Site investigations for the rehabilitation of low-trafficked roads using insitu recycling

1 INTRODUCTION

The success of a pavement rehabilitation project depends in part on the preplanning and site investigation that is carried out prior to the start of construction work. This Guideline outlines the site investigations and testing that needs to be undertaken to ensure that an adequate understanding of the past pavement performance is gained, and suitable information is obtained to arrive at an appropriate rehabilitation solution using insitu recycling techniques. Existing stabilised pavements can be recycled using the insitu stabilisation techniques.

The guideline provides information on current practice. However, it does not cover all situations and sound engineering judgement is required for successful solutions.

2 DESKTOP INVESTIGATION

Prior to any field investigation a desktop study should be conducted to determine what information is available on the pavement composition, traffic loading, and current performances data. The investigation should include finding original construction plans, or when these are not available, discussions with long term employees will provide much information.

Many road owners are now operating Pavement Maintenance Systems, which provide data on traffic loadings and current condition data in the form of Falling Weight Deflectometer (FWD) results. The FWD provides deflection, curvature and subgrade CBR information that may be used to interpret the possible cause of pavement distress.

A review of public utilities and any constraints on finished pavement levels should be completed as these may affect the rehabilitation method chosen and the type of testing program.

3 SITE INVESTIGATION

3.1 General

The site investigation should address the condition of the pavement, identify the environmental factors affecting pavement performance (normally only rainfall in Australia), and constraints that affect rehabilitation design and construction. The following areas should be addressed;

- condition of the pavement [*refer to Figure 1*]
- drainage patterns and existing structures
- topography and geology the road traverses [*refer to Figure 2*]
- location of services, grates, manholes, access to properties, trees etc [*refer to Figure 4*]
- proximity of residential and business properties
- traffic composition i.e. bus route etc, and some roads are busier than they seem.

Figure 1 This patch did not resolve the underlying subgrade strength deficiencies.

Collection of this information will provide invaluable data for developing a testing program, design and construction activities, and limit unpleasant surprises leading to contract variations.

3.2 Pavement Condition

Visual inspection of the pavement will identify symptoms of a weak pavement, which are the result of the traffic, pavement composition, surfacing and environment. A number of National and State guides [Ref.1] are available to assist with condition characterisation and assessment.

In general, defects are characterised as:

- Deformation
- Cracking
- Surface texture or wearing surface deficiencies
- Edge defects
- Potholing
- Patching

Figure 2 The closeness of the rock adjacent to the footpath indicates that rock is close to the surface or rock floaters may be near the surface.

Where patches exist, the engineer should identify the depth of the patches. Typically, if the patch is less than 75 mm in depth, a reclaimer/stabiliser will still remain productive. Where asphalt patches are deeper, a profiler is commonly used and this work should be included in the schedule of rates.

If deflection measurements from an FWD are not available, proof rolling the existing pavement with a 10-tonne roller could also detect weak sections of the subgrade. These weak sections could then be treated rather than allowing the contractor to stabilise the pavement.

3.3 Drainage

The presence and ingress of moisture into the pavement and increases to the subgrade moisture regime are prime causes of pavement failure and distress. The site inspection should take particular note of drainage conditions with special reference to the extent of maintenance and adequacy of the existing drainage system.

On rural pavements this relates to table drains, pavement crossfall, and variation in water table level.

The presence of ponded water [*see Figure 3*], water level marks and grass growth during dry periods is indicative of drainage problems and need to be investigated.

The water table level can be determined by auger and subsequently further investigated during test pitting if it is close to the underside of the pavement.

Figure 3 The presence of localised surface water indicates that there is a problem with drainage of the pavement material.

Urban pavements have defined drainage structures that rely on appropriate crossfall and longitudinal grades. These structures deteriorate over time or may be blocked and may allow water ingress into the pavement leading to the erosion of fines.

Prior to road construction damaged structures should be repaired.

3.4 Topography and Geology

The topography and geology of the land through which the road traverses can provide valuable information on the reasons for pavement failure. Topography relates closely to drainage. Particular attention needs to be given to pavements over flat terrain and in cuttings. Close examination of soil profiles in cuts and other geological information can provide information on subgrade conditions or materials.

3.5 Obstructions

The location of manholes, grates, services etc should be determined so as to allow decisions to be made on the need to lower or remove such obstructions for the rehabilitation process. In some areas tree conservation policies may preclude the use of some types of machines. Adjacent or overhanging trees needs to be identified and located [*see Figure 4*].

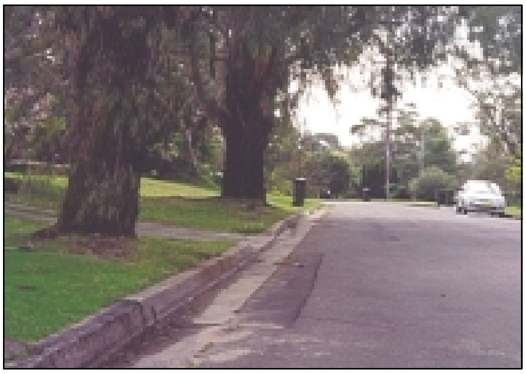

Figure 4   The presence of large trees close to the kerb need to be identified.

The introduction of Cable TV overhanging wires may also cause a problem for stabilisation and other equipment, and where possible these cables should be identified.

3.6 Proximity of Residential/Business Structures

The proximity of residential and business structures to the pavement needs to be established to ensure that correct roller application occurs. In some cases vibratory compaction may be restricted and this may be a major determinant in the rehabilitation method chosen [Ref.2].

3.7 Traffic Volume & Composition

Traffic volume information can be established through a variety of methods and an accurate assessment of commercial traffic i.e. bus/trucks, needs to be made for design purposes. The Austroads light traffic guide [Ref.3] provides estimates of design traffic for various local road classifications.

4 PAVEMENT MATERIAL EVALUATION

4.1 Sampling

Analysis of the data collected from the desktop study and site investigation will provide a good basis to determine the spacing of test sites and sampling locations. On pavements where good construction information is available then a test hole at 100 m spacing would be appropriate. On larger projects this is likely to be increased to 300 m.

The samples are usually taken in the outer wheel path and the location may alternate on each lane. Should variations be evident in pavement depth, materials or subgrade conditions then the spacing would be reduced and done on each side of the centreline to provide greater confidence in the assumed design values. At each test site location the following would be recorded:

- A record of the pavement surface condition.
- Thickness and description of each pavement layer.
- Visual assessment of the density and moisture of all layers.
- Insitu CBR by dynamic cone penetrometer (DCP) to at least 500 mm below the top of the subgrade.

If the DCP records low values at 500 mm depth it would be prudent to increase the test depth to establish the depth of the weak subgrade.

Samples of the pavement materials, including asphalt/seal, should be collected from at least three locations. Each material type should be individually bagged and not collected as a composite sample.

Figure 5 The existing pavement material can vary significantly in some locations.

Where it is anticipated the stabilised material may incorporate a small proportion of subgrade material, a sample should be collected for use in the laboratory testing. It must be remembered that the greater the sample represents the final pavement material, the closer the laboratory results will correlate to field conditions, and therefore, better prediction of performance.

The thickness of the existing pavement layers may vary at individual test sampling holes and the investigation engineer may wish to comment on the likelihood of the extent of this variation.

The number of samples is dependent on the size of the project. The number of samples from the roadway will need to take into consideration (at least) traffic restrictions and the location of road to test laboratories.

4.2 Laboratory Testing

The sampling program will dictate testing requirements. However, as a minimum the following should be completed:

- Plasticity index and sieve analysis of pavement layers from at least three test sites
- Soaked CBR value of the subgrade material from three test sites

- ❑ Unconfined compressive strength tests on at least three representative samples of the combined pavement material (to design thickness) with various amounts of the proposed binder. These tests should be repeated for at least two binder rates.

The grading curve is critical for foamed bitumen stabilisation and refer to the AustStab Model specification on bitumen stabilisation for more details [Ref.4].

4.3 Quantity of Sample Required

The quantity of material required for each test is dependent on the type of pavement material. For instance:

PI	Typically 2 to 5 kg Clays, silt/clay & fine sand–up to 3 kg Gravels – 3 to 5 kg
Sieve Analysis	Typically 2 to 5 kg Clay & medium fine grained sand - 1 to 2 kg 20 mm gravels from 8 to 12 kg 75 mm gravels from 25 to 40 kg
UCS*	Typically 10 to 25 kg

* See notes below

In the plastic index (PI) test, non-plastic materials require a smaller sample than those that are plastic do.

In the unconfined compressive strength (UCS) test normally two specimens per test are required, and the quantity of pavement material is a function of the moisture content, density and size of aggregate. For instance:

- ❑ 10 to 12 kg is required if UCS is carried out without a corresponding laboratory compaction to determine the relationship between moisture content and density.
- ❑ 20 to 25 kg is required is the above relationship is required.
- ❑ Materials which include +19 mm aggregates require more from the test pit than those with smaller aggregates.

If a designer selects three test pits and intends to evaluate 2 binders in the test program, the total amount of material needs to be carefully calculated.

5 SUMMARY

This Guideline summarises elements of site investigation and testing of existing pavements required prior to insitu recycling. The level of site investigation reflects the local knowledge and extent of construction records including drawings. Laboratory testing will always be required to identify the content and type of binder to be used in the recycling process.

REFERENCES

1. NAASRA *Guide to Visual Assessment of Pavement Condition* Sydney 1987.
2. Mayfield, M, Symons, MG and Collins, JR *Guide to the Selection of Vibratory Rollers for Road Construction* Structural Materials and Assemblies Group, University of South Australia, March, 1994.
3. Austroads *A Guide to the Design of New Pavements for Light Traffic* Sydney, 1998
4. AustStab *Model Specification for Insitu Stabilisation of Local Government Roads using Bituminous Binders* Sydney Version A, 1998

BIBLIOGRAPHY

Austroads *Guide to Stabilisation in Roadworks* Sydney 1998.
Austroads *Pavement Design, A Guide to the Structural Design of Road Pavements* Sydney 1992.
AustStab *Model Specification for Insitu Stabilisation of Local Government Roads using Cementitious Binders including Lime* Sydney Version B, 1998

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