NZ TRANSPORT AGENCY
WAKA KOTAHI

NOTES TO SPECIFICATION FOR THE MANUFACTURE AND CONSTRUCTION OF PLANT MIXED BOUND SUB-BASE PAVEMENT LAYERS

(These notes are for guidance of the supervising officers and consultants commissioned to draft tender documents and must not be included in contract documents)

1. SCOPE

The purpose of this specification is to have a framework to ensure best practices when specifying stabilisation activities on the state highway network.

There are two plant mixed stabilisation specifications, these being:

- Stabilisation of modified pavement layers (TNZ B/7:2012).
- Stabilisation of bound sub-base layers (NZTA B/8:2012).

Before using plant mixed stabilisation specifications, the user needs to be aware of what the stabilisation activity is intended to achieve. This Specification covers bound sub-base layers aimed at providing significant support for the layers above and reducing the stresses in the subgrade below by distributing loads over a larger area than is possible with unbound aggregate layers.

Unlike modified materials, strongly bound pavement layers present the risk of shrinkage cracks and / or fatigue induced cracking, which can reflect through bound base and surface layers above. Where the shrinkage cracks are fine (less than 3 mm), they will normally not adversely affect the pavement performance, however, wider cracks can result in poor load transfer with increased stresses in the layers below, eventually leading to performance problems. Wide cracks also allow water infiltration and subsequent pumping in the lower pavement layers and subgrade.

Sub-base layers can be designed with reflective crack mitigation measures that are much more difficult to achieve with base layers and therefore, this specification is suitable for the stabilisation of sub-base layers, both in new construction and in maintenance work of a substantial size, such as pavement rehabilitation treatments. It is therefore not suitable for use in maintenance patch-type operations.

The NZTA intends to provide an appropriate surface for the travelling public to use at all times. The Contractor should ensure that road users' vehicles are protected from deleterious effects of the binders used in construction at all times. Reasonable options for managing operations can include:

- stopping vehicles travelling on a freshly spread binder.
- stopping vehicle movement on a wet surface slurry if speed restrictions alone cannot prevent splashing.
- controlling the amount of water used in the construction process.
- positive traffic control in accordance with COPTTM.

- enhanced signage in advance of the site focusing on keeping vehicle speeds down.
- construction of part of the carriageway at a time.
- approved traffic detours of a reasonable length.

The use of "cement/lime splashes clean your car" signs alone is not an acceptable practice.

Design considerations

Bound sub-base layers require specific design for two main aspects of the layer performance as follows:

- Layer performance under trafficking, which will be dictated by the layer modulus. prior to fatigue cracking and the retained layer modulus after fatigue cracking.
- Mitigation of reflective cracking in the pavement layers above the sub-base.

It is imperative with this type of stabilisation treatment, that the design intention is reflected in the specific project requirements of the specification. Construction issues such as water content, cement content, compaction, curing and pre-cracking will all influence the performance of the sub-base under traffic loading and also the risk of reflective cracking. Reflection cracking mitigation techniques, (e.g. pmb chip seal interlayer, geotextile interlayer, unbound granular layer, etc.) will also be required to relieve the stress concentrations that result from cracks in the stabilised sub-base.

In addition to a site specific pavement design, a mix design will be required, based on the site and / or imported materials and the results from laboratory testing with the materials and binder agent(s) to be used.

A guide to mix design is contained in NZTA T/19. This guideline should be followed when undertaking pavement construction and rehabilitation design projects.

2. TERMINOLOGY

Some typical stabilisation terms that are used throughout the Specification and Notes are defined as follows:

Stabilisation
Any chemical or physical treatment of a road pavement material that enhances the engineering properties and thus the ability to perform its function in the pavement. Within the upper layers of a pavement, stabilisation is used to increase the shear strength of the aggregate by the reactions of cementation and/or modification.

Cementation
When water is added to cement millions of fine molecular strings "grow" from each particle of cement, which join together around the aggregate and thus bind the entire matrix together, thus also known as a hydraulic reaction.

Bound Pavement Layers

Bound stabilised materials are those to which significant quantities (greater than 3% by weight) of binders are added to provide a bound material with an elevated elastic modulus and significant tensile strength. Such materials are associated with fatigue and/or shrinkage induced cracking.

This stabilisation type is adopted when it is desirable to provide a high stiffness, strongly bound layer of material with significant load spreading capability.

Modification

Modified stabilised materials are those to which small quantities of binders are added to improve the performance attributes of the material whilst still maintaining the properties of an unbound granular material.

This stabilisation type is adopted when it is desirable to increase bearing capacity, stiffness and/or decrease moisture susceptibility at the same time maintaining flexible pavement characteristics

The two distress mechanisms of modified stabilised pavement materials are vertical deformation and shear. The materials should not exhibit excessive shrinkage cracks and / or fatigue induced cracking, which are associated with strongly bound pavement layers.

Cement

Cement is a mixture of mainly Portland cement clinker (65 to 100%) and other additives, such as slag, pozzolan, volatile ashes, fired slate or limestone. Portland cement clinker is a substance consisting of at least two-thirds calcium silicates, the remainder being aluminium-oxide, iron oxide and other elements.

The main task of cement is to bind the mineral mixes, thereby increasing their stability. Cement also contains a certain percentage of calcium oxide, which modifies the clay molecules of plastic materials. The percentage of calcium oxide in cement is much lower than that of lime. Therefore, generally, cement should only be used with aggregates, which have a plasticity index of less than 10.

Lime

Several terms are used to describe different forms of lime in stabilisation. It is important to understand the meanings of these terms from the outset so that no mistake is made interchanging one form of lime for another. The two most common forms of lime available are:

- Burnt Lime (Calcium Oxide) – produced by burning high quality limestone at elevated temperatures. The resulting product is then crushed and screened to specific sizes as required. The resulting product is stable but will react violently with water releasing considerable heat and steam. The fine burnt lime is very suitable and effective in drying and conditioning soils in bulk earthwork operations and modifying marginal aggregates. This product must be kept dry until used.
- Hydrated Lime (Calcium Hydroxide) – produced by the reaction of burnt lime with enough water to form a white powder. The product is then separated into

different particle sizes through air separators in order to meet the manufacturer's specifications. The resulting product is stable and should be kept dry until use.

Chemical Stabilising Agent Blends
Different blends of lime and cement for various applications are available on the market. Those with higher lime content are mainly used for modification, while those with higher cement content are mainly used for cementation. It is anticipated that a bound sub-base layer will use either cement or cement / lime blended as a stabilising agent.

Plant Modified Aggregate Mixing
Plant modified aggregate mixing is the process where a purpose built mixing plant is able to handle stockpiled aggregate in multiple bins, allowing blending of aggregate. The plant is able to feed a continuous pugmill type mixing chamber by weighing predetermined aggregate proportions and mixing these with a predetermined binder in the form of lime or cement from silo's; and/or bitumen emulsion, or hot bitumen to produce foamed bitumen from tanks, or road units. The plant modified aggregate is supplied in a ready to use state at optimum moisture content therefore further adjustment to the mixed aggregate should not be necessary. Modern plants are micro-processor controlled and when properly calibrated are highly versatile, accurate, and reliable.

Plant Modified Aggregate Construction
Plant modified aggregate construction is the process where the plant mixed aggregate is usually transported from the mixing plant, in close proximity to the work site, and materials supplied into a paver for laying OR transported and spread onto the formation for grader laying. Compaction and shaping are carried out as a normal construction process within the confines of the specification.

3. MATERIALS

As defined above, plant mixed modification is used to improve the physical properties, primarily shear strength, of the aggregate supplied for the pavement. These materials may be premium quarry supplied, marginal quarry supplied, or materials salvaged from an existing formation, OR a blend of these materials. One can and should however, make sure that the treated material, will exhibit targeted characteristics of a subbase, depending on what is being supplied.

Proposed Materials for Construction
To ensure that adequate information is available to design the pavement and to draft a tender document, a preliminary investigation of the proposed alignment OR existing road or network must be carried out. This investigation is outside the scope of the TNZ B/8 Specification.

The intentions of the designer's objectives, outcomes and end results must be made clear to all parties involved with the contract.

Sources of aggregate may be specified or left to the contractor to source depending on the nature of the contract Options may include;

- **Material won from the site as reclaimed pavement or suitable won processed rock.**
- **Marginal material deemed suitable from a quarry source.**
- **Premium material to a nominated specification sourced from a quarry.**

As a minimum materials should meet the requirements of Appendix 1 of this Specification where the Engineer provides suitable grading.

4. STABILISING AGENT

Stabilising agents may include either cement or a blend of lime and cement. The type of stabilising agent to be employed shall be detailed in the Project Specifications. The choice of stabilising agent or combination of stabilising agents is outside the scope of this specification and NZTA T/19 Guideline Mix Design for stabilised materials should be referred to.

Cement that is suspected of not being stored to protect it from deterioration shall be tested for loss of ignition in accordance with AS 2350.2 or Appendix B of NZS 3122. Cement with a loss of ignition test result greater than determined by the cement manufacturer shall not be used.

Before considering the use of cement (or cement/lime blends) for sulphate-bearing soils, i.e. those with Total Potential Sulphate (TPS) content greater than or equal to 0.25% SO4, refer to the Britpave Technical Guideline *Stabilisation of sulphate-bearing Soils.* [1]

5. WATER

Caution and common sense need to be exercised when sourcing water other than public supply. The main components in water that could affect the setting time, strength and durability are salts, sugars and suspended matter such as oil, clay, silt, leaves, and vegetable debris. Sugars are rarely found in water ways and salts could be found in waterways that are close to oceans and are under tidal influence. If water is sourced from these water ways and/or there is a suspicion of potential contamination, then that water shall be used in the mix design ITS test. The results of these ITS tests shall be greater than 90% of the results from the ITS test carried out with the same material using water from a public water supply.

In addition, sound practice, such as avoiding silty areas and drawing from the bottom of the source, should be used while drawing water from water sources other than public supply.

7. CONSTRUCTION

Optional Trial Section for Sub-base Layer
Prior to commencing with the full construction of the specified plant mixed paver/grader laid pavement layer, the Contractor should, if specified, construct a trial section of a modified sub-base layer on the proposed alignment, to demonstrate the capability of the Contractor to construct the pavement layer in accordance with the

specification. This is particularly important on larger projects. The trial section must be constructed with the same materials and equipment as those intended for use by the Contractor for the pavement layer, and should also demonstrate the methods proposed for joint construction.

An initial trial section of not less than 100m in length should be constructed in one continuous operation for testing and approval. This is a hold point and unless there are any deficiencies in the trial section, the Contractor can proceed with full construction of the sub-base pavement subject to acceptable testing results, tolerances and surface finish without segregation. In the event of deficiencies in the trial section, the Contractor must remove the previous trial section and construct a further trial section which will again be regarded as the initial trial section.

The designer needs to be given the adequate time period to review the Quality assurance test results and any other testing that may be required.

7.1 Limitations

7.1.1 Weather limitations

Temperature

If work is undertaken outside the temperatures given in clause 7.1.1 of the Specification, there is a risk that at low temperatures hydration of the cement will not occur and at excessively high temperatures curing will be too rapid. Both scenarios may result in the treated materials not developing their full mix designed physical properties, thus potentially causing early pavement failure.

Dryness, wind and rain

These weather conditions will cause excessive dust, a situation which has to be controlled. The main reasons for preventing excessive dust are:

- Safety – excessive cement/lime dust can cause a safety hazard in the construction site.
- Health – excessive cement/lime dust can cause a health risk to the workers and general public.
- Environment – agricultural and environmental harm.

Therefore consideration should be given to the following conditions:

- Seasonal and regional wind direction, speeds, etc.
- Agriculturally sensitive areas.
- Urban environments with high pedestrian usage nearby.

In these cases plant that has dustless capability (i.e. does not create dust) should be specified.

7.1.2 Time limitations

The time limitations for the stabilising agents are specified in this Specification to ensure that the mix designed physical properties are achieved and maintained in the field. Where these limits are exceeded the

Engineer shall review the density achieved at that time and approve the kind of remedial action to be taken.

7.2 Before Laying Commences

7.2.1 Initial Laboratory Testing

Where a mix design already exists, the Contractor should use representative samples of the granular sub-base material to be used in the stabilised pavement layer, and to carry out laboratory tests according to NZS 4402: 1986 Test 4.1.3 to confirm the OWC and likely MDD targets for the expected mix which includes the cement stabilising agent.

7.2.2 Surface preparation

In cases were the geometry of the road is critical to the safety of the user, referencing the required horizontal alignment should be specified and controlled. For example to prevent flattening or steepening of cambers in high-speed cambered corners.

7.3 Plant Batching and Mixing

Mixing is done at a suitable location by means of a mixing plant. The specified materials and water need to be thoroughly mixed at the mixing plant by a continuous mixing process with a suitable pugmill type mixer. The process of introducing the various materials should produce a final mix that is consistent with the required proportions. The aggregate and cement/lime proportions are measured by mass.

The plant must be calibrated. The aggregate cold feed bins require calibration after relocating the mixing plant prior to construction, then monthly during construction.

7.3.2 Handling and addition of aggregate

The project specifications will detail the materials to be plant mixed stabilised

7.3.3 Addition of cement

Cement

Cement content is specified as a percentage mass to dry mass of aggregate. In practice cement is added to stock piled aggregate which contains water.

$$\%\,Cement\,Content\,To\;Add\;To\;Aggregate = \frac{\%\,Specified\,Cement\,Content\;By\;Dry\,Weight}{1+\dfrac{Aggregate\,Stock\;Pile\,\%\,Water\,Content}{100}}$$

7.3.4 Addition of water

The water in the pug mill plant should be controlled by using a pumping and metering system to regulate the application in relation to mass of material being stabilised. The pumping system must be calibrated to deliver within a tolerance of +/- 5% by volume. Particular care is necessary to prevent any proportion of the stabilisied material from excessive wetting or dryness. This is controlled by the provision of readily checking the quantity of water by flow meter per the rate of flow for a continuous mixing plant. Control of the stockpiled material is necessary to prevent drying or segregation.

To achieve the specified densities and degree of saturation requirements the water content during compaction should be in the range of 90% to 100% of the material's optimum water content (OWC). Monitoring of the water content of the stockpile and the mixed aggregate should be carried out during the course of the mixing operation using methods which can determine the water content quickly, such as the microwave method. With the knowledge of the water contents and rolling characteristics during compaction, judgement should be used to adjust the water added to the mix at the mixing plant. The OWC of the mixed material shall also be determined by NZS 4402: 1986 Test 4.1.3 (New Zealand Vibrating Hammer Compaction Test).

This is important to use field experience and tests to make suitable plant mixing changes with water content to assist with the layability. Material and type of binder weather etc can all influence this.

7.3.5 Mixed Material testing

During construction, the Contractor shall take a pair of representative samples of material at the plant and shall have these samples prepared into a pair of compaction moulds for each day's mixing (preferably on site to avoid changes in moisture content). The freshly mixed material must be allowed to cure for one hour before compacting in the moulds at NZ Vibrating Hammer Compaction in the laboratory. Specimens should be tested in accordance to NZTA T/19.

The designer will need to be assured that the layer has achieved the design strength before the construction of the next layer. In combination with the lab ITS testing, testing should be carried out for the final layer strength after the curing period, (e.g. Benkelman beam or FWD). The testing should be specified in the project specification and scheduled in the tender documents.

Should the testing indicate that the layer has not met the design strength, it will be imperative that all of the QA Plan requirements have been met during construction before the failure to meet the design strength becomes a potential design issue.

7.3.6. Grading of plant mix

During the placing of the plant mix sample bags will be taken on site to ensure aggregate gradings comply with specified grading requirements. Wet sieve analysis will be completed within 4 hours of mixing to ensure all particle sizes can be washed off prior to cementing.

7.4 Loading, Transportation and Discharge

The mixed material should be loaded onto the trucks used for transporting the material. To reduce segregation, loading from the mixing plant conveyor belt direct into the trucks must be end on and commence at the front of the truck loading against the truck deck headboard or a false tray headboard. The truck progresses forward at least three times during the loading cycle ensuring each new drop is coned up tightly on the face of the previous drop.

Care must be taken to prevent excessive loss or gain of moisture between the time when the materials are mixed and when they are placed and compacted on the road. Where necessary, trucks must have protective covers to prevent any significant change in water content. The water content during compaction should be close to optimum such that the compaction operation achieves the specified density requirements.

7.5 Construction of Cement Bound Subbase Pavement Layers

Immediately prior to spreading either by paver or grader the underlying subgrade layer shall be moistened and kept moist to prevent a bone dry interface but not excessively wet.

7.5.1 Placement of modified materials

The plant mix material shall be spread by a mechanical paver or by truck tailgate or bottom dump truck over the underlying subgrade layer. This should be done to full lane width including shoulder or from edge of channel to centre line of alignment in which a longitudinal construction joint can be formed. The aggregate is spread to such a thickness as will comply with the thickness shown on the contract drawings after final compaction.

Trucks loading the paver must be operated to prevent segregation of the stabilised material in the hopper of the paver. Tailings are run out in front of the paver on the layer below. The paver must be fitted with cast off blades which front the pusher tracks to sweep these tailings away from the unpaved surface.

The paver should be operated such that segregation of the stabilised material does not occur. Keeping the paver hopper full, folding hopper wings only as required, and keeping the hopper gates opened high enough is all good practice. The object is to run the paver as continuously as possible, running the augers so that the outer edges of the auger paver side plates and area in front of the screed are kept full of material. The paver type must be fitted with a vibrating screed capable of thoroughly compacting the material and striking it off to a smooth dense surface.

The risk of segregation during the placement of a mix by paver, will increase as the layer thickness to be placed increases. The reason is that an increase in layer thickness will increase the drop height for the aggregate and the larger aggregate particles tend to drop to the bottom of the placed layer as it leaves the paver auger. During the placement of a layer greater than 180mm the engineer and contractor should assess and determine the extent of segregation during the layer placement; and take appropriate steps to correct any possible segregation by reducing the layer thickness or change the construction process.

7.5.3 Joints

At the end of each day's work, or when operations are delayed or stopped for more than one hour, a construction joint with an inclined rough face at less than 45 degrees from the vertical should be made in thoroughly compacted material, at right angles to the centre line of the road. Cutting back into thoroughly compacted material should also apply to longitudinal joints unless the two adjacent runs are paved in the same day.

Additional mixture must not be placed until the construction joint has been constructed.

7.6. Compaction

The compaction requirements generally follow TNZ B/02. It should be noted however, that initial compaction may require the use of a pad foot roller where the bound sub-base layer is overlying a weak sub-grade or is greater than 250mm in depth. At depths greater than 250mm a normal vibrating roller will not be able to adequately compact the lower part of the layer.

Trial Section
During compaction of any trial section, the Contractor should undertake density tests for the purpose of confirming that the laboratory derived MDD can be achieved on site, and for determining the minimum, and possibly the maximum number of roller passes required to achieve MDD. If the laboratory MDD is achieved on site then the laboratory derived MDD can be set as the target MDD. If the laboratory derived MDD is not achieved the target MDD should be agreed by the Engineer (this should be a hold point). Retesting the laboratory derived MDD and/or revising the roller sequence may be required to agree a new target value.

Following the compaction of any trial section, the Contractor should measure the moisture content using an IANZ endorsed NDM (Nuclear Density Meter). The Contractor should sample the stabilised sub-base immediately below the NDM and determine the true water content to NZS 4402:1986 Test 2.1. It is expected that the NDM measured moisture content will be higher than the laboratory tested water content due to the NDM incorrectly counting hydrogen in the cement as water. The difference should be used to correct all NDM field measured water contents and subsequent calculated dry densities.

$$Corrected\ Insitu\ Dry\ Density = \frac{NDM\ Wet\ Density}{1 + \frac{\%NDM\ Water\ Content - \Delta W}{100}}$$

Where:

$$\Delta W = \%\ NDM\ Water\ Content - \%\ Laboratory\ Water\ Content$$

The spread mixture should be compacted at or near the same optimum moisture content as that in the plant. Not more than one hour should elapse between the time of starting the mixing process and that of starting to compact the material.

From the time when the stabilising agent, aggregate and water are added together and mixed, not more than two hours should elapse until the primary compaction has been completed. Compaction equipment should be adequate for obtaining the specified density within the specified time limits.

7.7 Pre-cracking

Pre-cracking is likely to have a significant effect on the design modulus of the bound sub-base and should only be carried out if the designer has allowed for this in the design and has specified it in the Project Specifications.

7.8 Protection, Curing and Maintenance Before Overlaying

It is very important for the stabilised layer to be kept moist during the curing period so that the additive can fully hydrate and reach the design strength within the curing period. General construction traffic should be kept off the layer during the curing period and subsequent compaction of overlying layers should be done with the minimum amount of vibratory rolling possible. The bound sub-base provides a very good anvil on which to compact a granular or AC base layer and usually only three to four passes of a vibratory roller is required, with compaction being finished by static rolling.

If the designer has allowed for pre-cracking this can be done as per clause 7.7 of the Specification. The project specification may also allow pre-cracking to be carried out as part of the vibratory rolling when constructing the base layer, however, the number of passes of the vibratory roller will need to be limited so that the cement bound sub-base is only finely cracked and still maintains a relatively high modulus.

8 ACCEPTANCE CRITERIA OF THE CONSTRUCTED LAYER

8.1 Compaction

The objective of the compaction process is to ensure that the subbase layer is compacted to a uniform, dense, stable condition. The procedure for determining the maximum dry density (MDD), optimum water content (OWC) targets and the number of roller passes to achieve MDD at OWC for the spread paved layer shall be as described below;

The initial compaction should be carried out with plant which will achieve a stability suitable for subsequent compaction without causing undue displacement (shoving) of the material or deformation of the layer. The rolling pattern must be so designed as to retain the shape of the layers. The compaction equipment and techniques must be capable of producing the specified surface finish and density without any interruption.

The compaction target (MDD) at the laboratory determined optimum water content should be achieved by the minimum necessary number of passes of the compaction plant. Field compaction must be achieved by compaction equipment only and not by traffic.

Moisture Content

During construction of the pavement layer, the Contractor should check water contents over the mat using an IANZ endorsed NDM. The NDM measured water contents must be corrected as described in NZS 4402. Should there be a difference between the insitu water content and the OWC for the material, the Contractor must determine the amount of water to be added or subtracted at the pugmill mixing plant. From then on during the compaction process, the Contractor should measure both insitu water contents and dry density achievements to quantify the ongoing compaction achievements on site. The layer should not be slushed or over wetted. And any water added during or after the compaction process, should be to prevent surface dryback, and be carefully controlled as excessive application of water can not be allowed.

Target Maximum Dry Density

During construction following the trial OR first run, the target maximum dry density (MDD) for the material should be agreed by the Contractor and Engineer using the test data obtained from the laboratory testing before construction, and the insitu density testing of the trial run during construction.

The laboratory based target optimum water content (OWC) and target maximum dry density (MDD) should be determined for the subbase layer at minimum frequency of one OWC/MDD test per 5000 m^2 of material. If the aggregate source, processing method, or materials are expected to change then a new OWC and target MDD should be determined.

8.2 Construction tolerances

With this type of pavement layer there can be no remedial grading after the time limitations set out in 7.1.2 of the Specification. Also clause 8.2.2 very tightly controls the vertical tolerances and final layer depth after trimming so that the design depth is the minimum to be achieved. Any surface level or shape defects or damage of any nature, occurring during the construction or maintenance of the pavement layer before the overlaying layers are constructed, shall be made good by re-stabilising the layer with the addition of a suitable stabilising agent as directed by the Engineer.

10 BASIS OF PAYMENT

10.1 Extra over or under Clause 10.3 for the supply and spreading stabilising agents

At times mix designs or pavement designs have not been carried out at the time of tendering. In these situations the designer will typically specify an assumed depth, binder content and materials properties being envisaged for stabilisation. These are defined as the scheduled amounts.

The design binder contents and/or depth may however change from the scheduled content. In these cases it is practical to have the extra or lesser amount of design binder priced. The quantity shall be calculated by the difference between the scheduled theoretical total amount of binder scheduled in clause 9.4, and the amount calculated with the new design binder content as follows:

$$\boxed{Q_{EO\ or\ EU} = \frac{(A_{Act} \times B_{Act}) - (A_{Sched} \times B_{Sched})}{1000}}$$

Where:

$Q_{EO\ or\ EU}$	-	Extra or lesser binder quantity	[tonne]
A_{Sched}	-	Scheduled area at tender	[m^2]
A_{Act}	-	Design Actual area stabilised	[m^2]

B_{Sched}	-	Scheduled application rate	[kg/m^2]
B_{Act}	-	Design application rate	[kg/m^2]

And

$$\boxed{B_{Sched} = t_{Ass} \times C_{Ass} \times D_{Ass}}$$

and

$$\boxed{B_{Act} = t_{Act} \times C_{Act} \times D_{Act}}$$

t_{Ass}	-	Scheduled Hoe depth	[m]
t_{Act}	-	Design hoe depth	[m]
C_{Ass}	-	Scheduled binder content	[%]
C_{Act}	-	Design binder content	[%]
D_{Ass}	-	Scheduled density	[kg/m^3]
D_{Act}	-	Design density	[kg/m^3]

REFERENCES

[1] Britpave, the British In-situ Concrete Paving Association. 2005. Technical guidelines: Stabilisation of sulphate bearing soils. *Technical data sheet BP/16*. Britpave, Camberley, Surrey.

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- CPG
- Opus International Consultants Ltd
- MWH New Zealand Ltd
- GHD

APPENDIX 1:

Imported Aggregate Project Specification

Scope

This Appendix sets out requirements for the imported aggregate.

Compatibility

The contractor shall ensure that the material supplied is compatible with the intended treatment.

Proportion of Broken Rock

In each of the aggregate fractions between the 63.0mm and 4.75mm sieves greater than 50% by weight shall have two or more broken faces. It shall be free of organic matter.

Crushing Resistance

The crushing resistance shall not be less than 110kN when the aggregate is tested according to NZS 4407:1991 Test 3.10 “The Crushing Resistance Test”.

Weathering Resistance

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

Sand Equivalent

The sand equivalent shall not be less than 25 when the aggregate is tested according to NZS 4407:1991 Test 3.6 “Sand Equivalent Test”. The sand equivalent test may be neglected if the grading test shows less than 4% passing the 75 micron sieve.

Plasticity

The sand and/or filler (aggregates less than 2mm), when added for the purpose of altering the particle size distribution, shall be non-plastic.

Particle size distribution

When tested according to NZS 4402:1986 Test 3.8.1 “Standard Method by Wet Sieving”, the grading of the aggregate, prior to hoeing, shall fall within their respective envelopes defined below:

Sieve Size (mm)	% of Weight Passing (%)		
	Section 1 Envelope	Section 2 Envelope	Section 3 Envelope
63			
37.5			
19			
9.5			
4.75			
1.18			
0.075			