The designer must undertake surface skid resistance testing using Griptester or British Pendulum where required to determine the skid resistance of the surface.

The designer must design the slurry surfacing to suit the pavement strength and stiffness, and traffic loading in order to achieve the minimum design life of 10 years.

FWD testing must be carried out to determine the pavement strength and stiffness in accordance with Clause 4304.

All material sampling, testing and mix design must be performed by a laboratory which is accredited to ISO/IEC 17025 by an accreditation agency which is either internationally recognized or specifically recognized by Roading New Zealand and NZTA.

16.8.5 Pavement Deflection Criteria and Curvature Function

Function

It is defined as the measurement of the rebound deflection of a pavement using the Benkelman Beam test and is the preferred method to gauge the adequacy of a constructed pavement to confirm readiness for pavement surfacing and that it meets the design requirements.

Where the design pavement comprises of a thin asphalt surfacing, Benkelman Beam testing on top of the basecourse is used to confirm that the design (pavement layer stiffness) assumptions are achieved in the field. This deflection testing does not however provide a good indication of how the thin asphalt surfacing will perform. The fatigue failure of thin asphalt surfacing is a significant problem in Auckland and the requirements outlined below seek to address this mode of failure, which is especially prevalent in unbound granular pavements.

The curvature function has been added as a requirement to be targeted in the design and treatment selection process – with special consideration given to the limited reliability of unbound granular pavements in achieving the designed or expected curvature performance in the field. (Refer to the section Curvature Function as a Design Consideration, below Table 52**).** The curvature function is defined as the central deflection (d0) subtracted by the deflection at a point 200mm away (d200).

The deflection targets outlined below in Table 52 are 90th percentile values that are to be achieved post-construction of the basecourse layer and before surfacing. Note that the provisions of Table 52 allow for higher deflections in some circumstances (refer to Table 52 notes). **Benkelman Beam test results must be supplied to the Auckland Transport representative/Asset Manager or representative for approval prior to surfacing for all pavement types except structural asphalt and concrete pavements. The deflection values must be met before surfacing,**

unless otherwise approved by the Auckland Transport representative/Asset Manager or representative.

Pavement Deflection and Curvature Requirements

The pavement deflection and curvature requirements are outlined in Table 52. Refer to notes below for further details.

Table 52: Pavement Deflection and Curvature Requirements for Construction and Design*

Road Hierarchy	90th Percentile Values for Construction and Design [1, 3]		
	Benkelman Beam Deflection [1, 2] (mm) (for design & construction testing)		Curvature Function (mm) (for design purposes)
	Asphalt Surface	Chipseal Surface	
Arterial & Primary	1.0	1.2	0.15
Collector (Business)	1.0	1.2	0.15
Local (Business)	1.0	1.2	0.15
Collector (Residential –with buses*)	1.0	1.2	0.15
Collector (Residential – without buses)	1.2	1.4	0.18
Local	1.4	1.6	

***This should also include residential collector roads that are bus routes and any collector/local route with significant usage by heavy vehicles.**

Notes

1. For a number of pavement types (such as modified and stabilised pavements), due to the enhancement of pavement stiffness and greater control of the curvature, slightly higher deflections may be permitted. This is because in these cases the Austroads design criteria are clearly met despite slightly high deflections being expected. This can be demonstrated by mechanistic design modelling. As a result, for these cases the designer must provide in the design documentation the deflection values that are to be achieved on site.
2. Where low CBRs are encountered such as in undercut situations, design modelling shows that critical design criteria (subgrade damage and curvature or surfacing fatigue) are often fully met despite deflections being higher than given in the table or those

modelled for better subgrade conditions. This fact should be taken into account in the deflection testing and design of any undercut areas or situations where a pavement bridges soft subgrade conditions.

3. The deflection/curvature values given in the table are presented as "90th percentile" values, (meaning the 90th percentile of test data must not exceed this value, and areas exceeding this must be made good to rectify the 90th percentile). The 90th percentile is on the basis that pavement designs are generally based on a 10th percentile subgrade and a 90th percentile case in terms of overall pavement deflection/curvature.
4. The use of asphalt surfacing generally relates to arterial (or similar) routes with an AADT of more than 10,000 vpd, although there may be exceptions to this. The curvature function should be a key design consideration for all roads where a thin asphaltic concrete (AC) surface is to be used.

Curvature Function as a Design Consideration

In the design of pavements for heavily loaded road classes, the following should be taken into consideration in terms of treatment selection to ensure the design curvature function and thin surfacing performance is replicated in the field:

- Designers should consider that in the field, unbound granular pavements often exhibit less shear strength and higher curvature values than produced in design models using Austroads design methods.
- To achieve acceptable curvature in the field, this means designing for a more conservative curvature than given in Table 52, above, or;
- Alternatively, treatment selection for the use of modification or stiffness enhancement of granular material provides greater reliability.
  - Treatment selection guidelines are outlined in the NZ Supplement to Austroads.
  - Furthermore (as is outlined in 14.2.10) unbound granular pavements are not to be constructed on urban arterial roads. (Except where approved by the relevant AT Engineer/Asset Manager and with the exception of localised repairs.)
- For the definition of an urban arterial road refer to 16.2.8. Note that arterial roads are defined in *ATCOP Chapter 4 Road Classification.*
- Where a thin asphalt surfacing is not modelled (for designs using mechanistic methods), a check of asphalt fatigue should be undertaken.
- The use of asphalt mixes that are relatively fatigue resistant should be considered by the designer, with due consideration given to other relevant requirements.

16.9 Materials, Plant and Construction Requirements for Road Pavements

16.9.1 Earthworks

General

The work comprises the excavation / milling of the surrounding area, existing road pavement, filling operations and any other incidental work required to complete the work. These works will comply with the following items:

- The excavation of all existing materials encountered on site including solid material and existing formation materials, suitable material and unsuitable material.
- Sawcutting the existing pavement, concrete or asphalt footpath and kerb and channel as required by the drawings.
- Excavate all foundations and earthworks to the profiles and levels detailed in the design. Allow clearance for working space as necessary.
- Trim all excavations to required profiles, falls and levels. Remove all loose or disturbed material from the finished excavated surface.
- Import and place suitable material as compacted fill material as approved by the Auckland Transport representative. Generally granular materials are to be placed on top of non-granular materials and different types of materials are to be compacted in different layers.
- Excavate and remove all “contaminated fill” and “managed fill” materials off site and dispose to consented/licensed landfill.
- “Contaminated fill” is defined as soil containing concentrations of contaminants above the Maximum Admissible Concentrations (MAC) for managed fill at local landfill sites.
- “Managed fill” is defined as soil containing contaminants that are below the Maximum Admissible Concentrations (MAC) for managed fill at local landfill sites.
- Excavate and remove from site any material deemed unsuitable by the Auckland Transport representative. Replace with approved properly compacted fill.
- “Unsuitable material” is defined as any material that the Auckland Transport representative determines to be unsuitable for use as a foundation for the pavement because of its organic content or sensitivity to movement of machinery. All unsuitable material must be excavated down to suitable firm material, or as directed by the Auckland Transport representative and disposed off site.
- Import approved rock fill and hardfill material as required to complete the compacted fill areas.
- Provide temporary drainage works to control surface water and silt runoff from cleared areas in accordance with District Plan and RMA requirements.
- Inform the Auckland Transport representative when excavations are ready for inspection and for approval. Approval must be obtained before proceeding with any further work.
- Construction traffic must not be permitted on the excavated or filled surfaces until they have been protected by a properly compacted temporary protective layer. The temporary protective layer must be removed before permanent construction is commenced. No material must be stockpiled on excavated or newly filled areas without protection.
- The maximum depth of milling for shape improvement must be agreed with the Auckland Transport representative before the work is commenced.
- Carrying out testing of the subgrades CBR strength using Dynamic Cone Penetration Tests (Scala penetrometer test) and/or Benkelman Beam Tests and/or proof rolling using 10-12 tonne static steel drum roller, where appropriate.

Preservation and Maintenance

The Works must be protected at all times and particularly during wet weather. All necessary temporary drains needed to give such protection must be provided. The whole of the Works must be kept graded at all times to ensure that no areas pond water. The Works must be protected from damage during the handling of materials, tools and equipment by laying planks and must take other precautions as needed. In no case will vehicles be allowed to travel in a single track. If ruts are formed, the Works must be reshaped and re-compacted. Storage or stockpiling of materials on the top of the subgrade will not be permitted.

Where the Auckland Transport representative considers that these obligations have not been fulfilled to the extent that softening of, damage to or failure of the Works occurs, remedial works must be carried out that, in the opinion of the Auckland Transport representative are necessary to restore the Works and any subsequent work to their original condition.

The Auckland Transport representative is to be advised of any sensitive material encountered during the excavation.

Contaminated Materials

All consents, reports and test results are to be available on site to accurately determine the extent of the contaminated materials.

Any mitigation and/or removal of any contaminated material must be identified, marked out and managed in accordance with the approved Remedial Action Plan.

During construction all contaminated material to be removed from site must be kept separate from uncontaminated material. All measures must be taken to manage the removal of materials carefully so that the quantities of contaminated materials that need to be removed are kept to the minimum.

Materials to be excavated from site should be classified as follows;

- Contaminated Fill – contains contaminants above the maximum admissible concentrations for fill at local landfill sites;
- Managed Fill – contains contaminants below the maximum admissible concentrations for fill at local landfill sites;
- Cleanfill – material defined as cleanfill under the ALW and the Ministry “Guide for the Management of Cleanfills”.

Managed fill material can either be transported to a managed fill only site or as “managed fill” at a conventional landfill site. Examples of managed fill sites in the Auckland/Waikato Regions are Hampton Downs, Greenmount and Redvale landfill sites.

Each landfill site has specific acceptance criteria for the materials that can be accepted at the site. These criteria are based around the maximum admissible concentration levels for differing contaminants. The removal of any managed or contaminated fill must go to an appropriately

consented landfill and appropriate regular checks are made to ensure that the levels of contaminants being transported to the landfill do not exceed the landfill's consented criteria.

Contaminated fill material can generally be disposed of at the Hampton Downs landfill.

Verification of Earthworks

Immediately before the construction of any pavement the surface of the earthworks must be tested for compliance with the specified requirements for strength and surface tolerances and must be inspected to determine if the surface has loosened, disturbed, damaged or deteriorated. Any area found to lack the specified accuracy or to have suffered deterioration must be scarified, reshaped by adding, removing or replacing material, watered, recompacted or otherwise treated until the specified requirements for the earthworks and its surface are obtained.

When it is considered that the preparation of the earthworks 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 pavement layer(s), the Auckland Transport representative will carry out an inspection of the works. Testing must be carried out in accordance with the Inspection and test plan deemed necessary to confirm the strength and condition of the works including test rolling the works in the presence of the Auckland Transport representative.

Setting Out

The Works are to be correctly set out to ensure that the location, gradients and levels are strictly adhered to. Care must be taken at all times to preserve legal survey marks, bench marks and level pegs required for checking purposes. Should any such marks be disturbed they will be reinstated by the Auckland Transport representative and appropriate cost recovery charges made.

As required, the existing profile of the centre line, left hand and right hand edges of the road are to be surveyed prior to excavation to ensure that the new road profile matches the existing levels at the edges and the adjacent sections of roads with the goal of ensuring consistent cross fall between control points. Any discrepancies noted must be brought to the attention of the Auckland Transport representative for a decision to be made.

Where road re-profiling is necessary, the design levels are to be verified prior to commencement of any works.

The locations, levels and sizes of the drainage structures on the road must be surveyed and fixed prior to excavation to ensure that the structures are installed at the same locations and levels during rehabilitation and area wide pavement treatment works.

Earthworks Tolerances

All cut and fill work must be carried out to the lines and levels shown on the Drawings or otherwise established by the Auckland Transport representative.

The completed earthworks must be correct within the following tolerances:

- Final Road Subgrades - 20 + 0mm

- Fill Batters - 0 + 150mm
- All other cut or fill areas - 0 + 75mm

Greater tolerances may be permitted on reserve areas at the discretion of the Auckland Transport representative. However, no areas that might pond water will be permitted and all grades must be treated as minimum grades.

Drainage

All earthworks must be carried out in the dry. Both cut and fill areas must be sloped adequately during construction so that they do not pond stormwater and temporary drains must be provided, as necessary to ensure effective removal of stormwater from the areas of operation.

All areas of seepage must be drained by a subsoil drain or by a free drainage aggregate layer as determined by the Auckland Transport representative on site. These must not be covered until the Auckland Transport representative's representative has inspected the subsoil drainage and recorded the position and length.

Over-Excavation

Excavating beyond the designated profiles or contours should be avoided.

Any over-excavation beyond these profiles carried out without the written instruction of the Auckland Transport representative must be made good to the direction of the Auckland Transport representative with compacted fill meeting the specified compaction standards all at no cost to Auckland Transport.

Backfilling and Compaction

The Auckland Transport representative must be notified before backfill is placed in any undercut area, so that the depth of excavation required to meet the design strength of the subgrade prior to backfilling can be inspected. No additional undercut and fill must be undertaken until inspections have been made and the Auckland Transport representative has agreed that the backfilling can commence. The backfill material must be brought to an appropriate water content prior to compacting, be spread uniformly in layers of less than 200 mm and each layer must be compacted to the appropriate strength and density requirements.

Suitable rollers must be used for compacting on-site fill. Equipment used in transportation and spreading will not be permitted as compaction equipment. Compaction plant must cover the entire area of each layer of fill and give each layer a uniform degree of compactive effort. Operations will be interrupted as necessary to permit the Auckland Transport representative to carry out, with safety, control tests on the subgrade and backfill material.

Before full scale earthmoving is commenced a compaction trial is to be carried out under the observation of the Auckland Transport representative to determine the construction methods necessary to achieve the specified standard of compaction. The results of the compaction trial must form a guide as to the minimum amount of rolling required to be carried out, but this must in no way negate the full compliance required under the specified compaction standards.

Under no circumstances whatsoever must plastic clay be worked on any portion of the work during rain or wet conditions.

Excavation of Rock

The excavation of rock or other hard materials must be in accordance with the definition for rock materials given in NZTA F/1. This must include for the excavation, removal and disposal of all materials that meet this requirements including any single rocks or boulders.

16.9.2 Preparation of Carriageway Subgrades

General

The work comprises of preparation of the subgrade, trimming the new formation and any other incidental work required to complete the work. These works will comply with the following items:

- Trim sub grade and finish to requirements of NZTA F/1.
- The entire surface of the subgrade must be made firm, uniform and smooth by blading, grading and rolling with a heavy smooth-wheeled roller. The water content and rolling associated with the surface finish must be such as to comply with the compaction standards specified for subgrade on filling.
- The surface of the subgrade must be finished so that all points are within 15 mm from a 3 m straight edge laid parallel to the centre line of the road, and from a cross section camber board placed at right angles to the centreline.
- Sub soil drains must be installed in the locations and in accordance with the details shown on the drawings and in accordance with NZTA F/2. Drains must be laid with a minimum fall of 1%. Where 1% is not practical then a minimum 0.5% fall may be permitted, after consultation with the Auckland Transport representative.
- The invert levels of the inlet/outlet pipes are to be surveyed prior to commencing any subsoil works.
- Where subsoils are intercepted by existing services, the Auckland Transport representative is to be notified.
- All subsoil drains are to fall into catchpits.

Preservation and Maintenance

Care should be taken to limit the size and weight of the plant, equipment and vehicles in use to avoid damage either to the roading subgrades or to any other surface during pavement construction.

Backfill material must be placed without causing damage to the subgrade. Initial backfill material must be static rolled with appropriate plant. This may require initial layers of backfill to be track rolled by excavator before plant with a higher contact pressure can be used. The purpose of the undercut backfill is to create a layer of increasing strength towards top of subgrade.

Subgrade Improvement

Strength improvement techniques using geogrid, geotextile, granular aggregate (including sand) or stabilisation of the subgrade must be undertaken where shown in the pavement design or as required by the Auckland Transport representative where the subgrade strength is below minimum standards expected in the pavement design.

Verification of Carriageway Subgrades

The reaction of the subgrade under rollers, graders and other equipment is to be closely observed and, if necessary, other testing will be should be undertaken to satisfy the following:

- The whole subgrade between the testing points is adequately represented by the testing points.
- The design requirements shown on the drawings have been satisfied.

Scala Penetrometer testing of the subgrade is to be undertaken prior to commencement of the granular layers. The penetrometer tests must be in accordance with NZS 4402 (1988): Test 6.5.2. Benkelman Beam tests of the subgrade must also be carried out if required by the Auckland Transport representative. The beam tests must be in accordance with NZTA specification T/1.

The Auckland Transport representative is to be advised when the subgrade is satisfactory and meets the design requirements for backfilling and must supply all the test results.

Where required by the Auckland Transport representative, proof rolling of the subgrade must be undertaken in the presence of the Auckland Transport representative. Such rolling must be undertaken by a 10 to 12 tonne steel drum roller, or similar plant item. Any visual movement or otherwise unsatisfactory performance of the areas of the subgrade detected by such rolling must be treated in accordance with the Auckland Transport representative's instructions

Where the Auckland Transport representative is satisfied that the subgrade is prepared and/or improved in accordance with the requirements of the ATCOP and the design drawings, the Auckland Transport representative may then approve the laying of the first granular layer.

Under no circumstances must the prepared and compacted subgrade be left uncovered to suffer damage by weather, construction traffic or any other cause. Should any weakness in the subgrade develop during the compaction of the metal filter, or any failure occur in the pavement, which is attributable to weakness of the subgrade, then the metal is to be removed, the subgrade repaired/made good and the metal replaced and/or sealing to the satisfaction of the Auckland Transport representative. If, during the course of the remedial work it is found that the cause of the weakness was due to a failure to adhere strictly to the terms of the requirements of the ATCOP, then this remedial work will have no additional costs to Auckland Transport.

16.9.3 Granular Pavement Construction

General

The work covered by this section includes the supply of all labour, materials and construction equipment required for the construction of structural pavement layers consisting of subbasecourse and basecourse (for unbound granular pavement).

Materials

The Auckland Transport representative may sample aggregate material both at the source and at the Site at any time during the course of the construction of a pavement layer and to have tests carried out by a IANZ independent accredited laboratory to verify compliance with the requirements specified.

Failure of any aggregate material to meet the specified requirements will result in the Auckland Transport representative ordering the removal of such material from Site. It must be removed from site and be replaced with material that does comply all at no cost to the Auckland Transport.

GAP 65 Subbasecourse

The aggregate used must be GAP 65 free from clay, all organic matter and other deleterious materials. It must have a soaked CBR of not less than 35% (NZS 4407, Test 3.15) when compacted in the laboratory in accordance with NZS 4402 Test 4.1.3 (Vibrating hammer).

The aggregate must be well graded with a particle size distribution that falls within the following limits:

Table 53: Particle Size Distribution Limits

GAP 65	Percent Passing	
Sieve size (mm)	Lower limit	Upper limit
63	100	100
37.5	80	90
19	50	70
9.5	30	55
4.75	20	40
2.36	15	30
1.18	10	22
0.6	6	18
0.3	4	14
0.15	2	10
0.075	0	7

The subbasecourse must also comply with the following criteria:

- Crushing Resistance (minimum) 100kN
- Weathering Resistance CA or better
- Sand Equivalent (minimum) 25
- Plasticity Index < 8

NZTA M/4 AP40 Basecourse

Basecourse aggregate for all roads from SL1 to SL5 (inclusive) must comply with the requirements of NZTA M/4 unless instructed otherwise by the Auckland Transport representative.

AP40 Basecourse

Basecourse aggregate for all roads from SL6 to SL8 (inclusive) must comply with the following requirements unless instructed otherwise by the Auckland Transport representative.

Table 54: Basecourse Aggregate Requirements

AP 40	**Percent Passing**	
Sieve size (mm)	Lower limit	Upper limit
37.5	100	100
19	61	80
9.5	38	57
4.75	23	43
2.36	14	33
1.18	7	25
0.6	2	19
0.3	0	14
AP 40	**Percent Passing**	
Sieve size (mm)	Lower limit	Upper limit
0.15	0	10
0.075	0	7

The basecourse must also comply with the following criteria:

- Crushing Resistance (minimum) 110kN
- Weathering Resistance CA or better
- Sand Equivalent (minimum) 30
- Plasticity Index < 5

Pre – Treated (Plant Mixed) Subbasecourse and Basecourse Aggregates

This section applies to the manufacture and construction of plant mixed aggregates to produce grader or paver laid pavement layers using cement, lime, bitumen emulsion or foamed bitumen.

Subbasecourse and basecourse aggregates to be pre-treated or plant mixed must comply with the requirements of the ATCOP.

Cement must comply with NZS 3122 Specification for Portland and blended cements. General purpose Portland cement, type GP, must be used unless otherwise instructed by the Auckland Transport representative.

Foamed bitumen must be produced from 80/100 or 180/200 penetration-grade bitumen as specified in the pavement design and any relevant industry or project specifications. The bitumen must comply with NZTA M/1 and must be able to achieve a minimum expansion of 10 times its original volume and a minimum half-life of 6 seconds. Refer to the definitions in the RNZ Technical Note 001[2] for an explanation of expansion and half-life.

Bitumen emulsion must be produced from 80/100 or 180/200 penetration-grade bitumen. The bitumen must comply with NZTA M/1. The bitumen emulsion must be produced so that breaking of the bitumen emulsion occurs during compaction of the stabilised material, not before.

The batching and mixing plant must be purpose-built by a manufacturer having a demonstrable track record and manufacturing history for the equipment used. Plant and equipment not meeting this requirement must not be used.

The batching plant must be calibrated as per the manufacturer's procedures every time it is moved and monthly thereafter.

The mixing plant for cement stabilised materials must be capable of consistently producing a uniform mixture with tight controls over the addition of water and cement. The cement must be fed uniformly and measured by mass on a continuous basis and it must not vary by more than 5% from the specified application rate. Water must be added during the mixing process to ensure that the modified material is within 90 to 100% of the materials optimum water content during compaction. Particular care must be taken to prevent excessive wetting of the cement treated material.

For plant mixed cement stabilised basecourse and subbasecourse materials, the following performance criteria applies:

- The target minimum unconfined compressive strength (UCS) is 3Mpa after a 7-day cure. The mould size for the UCS testing must be 100mm in diameter and 200mm high. Compaction of the sample must be in accordance with NZS4402:1986 4.1.2 NZ Heavy.
- The target minimum indirect tensile strength (ITS) after a 7-day cure is 1.3Mpa (dry) and 1.25Mpa (wet). The mould size for the ITS testing must be 150mm in diameter and 126mm high. Compaction of the sample must be in accordance with NZS 4402 test 4.1.3 NZ Vibrating Hammer.

For all other plant mixed stabilised/modified basecourse and subbasecourse using foamed bitumen, emulsion, cement/lime/KOBM and other stabilising agents, the minimum UCS and ITS strengths must be designed and nominated by the designer. Written approval must be sought from the Auckland Transport representative prior to specifying these materials.

Subbasecourse Layer Construction and Maintenance

Preparation

No pavement material must be placed until the subgrade has been prepared, tested and subsequently accepted by the Auckland Transport representative.

Should rain fall on the subgrade between the time of initial acceptance and the commencement of pavement construction, a further inspection of the subgrade surface must be carried out to confirm that the subgrade is still suitable for pavement construction to proceed.

Level control between edges of the pavement must be by means of level stakes or steel pins placed in lanes parallel to traffic routes and at intervals which will permit string lines or check boards to be placed between the stakes or pins.

To protect the subgrade and to ensure proper drainage, the spreading of the pavement material must begin along the crown of the pavement.

Supply, Placement and Compaction

The aggregate must be carefully spread to the depth shown on the drawings or as directed by the Auckland Transport representative. It must then be compacted in accordance with NZTA B/2.

Where sand is specified for back filling, Woodhill sand must be used. Where other types of sand are deemed suitable the following documentation may be submitted to the Auckland Transport representative for consideration.

- Particle Size Distribution
- CBR
- Compaction Curve
- Previous performance results

The Auckland Transport representative will assess the submitted information. If the Auckland Transport representative is satisfied that the alternative material is appropriate, the Auckland Transport representative may approve this alternative material as a substitute of Woodhill sand

Placing procedure must be such that no damage to or rutting of the subgrade occurs. Placing of each layer must begin along the high side of the pavement. Cartage must be arranged such that trafficking of the subgrade is completely avoided.

Verification of Subbasecourse

For all granular and modified/stabilised granular pavements, the acceptance of the compaction must be in accordance with NZTA B/2 and B/5 respectively.

For all pavements, granular, modified/stabilised granular and structural asphalt the surface shape and tolerances must comply with the requirements of NZTA B/2, B/5 and the ATCOP.

Where specified on the design drawings, Benkelman beam testing must be carried out on top of the subbasecourse and/or modified/stabilised subbasecourse in accordance with NZTA T/1 at 10

m intervals in all wheel tracks over the area of new pavement. The pavement will be acceptable for placing of structural asphalt, modified/stabilised basecourse layers if the results of the deflection measurements meet the design criteria outlined in the detailed design report and the design drawings.

Should any area fail to meet these criteria additional compactive effort may be applied to the top of the subbasecourse layer and/or let it dry back and then perform a second set of Benkelman Beam tests. The Auckland Transport representative may elect to undercut any areas that do not comply in order to meet the design requirements. The subgrade CBR strength will determine the depth of undercut required.

Preservation and Maintenance

Any yielding or otherwise unsatisfactory areas of the subbasecourse which become evident must be treated in accordance with the Auckland Transport representative's instructions which may include:

a. scarifying and re-compaction;
b. stabilisation with lime or cement, or
c. excavation and replacement of a complete section of subbasecourse.

No placement of pavement layers must commence until the underlying layers are deemed acceptable by the Auckland Transport representative.

Following the final shaping of the material, the subbasecourse must be maintained to the specified standards until construction of the next course. Should any damage occur to the subbasecourse, the Auckland Transport representative may direct that the surface be loosened, trimmed and re-compacted at no additional cost to Auckland Transport.

Traffic is not allowed to travel over the prepared granular/modified/stabilised sub-base layer unless otherwise agreed with the Auckland Transport representative prior to the commencement of construction.

Lean Mix or Higher Strength Concrete Sub-base Layer Construction

Preparation

No concrete sub-base must be placed until the subgrade has been prepared, tested and accepted by the Auckland Transport representative and their representative.

Should rain fall on the subgrade between the time of initial acceptance and the commencement of pavement construction, a further inspection of the subgrade surface must be carried out and to be confirmed by the Auckland Transport representative and his/her representative that the subgrade is still suitable for pavement construction to proceed.

Level control between edges of the pavement must be by means of level stakes or steel pins placed in lanes parallel to traffic routes at intervals not exceeding 10 m which will permit string lines or check boards to be placed between the stakes or pins.

Supply, Placing and Compaction

Supplying, placing and compacting of concrete sub-base must be in accordance with NZS 3109. The concrete mixes must be workable and be able to produce an average compressive strength in compliance with NZS 3109 table 6.1 for the specified compressive strength which must be clearly defined on the drawings and any project specifications or as directed by the Auckland Transport representative on site.

The concrete sub-base must be manually paved and must be placed by a chute or pump unless otherwise stated in the drawing or the project specifications. In weak subgrade areas care must be taken not to damage the subgrade by pouring concrete from chutes more than 0.5 m height above the subgrade surface.

Under no circumstances must the newly laid concrete sub-base be trafficked by construction equipment or other traffic until the in-situ strength of the sub-base has reached a minimum strength suitable to protect the subgrade. Thereafter, construction equipment will be allowed but only limited to the equipment necessary to complete the construction of the upper layers.

Verification of Concrete Sub-base

The acceptance, evaluation and rejection of concrete sub-base must be in accordance with NZS 3109 Clause 9.5 compression test.

Preservation and Maintenance

Concrete must not be placed during rain or when rain appears imminent.

All construction and other traffic must be kept away from the concrete sub-base during the curing period.

Basecourse Layer Construction and Maintenance

Preparation

No basecourse must be placed until the underlying layers have been tested and accepted by the Auckland Transport representative.

Level control between the edges of the pavement must be by stringing between level stakes or steel pins placed in lanes parallel to traffic routes at intervals not exceeding 10 m or by means of laser levelling equipment.

Supply, Placing and Compaction

The aggregate must be spread to the depth shown on the drawings or as directed by the Auckland Transport representative. Care must be taken to assure that the aggregate does not segregate during laying or shaping. Any area of segregation must be removed and replaced with material that does comply. Adequate water must be added as a fine spray until the whole layer is at or near optimum water content. It must then be compacted in accordance with NZTA B/2 except that vibrating rollers must not be used until the layer has been compacted to ensure that segregation cannot occur when the vibrating rollers are applied.

Verification of the Basecourse

The mean NAASRA roughness of the finished basecourse prior to chip sealing must not exceed 60 counts/kilometre and the maximum reading must not exceed 70 counts for asphalt surfacing NAASRA will be carried out on top of the asphalt surface. A Benkelman Beam test in accordance with NZTA T/1 must be carried out on the surface of the basecourse. Tests must be at 10m staggered intervals in each traffic lane. The pavement must be considered acceptable for surfacing if the results of the deflection measurements meet the following criteria:

- Not more than 5% of the deflections exceed 1 mm.
- No single deflection exceeds 1.5 mm.

The Auckland Transport representative may also direct further testing in the areas of excessive deflection to verify the following:

- Actual thickness of the pavement layers comply with the design thickness.
- Subbasecourse and basecourse materials comply with the specified requirements for grading and plasticity.
- in-situ dry density of the sub-basecourse and basecourse conform with the requirements of NZTA B/2 and
- CBR of the subgrade.

Grading, plasticity index and in-situ density tests must be performed in a laboratory accredited by IANZ.

If the results of these tests verify that the basecourse conforms to the requirements of the ATCOP in all respects other than deflection, the Auckland Transport representative may accept the pavement, or he/she may direct the excavation and reconstruction of a thicker pavement or to stabilise the basecourse layer in the defective areas.

If the results of the tests verify that the basecourse does not conform to the requirements of the ATCOP, the Auckland Transport representative must define those sections where he requires remedial work carried out so that the pavement can conform to the requirements of the ATCOP.

The finished basecourse layer must be inspected and approved by the Auckland Transport representative before sealing the surface.

Preservation and Maintenance

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. Such trafficking must cease as soon as it becomes apparent that cartage is causing damage.

The surface must be kept clean and free from foreign material and must not be permitted to pothole, ravel, rut or become uneven. The basecourse must be properly drained at all times.

The basecourse layer is to be sealed as soon as practicable to prevent damage from the traffic or inclement weather.

Quality Assurance

Results are to be forwarded to the Auckland Transport representative progressively as testing is completed. All testing is to be undertaken by a suitably qualified person and in a registered laboratory. Testing of granular pavement layers during construction are to comply with the requirements of NZTA B/2 and must include:

- Quarry test certificates from stockpiles less than three months old must be supplied for materials. For grading, cleanliness, and Clay Index. NZTA M4 materials with a Clay Index above 3 must not be used on the contract works.
- Mat testing of aggregates to confirm compliant grading at a minimum frequency of 1 test per 100m3 loose delivered to site or part thereof.
- Clay index testing on one of every five mat samples.
- A site map showing where each truck load of material was placed, referencing the delivery docket number.
- Where the subgrade is exposed scala penetrometer tests must be undertaken in accordance with NZS 4402 Test 6.5.2 and calibrated to IANZ requirements. Testing must be undertaken at a minimum frequency of 1 test per 50m2, and the results provided to the Auckland Transport representative. Placing of any material on the subgrade will not be permitted until the Auckland Transport representative has approved the test results.
- Clegg Hammer tests must be undertaken on each granular layer of material placed to confirm the desired compaction is achieved.
- Nuclear densometer results on compacted granular pavement layers in accordance with the requirements of NZTA B/2, showing compaction compliance in accordance with the MDD for the respective aggregate layers, the saturation ratio for each granular layer and the air voids and moisture content.
- Benkleman Beam tests must be carried out on the completed Sub-basecourse and basecourse layers in accordance with NZTA T/1 at 10 m intervals in all wheel tracks over the area of new pavement
- A joint inspection with the Auckland Transport representative is to be undertaken prior to surfacing.
- Where additives are used in the membrane seal the application rate must be measured using a one metre square canvas mat laid ahead of the spreader and should be within the range of -0.5% to +0.5% (by weight) of the target rate. The application rate must be measured on every application run.
- Proposed corrective actions to be taken for any non-conforming product incorporated into the works.
- All other testing specified within the requirements of the ATCOP.

16.9.4 Construction of Pre–treated (Plant Mixed) Sub-basecourse and Basecourse Layers

Construction of cement (and/or other chemical additives) treated aggregate layers must only commence once all the testing requirements on the underlying layers have been met.

The maximum laboratory dry density at the optimum water content (OWC) of the modified material must be determined in accordance with NZS 4402:1986, Test 4.1.3. The Solid Density of the aggregate tested must be determined according to NZS 4407:1991, Test 3.7. The tests must be undertaken on the modified material that is representative of that used in construction and a grading for the material tested must be supplied with the results.

The plant mixed cement (and/or other chemical additives) treated sub-basecourse and basecourse must be placed and compacted in accordance with the NZTA B/5 Specification with the following additional requirements:

- The maximum time period, from mixing the aggregate with cement to primary compaction must be two (2) hours. Final trimming and compaction must be within four (4) hours of mixing. Where the time limit is exceeded, details of the remedial actions taken must be submitted to the Auckland Transport representative for approval.
- Work must not be started if the ambient air temperature is below 5ºC or above 30ºC. Careful monitoring is required to ensure excessive drying between the mixing transporting and the laying process does not occur.
- At the outset of compaction plateau density tests must be undertaken for the purpose of determining the practicality of both the OWC and the MDD targets, the minimum, and possibly the maximum, number and type of roller passes required to achieve the MDD for the proposed compaction plant and stiffness of lower pavement 'anvil' beneath the layer to be compacted. The plateau tests must be undertaken with compaction plant that is to be used for construction – which must be appropriate for the depth and type of materials to be compacted.
- No mixing or placing must commence if it is raining or is likely to start raining before the stabilised material is placed and compacted. If, during construction, rain starts, no further work must be permitted other than compaction and finishing.
- Where the plant mixed cement (and/or other chemical additives) treated aggregate is not covered by the next pavement layer, or a seal coat applied, it must be lightly watered to maintain a damp surface.
- The types of rollers to be used must be selected having regard not only to the characteristics of the pavement materials and target density, but also to the strength of the subgrade and cover over existing services. Overstressing of the subgrade area or damage to services will not be permitted.
- Cement and/or other chemical additives) treated aggregate samples must be taken from the material delivered to site for UCS and/or ITS testing. The 7-day UCS of the samples must be determined using NZS 4402 Test 6.3.1. ITS must be carried out in accordance with the latest NZTA standards. No test result must be less than the required UCS and/or ITS stated in this chapter of the ATCOP.

- Pre-cracking of the cement-bound sub-base layer must be done between 24 and 48 hours after stabilisation is completed and must be achieved with two passes of the single drum vibratory roller, which was used for primary compaction, at maximum amplitude and travelling at a slow walking speed of about 3 kph. The rolling pattern must be carefully planned and recorded.

The modified pavement layer must be compacted to a uniform, dense, stable condition.

Compaction testing of the modified pavement layers must be carried out in lots. A lot is defined as a section where the pavement layer appears homogeneous and evenly compacted. The area of a lot must not exceed 1000 m2.

The degree of compaction for each lot must be determined by testing at least five randomly selected areas. The compaction requirements must be met if the mean and minimum compaction values of the tests taken comply with the values in the table below. In preference to random selection the Auckland Transport representative may carry out any testing for uniformity to determine the location of density tests.

The Maximum Dry Density of the modified material must be determined for each layer at a minimum frequency of one Maximum Dry Density per 5,000m2 of material laid. If the aggregate source, processing method, or modified materials are expected to change then a new OWC and target MDD must be determined.

Table 55: Mean and Minimum Degree of Compaction for Pavement Layers as a Percentage of Maximum Dry Density

Degree of Compaction	Pavement Layer	
	Subbase	Basecourse
Mean	≥ 95 %	≥ 98 %
Minimum	≥ 92 %	≥ 95 %

The following tests are required in addition to those specified for subbasecourse and basecourse aggregates.

UCS 2 tests for each aggregate / chemical additive combination

ITS 2 tests (2x dry and 2x wet) for each aggregate / chemical additive combination

Table 56: Construction Control Testing and Acceptance Criteria

UCS:	UCS tests must be undertaken on samples of cement (and/or other chemical additives) treated aggregate

	from site at a rate of 1 test for every 1000m^2 of material.
ITS	ITS tests must be undertaken on samples of cement (and/or other chemical additives) treated aggregate from site at a rate of 1 test for every 1000m^2 of material.

16.9.5 Structural Asphalt Construction

General

Works at each site may include some of the following:

- Development of an inspection and test plan for each site to demonstrate conformance with the design and any project specifications.
- Excavation or milling of existing pavement layers
- Undercutting and placement of GAP40
- Construction of hot mix asphalt concrete
- Application of a bituminous emulsion tack coat or prime coat
- Construction of kerb and channel, traffic islands and medians
- Road Marking and signage
- Site reinstatement
- As-built plans and RAMM information

The Auckland Transport representative can specify that particular sites be undertaken as night works or outside the specified hours of work, or peak periods (ie during the summer holiday period.

Materials

Bituminous Materials

In addition to complying with NZTA M/1 bitumen must meet the following requirement:

Table 57: Bituminous Materials Requirement

Bitumen Grade	60/70	80/100
Softening Point ºC (Ring & Ball)	48-56	45-52

Upon request, test reports for all bituminous materials proposed to be used in the Works, together with a statement as to their source are to be provided to the Auckland Transport representative. The manufacturer or producer of the bituminous materials must furnish material subject to this and all other pertinent requirements of the Auckland Transport representative. Only those materials which have been tested and approved for the intended use must be acceptable.

Mineral Aggregate for Asphaltic Concrete

Mineral aggregate for dense grade asphalt and stone mastic asphalt must, depend on the mix selected, comply with the requirements of NZTA M/10 or NAS specification 2004 and its NZ Supplement 2006.

With prior approval from the Auckland Transport representative, the use of reclaimed aggregate pavement (RAP), up to 15%, are permitted, for asphalt surfacing and intermediate rut resistant layer.

All required testing of the coarse, fine, fillers and other additives must be carried out in accordance with NZTA M/10 or NAS specification 2004 and its NZ Supplement 2007.

Combined Aggregate/Filler Grading Requirements

The grading of the combined mineral aggregates and mineral filler must be such that it complies with Table 58.

Table 58: Table Mix Envelopes – Mix 40 and Mix 20

TABLE MIX ENVELOPES (Dense Graded Asphalt)		
SIEVE SIZE	**MIX 40 Rut Resistant Intermediate Layer**	**MIX 20 High Fatigue Base Layer**
	Percentage Passing Sieve Size by Mass	
37.5	100	
26.6	84 – 95	100
19.0	70 – 90	100
13.2	62 – 82	83 – 95
9.5	55 – 75	70 – 90
6.7	48 – 67	60 – 79
4.75	43 – 60	52 – 70
2.36	32 – 47	40 – 55
1.18	23 – 37	29 – 43
0.600	16 – 28	20 – 32
0.300	10 – 20	13 – 23
0.150	6 – 14	8 – 16
0.075	3 – 8	4 – 10
Total Binder Content % by mass	4.0 – 5.5	5.0 – 6.0

The target combined aggregate grading (including filler) and binder content for all other NAS type asphalt mixes must comply with NAS specification and its NZ Supplement.

Table 59: Table Mix Envelope – AC 14

TABLE MIX ENVELOPE (Dense Graded Asphalt)	
SIEVE SIZE	**AC 14 Surfacing Layer**
	Percentage Passing Sieve Size by Mass
37.5	
26.6	
19.0	100
13.2	90-100
9.5	72-83
6.7	54-71
4.75	43-61
2.36	28-45
1.18	19-35
0.600	13-27

TABLE MIX ENVELOPE (Dense Graded Asphalt)	
0.300 0.150 0.075	9-20 6-13 4-7
Total Binder Content % by mass	4.0-6.0

Milling

The milling depth and the extent must be nominated in the design or as specified by the Auckland Transport representative.

Where directed by the Auckland Transport representative the milling operation must include the re-profiling of the milled surface to improve the cross fall and longitudinal profile.

Milling must be carried out across the full width of the road (from channel to channel).

Unless directed otherwise by the Auckland Transport representative all millings must be disposed of off-site.

Weather Limitations

Asphaltic concrete must 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 the Table 60

Table 60: Base Temperature Limitation

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

Asphalt Plant

Asphalt plant must comply with the requirements of NZTA M/10 and P/9P.

The paver screed must be fitted with a compaction device capable of compacting the asphalt mixture to at least 80% of its specified final density.

The paver must be equipped with an automatic screed control system. The control system must 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 must be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls must 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 string line” e.g. “Paveset”.

Paving Sequence

The laying procedure must be programmed so that the intermediate layer must be protected by the final surfacing layer at an interval no greater than 5 working days from the date of completion of the intermediate layer. Traffic must not be allowed to drive over the asphalt base layer.

Preparation of Mixture

The mixing plant and procedures must be in accordance with all the relevant requirements of NZTA M/10 or NAS specification 2004 and its NZ Supplement 2007

Preparation of Area to be Paved

Surface preparation must be in accordance with NZTA P/9P.

Where asphaltic concrete is to be placed on sub-base, the finished sub-base surface must be broomed clean of all dirt, dust, aggregate fines and other deleterious material before priming or tack coating. Sweepings must be collected and removed from the Site. The broomed surface must present a mosaic pattern of large aggregate tightly bonded with fines, and must be inspected and approved by the Auckland Transport representative before the application of the prime or tack coat.

Prime coat to subbasecourse surface must be CAT60 emulsion spread at a rate to suit the surfacing (approximately 1l/m^2). A blinding must be spread if required to prevent pick up during asphalt paving operations.

Tack coat to bridge decks, concrete subbase and between asphalt layers must be CRS-1 quick break emulsion. Tack coat must be applied to the prepared surface at a rate of 0.5-1l/m^2 depending on the surface condition. Tack coat application must be adjusted to suit site condition and must be approved by the Auckland Transport representative. A blinding must be spread if required to prevent pick up during asphalt paving operations.

All necessary measures must be taken to ensure that the surface of the Intermediate layer does not pond water prior to the application of the surfacing layer.

Storage of Asphalt Mix

Storage of asphalt mix must be in accordance with NZTA M/10.

Transport of Asphalt Mix

The hot mixed asphaltic concrete must be transported in accordance with NZTA specification P/9P.

Mix Temperatures

Mixing, carting, placing and compaction temperatures must comply with the maximums and minimums specified in NZTA M/10 and P/9P.

Placement and Compaction

The spreading, finishing and compaction of the hot mix asphaltic concrete must be generally in accordance with NZTA Specification P/9P for dense graded asphalt.

For the initial pass a control line must be used on both sides of the paver to maintain grade control. Subsequent passes may be controlled by a joint matcher on the newly laid asphalt, and a raised control line or equivalent on the opposite side. The paver must not be manually controlled.

The mix must be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements.

Cartage across freshly placed hot mix asphaltic concrete must not be permitted unless temperature of the pavement material is below 65ºC.

Quality Assurance

Results are to be forwarded progressively to the Auckland Transport representative as testing is completed. All testing is to be undertaken by a suitably qualified person and in a registered laboratory. The plan must include:

- A site map showing where each truck load of material was placed, referencing the delivery docket number.
- Where the subgrade is exposed scala penetrometer tests must be undertaken in accordance with NZS 4402 Test 6.5.2 and calibrated to IANZ requirements. Testing must be undertaken at a minimum frequency of 1 test per 50m², and the results provided to the Auckland Transport representative. Placing of any material on the subgrade will not be permitted until the Auckland Transport representative has approved the test results.
- Benkleman Beam tests must be carried out on the completed Subbasecourse where exposed to NZTA T/1 at 10 m intervals in all wheel tracks over the area of new pavement
- A joint inspection with the Auckland Transport representative is to be undertaken prior to surfacing.
- Where additives are used in the membrane seal the application rate must be measured using a one meter square canvas mat laid ahead of the spreader and should be within the range of -0.5% to +0.5% (by weight) of the target rate. The application rate must be measured on every application run.
- Test results of materials to ensure compliance with the testing requirements detailed in the design or any relevant industry of project specifications.
- Proposed corrective actions to be taken for any non-conforming product incorporated into the works.

Acceptance and Testing

All acceptance sampling and testing necessary to determine compliance with the requirements specified in this section must be performed by an IANZ accredited laboratory. All equipment in the laboratories must be calibrated by the testing organisation prior to the start of operations.

Plant-Produced Material for Mix40 and Mix20HF

Plant produced material must comply with the grading and binder content requirements in Table 6.1 of BCA 9808 and the table below.

For Marmust designed mixes dense graded asphalt production must be tested by sampling material sufficient for one set of 3 Marmust Blocks for each 300 tonnes or part thereof from the plant production each day for each layer. These must be tested for stability and flow, grading, density, bitumen content and air voids evaluated in accordance with the table below.

For gyratory designed mixes, dense graded asphalt production must be tested by sampling material for each 300 tonnes or part thereof from the plant production each day. These must be tested for grading, bitumen content and density evaluated in accordance with Table 61:

Table 61: Production Testing Limits

Mix Criteria & Test	Mix Designation	Minimum	Maximum
Marmust Method			
Blows at both ends ASTM D1559	All mixes	75	75
Stability of the Mix (kN) MS-2	Mix 40 intermediate Mix 20 Hi Bitumen	12 12	N/A N/A
Flow of the Mix (mm) MS-2	Mix 40 intermediate Mix 20 Hi Bitumen	2 2	4 4
Air Voids (%) ASTM D2726, D3203, D2041	Mix 40 intermediate Mix 20 Hi Bitumen	4.5 2.0	5.5 3.5
Total Binder Content (% by mass)	Mix 40 intermediate Mix 20 Hi Bitumen	4.0 4.5	6.0 6.5

Grading Tolerances and Binder Contents for Mix40 and Mix20HF

- For dense graded NZTA mixes see NZTA M /10 Table 7.1
- For dense graded APRG mixes see AP- T20 Table 4.4.1

Plant-Produced Material for other NAS Asphalt Mixes

Plant produced material must comply with the grading, binder content, and other requirements as stated in NAS specification 2004 and its NZ Supplement 2006. All mixes must be sampled and

tested for grading, binder content, maximum specific gravity, temperature and other requirements as detailed in the NAS specification 2004 and its NZ Supplement 2007

Field Placed Material

Field placed material must be tested and evaluated as specified below:

Nuclear densometer testing for density acceptance is not approved unless calibration with the statistical results from cores taken from field placed material of the particular layer is proven to the Auckland Transport representative.

Air voids must be calculated using the maximum theoretical specific gravity obtained for that Lot.

Thickness will be evaluated for compliance by the Auckland Transport representative to the requirements shown on the plans. Measurements of thickness must be made using the cores taken as per NZTA P/9P Specification.

The average height of each set of cores must not be less than the nominal thickness shown on the Drawings. No core must have a height less than 90% of the nominal thickness required.

The total thickness of the asphalt layers must not be less than the design thickness in any area.

Layer top surface tolerance must be in accordance with Table 62.

Table 62: Top Survace Layer Tolerance

TOP SURFACE LAYER TOLERANCE	
Mix 20 High Bitumen Base or other NAS High Fatigue Base	+10 -0
Mix 40 Intermediate Layer or other NAS Rut Resistant Intermediate Layer	+10 -10

Finishing Tolerances

The finished surface of the pavement must not vary by more than ±5 mm from design levels. The smoothness must be evaluated with a 5 metre straight edge in accordance with NZTA P/9P. No depressions or hollows allowing ponding of surface water must be accepted.

Where the pavement crosses a pram crossing or pedestrian crossing the final finished level must not contain a lip which creates an impediment to push chairs, wheel chairs or mobility scooters.

Acceptance/Rejection

Any batch which fails to meet the requirements of P/9P must be rejected.

In the event of non-compliance with the specified compaction requirements, additional samples in accordance with NZTA P/9P may be taken to determine the extent of areas of unsatisfactory compaction within a sub-batch. Any sub-batch that does not comply must be removed.

Acceptance of the balance of the batch as being satisfactory will be at the Auckland Transport representative's sole discretion.

Repair

Patching of dense graded asphalt intermediate and base courses is permitted. Patching of dense graded asphalt surfacing and stone mastic asphalt surfacing is not permitted. Should any sections fail to meet the requirements for density, thickness or surface tolerances, such sections must be removed over the full width of the paver run and over such length between saw cuts at right angles to the paver run as may be directed by the Auckland Transport representative. New asphaltic concrete paving must be laid in full compliance with the requirements of the ATCOP.

16.9.6 In Situ Pavement Stabilisation

General

Works at each site may include some of the following:

- Development of an inspection and test plan for each site to demonstrate conformance with the design and any relevant industry and/or project specifications.
- breaking down and recovering material in the upper layer(s) of the existing road pavement;
- altering the grading of the recovered material by addition of imported material;
- if necessary, increasing the pavement thickness by addition of imported material;
- supply, transport and mixing-in of stabilising agents and water; and
- compacting, trimming and curing of the stabilised material to achieve a stabilised basecourse layer.
- Capturing and disposal of runoff from all activities in accordance with District Plan and RMA requirements.
- Construction of kerb and channel, traffic islands and medians
- Road marking and signage
- Site reinstatement
- As-built plans and RAMM information

The Auckland Transport representative can specify that particular sites be undertaken as night works or outside the specified hours of work, or peak periods (ie during the summer holiday period).

Materials

Imported Natural Materials

Natural material (sand, gravel, etc.) and/or crushed stone products may be required to mix with the stabilised material for the purpose of:

- Altering the grading of the post-stabilised material;
- Effecting mechanical modification; and/or
- Supplementing the stabilised material for shape correction.

The requirements of these imported materials must comply with the requirements of NZTA M/4: Specification for basecourse aggregates or specific requirements nominated in the pavement designs are to be determined via laboratory testing and stabilisation mix designs. NZTA M4 materials with a clay index above 3 must not be incorporated into the contract works.

Stabilising Agents

Stabilising agents include either one or both chemical and bituminous types. The requirements of the specific stabilising agent or combination of stabilising agents, that are to be employed must be detailed in the pavement design and any relevant industry or project specifications.

Any in situ stabilisation works undertaken during the course of this contract are to be carried out under the current NZTA specification – NZTA B5 2008.

Chemical Stabilising Agents

Chemical stabilising agents must be either one or more of the following:

Lime: Lime must comply with NZTA M/15.

Cement: Cement must be ordinary grade cement complying with NZS 3122. Note that rapid-hardening Portland cement must not be used as a stabilising agent.

KOBM: KOBM must be that product manufactured by the Slag Reduction Company of Glenbrook. The reaction of the KOBM to be used with the materials is to be confirmed to be stabilised prior to work commencing. Unless otherwise approved by the Auckland Transport representative the KOBM must be supplied in powder form. The water content is not exceed (8%) by weight at the time of application.

Other chemical stabilising agents: Requirements for any other chemical stabilising agents must be detailed in the pavement design and any relevant industry or project specifications.

Note: From the time of purchase to the time of use, all powered chemical stabilising agents must be kept under cover and protected from moisture, all in accordance with the manufacturer's or supplier's recommendations. All consignments of these materials must be used in the same sequence as that of their delivery on site. Stocks stored in excess of three months must not be used in the works without authorisation.

Bituminous Stabilising Agents

Bituminous stabilising agents must be either of the following agents, and must comply NZTA B5 2008.

Foamed Bitumen: Foamed Bitumen must be produced from 80/100 penetration-grade bitumen complying with NZTA M/1 and must be produced to achieve a minimum expansion rate of 10 times and a minimum half-life of 10 seconds.

Bitumen emulsion: Bitumen Emulsion must be produced using penetration-grade bitumen complying with NZTA M/1. The bitumen emulsions must be produced so that the breaking occurs

during compaction of the stabilised material. As a guide medium to slow setting emulsions usually meet these criteria.

Note: References to 'fluid stabilising agents' in these specifications must include all forms of bituminous stabilising agents.

Water

Water must be clean and free from detrimental concentrations of acids, alkalis, salts, sugar and other organic or chemical substances.

Plant and Equipment

All plant must be supplied and operated in such a manner as to stabilise the in-situ material to the specified depth and construct a new layer in a single pass, all in accordance with the requirements of this specification and NZTA B/5. Plant and equipment employed must be of adequate rated capacity and in good working order. Obsolete, poorly maintained, underpowered or dilapidated plant will not be allowed on site.

Plant for supply of stabilising agents

Generally all stabilising agents must be delivered to the site in bulk tankers. For areas less than 1000 m2 the powdered stabilising agents may be delivered in pockets. Each bulk tanker must be issued a “Certificate of Loading” that contains the following information:

- Tanker’s identification details;
- product identification;
- weighbridge certificate indicating net mass of product;
- name of the supplier ;
- batch number and date of manufacture (if possible);
- date, time and place of loading;
- comments on the state of the tanker at the time of loading in terms of cleanliness, details of the previous load carried and whether there was any residual product from the previous load; and
- details of any chemical or other substance added to the product before, during or after the loading procedure.

When stabilising with foamed bitumen the bulk delivery tanker must, in addition to the above, include the following features:

- temperature at which the product was loaded;
- tankers must be equipped with a built-in thermometer (calibrated within 6 months of use) and heating facilities to ensure that the bituminous stabilising agent is maintained within 5 °C of the application temperature specified in the pavement design and any relevant industry or project specifications.

The certificates must be provided with the monthly report.

Plant for stabilisation (mixing process)

Stabilisation must be effected by utilising a stabilising machine to mill, to the specified depth, the material in the upper layers of the existing pavement, together with any imported material and to achieve the required grading and consistency of mix, all in a single pass. Mixing using graders,

profilers, rotary hoes and other agricultural type implements must not be approved for stabilisation work.

As a minimum, the stabilising machine must have the following features:

- To achieve a uniform mix, the capability of milling to the specified depth in a single pass while maintaining a constant rotor and forward speed in addition to being fitted with a system to accurately maintain a preset depth of cut;
- where the milling depth exceeds 200 mm, the effective volume of the mixing chamber must increase in relation to the depth of the cut in order to accommodate additional material generated by increasing the depth of cut;
- a milling drum that rotates upwards into the direction of advance and achieves at least 2.0 m of cut width in a single pass; and
- an adjustable exit gate to ensure that the mixed material exits from the mixing chamber in a manner that prevents particle segregation.

In order to mix the milled material with water and chemical stabilising agents, the mixing equipment must include the following features:

- a controlled pumping and metering system to regulate the application of water and/or fluid stabilising agent in relation to travel speed and mass of material being stabilised. The pumping systems must be calibrated to deliver within a tolerance of ± 3 % by volume,
- a system of nozzles that promotes a uniform application of water and/or fluid stabilising agent across the full width of treatment. The application systems must be capable of adjustments for varying widths of treatments;

When stabilising with foamed bitumen the mixing equipment must in addition to the above, include the following features:

- to ensure that the required expansion and half-life qualities of the bitumen are being achieved, the system for foaming the bitumen must be equipped with a test nozzle capable of producing a replicate sample of the foamed bitumen being injected into the stabilised material;
- an electrically heated, self-cleaning nozzle system that promotes a uniform application of foamed bitumen across the full width of treatment;
- the bitumen must not be pumped back into the bitumen tanker;
- the injected bitumen must be controlled by a calibrated bitumen flowmeter in relation to the forward speed and mass of material being stabilised; and
- to ensure effective mixing of materials, the mixing equipment must have a power output of at least 300 kW (400 HP).

Construction

General Limitations

Weather Limitations

Work must not be undertaken if the ambient air temperature (measured in the shade) is below 5 °C. No further work, other than finishing and compaction, will be permitted if the air temperature drops below 10 °C during operations.

Spreading of powdered chemical stabilising agents on the road ahead of the recycling machine must not be permitted when the wind speed exceeds 25 km/hr, except if the mixing and spreading is carried out in one unit that effectively contains the powdered stabilising agent.

Time Limitations

The type of stabilising agent(s) used must determine the maximum time period between mixing and compacting the treated material. Where two or more different stabilising agents are combined, the time limitation must be the shortest of the individual agents:

- **cement**. Two (2) hours;
- **lime**. Four (4) hours if kept moist;
- **bitumen emulsion**. Before the emulsion breaks;
- f**oamed bitumen**. Four(4) hours if kept moist; and
- **proprietary chemicals**. As per manufacturer's instructions.

Before Stabilisation commences

Referencing the Horizontal Alignment

If required by the Auckland Transport representative the existing horizontal alignment must be referenced using a series of pegs (or poles) placed on either side of the road. These pegs (or poles) must be positioned outside the working area at a constant distance from, and at right angles to the existing centre-line, and must be used to reinstate the centre-line after recycling operations are complete. The distance between successive pegs (or poles) must not exceed 20 m on curves, or 40 m on tangents (straights).

Surface preparation

Before any work commences, the surfaces of the existing road to be stabilised must be prepared by:

- Cleaning all vegetation, detritus and other foreign matter from the full road width, including any adjacent lanes or shoulders even if they are not to be recycled;
- removing any standing water;
- pre-milling where high-spots are to be removed (if required); and
- accurately pre-marking the proposed longitudinal cut lines on the existing road surface.

In addition all road marking features, such as barrier line details, that will be obliterated in the recycling process must be recorded.

Surface shape and level requirements

Where the grade line and cross-sectional shape of the existing road are not excessively distorted, the operations are to be conducted in such a manner as to ensure that the finished surface levels are consistent with the general cross section and longitudinal section of the road.

Where surface defects are to be corrected and/or modifications made to the grade line these may be achieved prior to recycling by either pre-milling to remove in-situ material or by importing material and accurately spreading on the existing road surface.

Dealing with material which has a high moisture content

Where test results show that the in-situ moisture content of the material to be stabilised is in excess of the moisture limitations described in clause 6.6 below, pre-treatment prior to recycling will be necessary. The pavement design and any relevant industry or project specifications will describe the requirements of such pre-treatment.

Supply of Aggregate to Site

The supply of aggregate to the site and any stockpiling or other movement prior to its placement on the road must be controlled to prevent contamination or segregation. Contaminated or segregated aggregate must not be used.

A comprehensive control system must be instituted to ensure that the quality of all imported materials meets the requirements of the ATCOP.

Shape correction

Where material is required to be imported as make-up material for the purpose of shape correction, the prescribed material must be imported and spread on the existing road surface prior to stabilising. Should the thickness of imported material exceed the intended stabilising depth, then the existing pavement's seal and bound layers must be milled to ensure adequate drainage.

Particle size improvement of the stabilised material

Where material is to be imported for the purpose of altering the grading of the stabilised material, or effecting mechanical modification, the prescribed materials must be imported and applied to the surface of the existing road as a layer of uniform thickness prior to milling. Should the thickness of imported material exceed the intended stabilising depth, then the existing pavement's seal and bound layers must be milled to ensure adequate drainage.

Addition of Chemical Stabilising Agents

The type(s) of stabilising agent(s) and the required application rate(s), expressed as a percentage (%) of the stabilised material's mass and as a mass per square area (kg/m2), will be detailed in the pavement design and any relevant industry or project specifications. If stabilisation takes place in areas were dustless addition of chemical stabilising is desired, such as urban or agricultural sensitive areas, the use of dustless technology must be utilised.

The binder must be uniformly spread at a controlled application rate across the pavement with an approved mechanical spreader. The mechanical spreader must be capable of varying the spread width to cater for different road widths and must be fitted with a curtain to minimise the amount of stabilising agent blown by the wind.

The area of spread, tonnage of binder used per run, and mat results must be recorded at least once every 200 m, and keep these records as recommended in the Quality Plan. The construction tolerance for the spread rate must be ± 0.5 kg/m2 of the specified value.

Addition of Bituminous Stabilising Agents

Bituminous stabilising agents that conform to the requirements of the ATCOP, pavement design and any relevant industry or project specifications must be added to the milling / mixing process by pumping from mobile bulk tankers, which are pushed ahead of the stabilising machine.

Bituminous stabilising agents, which have been heated above the maximum temperature given in the NZTA Specification, must not be used and must be removed from the site.

When working with foamed bitumen, the foaming characteristics, being expansion and half-life, must be checked at the test nozzle within five minutes of starting with each new tanker load.

Controlling the Moisture Content of Stabilised Material

Sufficient water must be added during the recycling process to meet the moisture requirements specified below. Water must be added by means of a system that controls water addition in relation to the forward speed of the stabilising machine. Particular care must be taken to prevent any portion of the work from excessive wetting.

At the time of compaction, the type of stabilising agent used must govern the moisture content of the stabilised material and be within ± 5% of the moisture contents set out in points i) to iii) below:

- **i) Cementitious stabilising agents**

  The moisture content during compaction must never exceed 75 % of the saturation moisture content of the natural material without stabilising agent, calculated at Maximum Dry Density.

  The moisture content at the specified degree of saturation must be determined as follows:

$$W_v = S_r \times \left(\frac{X_w}{X_d} - \frac{1000}{G_s} \right)$$

Figure 102: Moisture Content Saturation

Where W_v = moisture content of the material at the specified degree of saturation in %

Sr = specified degree of saturation in %

Xw = density of water in kg/m³

Xd = maximum dry density of the natural material in kg/m³

Gs = apparent density of the material in kg/m³

ii) Non-cementitious stabilising agents and material recycled without stabilising agents.

The moisture content during compaction must not exceed the Optimum Moisture Content, nor must it be more than 2 % below Optimum Moisture Content.

iii) Bitumen emulsion stabilising agents

The total fluid content of the material during compaction must not exceed the optimum total fluid content. The total fluid content must be determined by adding half the bitumen amount and the entire water amount within the bitumen emulsion to the in-situ moisture content before mixing, plus any other water applied.

In-situ mixing

The stabilising machine must be set up and operated to ensure the following key requirements are met:

Grading of the recycling material

The forward speed of the recycling machine, rate of rotation of the milling drum and the positioning of the gradation control beam must be set so that the in-situ material is broken down to an acceptable grading.

Addition of Water and Fluid Stabilising Agents

The control system for the addition of water and fluid stabilising agents must be set and carefully monitored to ensure compliance with the requirements for compaction moisture and stabiliser content.

The actual usage at the end of each bulk supply tanker must be checked against the calculated theoretical demand for the particular area stabilised.

Control of Cut Thickness

The actual depth of the cut must be physically measured at both ends of the milling drum at least once every 100 m along the cut length.

Overlap on Longitudinal Joints

To ensure complete stabilisation across the full width of the road, longitudinal joints between successive cuts must overlap by a minimum of half the layer thickness.

The stabilising machine must be steered so as to accurately follow the pre-marked cut lines. Any deviation in excess of half the layer thickness must be rectified immediately by reversing to where the deviation commenced and reprocessing along the correct line, without the addition of any further water or stabilising agent.

The overlap width must be confirmed before starting each new cut sequence and any adjustments made to ensure that the amount of water and fluid stabilising agent to be added is reduced proportionately by the width of the overlap.

Continuity of Stabilised Layer

No gaps of un-stabilised material remain between successive cuts (along the same longitudinal cut line), nor are any untreated wedges created by the entry of the milling drum into the existing material.

The exact location of the end of the cut must be carefully marked. This mark must coincide with the position of the centre of the mixing drum at the point at which the supply of stabilising agent ceased. To ensure continuity of the stabilised layer, the next successive cut must be started at least 1 m behind this mark.

The stabilised area should be squared off at the end of the day's production, which must be recorded on the daily production plan if different to the planned chainage.

Compaction and finishing

The compaction of the stabilised basecourse and the acceptance criteria must comply with NZTA B/2: 2005, with the following amendments:

- Laboratory tests according to NZS 4402 : 1986, Test 4.1.2 modified to 150 diameter mould must be undertaken.

To avoid re-shaping after the binding agent's reaction time, which can potentially result in laminated layers at the top of the stabilised layer, compaction must be achieved by the compaction equipment only.

Surface shape and finish

The surface shape and finish must comply with NZTA B/5.

Subgrade Finish

The subgrade after stabilising and compaction must be cut to the specified level and all trimmings cut to waste. All dimples created by the vibrating Padfoot Roller or marks or depressions from other machinery or sources must be removed.

Subgrade Too Low

In the event of the subgrade being too low the only approved method of adding material will be; spread over the low area sufficient material treated with the appropriate stabilising agent at optimum moisture content. This material will be mixed into the underlying subgrade layer with an approved pulveriser – mixed to create a homogeneous layer. The depth of hoeing into the layer must not be less than 100mm. The layer will then be recompacted with the appropriate vibrating padfoot roller and the subgrade trimmed as described above.

Subgrade Too Dry

If at any time the subgrade is allowed to dry below optimum the dry surface affected must be removed to waste and additional material added as described above.

Presealing Requirements

The preseal requirements must comply with NZTA B/5. If sealing takes place more than 24 hours after spreading the cement, the degree of saturation (DOS) must be less than 70% for pavements with a design traffic loading in excess of $5x10^6$ ESAs and a DOS less than 80% for other roads.

The completed stabilised layer must be maintained and protected until the next layer or surfacing is applied. In addition to frequent light watering to prevent the surface from drying out, maintenance must include the immediate repair of any damage to or defects in the layer and must be repeated as often as it is necessary. Any defects or damage of any nature, occurring during the construction or maintenance of the pavement layer before the seal is applied, must be made good immediately. If the duration between finishing and sealing the stabilised basecourse is prolonged, then a running course complying with clause 10 of NZTA B/2:2004 is given as a guide. Where rutting or potholes occur in the unsealed pavement, they must be fixed by restabilising and if necessary applying more binder as instructed by the Auckland Transport representative.

The surface must not be slurried.

Construction Tolerances

Construction tolerances must comply with NZTA B/2.

In addition, the layer thickness of a lot, which must be at least 20 layer thicknesses, must comply with the following tolerances:

a. $D_{90} \geq 10$ mm (i.e. at least 90 % of all thickness measurements are equal to or thicker than the specified thickness minus 10 mm);

b. $D_{mean} \geq 80\%$ of D_{Spec} (i.e. the mean layer thickness for the lot must not be less than 80% of the specified layer thickness); and

c. $D_{min} > D_{spec} - 30$ mm (i.e. no individual layer thickness measurement must be less than the specified thickness minus 30 mm).

Quality Assurance

Results are to be forwarded progressively to the Auckland Transport representative as testing is completed. All testing is to be undertaken by a suitably qualified person. The plan must include:

- Benkleman Beam tests must be carried out on the completed pavement layers where exposed to NZTA T/1 at 10 m intervals in all wheel tracks over the area of new pavement
- A joint inspection with the Auckland Transport representative is to be undertaken prior to surfacing.
- Test results of materials to ensure compliance with the pavement design and any relevant industry or project specifications.
- Proposed corrective actions to be taken for any non-conforming product incorporated into the works.
- Certificates of loading.

The following control testing must be carried out during stabilisation:

- Continuous assessment of the homogeneity of the stabilised mixture directly behind the stabilising equipment,
- Stabilised depth every 100 m cut,
- Overlap widths every 100 m of cut,

- Spread and/or injection width at the beginning of each cut,
- Binder content at the end of each cut.

Every 3000 m^2 or at least once a day, whichever is the lesser; the following tests must be performed on the stabilised material:

- Moisture content,
- Grading analysis,
- To ensure that the correct target density for the degree of compaction is used, the material's maximum dry and moist densities must be determined by compacting samples in accordance with NZS 4402: 1986, Test 4.1.2 New Zealand Heavy compaction test. If this cannot be achieved for any reason than the testing authority must ensure that the sample retains its mixed moisture content by placing in an airtight container. The test sample must be manufactured before the maximum time allowed for the binder that is being utilised in accordance with sub clause 7.1.2.

Before sealing or applying the wearing course the following tests must be carried out on the compacted and finished layer:

- Density checks in accordance with the NZS 4407: 1991, Test 4.2.2 using Nuclear Density tests – backscatter method.

Note: When stabilising with bituminous binders the nuclear testing machine detects the carbons in the bitumen and considers these as moisture, thus giving a lower dry density. Either the Sand Replacement or the Balloon test must be carried out at least once every 3000 m2 to correlate the density readings or a series of samples need to be taken to determine the correlation between the measured and oven-dried moistures. The density is expressed as a percentage of the density determined above.

16.10 Materials, Plant and Construction Requirements for Road Surfacing

16.10.1 General Surfacing Requirements

Construction Equipment and Care of the Site

All equipment must be in good mechanical condition and no fault that could present a hazard must be permitted. Oil, water or fuel leaks will render a plant item unacceptable.

The site must be inspected before work commences. The available plant is to be suitable and appropriate for chipsealing under the canopy of any overhanging trees. When working within the canopy or drip line of large trees, appropriate care is to be taken to ensure that there is no damage to the trees root structure.

All sites must be inspected in advance of work with Council's Arborist. If protected trees are identified the Auckland Transport representative is to be immediately advised if it is considered that the overhanging trees will prevent work from reasonably being undertaken.

Care must be taken to avoid damage to roadside trees. If any damage occurs the Auckland Council Parks Department are to be immediately notified that remedial work is required. No tree damaged as a result of the surfacing operations is left in a condition that could pose a risk to the public. Any broken branches or other debris must be removed from the site and disposed of in an appropriate manner.

Preparation of the Road Surface

Where pre-reseal repairs have been performed they must present a dense, waterproof surface with a surface texture within +15% of the sand circle of the adjacent seal. All preseal repairs must comply with the requirements *ATCOP Chapter 25*.

Immediately prior to resealing or paving being performed, the existing surface and channel must be swept clean of loose aggregate, dust, dirt, moss, lichen, vegetation and any other deleterious matter. Any materials still adhering to the surface after sweeping must be removed by shovel, wire brush etc.

The surface must be dry, and any loose material, dust, clay or foreign matter must be removed by sweeping. Any materials still adhering to the surface after sweeping must be removed by shovel, wire brush etc.

All existing line marking must be 'tagged' out (off set) and/or sufficient details will be recorded for the line marking to be reinstated at a later date.

Raised pavement markers adhered to the existing surface must be dislodged and removed. Any damage caused to the existing surface must be reinstated before sealing commences.

Thermoplastic paint must be removed prior to resurfacing. Payment for these items must be included in the resurfacing rate.

Public Notification

A leaflet with an Auckland Transport letterhead notifying all homeowners and businesses of any proposed resealing works must be produced and distributed. The leaflet must be distributed at least three (3) days prior to the proposed date of resealing. The leaflet is to be forwarded to the Auckland Transport representative for approval prior to any distribution being undertaken. If requested by the Auckland Transport representative all affected residents are to be personally notified of the works.

The notification must outline the following information, as a minimum:

- 24 hour contact details
- Likely extent and time frame of the works
- Potential impact of the work on adjoining properties
- The effect of chipsealing and AC resurfacing and precautions necessary to be taken
- On street parking arrangements

The letter is to be delivered to properties within 100m of the site boundaries.

For any delay in undertaking the planned resealing works, of more than 3 days from notification, the leaflet is to be reissued under the same conditions as described above.

When resurfacing or chip seal works are adjacent to rehabilitation sites, the surfacing works on both sites must be coordinated to be undertaken at the same time to minimise stakeholder and traffic management impacts and to ensure a smooth and coordinated interface of both projects.

Traffic Management and Signage

All signage and devices required to manage traffic including Speed Restriction Signs, cones and barriers, 'New Seal' and 'No Road Marking Signage' at the site must remain in place until the road has been swept and all roadmarking has been reinstated.

To minimise traffic congestion on roads carrying high traffic volumes, the Auckland Transport representative may specify that particular sites be resurfaced at night.

Pavement Marking

On chipseal sites, all existing markings should be recorded using a site plan and reinstated within 48 hours of the site being sealed.

On AC sites the reinstatement of the temporary pavement marking must be carried out within 12 hours of each shift being completed and as per the existing markings and the permanent markings and RRPM's must be reinstated within 24 hours.

The required level of temporary traffic management is to be maintained on site until all pavement markings have been fully reinstated.

Remedial Work

Any defects arising in the new seal or surfacing or poor construction practice are to be repaired immediately.

This work must be carried out within two (2) working weeks after completion of the seal or after the defect was identified or before the seal deteriorates further, whichever is the lesser time.

Repairs performed must produce a surface uniform with that of the surrounding area.

On no account should repairs increase road roughness NAASRA counts or increase or decrease texture from that of the surrounding area (determined by way of the NZTA T/3 sand circle test).

Additional to the above, on AC sites flushing, stripping and shoving defects are not acceptable on the completed AC surfacing layer. These must be removed using techniques such as milling and new mix placed to the satisfaction of the Auckland Transport representative and Council.

Water cutting, as a means of correcting flushing, is not an acceptable solution for new asphalt surfaces or for surfaces that later exhibit flushing within the defects liability period.

Quality Assurance

The quality system must have the capability of ensuring the agreed expectations and outcomes defined in the ATCOP and any industry standards, specifications or guidelines can be delivered to the required standard and within the stated time frames.

It will detail the proposed liaison with the Auckland Transport representative's Representative on all issues related to quality assurance and quality control, including material testing, compliance testing, the management of non-conformances and the implementation of the Quality Plan.

The Quality Plan must include comment in the following areas as a minimum:

- The methodology to achieve the specified requirements of this contract, e.g. chipseal, AC, slurry, mix design, mix production control, ride, surface tolerance, mat depth, mat density and traffic management etc
- Detail of the communication flow and the interface with the Auckland Transport representative

- Proposed chipseal, AC, slurry, mix designs
- Sealing chip material properties
- Testing requirements and frequencies
- Construction QA requirements
- Audit of the Quality Plan
- Management of Non Conformances

As Built Records, RAMM Data and Resurfacing Records

All site resurfacing records are to be supplied to the Auckland Transport representative on a weekly basis. The information required includes the delivery dockets for the surfacing materials, used at each job together with a detailed plan displaying the dimensions of the resurfaced area.

These records are an essential part of the on-going monitoring of road resurfacing process. The Auckland Transport representative may stop all resurfacing works if these reports are not supplied in a timely manner and on a regular basis which must be stated within the Quality Plan.

The records must be presented on approved standard forms from the accepted Quality Plan.

The provision of As-Built resurfacing data and RAMM records must comply with the requirements of *ATCOP Chapter 24*.

Utility Service Covers.

All existing service covers and grates must be adequately protected from the resurfacing operations. All surrounding catchpits / drainage covers are to be suitably protected to ensure that no hydrocarbons or chip enter the drainage system.

Before resurfacing the positions of all service covers must be offset marked out on the road surface so they can be readily located after resurfacing operations are completed. They must be covered adequately to protect them from resurfacing materials.

Where required, all service covers must be raised during resurfacing operations to be flush with the adjacent finished pavement surface level.

Where this is not practical, and the cover is below the road surface level, service covers must be covered with an AC layer to make safe, and raised within 7 days.

Traffic Signal Loops

All resurfacing work within 100 m of signalised intersections must be coordinated with the Joint Traffic management Control Centre, (JTOC) in relation to loop installation and reinstatement during paving activities. Signal loops damaged during paving operations must be reinstated within 24 hours. JTOC are to be notified 1 week prior to works and again upon completion so they can check the signal phasing.

Before work commences on any site where there are traffic signal loops:

- JTOC are to be notified of when loops will be removed and arrange for temporary operation of the traffic signals
- provide relevant contact details for reinstatement

After work is completed, JTOC are to be notified who will then arrange for their contractor to replace the cut loops.

Reinstatement

On the completion of works the site must be cleared of all debris and reinstated to the original condition within 12 hours. This work must include, but not be limited to:

- removal of loose chip /debris from channels/cesspits
- removal of loose/ debris from the surrounding area
- removal of any binder spray or loose chip, excess material, debris outside the required areas
- repair of any items adversely damaged by the works.

16.10.2 Chip Sealing

Bitumen Equipment

Bitumen Distributors

Bitumen distributors must possess a current Certificate of Compliance in terms of the E/2 Specification for the Performance of Bitumen Distributors. Copies of the Certificate must be submitted to the Auckland Transport representative prior to commencement of sealing operations, and on an on-going annual basis, if necessary.

Bitumen distributors intended for use on the Contract must be provided with a nozzle adjustment facility to adjust the application rates over existing flushed areas. They should also be fitted with end bar devices to prevent overspray beyond the width of the bar.

Chip Spreaders

Chip spreading equipment must be capable of spreading the aggregate evenly, and at a controlled rate, over a width of at least 2.4 m and must be fitted with a positive means of adjusting the width of spread.

The design of the spreading equipment and the operating speed of the spreading vehicle must ensure sealing chip is dropped such that it does not bounce and tumble on impact with the sprayed road surface.

Rollers

The rollers must be a self-propelled type with a minimum mass when operating of not less than seven (7) tonnes, spread over at least seven smooth pneumatic tyres, smooth treaded wheels. Sufficient rollers must be provided to undertake the rolling.

Residual Bitumen Binder

Bitumen

Auckland Transport's preferred option is 80/100 penetration grade. However 130/150 penetration grade may be used with agreement of the Auckland Transport representative.

Emulsion

Where it is proposed to use a bitumen emulsion, it must meet the requirements of NZTA M/1 Specification for Asphaltic Bitumen.

Regular test reports on the bitumen and emulsion are to be supplied to the Auckland Transport representative.

All testing must be performed by an IANZ accredited laboratory.

SBS Polymer Additive

Where a polymer is to be added to either bitumen or emulsion binder, then it must be used in strict accordance with the manufacturer's instructions.

The following product details are to be submitted for the approval of the Auckland Transport representative:

- Proprietary product, name, type and claimed properties
- Track record of the product
- Track record in using the product

Any SBS polymer modified binder used must have a proven track record relating to life expectancy. Details are to be provided of the track record of the product and any track record of use of the product.

The general properties of the polymer must meet the following requirements, or alternatives approved by the Auckland Transport representative:

- Polymer Type SBS
- Polymer Percentage SBS: Min. 4% Residual from Evaporation, by mass: Min. 75%
- Particle Charge: Positive
- Brookfield Viscosity at 25C, (MPa.s): Min 250-400
- Torsional Recovery @ 25C: Min 48%
- Softening Point Deg C: Min 70
- Viscosity @ 135C, (Pa.s): Min 1.8
- Elastic Recovery @ 60C, (Pa.s): Min 70%
- Viscosity by Elastomer @ 60C, (Pa.s): Min 2000

Blending and application must be carried out in strict accordance with the manufacturer's recommendations and the pavement design and any relevant industry or project specifications.

Adhesion Agent

An adhesion agent approved and blended in accordance with the requirements of NZTA M/13 Specification for Adhesion Agents must be incorporated in the bitumen binder.

Cutter

The bitumen must be cut back with lighting kerosene so that the total diluent content of the binder complies with the requirements stated in NZTA M/1 Specification for Asphaltic Bitumens, NZTA P/3 First Coat Sealing, and the guidelines stated within “Chipsealing in New Zealand” (NZTA 2005).

Cutters are not permitted in chipseal membranes that later will be overlaid with asphalt.

Blending of Binder

The total quantity of each component incorporated into the bitumen binder must be accurately measured by a volume metering or weighing device certified by the Weights and Measures Section of the Department of Labour or other approved calibration agency. The binder must be thoroughly mixed before use.

A blending certificate must be produced for each load of binder. This certificate must list the following:

- time and date of blending
- temperature of bitumen when blended
- penetration grade of bitumen
- number of parts of AGO per 100 parts of bitumen
- number of parts of kerosene per 100 parts of bitumen
- type and quantity of adhesion agent in parts per hundred of bitumen
- the blending certificates must be included in the monthly report

Testing of Binder

Bituminous binder test are to be supplied or, as appropriate, emulsion reports to the Auckland Transport representative. All testing must be performed by an IANZ registered laboratory.

Each sample of binder must be taken from the bitumen distributor in accordance with NZTA M/1 at a frequency of one sample of every 5000 litres of binder applied. Where a polymer modified emulsion binder is chosen to be used, the modified binder must be sampled and tested before it is emulsified.

The samples must also be tested for kinematic viscosity in accordance with ASTM D2170-01a, diluent content and presence of adhesion agent.

Application of Binder

The rate of application of binder must be determined generally in accordance with NZTA P/4, P/17 or the procedures outlined in “Chipsealing in New Zealand (NZTA 2005) or any other approved design method.

The binder must be applied with a bitumen distributor, operated in accordance with the Roading New Zealand safe Handling of Bitumen and its E/2 Certification for Performance of Bitumen Distributors and must have a valid E/2 Certification

Spraying must be stopped immediately if any defect in the sprayer becomes apparent, and the fault must be rectified before spraying recommences.

The quantity of binder sprayed in any spray run, measured by dipstick reading, must not vary from the amount directed by more than 50 litres plus four percent of the amount directed.

Should a greater variation occur more than twice during spray operations in a single day then the bitumen distributor must be removed from the operations until the problem is identified and then rectified.

Where a calibrated accumulating revolution counter is fitted to the distributor, the counter may be used to measure the binder used in a single run, for the sole purpose of checking application rate. However, the dipstick measurement before spraying is commenced from the tank and after the last spray from the tank or prior to refilling must be required for payment purposes and for checking the variation from the directed amount as described above and to check the accuracy of the revolution counter.

The road must be reasonably dry before binder is applied. No spraying of hot binder must be carried out when the air temperature measured at the spraying site is below 10°C in the shade.

To ensure the required rate of application is obtained at the commencement of the spray run and a sharp and even joint is obtained at the finish of the spray run, a 1 m minimum width of non-porous paper or fabric must be placed across the pavement where each run of the spray runs start and finish.

Adequate measures are to be taken to secure the paper against lifting by wind or traffic by placing a clean material that will not affect the operation of the works on the paper.

All existing service covers and grates must be adequately protected from the chipsealing operation by means of placing non-porous paper or fabric. All surrounding catchpits / drainage covers are to be suitably protected to ensure that no hydrocarbons or chip enter the drainage system.

Immediately prior to any spray run, binder must be circulated through the spray bar until the bar is fully heated.

Protection of Existing Streetscape

Before any binder is sprayed, the positions of all service covers are to be offset marked out on the road surface so they can be readily located after sealing operations are completed. They must be covered adequately to protect them from spray.

When spraying and chip spreading is completed the covers must be cleaned off.

Edge Definition

The edges of the sealing course must be clearly defined. Where kerb and channel exists, the edge of the sealing course must overlap the edge of the channel by 10-15 mm.

For roads without kerb and channel the width of the sealing course will be the edge of the existing seal.

Ragged or irregular edges to the sealing will not be permitted.

Sealing Chip

Sealing chip must comply with the requirements of NZTA M/6 Specification for Sealing Chip. Test reports on the size, shape and cleanness of the stockpiled chip for every 500 m^3 of chip used and part thereof in the current sealing season must be supplied.

All testing must be performed by an IANZ accredited laboratory.

Pre-coated chips must comply with the requirements of NZTA M/11 Specification for Pre-Coating Sealing Chips. Alternative methods of Pre-coating sealing chip may be used subject to the approval of the Auckland Transport representative.

The aggregate may be damp but must be free of any dirt or foreign matter.

Size

Sealing chip should be at the lower end of the ALD range for the grade of chip specified.

Shape

Where chip is used in two coat seals the ALD's are to be compatible, as outlined in "Chipsealing in New Zealand" (NZTA 2005).

The AGD/ALD ratio of the sealing chip must be within the following limits:

$1.7 \leq AGD/ALD \leq 2.25$

Polished Stone Value (PSV)

The PSV of the Sealing Chip for each site, must be determined as part of the seal design in accordance with the requirements of NZTA T10 Specification for State Highway Skid Resistance Management and / or Appendix A of the NZTA Maintenance Guidelines for Local Roads.

PSV must be measured in accordance with BS 1097-8:2009.

Sealing chip must have a minimum PSV of 52 and be in the range of 52 to 57.

Where higher PSV chip is requested the minimum polished stone value must be 64 as directed by the Auckland Transport representative. The stone source must be advised to the Auckland Transport representative for approval before use.

Spreading of Chip

After spraying the binder, spreading of chip must commence promptly. All binder sprayed must be covered with chip across the full sprayed width, apart from necessary longitudinal laps, at the nominated rate of spread, immediately after spraying.

The rate of chip spread must be determined following the guidelines set out in "Chipsealing in New Zealand" (NZTA 2005).

The spread rate of the sealing chip must be such that after trafficking, the chip must be bedded down and in shoulder-to-shoulder contact with the individual stones lying flat. The binder rise must be consistent with the design method used and must provide a reseal complying with the performance criteria.

Rolling

All rolling must be completed, as a minimum standard, as specified in NZTA P/4. Specific locations may require more rolling, as required by the situation.

Protection of Overspray

Before any binder is sprayed, the positions of all service covers are to be offset marked out on the road surface, so that they can readily be located afterwards, and must cover them adequately to protect them from spray. Once spraying and chip spreading is completed the covers must be cleaned off.

Care must be taken to ensure there is no binder deposited on the berm, footpath or vehicle crossings.

Kerb and channel, marker and sign posts, and other road furniture adjacent to surfaces to be sealed, must be adequately protected against over sprayed binder and from roller or other damage. Any blemish or damage so caused must be made good to the satisfaction of the Auckland Transport representative.

Removal of Surplus Chip

All surplus stone chip must be removed from the sealed surface within 48 hours of rolling and before the removal of speed restriction signage. In removing the surplus chip / debris, the following areas are to be cleared but not limited to:

- All catchpit / chambers in the vicinity of the work
- Channels and drives
- All chip from grass berms, driveways, and pedestrian walkways
- All other areas in the road reserve
- All areas to where chip has tracked

Any windrows of chip that form, either on the shoulder or the sealed surface, must be removed before they become a traffic hazard.

Any build-up of surplus chip is to be removed within 2 days, should the Auckland Transport representative direct. There must not be 50 loose chips must be left on any 2 square metre area of the sealed surface. On other areas such as berms, footpaths and vehicle crossings not more than 20 loose chips must be left on any 2 square metre area. Hand sweeping of these areas must be undertaken if required.

Additional sweeping must be carried out or any other chip removal method to remove all loose chip from the chip sealing works.

Particular situations and seal types may dictate the use of vacuum sucker trucks. This should be considered and allowed for to suit the situation.

Removal of Surplus and Waste Materials

Paper or fabric placed across the pavement for the start and finish of spray runs and binder twine or cord lines used to define the edges of the sealing must be uplifted immediately upon completion of the seal run.

Those items and all empty containers, surplus binder and other materials must be stored neatly until removed from the site at the end of the working day.

Stockpile sites must be cleared of excess chip within one (1) month of completion of that season's sealing.

No Fouling of Sealed Surface

The road surface must not be fouled by water, oil, petrol, binder or other droppings from construction plant or vehicles during sealing works.

If necessary, trays or pans must be fitted under trucks or other plant to prevent fouling of the road surface.

Care must be taken, when emulsion binders are sprayed, to avoid windblown emulsion causing damage to third party property.

Dry Locking

When required by the seal design a dry lock must be applied to nominated areas of the new seal.

The dry lock must generally be applied within 1 day of completion of primary rolling.

The dry locking will involve the uniform spreading of compatible Grade 5 or 6 chips over the nominated areas at an appropriate application rate.

Chip Applications for "Racked In" Sealing

The "Racked In" process is where a single application of modified residual binder is sprayed, followed by two separate applications of chip.

For example, a larger chip size of ALD approximately 8.8 mm followed by a second application of chip with an ALD approximately half that of the larger chip (ie. in this case 4.4 mm).

The chip application should be as follows:

- Apply a single coat of the modified residual binder (the choice of cut-back or emulsion binder must be identified by a specific design)
- Spread a uniform coverage of the larger grade chip and immediately roll with a single pass of an approved steel wheeled roller
- Rubber tyred rollers are not to be used, on the first larger chip application

- The application of the larger grade of chip must be left open by leaving "windows" of residual in the surface to allow the second smaller grade chip to fill the gaps and make direct contact with the surface of the residual
- Spread the second smaller grade chip to completely cover the residual binder and then complete the rolling by applying one pass of the steel drum roller and finish rolling using an approved rubber tyred roller for the duration described in “Chipsealing in New Zealand” (NZTA 2005)

16.10.3 Asphalt (AC) Surfacing

Testing Requirements

Test results must be provided to the Auckland Transport representative to show that the source properties of the coarse and fine aggregates, mineral filler and binder used in the production of asphalt comply with the requirements of the NZTA M10 specification or the NAS and its NZTA Supplement, where appropriate

Individual aggregates utilised in the asphalt production must be tested to ensure that the stockpile grading complies with the grading utilised in the original mix design for the specific mix. Test frequency must be 1 per 200 tonnes for each aggregate. The quarry may provide this test if in the view of the Auckland Transport representative there is a suitable level of traceability and the quarry laboratory is IANZ accredited for the test and registered.

Depending on the consistency of the results, the frequency may change as directed by the Auckland Transport representative.

The asphalt must be tested for binder content and aggregate grading as specified in the relevant sections of the design or any relevant industry or project specifications. When asphalt is identified as non-conforming the testing frequency must be increased until the mix quality is demonstrated as being within specification. Sampling must be in accordance with the required specification.

Asphalt mixes, designed in accordance with the NZTA M/10 specification, larger than 10mm nominal size must be tested for Marmust properties at the rate of one test per 100 tonnes up to a maximum of 3 tests per shift. One 'Test' must comprise 3 Marmust blocks. Test results must be compared with the results obtained during the trial prior to full production and the results reported to the Auckland Transport representative.

Where the mix depth (compacted) is 35 mm or greater the mix density must comply with NZTA P/9P except that the required air voids range must be 3% to 6%. Coring is the preferred method for measuring the final mat density. Coring may also be used to confirm thickness of mat when instructed or required by the Auckland Transport representative.

For asphalt mixes designed in accordance with the requirements of the National Asphalt Specification (NAS), asphalt sampling, testing mix density and coring requirements must comply with NAS and the NZTA Supplement.

For thicker asphalt lifts, coring will be also used to determine air voids and density.

Layer thicknesses are to be routinely recorded at the time of construction. Measurements must be undertaken using appropriate thickness gauges (feeler gauge or similar).

The Auckland Transport representative may consider nuclear densometer or other methods where a valid and recent correlation against core results can be provided.

In cases of dispute regarding contract compliance (thickness or density), core results will take precedence.

If a test result falls outside the stated limits it will be considered non-conforming and payment for the 'lot' (as defined in NZTA P/9P) will be withheld until further testing confirms the validity of the test results. Payment reductions or removal and replacement will be considered by the Auckland Transport representative for non-conforming results.

During the last week of every month a joint audit of performance against the requirements of the approved Quality Plan must be undertaken. The audit report will be compiled and submitted to the Auckland Transport representative within one week of the audit date along with any corrective and/or preventative actions required.

At the discretion of the Auckland Transport representative samples of the material being laid are to be supplied to the Auckland Transport representative's materials testing laboratory.

Materials

Mineral Aggregate

All tests on mineral aggregates must be made on representative samples obtained from the cold aggregate feeders or approved stockpiles and must meet NZTA M/10 Specifications or the NAS or its NZTA Supplement, as appropriate.

The source test Polished Stone Value for the coarse aggregate fraction of the mix must be 55 (min). This value must apply to at least 85% by mass of the coarse aggregate. If directed by the Auckland Transport representative, a higher PSV aggregate must be used.

Samples of all aggregates to be used must be obtained and combined in the proportions required by the mix design grading.

The combined aggregate must be split on a 4.75 mm sieve, and that portion retained on the sieve must meet the requirements for coarse aggregate as defined below.

The portion of the combined aggregate which passes the 4.75 mm sieve must meet the requirements for fine aggregate as defined below:

(i) Coarse Aggregate

Coarse aggregate must consist of crushed stone or crushed gravel or a combination of the two, produced from hard, durable rock or river boulders. From any representative sample of the coarse aggregate, a minimum of 98% of the particles must have at least one cleanly broken face, and 60% minimum must have not less than two cleanly broken faces.

When tested in accordance to Test Method NZS 4407, Test 3.10, the aggregate crushing resistance must not be less than 200 KN.

When tested in accordance to Test Method NZS 4407, Test 3.11 (Weathering Resistance), the quality index must be AA or BA.

When tested in accordance to Test Method NZS 4407, Test 3.9 the aggregate cleanness value must not be less than 65.

(ii) Fine Aggregate

Fine aggregate must consist of tough particles of sand, crushed stone or crushed gravel or a mixture of these materials.

Fine aggregate must be free of weathered particles, sound and durable. (A sand equivalent of not less than 35 when tested in accordance with NZS 4407, Test 3.6, and the fraction of aggregate passing the 0.075 mm sieve must have a clay index less than or equal to 3 when tested to NZS 4407, Test 3.5)

The presence of clay, loam or silt, either free or as a coating on the stone, will render the fine aggregate unacceptable if the total weight of these undesirable materials exceeds 2% of the weight of the fine aggregate.

The parent stone from which any crushed fines are produced must, when tested in accordance with NZS 4407, Test 3.10, have a crushing resistance not less than 200 KN.

Mineral Filler

Mineral filler must be defined as finely ground particles of limestone, hydrated lime, Portland cement or other non-plastic mineral matter that is combined with the mineral aggregate. Pumice and other similar absorbent materials are not acceptable.

The mineral filler must be thoroughly dry and free from lumps, and must meet NZTA M10 Table 63 gradation requirements as follows:

Table 63: Gradation Requirements

Sieve Size	% Mass Passing (Dry Sieve)
0.6 mm	100
0.15 mm	>90
0.075 mm	>65

Mineral Dust

Mineral dust must be defined as all mineral matter that passes the 0.075 mm sieve and will be composed of fine particles of the coarse or fine aggregates and/or mineral filler.

Any representative sample of mineral dust obtained from the mixed material at the end of the dry mixing period must be free from organic matter.

Asphalt Binder

The asphalt binder must comply with the requirements for the grade as defined in NZTA M/1 Specification for Roading Bitumens.

Tack Coat

The tack coat must be either a 180/200-bitumen binder or a cationic quick breaking bitumen emulsion with a residual binder content of 60% (CQ 60).

It must be applied as a fog coat at a rate of application determined in the seal design and/or after inspection of the surface conditions.

No cutters or diluents must be used.

Membrane Seal

Where specified by the Auckland Transport representative a membrane seal must be used. The chip size to be used must be detailed in the surfacing design and agreed with the Auckland Transport.

The asphalt binder must be 80/100 penetration grade. No cutters are permitted.

The residual asphalt binder quantity per square metre must be not less than 1.0 litre at 15ºC. Unless agreed otherwise, a Grade 4 sealing chip must be used as the cover material.

The actual residual binder quantity required must be detailed in the surfacing design. The sealing chip will be spread to a standard that ensures that there are little to no windows and exposed bitumen and any loose chip must be removed. Asphalt surfacing placement must commence the same day following the application of the membrane seal.

Testing of Materials

Regular test reports are to be supplied to the Auckland Transport representative on all materials used in the mix.

All testing must be carried out by an IANZ registered laboratory for the appropriate tests.

Mix Type

- The mix design must allow for the asphalt mix to be laid at the minimum specified thicknesses.
- NZTA Mix 15 or NAS AC14 must be the type of mix used and must be laid as a wearing course to a minimum compacted depth of 35 mm.
- A Mix 15 or NAS AC14 utilising up to (but not more than) 15% reclaimed asphaltic pavement (RAP) may be used with the prior approval of the Auckland Transport representative and must be laid as a wearing course to a minimum compacted depth of 35 mm.
- NZTA Mix 20, where specified, must be laid to a minimum compacted depth of 50 mm.
- NZTA Mix 10 must be used as a levelling mix or for other applications
- An ultra-thin surfacing mix of 10-12mm compacted depth may be used in some circumstances as with the Auckland Transport representative.

- Stone Mastic Asphalt (SMA 10), where specified, must be laid to a minimum compacted depth of 35 mm. For other SMA types, such as SMA 14, the minimum compacted layer thickness must be 45mm.
- The Job Mix Formula must be supplied to the Auckland Transport representative (in accordance with the requirements of NZTA MS 2 and NAS) to demonstrate compliance with the requirements of the design, the ATCOP and any relevant industry or project specific requirements.

Mixing Plant

The plant must comply with NZTA M/10 or the NAS and its NZTA Supplement.

Preparation of Asphaltic Binder

Asphalt binder must be heated at the plant to a temperature at which it can be properly handled through the pumping system.

Any binder heated at any time to a temperature more than 10^{O}C above the temperature for the bitumen grade, given in 76, or held at a temperature above this temperature for longer than 8 hours will be rejected and must not be used unless subsequent testing confirms that the binder complies with NZTA M/1.

Table 64: Asphaltic Binder Temperatures

Type of Binder	Maximum Temperature (ºC)
60/70	162
80/100	160
180/200	155

Mixing

All mixes must be dry mixed for at least the time necessary to charge all aggregates.

Wet mixing must continue for the minimum time necessary to obtain a thoroughly blended mix in which all coarse aggregate particles are fully coated.

Any temperature selected outside the range given in the table below and temperatures for mixing SMA must be subject to approval by the Auckland Transport representative.

Table 65: Temperatures for Mixing SMA

Type of Binder	Temperature of Aggregate (ºC)		Temperature of Binder (ºC)	
	Minimum	Maximum	Minimum	Maximum

60/70	150	162	140	162
80/100	145	160	138	160
180/200	133	155	133	155

The average temperature of the mix when discharged from the mixer must be within ±80C of the mixing temperature agreed by the Auckland Transport representative.

In addition, any batch of asphalt heated to a temperature of 15ºC above the agreed mixing temperature will be rejected at the mixing plant and must be deposited at a nominated dump area.

Levelling Course

Where a levelling course is required it must be placed by means of a paving machine or a self-propelled long wheel base grader fitted with a blade having an edge that is straight and true.

The layer must be placed to give zero thickness over high spots and to fill depressions until the pavement shape is restored and the gap under a 5 m straight edge placed at any position on the road does not exceed 8 mm. The layer must be compacted before the placing of a subsequent paving course or courses.

Any levelling required prior to sealing is to be identified and approval obtained from the Auckland Transport representative before any levelling course is laid.

Tack Coat / Waterproof Membrane

Prior to paving a tack coat must be applied to all horizontal and vertical surfaces. The rate of application must be determined after inspecting the surface conditions.

If the basecourse is exposed during milling operations, a waterproof membrane seal (single coat Grade 4 or similar) must be applied before resurfacing. The membrane seal must extend beyond the exposed area by 200mm.

The Auckland Transport representative may direct a membrane seal is to be used in some situations.

Transportation, Spreading, Finishing and Compaction

The transportation, spreading, finishing and compaction of asphalt, including formation of joints, must be in accordance with the following and also with NZTA P/9P or the National Asphalt Specification and its Supplement, as appropriate for the material being placed.

(i) Transportation of Mix

The temperature of the delivered material must not be more than 10oC below the delivery temperature agreed with the Auckland Transport representative.

The delivery temperature is defined as the temperature of the material measured and recorded immediately prior to the material being tipped into the hopper of the paver.

(ii) Spreading, Trimming and Formation of Joints

The markings to be followed by the paver are to be set out on site in constructing longitudinal joints and edges.

Where new paving abuts an old road surface, the old surface must be milled or cut back to form a vertical face and straight alignment throughout the length of the lane. Longitudinal joints in the surfacing must not be in wheel paths and must be offset 150 mm from joints in the layer underneath.

A detailed paving plan to be followed by the paver in placing individual lanes must be supplied. This plan must detail the proposed location of paving joints and it must be provided for the Auckland Transport representative's approval in advance of work commencing on site.

Handwork will not be permitted except at the edges of the mat. Segregation of materials must not be permitted. If segregation occurs, the spreading operation must be immediately suspended until the cause is determined and corrected. Any area of segregation that is not corrected prior to rolling must subsequently be removed and replaced with material supplied and compacted to the specified requirements.

Excess material forming high spots must be removed with a shovel or lute. Indented areas must be filled with AC mix and smoothed. Fanning of material over such areas must not be permitted.

(iii) Longitudinal Joints

Longitudinal joints must be prepared by rolling the edge of the first lane with a rubber tyred roller so that the edge becomes feathered at an angle of approximately 45 degrees The material being placed in the abutting lane must then be tightly crowded against the face of the previously placed lane.

The Quality Plan must state the maximum paving run length before rolling commences, to ensure there are no cold longitudinal joints. The Auckland Transport representative may direct joints deemed too cold to achieve good compaction to be saw cut. All cold joints must be saw cut back to an angle of 900 and must have tack coat applied prior to the placement of adjoining material.

The density obtained at longitudinal joints must equal that obtained over the full width of the lane as appropriate for the mix being laid. The Auckland Transport representative may direct material to be cut from the mix if this requirement is not being met or if the pavement surface adjacent to the joint is distorted.

(iv) Edges

Care must be exercised when compacting the asphalt course along the entire length of the edges.

Before it is compacted, the material along the unsupported edges must be slightly elevated with a tamping tool or lute, to permit the full weight of the roller wheel to bear on the material to the extreme edges of the course. In rolling pavement edges, steel roller wheels must extend 50-100 mm beyond the pavement edge.

Paving over channels is expressly prohibited. Where this the asphalt is to be removed from the channel.

Where there is a build-up of lip on channel edge this will be removed as resurfacing operations where milling and filling has occurred on the street.

Density, Thickness and Surface Requirements

The final surface must be of a uniform texture conforming to the line and grade specified by the Auckland Transport representative. The surface must be free from flushing, bleeding and segregation.

During the progress of laying work, the thickness of the various courses must be monitored, measured and recorded. Unsatisfactory work must be repaired, replaced or corrected.

Density, thickness and surface shape must be carefully controlled during construction and must be in full compliance with the mix design and the relevant specification. Density testing will be carried out in accordance with NZTA P/9P or the National Asphalt Specification, including the NZTA Supplement, whichever is appropriate. When instructed by the Auckland Transport representative, core tests will be undertaken for the purpose of checking thickness.

Density requirements must be in accordance with the requirements of NZTA P9/P or the National Asphalt Specification, including the NZTA Supplement, whichever is appropriate. Additionally, with NAS (including the NZTA Supplement) mixes used for heavily trafficked roads and intersections, the minimum characteristic air voids value for surfacing mixes, when measured from cores, must be 4%."

The quality assurance documentation will detail a comparison of the tonnage of the asphalt used on the site compared to the surface area paved.

The surface texture for SMA type mixes must exceed 1 mm following completion of the work. It must be tested, recorded and compared to the expectations set out in the JMF. This testing will be completed by the Sand Circle Method, as outlined in the NZTA, T/3 specification.

Flushed SMA type surfaces are not acceptable and must be replaced. Water cutting is not an acceptable solution for treating flushed SMA type mixes.

A 5m straight edge must be used to test the finished surface, as specified in NZTA P9/P. Any irregularities that vary by more than 6 mm from the straight edge longitudinally or transversely must be corrected by means approved by the Auckland Transport representative.

Irregularities that develop before the completion of rolling must be remedied by loosening the surface mix and removing or adding material as may be required. Should any irregularities or defects remain after final compaction, the material must be removed promptly and sufficient new material placed to form a true and even surface. All minor surface projections, joints and minor honeycombed surfaces must be ironed smooth to grade.

To achieve a satisfactory finished surface it is essential that the pavement be checked regularly before and during the final compaction operation with the aid of a straight edge.

A straight edge must be kept on the site of the works and to use it in the control of the final rolling operation. Unless otherwise directed by the Auckland Transport representative the final surface must be flush with the channel lip.

Temporary Ramps

If the paving on a site is not completed on the same shift that it is commenced, temporary ramps must be constructed. The location of these ramps must be where there is any drop off between the new surface and the existing surface of more the 20mm. This includes but is not limited to services, end of paver runs, longitudinal joints. The temporary joints must be constructed using suitable plant mix and must be able to with stand the traffic loadings anticipated to be experienced at the site.

In the event of inclement weather or if the ramp is to be in service for more than one shift, regular inspections must be completed to ensure the carriageway is maintained in a suitable and safe condition.

Milling

Milling and Surface Preparation

The existing surface is to be milled to the minimum depth required to place the specified and designed asphalt surfacing layer and provide a “key in” between the new and existing surfacing. The milling depth and the extent must be approved by the Auckland Transport representative and in all cases the completed surface is to be flush with the channel level.

Where directed by the Auckland Transport representative the re-profiling of the milled surface within the milling operation to improve the cross fall and longitudinal profile must be included.

Unless directed otherwise by the Auckland Transport representative all millings must be disposed of off-site.

Milling for Overlay Purposes

Where directed by the Auckland Transport representative a chamfer between 0mm and the specified depth for a width of 1m on either side of the road is to be milled.

16.10.4 Slurry Surfacing

Surface Preparation

All loose materials and deleterious matter are to be removed from the road surface before any slurry is placed.

Materials

Bitumen

Unless specified otherwise, the bitumen used for emulsion manufacture must comply with the NZTA M/1 Specification for Roading Bitumens.

Mineral Aggregates and Filler

Mineral aggregates and filler used in the manufacture of slurry surfacings must comply with the properties specified in NZTA M/10 with the exception that the sand equivalent must meet a minimum of 60.

No provision is given for acceptance of an aggregate stockpile based on clay index test results.

Mineral aggregates must be crushed from quarried rock or water worn gravel. All particles must consist of hard sound material of uniform quality, free from soft or disintegrated rock or other deleterious material.

Water

The water that is used to control the slurry consistency must be potable and compatible with the other slurry components.

Additives

Additives may be added to the slurry to control, by retarding or accelerating, the rate of break. The additives must be compatible with the other slurry components.

Table 66: Performance Requirements for Slurry Design

Test Property	Method	Specification
Wet Track Abrasion 1 hour: 6 day:	ISSA TB-100	538 g/m² maximum 807 g/m² maximum
Wet Stripping	ISSA TB-114	Pass (90% minimum retained coating)
Wet Cohesion 30 minutes: 60 minutes:	ISSA TB-139	12kg-cm minimum 20kg-cm minimum

Table 67: Suggested Grading, Residual Binder Content, Application Depth Thickness and Typical Texture Depth for Slurry

SIEVE SIZE (mm) (Austroads Name)	PERCENTAGE PASSING BY MASS Refer Note (i)		
	TYPE 1 (Size 3)	TYPE II (Size 4)	TYPE III (Size 7)
Maximum Aggregate Size (mm)	**3mm**	**5mm**	**7mm**
13.2	100	100	100
9.5	100	100	100
6.7	100	100	85-100

SIEVE SIZE (mm) (Austroads Name)	PERCENTAGE PASSING BY MASS Refer Note (i)		
	TYPE 1 (Size 3)	TYPE II (Size 4)	TYPE III (Size 7)
4.75	100	90-100	70-90
2.36	90-100	65-90	45-70
1.18	65-90	45-70	28-50
0.6	40-65	30-50	19-34
0.3	24-42	18-30	12-25
0.15	15-30	10-21	7-18
0.075	10-20	5-15	5-15
Nominal Application Depth (mm) Refer Note (ii)	3-5mm	5-7mm	7-10mm
Typical Texture Depth after 12 months (mm)	0.3mm	0.5mm	0.7mm
Typical Residual Binder % by Mass Refer Note (iii)	6.5-10.5	5.0-9.0	4.2-7.5

Note (i). The JMF particle size distribution may need to deviate outside the limits in the above table to achieve the required properties. This is acceptable.

Note (ii). The nominal application depth for Rut-filling may be up to 40mm, beyond which it is recommended that it be carried out in two layers

Note (iii). Residual Binder % is determined during mix design and forms part of the job mix formula.

The figures provided are only an indication of the typical range.

Sampling and Testing

The sampling and testing frequency of the aggregates must be in accordance with the guidelines given in RNZ 9805.

The sampling frequency of the slurry must be one per mixing unit per day's production or as specified whichever is the higher. The slurry must be tested for the binder content and aggregate grading.

Table 68: Recommended Test and Sampling Methods

Test	Method
Sampling of Aggregate	NZS4407: Part 2
Sampling of Binder	ASTM D140
Sampling of Slurry	AG:PT T221 (Austroads)
Aggregate Grading	ASTM 136 & ASTM C117 or NZS4407: Test 3.8.1
Sand Equivalent	NZS4407: Test 3.6
Binder Content	ASTM D2172 or ASTM D6307 or ADL 4.02/15a

All testing must be performed by a Laboratory Accredited by IANZ.

Joints

Where possible, longitudinal joints must be at or adjacent to the lane or centre-line markings and transverse joints must be perpendicular to the centre-line or kerb.

Joints must be butted-up to the adjacent run or must be lapped, with the lap not exceeding the nominal layer thickness. Joints must not have gaps or uncovered areas.

Edges and joints to existing surfaces must be tapered to provide a smooth transition from the slurry to the adjacent surfaces.

16.10.5 High Friction Surfacing

The use of High Friction Surfacing (HFS) will only be considered when it can be demonstrated that the specific requirements for the surfacing site being considered are driven by the surface friction requirements from NZTA T/10 **and** cannot be remedied by the use of an asphalt and/or chip seal surface with high PSV aggregate. The use of HFS will only be allowed with the written consent of the AT representative.

The requirements of the ATCOP are to be read in conjunction with NZTA P25 Specification for Calcined Bauxite.

Surface Preparation

It is essential that the pavement condition be assessed and documented with photos and visual inspection comments prior to any application of high friction/coloured surfacing. Surface preparation is essential to obtain necessary durability and effective skid/resistance of the applied product. Unless AT decides otherwise, the following work flow table should be referred to for surface preparation prior to the installation of high friction/coloured surfacing. This flow table will help minimise the risk of high friction surfacing/coloured surfacing failing prior to the expected life of 6-8 years.

Table 69: Work Flow Prior to Installation of High Friction/Coloured Surfacing

<table>
<tr><th>Document Items</th><th>Pavement Condition Assessment</th><th>Pavement Treatment</th><th colspan="2">Surface Preparation</th></tr>
<tr><td rowspan="3">• Prior HFS treatment
• Visible Cracking
• Age of Seal
• Thickness of AC Surface
• Service Covers
• Existing Markings</td><td>Good Condition
• Surface hairline cracking (no obvious movement along the surface)
• At least 35mm of AC surface</td><td>• Bandaging if possible
• At least 35 mm of AC surface</td><td rowspan="3">Weathering
• Four weeks minimum - preferably two months</td><td rowspan="3">Water cutting to remove contaminants to provide sufficient surface texture by removing excess binder</td></tr>
<tr><td>Substrate Defects
• visible large cracks</td><td>Mill and Fill</td></tr>
<tr><td>Sub base Defects</td><td>Dig-out</td></tr>
</table>

WORK FLOW

If the high friction/coloured surfacing is proposed on a section of road with any service covers present, these service covers will need to be cleaned before the application of binder or be marked out prior to installation (AT to decide).

Material Selection

Material Selection must comply with Sections 3.0 and 5.0 of NZTA P25.

(i) Binder

Current binders in use are polyurethane resin, epoxy resin, rosinester thermoplastic and methyl methacrylate. AT prefers the use of the two resin based binders: polyurethane and epoxy. Other binders, such as thermoplastic, may also be considered for use by AT depending on the circumstances why the preferred materials cannot be utilised.. A copy of an authorised 'supply and apply' Partnership Agreement between the contractor/sub-contractor and its binder manufacturer needs to be provided to AT before the application of the binder. Manufacturer Material Quality control requirements including comprehensive materials testing documentation need to be provided to AT in the form of QA documentation. Internationally recognised certification should also be provided if available with written confirmation that it can support up to 2500 commercial vehicles per lane per day.

(ii) Chip

When selecting suitable chip, the minimum PSV value required for Calcined Bauxite aggregates is 70. Manufacturer Material Quality control requirements including comprehensive materials testing documentation needs to be provided to the client in the form of QA documentation.

(iii) Additives

Common additives include compatible primers for applications on cementituous surfaces and catalysts to accelerate the curing process of the binder during colder months. For all additives, Manufacturer Material Quality control requirements including comprehensive materials testing documentation need to be provided to the client in the form of QA documentation.

Installation

The installation must comply with sections 3.0 and 5.0 of NZTA P25PN.

Sweeping of loose aggregate is to be undertaken as per section 3.5 of the P25PN document.

(i) Installation Method Statement

A copy of the original Installation Method Statement from the binder manufacturer must be submitted as it contains information about installation parameters and techniques. Additionally, the contractor must submit its own company statement outlining its adopted methodology for the installation of its system and quality assurance promise to AT.

Health and Safety and Environmental Plan and Material Safety Data Sheets (written by manufacturers) are to be provided to the client and require that the

materials are stored and applied in accordance with the Contractor's Health, Safety and Environmental Plans. The Health and Safety Plan should be onsite and available upon request.

Loose aggregate are to be removed from the surface, kerb channel, any road side drainage structures and the shoulder. The contractor will maintain the surface to allow no more than:

- 150 grams of loose aggregate is left on any 1 sqm area of the surface during the first two months of operation
- 50 grams of loose aggregate is left on any 1 sqm area of the surface after two months of operation.

Maintenance of Surfacing

Skid resistance testing is to be arranged by the contractor once the surface has fully cured and results are to be entered into RAMM.

A defects liability period of two years applies to all HSF Works. In addition to the requirements of the specification, for good asset management of the on-road performance, it is important that AT completes an assessment of the on-road performance of the high friction/coloured surfacing two years after application. Skid resistance values after the 2-year liability period are also to be entered into RAMM. Once the defects liability period is finished, AT will programme annual reviews and inspections.

Performance Requirements

Acceptance of the binder-chip system skid resistance must be based on two factors: Equilibrium SCRIM Coefficient and Macrotexture. Preferred testing methods are as follows:

(i) Equilibrium SCRIM Coefficient (ESC)

Upon installation the High Friction Surface is expected to have 0.65 Equilibrium SCRIM Coefficient (ESC) and may go down to 0.60 ESC during the course of its performance life. If the ESC of the surface falls in to question use of a British Pendulum Tester (BPT) is acceptable as an interim measure. When the BPT method is use, initial skid resistance must meet or exceed 87 BPN for at least 95% of all tested points and 80 BPN for 100% of the tested points. Other testing methods will require approval from the relevant AT engineer

(ii) Macrotexture

Upon installation it is expected that the macro texture must meet or exceed 0.90mm MPD based on the SCRIMM+ methodology. If the macro texture falls in to question use of the Sand Circle Method (NZTA T3:1981) is an acceptable interim measure. When the Sand Circle Method is used the initial Macrotexture

must meet or exceed 0.90mm on all tested points. Other testing methods will require approval from the relevant AT engineer

16.10.6 Coloured Safety Surfacing

The specifications for coloured surfacing are covered by the NZTA P33 Performance Based Specification for Coloured Surfaces (pending). Information below is additional

Surface Preparation

The Work Flow table under Section 14.10.5 of the ATCOP should be referred to for surface preparation prior to the installation coloured safety surfacing.

If the coloured safety surfacing is proposed on a section of road with any service covers present, these service covers will need to be cleaned before the application of binder or be marked out prior to installation Relevant AT engineer to decide on treatment of surface cover.

Material Selection

Material Selection must comply with NZTA P33 upon its release. In the interim, the guideline below may be used until the release of the NZTA P33 specification.

(i) Binder

Refer to Section 8.2.7.2 for interim guidelines

(ii) Aggregate (Roads)

The minimum PSV value required is 55. With Size range of 1.18mm – 3.35mm. Manufacturer Material Quality control requirements including comprehensive materials testing documentation needs to be provided to the client in the form of QA documentation.

(iii) Aggregate (Pedestrians/Cyclists)

The minimum PSV value required is 55. With Size range of 0.90mm – 1.40mm. Manufacturer Material Quality control requirements including comprehensive materials testing documentation needs to be provided to the client in the form of QA documentation.

(iv) Aggregate (Colours)

Colour selection must comply with the NZTA P33 upon release. Interim colours to be used are to be approved by the relevant AT engineer.

(v) Aggregate Colour change

Overall colour change is expected due to ultra violet radiation exposure and general traffic wear. Overall aggregate colour change must comply with NZTA P33. Interim requirements for the overall colour change index (ΔE), as based on the British Board of Agreement (BBA) for resistance to UV-A radiation, are as follows:

- Red – Maximum 8.00 ΔE

- Green - Maximum 15.00 ΔE
- Yellow - Maximum 22.00 ΔE
- Blue - Maximum 9.00 ΔE

Alternative guidelines/certification to the British Board of Agreement (BBA) for resistance to UV-A radiation may be presented for consideration of AT.

(vi) Additives

Common additives include compatible primers for applications on cementituous surfaces and catalysts to accelerate the curing process of the binder during colder months. For all additives, Manufacturer Material Quality control requirements including comprehensive materials testing documentation need to be provided to the client in the form of QA documentation.

Installation

The installation must comply the Installation Method Statement from the binder manufacturer.

(i) Installation Method Statement

A copy of the original Installation Method Statement from the binder manufacturer must be submitted as it contains information about installation parameters and techniques. Additionally, the contractor must submit its own company statement outlining its adopted methodology for the installation of its system and quality assurance promise to AT.

Health and Safety and Environmental Plan and Material Safety Data Sheets (written by manufacturers) are to be provided to the client and require that the materials are stored and applied in accordance with the Contractor's Health, Safety and Environmental Plans. The Health and Safety Plan should be onsite and available upon request.

Loose aggregate are to be removed from the surface, kerb channel, any road side drainage structures and the shoulder. The contractor will maintain the surface to allow no more than:

- 150 grams of loose aggregate is left on any $1m^2$ area of the surface during the first two months of operation
- 50 grams of loose aggregate is left on any $1m^2$ area of the surface after two months of operation.

Maintenance of Surfacing

Skid resistance testing is to be arranged by the contractor once the surface has fully cured and results are to be entered into RAMM.

A defects liability period of two years applies to all Coloured Safety Surfacing Works. In addition to the requirements of the specification, for good asset management of the on-road performance, it is important that AT completes an assessment of the on-road performance of the high friction/coloured surfacing two years after application. Skid resistance values after the 2-year liability period are also to be entered into RAMM. Once the defects liability period is finished, AT will programme annual reviews and inspections.