GEOPAVE MATERIALS TECHNOLOGY

21 Technical Note

IN SITU STABILISATION OF PAVEMENTS USING CEMENTITIOUS BINDERS

1. INTRODUCTION

Over the past 10 years, in situ cement stabilisation has become a popular method of road pavement rehabilitation. It is usually more economical to recycle and improve the quality of in situ materials within an existing pavement rather than importing better quality virgin material. In Victoria, in situ stabilisation is normally adopted to improve the strength and durability of pavements and reduce the moisture sensitivity of poor quality materials.

There is now a range of cementitious binders available with different properties and setting times and the choice of binder generally depends on minimisation of potential shrinkage cracking, size of job, depth of stabilisation, condition of the existing materials, and the climate or time of year work is to be carried out. Slow setting cementitious binders allow more time to achieve compaction and to trim to level without sacrificing long term strength.

As most cement stabilised pavements suffer from shrinkage cracking to varying degrees, the process may not be appropriate for base materials on very heavily trafficked pavements where it is more difficult and costly to carry out routine maintenance. Stabilisation of these pavements should be restricted to sub-base layers where a minimum cover of 175 mm of asphalt or 200 mm of granular base is proposed. In situ cement stabilisation is generally not acceptable in residential areas because of objections to airborne cement and vibration from heavy compaction equipment. It is most suited for rehabilitation of moderately trafficked pavements in rural areas.

2. SITE INVESTIGATION

To optimise the performance of the stabilisation treatment, a thorough site investigation of the existing pavement is required. The site investigation should include:

- determine the in situ pavement strength usually by deflection testing;
- sample materials for laboratory testing and determine existing pavement composition;
- determine sub-grade strength usually by dynamic or static cone penetrometer testing; and
- assess the effectiveness of existing pavement drainage.

Deflection test results are used to evaluate pavement strength and to determine the amount of additional material required, if any, to adequately strengthen the pavement. Isolated very weak areas which may require special treatments in addition to stabilisation, can also be identified.

It is most important to determine the location of deep asphalt patches which might have been subsequently resurfaced; deflection testing will generally locate these as stiffer sections of pavement which can be later confirmed by test holes or Ground Penetrating Radar. In locations where the depth of asphalt exceeds 50 % of depth of stabilisation it may be necessary to remove and replace all or part of it with a granular material. The location of materials such as Macadam, large sized ripped rock or material with an excessive plasticity needs to be determined so that provision can be made to either avoid or remove and replace these materials with a more suitable material. If these materials are left in place, the stabilised pavement may inherit undesirable properties or become very difficult to work, particularly if it is a base layer requiring preparation for a sprayed seal.

Any problems with drainage of the pavement should be thoroughly investigated so improvements can be made prior to stabilisation.

3. LABORATORY TESTING

Laboratory testing carried out on the materials to be stabilised should include:

- Particle Size Distribution (PSD) and Plasticity Index (PI) of the material to be stabilised; and
- Unconfined Compressive Strength (UCS) Testing.

If the in situ material has a poor PSD or is prone to break down during mixing and compaction, virgin material may need to be added prior to stabilisation to improve the PSD and achieve the required strength, e.g. addition of “no fines” crushed rock to a soft sandstone. Improving the PSD usually results in a reduced amount of cementitious additive to achieve the required strength hence there is less potential for subsequent shrinkage cracking.

The UCS should be 1.0 - 1.5 MPa for a modified material (usually requires 2% to 3% cementitious binder by mass) or 2.0 - 2.5 MPa for a fully bound material (usually requires

4% to 5% cementitious binder by mass) for deep lift stabilisation.

The PI for base material and sub-base material prior to stabilisation should not exceed 10 and 20 respectively.

4. PAVEMENT DESIGN PRINCIPLES

Unbound Pavements with Materials Modified by In situ Stabilisation.

As a general guide, if deflection testing shows that the existing pavement strength is not adequate then additional material needs to be added either in advance of mixing or as a subsequent resheet to achieve the required pavement depth (i.e. cover to the subgrade) to avoid premature cracking of the stabilised base or excessive deformation. (Granular resheets are designed in accordance with Technical Bulletin 33).

In the absence of deflection testing, or for a new pavement incorporating materials modified by stabilisation, the granular pavement design chart (Fig 8.5 of Technical Bulletin 37) can be used to design the pavement provided that thorough pavement investigation has been carried out.

If a rutted, distressed pavement has adequate depth but laboratory testing shows that the distress is caused by weak or poor quality materials within the pavement, laboratory testing may indicate that in situ stabilisation can be used to strengthen the existing materials to achieve satisfactory pavement performance without addition of virgin pavement material.

Fully Bound In situ Stabilised Pavements

Deep lift insitu stabilised pavements are usually designed and constructed as fully bound pavements. Mechanistic design principles are used to determine the strains in the critical pavement layers and the subgrade to calculate the number of loading cycles using a fatigue performance relationship. The modulus (stiffness) of the stabilised material used in the analysis can be either calculated using UCS data from the formulae given in Sub-section 6.3.2.3 of the AUSTROADS Pavement Design Guide or by more sophisticated laboratory and/or field test procedures.

5. TESTING REQUIRED DURING CONSTRUCTION

The depth of stabilisation, dosage rate of cementitious binder, degree of compaction and moisture contents need to be regularly checked as part of the quality inspection plan. As there is usually significant variation in the in situ pavement material along a stabilisation job, laboratory and field densities may be required at every compaction test site in order to make an accurate determination of the Characteristic Density Ratio. This requires a laboratory to be located close to the site as mixed samples must be compacted within 2 to 3 hours after addition of cement unless a slow setting cementitious binder is used such as slag/lime blend, where six to eight hours are available to complete compaction.

If the stabilised material is sufficiently bound to enable cores to be taken from the pavement after 7 days, a lot of UCS tests could be used as an alternative (or supplementary) means of acceptance of the final product and also as a means to make an assessment of density nonconformances.

6. TYPICAL APPLICATIONS FOR IN SITU PAVEMENT STABILISATION

For heavily trafficked pavements, existing poor quality base materials are stabilised to produce a subbase of adequate strength and quality prior to the placement of a 200 mm crushed rock resheet.

- To convert an existing granular pavement into a strong stiff sub-base for a deep strength asphalt pavement.
- To enable an imported gravel (after in situ stabilisation) to be used as a low cost base material to resheet a weak pavement as an alternative to crushed rock or premium material on roads with a DTL of less than 1 x 10^6 ESAs.
- To improve the quality and strength of in situ pavement materials in a rutted or deformed pavement which has adequate overall depth without the need for a resheet.
- Deep lift stabilisation to convert a weak unbound pavement of inadequate depth to a fully bound pavement of adequate depth as an alternative to a crushed rock resheet.

7. REFERENCES

1. AUSTROADS APRG Technical Note No 5 - Deep Lift Stabilisation
2. VicRoads Technical Bulletin No. 33 - Pavement Strength Evaluation and Rehabilitation
3. VicRoads Technical Bulletin No 37 - VicRoads Pavement Design Guide
4. NAASRA - Guide to Stabilisation in Roadworks 1986 (A new Austroads Guide is to be produced to replace this reference during 1998)

8. CONTACT OFFICERS

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