

TECHNICAL NOTE 107

GUIDANCE MATRIX FOR ROAD CONSTRUCTION MATERIALS

INTRODUCTION

The last decade has seen a significant expansion in the availability and quality of recycled materials for use in road building. As pavement materials predominantly consist of crushed rock and aggregate there is significant opportunity to utilise alternative materials incorporating recycled products. This Technical Note is intended to provide guidance in the use of recycled material in pavement works as an equivalent alternative to conventional materials produced directly from quarried sources.

SUSTAINABILITY

While Victoria's geology is favourable and provides plenty of high quality rock, accessible sources are becoming very limited. The ever increasing public demand for residential land and associated environmental constraints have meant the establishment of new metropolitan-based hard rock quarries or extensions to existing quarries are now very costly and time consuming to achieve. Hence, metropolitan or urban sources of quarried product is finite. Furthermore, local sources are needed to minimise cartage costs. High cartage costs make construction more expensive when quarry products are transported into the metropolitan area from distant regional sources. Transporting materials over long distances also add significantly to the carbon footprint of road construction and increase road wear.



Figure 1 – Hard rock quarry

Alternative materials to supplement the use of virgin quarry rock exist in Melbourne. Currently, there are steady supplies of recycled materials such as crushed concrete, Newer Basalt surface spalls (NBSS), crushed brick and reclaimed asphalt pavement (RAP). Combined with good processing facilities there is significant opportunity to utilise these materials in pavement works.

Using recycled materials in appropriate applications can contribute significantly towards making prime non-renewable rock resources last longer. This is

particularly important for applications where virgin hard rock cannot currently be substituted.

MATERIALS

VicRoads specifications allow a range of recycled product to be utilised in road pavements. Recycled product includes water, crushed concrete, RAP, crumbed rubber, crushed brick ~~and crushed glass and whitewares~~. The two most commonly used recycled materials as alternatives to granular material are crushed concrete and RAP. These are discussed in further detail below.

Crushed Concrete

Recyclable concrete often becomes available from demolition works and other construction activities. In recent years recycled crushed concrete has been produced (currently up to 2 million tonnes annually) and supplied in competition to more traditional quarried rock products. Crushed concrete by definition is composed of rock fragments coated with cement with or without brick, sands and/or filler, produced to close tolerances of grading and minimum foreign material content. Substantial quantities have been used in numerous applications including the stabilised subbase of various sections of the Western Ring Road.

Figure 2 – Reclaimed concrete for crushing



Figure 3 – Crushed concrete

VicRoads Standard Section 820 *Crushed Concrete for Pavement Subbase and Light Duty Base* covers the requirements for the manufacture of recycled crushed concrete and plant mixed wet-mix crushed concrete products. VicRoads Standard Section 821 *Cementitiously Treated Crushed Concrete for Pavement Subbase* covers the requirements of 20 mm nominal size crushed recycled concrete or crushed rock/concrete blends for pavement subbase, treated with cementitious binder to produce bound material.

Reclaimed Asphalt Pavement

VicRoads Standard Section 407 *Hot Mix Asphalt* permits processed RAP to be added to most dense grade asphalt mixes. The maximum allowable amount of RAP to be added depends on the type and importance of the mix. Generally, a lesser amount of RAP is permitted in mixes used for high stress locations.



Figure 4 – Reclaimed asphalt for crushing



Figure 5 – RAP after processing

The specification also provides an opportunity for the amount of RAP to be increased by up to 10% (by mass) over the specified limits for numerous asphalt types. This is provided that comparative performance tests are carried out to show that the RAP mix has equivalent performance characteristics to the corresponding mix manufactured wholly from virgin components.

APPLICATIONS

There are a number of fundamental attributes that a pavement material should have and the degree to which each material should exhibit these attributes depends on the position it will occupy in the pavement. Since the intensity of stresses from traffic loads reduces significantly with depth below trafficked level, the quality of the material in terms of bearing capacity may also decrease for each successively lower layer of pavement. The materials in the lower layers therefore may be selected for economy and to conserve higher quality resources, but still must be sufficiently durable to resist significant degradation during the design life of the pavement. Furthermore for lower loading applications there is scope to use lesser quality products in upper pavement layers.

MATERIALS USE GUIDANCE MATRIX

Table A provides guidance on how recycled material can be used as an alternative to conventional quarried products. It also outlines permissible additives in recycled material and notes the applicable VicRoads Standard Specification section.

REFERENCES

- VicRoads Standard Specifications Section 820 *Crushed Concrete for Pavement Subbase and Light Duty*
- VicRoads Standard Specifications Section 821 *Cementitiously Treated Crushed Concrete for Pavement Subbase.*

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The following matrix has been prepared as a guide in the selection and use of recycled materials in lieu of conventional materials to promote the consideration of alternative recycled materials in appropriate situations. Road construction materials can also include components of recycled materials as allowed by VicRoads specifications. Such materials can offer savings to the project through the prescription of less expensive materials and also provide a benefit to the environment. Requirements for source accreditation, placement and compaction must be met.

Conventional Crushed Materials Reference and Typical Usage	Common Material	Alternative Recycled Material	Permissible Supplementary Materials to Recycled Material	Recycled Material Reference
<p>Unbound Granular Pavements Class 1, 2 and 3 20 mm CR and Class 4 CR, supplied to Section 812 - <i>Crushed Rock for Base and Subbase Pavement</i>. Crushed rock class required depends on layer type and depth within pavement.</p>	20 mm Class 1 CR or Class 2 CR	Light Duty Base CC2 ¹	<ul style="list-style-type: none"> • Clay filler max of 2% • Clayey sand or crusher fines as per total content list below • RAP, up to a maximum of 20 % • Crushed Brick in CC3 (maximum of 15%) and in CC4 (maximum of 50%) ¹ Limits for total content of all supplementary materials: <ul style="list-style-type: none"> • Maximum of 15% in CC2 • Max 20% in CC3 • Max 50% in CC4 	Section 820 - <i>Crushed Concrete for Pavement Subbase and Light Duty Base</i> <ul style="list-style-type: none"> • All mix designs must be registered in accordance with VicRoads Code of Practice RC500.02. • Use of “Experimental” mixes only with approval of Project
	20 mm Class 3 CR	Upper Subbase CC3		
	Class 4 CR	Lower Subbase CC4		
<p>Bound Pavement Subbase Supplied to Section 815 - <i>Cement Treated Crushed Rock For Subbase Pavement</i> for Deep Strength Asphalt Pavement</p>	20 mm Cement Treated Class 3 CR	Cement Treated CC for Subbase	Additions of small percentages of additives or supplementary materials may be approved as part of a registered mix design	Section 821 - <i>Cementitiously Treated Crushed Concrete for Pavement Subbase</i>
<p>Miscellaneous Bedding for footpaths, building slabs, kerbs, channels, culverts and low risk applications. Unsealed Roads or Haul Roads. Culvert Backfill under pavements.</p>	20 mm CR as Class 3 or Class 4 material	Crushed concrete (CC3 or CC4)	Additions vary with crushed concrete class (refer to limits above)	Section 820 - <i>Crushed Concrete for Pavement Subbase and Light Duty Base</i>
<p>Hot Mix Asphalt, for All Conventional Asphalt Road Pavements <i>Wearing, Intermediate and Base Courses of types as required by the pavement designer</i></p>	Asphalt Material Type and Permitted Content of Recycled Component			Section 407 - <i>Hot Mix Asphalt</i> <ul style="list-style-type: none"> • All mix designs must be registered in accordance with VicRoads Code of Practice RC500.01. • Use of “Conditional” or “Experimental” mixes only with approval of Project
	Dense Graded Asphalt may contain RAP as a percentage of mass as follows: <ul style="list-style-type: none"> - Wearing Courses: Type L - up to 20%, Type N - up to 15%, Type H - up to 10%, - Intermediate Course: Type SI & SG – up to 20%, and - Base Course: Type SF – up to 30%. The RAP content in the above mixes may be increased by a further 10% subject to specification requirements being met. RAP is not permitted in Types V, HP, HG, SS or SP mixes.			

¹ Suitable for roads with a Design Traffic Loading of less than 3 x 10⁶ ESA (Equivalent Standard Axles) or 4000 AADT (Average Annual Daily Traffic) with less than 10% commercial vehicles

² Abbreviations: CR - Crushed Rock; CC - Crushed Concrete, RAP - Reclaimed Asphalt Pavement