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Technical Note

PREDICTING THE PERFORMANCE OF MARGINAL ROADBASE MATERIALS

PURPORSE

This Technical Note provides a method to assist in ranking the expected field performance of pavements constructed using marginal materials. The information presented here was based on the outcomes of a VicRoads' research and development project (Rykers and Tsoumbanos 2005).

The ranking of the insitu performance of a range of marginal (or non-standard) materials within a limited number of pavement sites in south-west Victoria was compared to the rankings derived from performance data obtained from the draft Repeated Load Triaxial (RLT) testing procedure (Standards Australia 2002) undertaken in the laboratory. By comparing field to laboratory rankings, it is possible to develop test protocols which can improve the laboratory ranking based on expected field performance of competing marginal materials and methods of construction.

MARGINAL MATERIALS

Crushed rock products are widely used in Victoria to provide the main structural element of pavements. For heavy duty pavements, the physical properties required of the source rock and the resulting product are well known and are tightly specified in VicRoads' Standard Specification's Sections 801 and 812. Conformance to these specifications will generally provide a base course material with good to high insitu performance.

However, access to high quality source rock and the cost of processing to meet tight material properties' tolerances is limited, and much of the State and local government road network, particularly lower trafficked pavements, comprise materials of lesser quality and cost. These are typically referred to as marginal or non standard materials. Whilst VicRoads Standard Specification Sections 811 and 818 describe the requirements of non-standard materials, the basic soil tests, typically those referred to in standard specifications, are not capable of predicting or ranking the performance of non-standard materials. Repeat Load Triaxial testing is considered to have the potential to provide such ranking of these materials.

REPEATED LOAD TRIAXIAL TEST AND RANKING OF MATERIALS

VicRoads' Technical Note 51 (VicRoads 2001) contains an overview of the RLT test. The test aims to replicate the behaviour of a laboratory moulded cylinder of road base under various confining pressures, applied loads and repetitions of those loads. The relevant outputs from RLT testing are:

- Permanent strain developed during a loading 'level'; this may be analogous to the rut development potential of an in-service pavement measured in dimensionless units of strain (m/m or more commonly μm/m);
- Resilient modulus; this is the 'strength' of the material measured whilst in its elastic or recoverable loading range, measured in MPa (Mega Pascals).

Ranking of materials takes into consideration the following:

- Survival of complete (usually 10,000 cycles) load or stress 'levels' starting from a low stress and increasing in given increments. The greater the stress level survived by the sample, the higher its ranking; and
- The lower the permanent strain developed (for the same number of stress levels survived), the higher its ranking.

FIELD TESTING AND RANKING OF MATERIALS

Twenty-one sites in south-west Victoria expected to comprise marginal materials, were selected via a desk top study. Following extensive testing, particularly to ensure the presence of a marginal material, ten sites were selected for further analysis and recovery of bulk samples for RLT and other laboratory testing.

Marginal materials encountered comprise either Scoria (igneous rock containing many gas bubbles or vesicules), Tuff (compacted volcanic ash ejected from vents during a volcanic eruption) or a combination of these mixed with other materials including limestone.

Ranking of the pavement sites' performance is by *rut development* divided by the *traffic loading* sustained over a ten-year period; viz.

$$\text{Field Performance Ranking Value} = \frac{\text{Ave. Rutting (2004)} - \text{Ave. Rrutting (1994)}}{\text{ESA* between 2004 \& 1994}}$$

** ESA Equivalent Standard Axles*

The lower the 'Field Performance Ranking Value' the higher the site (performance) is ranked.

Sites were selected such that the likelihood of rut development within the pavement would be largely due to deformation within the base layer, rather than due to either a thin base layer, a weak subgrade or poor drainage etc. Rut data was determined over the ten-year period by assessing the biennial laser-profilometry data. Traffic loadings sustained at each site over the ten-year period were derived from VicRoads South Western Region's traffic data base.

FINDINGS

The major findings of this research are:

- By comparing RLT test data to field performance data a correlation between rutting performance (ranking) and RLT testing laboratory predicted performance (ranking) is achievable for marginal pavement materials, where there is less than 5% by mass of material greater than 19 mm in size (current RLT testing constraint);
- The RLT test ranking method used in this project produces comparable rankings to those observed in the field, where there is less than 5% by mass of marginal material greater than 19 mm in size;
- For the marginal materials tested in this project, the RLT showed that the performance of these materials improves as density increases;
- Additional RLT testing of a variety of materials (both marginal and of known performance) over a range of moisture and density ratios is required to develop practical performance limits for inclusion into VicRoads' specifications.

APPLICATION

RLT testing, in combination with basic soil characterisation tests, provides a means to assist in the ranking of a marginal material's likely performance both against a competing like material and also over a range of densities. Inclusion of RLT related performance criteria in standard specifications is however considered premature at this time as further issues with the test need to be addressed. These include the moisture condition, density of test specimens and the handling of oversize (> 19 mm) material.

Often the grading of non-standard materials typically and deliberately include a significant proportion of material grater than 19 mm and therefore the RLT test results may not be comparable with actual field performance.

To assist in further developing the use of RLT, Austroads is undertaking a project that aims to develop procedures for incorporation of RLT test results into performance based specifications and mechanistic pavement design.

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