



PERFORMANCE BASED SPECIFICATION FOR STRUCTURAL DESIGN AND CONSTRUCTION OF FLEXIBLE UNBOUND PAVEMENTS

1. SCOPE

This specification sets out design, maintenance and performance requirements of the surfacing and unbound flexible pavement layers for the construction of new pavements and re-construction of existing pavements.

The Contractor is required to design the first coat seal and pavement including: determining appropriate pavement materials; pavement layer thicknesses; drainage within the pavement structure; and the bitumen type and application rate for the first coat seal based on the site data given in the Schedule to this contract. There is provision in this specification should the site information prove to be incorrect. It is the contractors responsibility to maintain the surface shape, structural integrity of the pavement and surfacing of the pavement for 12 months after construction of the surface. Meeting the requirements of this specification during and immediately after construction does not exempt the Contractor from the performance criterion in Clause 12 of this specification during and at the end of the maintenance period given in the Contract Documents.

2. SITE INFORMATION FOR DESIGN

The traffic volumes, expected environmental conditions, information on existing pavement structure (e.g. age, failure mechanism), surfacing type for first coat seal and relevant site data is given in the Schedule to this contract and are to be used for design and are the basis of tendering.

3. SITE ACCEPTANCE

The requirements of NZS 3910 shall apply for situations where the site information given at the time of tender that was used as the basis for the design is proven to be incorrect.

Payment for any testing required by the Contractor shall be as per Clause 14.1 of this specification.

3.1 Pavement Design

Where the Contractor considers that the actual site condition for a specific area is different than as indicated by the site information given at the time of tender, the Contractor may notify the

Engineer. The Engineer shall confirm if these areas as indicated by the Contractor are in fact different than indicated by the site information given at the time of tender and will allow either:

- additional works such as: subgrade improvement; existing pavement repairs; pavement drainage;
- a different design strength for the subgrade or existing pavement and therefore an increase or decrease in pavement depth resulting from a redesign; and/or
- alter the acceptance criteria.

Unless otherwise agreed by the Engineer laboratory 4 day soaked CBR tests are required to confirm any increase in subgrade strength from the strength specified at the time of tender. Unless otherwise agreed by the Engineer an increase in subgrade strength will not be accepted unless at least 95% of a minimum area of 1000 m² has a subgrade strength greater than or equal to the newly assigned subgrade strength.

3.2 Surfacing

The Contractor is responsible for the full design and performance of the surfacing until the end of the maintenance period. After constructing the pavement the Contractor may choose to alter the surfacing design. The Engineer shall be notified of any intention to alter the surfacing design at least seven days prior to construction of the surfacing. The payment of the surfacing will not alter from the Tendered unit rate.

4. DIMENSIONS

The pavement shall be constructed in accordance with the Contractors pavement design, and the Engineers drawings of levels, grades and cross-sections.

5. CONSTRUCTION TOLERANCES

Maximum variations from specified dimensions shall be:

(a) Width

Unconstrained : -20 mm +100 mm
Constrained : Zero

(b) Vertical**TABLE 1: Maximum Vertical Variations**

Pavement Layer	Between Pavement Centreline and Pavement Edge	
	Without Concrete Channel	With Concrete Channel
Sub-base course	-25 mm +5 mm	-25 mm +5 mm
Basecourse	-5 mm +15 mm	varies see note 1
Note 1: Tolerance	(i) at or close to the lip of channel -5 mm +0 mm (ii) at other locations on pavement -5 mm +15 mm	

(c) Crossfall

The crossfall between any two points more than 2m apart, transverse to the centreline, shall not depart from the crossfall shown in the documents by more than 0.5%

Compliance with the above tolerances and the requirements shall be checked by the Contractor, as detailed in the Quality Plan, and records made available for inspection by the Engineer. However, measurement of crossfall should not be necessary unless there are indications that the requirements of this specification have not been met.

If the surface subsequently deteriorates such that finished surface levels may be affected then the contractor shall carry out further measurement of the construction dimensions to confirm compliance.

6. EDGE DEFINITION

The edges of the sealing course shall be clearly defined. Ragged or irregular edges to the sealing will not be permitted. No pegs or spikes shall be left in the pavement.

7. PROTECTION OF ROAD FURNITURE

The Contractor shall protect from bituminous binder spray all service covers, railway crossing rails in the road surface, and bridge expansion joints.

Kerb and channel, marker and sign posts, and other road furniture adjacent to surfaces to be sealed shall be adequately protected against over sprayed binder and from roller or other damage. Any blemish and damage so caused shall be made good at the Contractor's expense and to the satisfaction of the Engineer.

8. NO FOULING OF SEALED SURFACE

During construction the sealed surface shall not be fouled by soil, water, oil, petrol or other droppings. The movement of plant and traffic onto the new seal and into and out of stockpile areas shall be controlled to prevent the carrying of material onto the seal by vehicle tyres.

9. REMOVAL OF SURPLUS AND WASTE MATERIAL

Paper or fabric placed across the pavement for the sprayer runs, and binder twine or cord lines used to define the edges of the sealing shall be uplifted immediately after the chip is spread. These items and all empty containers, surplus binder and other materials shall be stored neatly and removed from the site at the end of the working day. Unless otherwise approved by the Engineer, the Contractor shall remove all surplus chip in stockpiles on the road reserve within one month of construction.

10. REMOVAL OF SURPLUS CHIPS

Surplus chips shall be removed from the sealed surface prior to the removal of the temporary speed restriction signs. In un-kerbed rural sections, chips may be swept evenly across the unsealed trafficable shoulder, but in all other cases chip shall be uplifted and removed from the works.

11. ACCEPTANCE TESTING

11.1 Accreditation

All material sampling and testing shall be performed by a laboratory which holds either accreditation by International Accreditation New Zealand or registration to ISO Guide 25:1990 from a JAS-ANZ accredited agency for the specified tests, or alternative certification as accepted by the Engineer.

11.2 Aggregate Sealing Chip Properties

The Contractor shall supply test results for the aggregate properties to demonstrate compliance with TNZ M/6 for source properties and the PSV (Polished Stone Value) given in the schedule to this Contract.

11.3 Bituminous Binder Properties

Bitumen used shall comply with TNZ M/1 and be the grade as detailed in Schedule A. The Contractor shall demonstrate, through a Quality Plan, that the bitumen penetration value is within the grade tolerances and that there are no added diluents in the bulk supply.

Where a flux is specified, it shall be automotive gas oil complying with TNZ M/1. Assurance of the correct quantity shall be detailed in the Quality Plan. Confirmation tests shall be performed at a frequency no less than one sample for each 100,000 litres of bitumen used.

Where a polymer modified binder is specified it shall comply with the specific contract requirements.

11.4 Pavement Materials

The Contractor shall demonstrate through compliance with TNZ M/4, TNZ M/3, TNZ M/22 Notes and/or other supporting information in their Tender and prior to Construction that the properties for the pavement materials including the basecourse and sub-base have the necessary shear strength, stiffness, durability and weathering resistance to: meet the following requirements: of their pavement design; ensure the pavement material properties are maintained during the life of the pavement as given in the Schedule to this Contract; and the performance criterion in Clause 12 of this specification are met at the end of the maintenance period given in the Schedule to this Contract.

The Engineer will evaluate the compliance to this clause of the Contractors chosen materials at the time of Tender.

12. COMPLIANCE ASSESSMENT

12.1 Pavement Design

The pavement design(s) will only be accepted if the maximum allowable traffic volume computed using the procedures in the Austroads Pavement Design Guide and the accompanying New Zealand Supplement exceed the design traffic loading given in the Schedule to this Contract.

In addition to the pavement design the Contractor shall also design the drainage requirements and demonstrate how this will ensure full (100%) saturation of the pavement materials will not occur over the life of the pavement given in the Schedule to this Contract.

The Contractor's pavement design shall remain the responsibility of the Contractor for the specified design life notwithstanding the approval of the Engineer to the Contract. The Contractor's design shall have a design certificate from a Registered Engineer, submitted with the Contractor's tender, and updated should re-design occur at the site acceptance stage in 3.1.

A review of the Contractor's design shall be undertaken by the Engineer when evaluating the Tenders. Re-designs undertaken at the site acceptance stage in Clause 3.1 are required to be carried out by the Contractor's designer and reviewed for compliance by the Engineer before construction.

12.2 Pavement Materials

The Contractor shall as per their Quality Plan assess representative samples of pavement materials to determine if the pavement materials used in construction are the same as the pavement materials that were used to assess compliance as per Clause 11.4.

As a minimum requirement the Contractors Quality Plan shall include assessment of representative samples of pavement materials (basecourse, upper and lower subbase) that may be taken from either the conveyor belt, bin, stockpile, truck, or stabilised materials as mixed on site. Representative samples of the pavement materials shall be obtained in accordance with NZS 4407 : 1991. Stored pavement materials shall be subdivided into lots so that pavement materials of visible difference are sampled and tested separately. The rate of obtaining samples from lots shall be as per the Contractors Quality Plan where the minimum testing rate shall be as per Table 2.

TABLE 2: Minimum sampling rate for production property tests

Lot Size		Number of Samples
From	To	
1 m ³ 400 m ³	400 m ³	2

1500 m ³	1500 m ³	3
	4000 m ³	4

Where the lot size exceeds 4000 m³ additional testing shall be at a minimum rate of one sample for every 1000 m³.

12.3 Acceptance Criteria for Pavement Layer Compaction

Compaction testing of the pavement layers shall 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 shall not exceed 1000 m².

The degree of compaction for each lot shall be determined by testing as per the Contractors Quality Plan. A minimum of 5 selected areas shall be tested on top of the sub-base and base. The compaction requirements shall be met if the compacted dry densities measured are greater than the target compacted dry densities specified in the Contractors Quality Plan. The Contractor shall demonstrate in the Quality Plan how the target compacted dry densities for the sub-base and base were determined. It is expected that the target dry densities should be obtained from either: the dry density that was needed in order for the pavement material to meet the minimum strength requirements as per Clause 11.4; and/or the requirements for compaction in TNZ B/2 *Specification for the Construction of Unbound Granular Pavement Layers*. The Engineer may request additional areas to be tested.

12.4 Pavement Stiffness

The Contractor shall demonstrate in their Quality Plan prior to surfacing that the pavement layer stiffnesses (moduli) or strength assumed in their tendered pavement design have been achieved in the constructed pavement.

- For pavements designed using an example pavement thickness design chart from the Austroads Pavement Design Guide (Austroads, 1992). It is expected the Quality Plan shall include:
 - how the pavement materials (modulus or CBR) detailed in the design chart for each pavement layer (including stabilised subgrade layers) has been obtained in the constructed pavement. It is expected that compliance will be shown through demonstration of materials complying with appropriate specifications and/or proven through insitu and/or lab tests.
- For pavements designed using a computer program like CIRCLY for mechanistic analysis. It is expected the Quality Plan shall include either:

- demonstrate that the moduli assumed for the various pavement layers (including stabilised subgrade layers) are either: derived from insitu and/or material tests; and/or conservative low moduli derived from pre-sumptive values; or
- a minimum target deflection on top of the sub-base and base on the constructed pavement. The Quality Plan shall explain how the minimum target deflection value was established for the top of the sub-base and base. The testing location and frequency shall be in accordance with the Contractors Quality Plan where at least 5 deflection tests are required for each lot. A lot is defined as a section where the pavement is homogeneous (i.e. with the same pavement cross-section). A lot shall have an area of at least 1000 m². Compliance will be achieved if 95% of the measured deflections are less than the target deflection specified in the Contractors Quality Plan for the appropriate pavement design cross-section. The Engineer may request further tests.

12.4.1 Non-Compliance with Pavement Stiffness

If it can be shown that non-compliance is a result of the actual stiffness (modulus) of the subgrade being less than the subgrade stiffness used for design, then the Engineer shall decide the appropriate cause of action and any changes in material quantities will be treated as a variation.

In the event of non-compliance, where the pavement layers stiffnesses assumed in the design were not achieved in construction, the Contractor is required to:

- adjust the moduli values of the pavement layers to a value actually achieved in construction and redesign the pavement using these new values to determine the required increase in the pavement layer thicknesses. The new moduli values determined need to be agreed by the Engineer, where the Contractor is required to demonstrate how these new moduli values were obtained. The Contractor is required to increase the pavement layer thicknesses as determined at no extra cost; or
- for stabilised pavements the Contractor may re-stabilise in-order to achieve the required pavement layer stiffness.

12.5 Surface Shape

The Engineer shall test for compliance after construction and in the period of within 2 months of the end of the maintenance period given in the Schedule to this Contract.

The surface shape shall be such that:

- There shall be no obvious defects related to poorly constructed longitudinal or transverse joints, blocked spray nozzles or any other construction fault.
- No area of the completed surface shall have any depressions that will allow water to pond where the specified levels are such that the slope is greater than 1 in 50.

- The longitudinal smoothness is such that no point in the surface varies more than 10 mm from a 3 m straight edge placed parallel to the centreline of the road, and any deviation from the straight edge is gradual.

12.5.1 Non-Compliance with Surface Shape

For locations of non-compliance with surface shape where it can be shown at these locations that the actual stiffness (modulus) or CBR of the subgrade being less than the subgrade stiffness (or CBR) used for design and the weakness of the subgrade was not caused by non-compliance with Clause 12.10 *Surface Waterproofness* and/or inadequate pavement drainage, then the Engineer shall decide the appropriate cause of action and any repairs required will be treated as a variation for these locations. For other areas of non-conformance with surface shape the Contractor shall repair these areas as per Clause 13 of this specification.

12.6 Rut Depth

Rutting includes both upward and downward deformations of the pavement at right angles to the road centreline and the Engineer shall test for compliance after construction and in the period of 10-12 months after initial trafficking on the pavement.

The maximum rut depth at any point in the wheel paths measured by a wedge under a 2 m straight edge placed at right angles to the centreline of the road is less than the rut depth calculated using Equation 1:

$$\text{rut depth} < \text{the larger of either: } 10 \text{ mm; or} \\ 2 + \text{AGD} - \text{ALD} \quad (1)$$

where:

rut depth = is the rut depth at any point in the wheel paths measured by a wedge under a 2 m straight edge placed at right angles to the centreline of the road in mm.

AGD = Average Greatest Dimension of the sealing chip used in mm.

ALD = Average Least Dimension of the sealing chip used in mm, where:
 $\text{AGD}/\text{ALD} \leq 2.25$ as per TNZ M/6.

12.6.1 Non-Compliance with Rut Depth

For locations of rutting where it can be shown that non-compliance is a result of the actual stiffness (modulus) or CBR of the subgrade being less than the subgrade stiffness (or CBR) used for design and weakness of subgrade was not caused by non-compliance with Clause 12.10 *Surface Waterproofness* and/or inadequate pavement drainage, then the Engineer shall decide the appropriate cause of action and any repairs required will be treated as a

variation for these locations. For other areas of non-conformance with rut depth the Contractor shall repair these areas as per Clause 13 of this specification.

12.7 Roughness

The Engineer shall test for compliance after construction and within 2 months of the end of the maintenance period given in the Schedule to this Contract.

The average roughness over the project length and the maximum roughness over a 100 m length shall be less than the values given in Schedule A.

12.7.1 Non-Compliance with Roughness

For 100 m length road sections where the maximum roughness is greater than the value given in Schedule A then the area affected will require repair as per Clause 13 of this specification.

12.8 Surface Texture Requirements

For assessment the pavement will be divided into lots of around 200 m length.

The Engineer shall test for compliance within 2 months of the end of the maintenance period given in the Schedule to this Contract.

Through the use of a random sampling scheme, a longitudinal location shall be selected within each lot and surface texture measurements taken either across the width between the pavement edge lines or where edge lines are not present the total sealed width shall be assessed. The measurements shall be taken at the following locations as defined in TNZ T/4 Specification:

Outer wheel path, between wheel path, centerline, inner wheel path, outer wheel path. Where the site consists of more than one lot the inner wheel path and between wheel path measurements shall be performed alternating from one lane to the other for each lot.

The surface texture will be accepted if the texture depth is greater than that required to obtain the design life of the seal.

The design life of the seal in years (Yd_{seal}) is given in Schedule A.

The minimum value of the average texture depth calculated from the sand circle test as defined in TNZ T/3 Specification shall be:

$$X - 0.519 S \geq 0.07 ALD [\log (elv \times 365 \times Yd_{seal}) - \log (elv \times 365)] + 0.9 \quad (2)$$

where S = sample standard deviation calculated from the 5 tests.

X = average of the texture depth measurements in mm.

ALD = Average Least Dimension of the largest stone chip used.

Equivalent light vehicles/lane/day is calculated as:

$$elv = \frac{AADT}{No \ of \ lanes} \left(1 + \frac{9}{100} \times \%HCV \right) \quad (3)$$

where *AADT* = annual average daily traffic on the road section given in Schedule A.

% HCV = percentage heavy commercial vehicles given in Schedule A.

12.8.1 Non-Compliance with Surface Texture

For 200 m length road sections where there is non-compliance with surface texture then the area affected will require repair as per Clause 13 of this specification.

12.9 Chip Retention

The Engineer shall test for compliance within 2 months of the end of the maintenance period given in the Schedule to this Contract.

For seals a visual assessment of the surface shall be performed to assess the level of chip coverage and retention. Chip retention shall be assessed by determining the chip coverage on any 300 mm x 300 mm area.

Where edge lines are not present the lot shall be rejected if any 3 locations assessed have less than 95% chip coverage. Where edge lines are present chip coverage on any 3 locations assessed within the edge lines shall not be less than 95%. On the shoulder areas outside the edge lines chip coverage shall not be less than 90%.

12.9.1 Non-Compliance with Chip Retention

The areas where there is non-compliance with chip retention will require repair as per Clause 13 of this specification.

12.10 Surface Waterproofness

The Contractor is required to demonstrate through a Quality Plan that the residual binder application rate to be used for the surfacing is not less than 1 l/m² prior to and after construction of the seal.

The Engineer shall test for compliance within 2 months of the end of the maintenance period given in the Schedule to this Contract.

From a visual assessment within the sealed area, there shall be no:

- bald areas (i.e. where the underlying pavement or seal can be seen) that have a diameter greater than 70 mm.
- cracks with a width > 1 mm and length > 100 mm

12.10.1 Non-Compliance with Surface Waterproofness

The areas where there is non-compliance with surface waterproofness will require repair as per Clause 13 of this specification.

12.11 Saturation Prior to Sealing

Prior to sealing the moisture content testing of the pavement surface shall 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 shall not exceed 1000 m².

The moisture content for each lot shall be determined by testing as per the Contractors Quality Plan. A minimum of 5 selected areas shall be tested on top of the base prior to sealing. The saturation requirements shall be met if the saturation calculated from moisture contents measured are less than the target saturation specified in the Contractors Quality Plan. The Contractor shall demonstrate in the Quality Plan how the target saturation was determined. It is expected that the target saturation should be obtained from the requirements for saturation in TNZ B/2 *Specification for the Construction of Unbound Granular Pavement Layers*. The Engineer may request additional areas to be tested.

12.12 Repairs

provided Clauses 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9, 12.10, and 12.11 are complied with, the Engineer shall test for compliance within 2 months of the end of the maintenance period given in the Schedule to this Contract.

For assessment the pavement will be divided into lots of around 100 m length.

- the total area of patching shall not exceed 20% of the sealed area of the 100 m length lot.

A patch is considered to be any repair where the location of a repair is visible.

12.12.1 Non-Compliance with Repairs

The 100 m length lot where there is non-compliance with repairs will require repair as per Clause 13 of this specification.

13. MAINTENANCE

It is the Contractor's responsibility to maintain the pavement and seal from the construction date until the end of the maintenance period given in the Schedule of this Contract.

The Contractor is to ensure through appropriate maintenance that the:

- surface texture depth will meet the requirements detailed in Clause 12.8 of this specification;

For the safety of the public, the necessary repairs to restore the surface texture to meet the requirements in Clause 12.8 of this specification shall be carried out promptly. If the Contractor is unable to perform the repairs as required, the Engineer will direct alternative agencies to perform the work.

- surface waterproofness and chip retention will meet the requirements detailed in Clauses 12.9 and 12.10 of this specification;
- surface and surrounding areas which are affected by the site shall have no more than 100 loose chips left on any 2 m² area when there are no speed restriction signs.
- surface shape, rut depth and roughness will meet the requirements detailed in Clauses 12.5, 12.6 and 12.7 of this specification;
- repairs will meet the requirements detailed in Clause 12.12 of this specification.

If at any time a surfacing is applied to meet the requirements of Clause 12.12 of this specification then the maintenance period and acceptance criteria of the area surfaced shall be agreed with the Engineer.

If the pavement lost shape or potholes formed it is the Contractor's responsibility to restore the surface shape, surfacing and structural integrity of the pavement to meet the requirements detailed in this specification.

If at any time during the maintenance period repairs are required over an area greater than 10% of the project area then the proposed repair technique and acceptance criteria shall be agreed with the Engineer.

The cost for all repairs including those performed by other agencies will be met by the Contractor unless determined in the non-conformance Clause(s) that the repair shall be treated as a variation.

14. PAYMENT

Provision for payment is detailed in the Contract documents.

14.1 Site Investigation

Unless otherwise given in the Contract documents, payment will be made at the tendered lump sum rate for the cost to undertake the site investigation required as per Clause 3 of this specification to confirm the site information given in the Schedule to this contract.

14.2 Pavement Design

Unless otherwise given in the Contract documents, payment will be made at the tendered rate for each additional pavement design that is required at locations where as a result of the Contractor's site investigation the subgrade or existing pavement strength is different than what was specified in the Schedule to this contract as agreed in Clause 3.1 of this specification.

14.3 Pavement Layers

Unless otherwise given in the Contract documents, payment for the construction of the basecourse, upper and lower subbase layers, insitu stabilisation (existing pavement or subgrade) shall be at the tendered in place square metre rate for the procurement, placement and compaction of each different material used as calculated from drawing dimensions, and tendered pavement designs.

Unless otherwise given in the Contract documents, for altered pavement designs (as agreed in Clause 3.1 of this specification) any adjustment in quantities will be treated as a variation.

14.4 Surfacing

Unless otherwise given in the Contract documents, payment will be made in accordance with the tendered square metre rate for the surfacing.

SCHEDULE A

Schedule A will include information in the following pages on:

- Yd_{seal} = first coat seal or multilayer seal design life
- T_{year1} = annual traffic loading in first year in ESAs
- g = annual traffic growth rate in terms of a decimal (e.g. 0.04 for a 4% growth rate pa)
- Yd = pavement design life in years (usually 20 years)
- T_{design} = total design traffic in ESAs over the design life
- Traffic data (AADT, %HCV, ESA);
- Maintenance period;
- Pavement and subgrade investigation results including any deflection tests;
- Design subgrade strength to be used for pavement design;
- Surfacing (minimum PSV, temperature range etc);
- Acceptable maximum roughness in NAASRA counts/km for a 100 metre section after 12 months of traffic (usually 70 NAASRA counts/km) and a average over the project length (usually 55 NAASRA counts/km).