

Use of Recycled Materials in Road Pavements

Technical Note 107

July 2023

Version 3.0

1 Purpose

This Technical Note (TN) provides a summary and general guidance on the use of selected recycled materials in road pavements.

2 Introduction

The last two decades has seen a significant expansion in the availability, quality and use of recycled materials in road pavements. At the same time, the supply of traditional quarry materials is becoming increasingly constrained due to a high demand and depletion of natural deposits. Where recycled material is supplied in accordance with specification requirements, including additions to material, they are considered as equivalent products to traditional quarry material.

3 Sustainability

While Victoria's geology comprises high quality rock, accessible sources are becoming limited. The increasing demand for residential land and additional environmental constraints have meant the establishment of new metropolitan-based quarries or extensions to existing quarries are limited.

Local sources of road pavement materials are desirable to minimise cartage costs for metropolitan infrastructure projects. High cartage costs make construction more expensive when quarry products are transported into the metropolitan area from distant regional sources. Further, this additional cartage adds to the carbon footprint of road construction.

Using recycled materials in appropriate applications can contribute significantly towards preserving prime non-renewable hard rock resources for applications where they currently cannot be substituted.

4 Pavement Applications

Pavement materials, including those containing recycled material, must have properties that provide the required service life of the pavement. The relative performance that each layer of pavement material needs to achieve depends on the position the layer will occupy in the pavement. The intensity of stresses from traffic loads reduces significantly with depth below the driving surface. Therefore, the designed quality of the material may also decrease for each successively lower layer of pavement.

The materials in the lower layers may be selected for economy, for example to include higher proportions of recycled material, to conserve higher quality resources. However, the lower layers must still be sufficiently durable to resist degradation during the life of the pavement.

5 Materials

Recycled materials to supplement the use of traditional quarry materials for road pavements readily exist in and around Melbourne and investments are now being made in regional areas to process recycled material into road pavement materials. The currently available recycled materials and their use are discussed below.

5.1 Crushed Concrete

Recyclable concrete becomes available from demolition works and other infrastructure construction activities (refer Figure 1). During the processing of the concrete, steel and other contaminants are removed and crushing and screening produces a graded road-making material, similar to traditional crushed rock mixes (refer Figure 2).



Figure 1 - Concrete from demolition works



Figure 2 – Crushed concrete

Crushed concrete is composed of rock fragments coated with cement, sand and/or filler. The manufacturing process is required to produce a product that complies with tolerances for crushed rock gradings and which minimises foreign material content.

The use of crushed concrete has been well established in Victoria since the mid-1990s.

5.2 Crushed Brick

Crushed brick, which also becomes available from demolition works, is a softer material than crushed concrete and crushed rock. It is permitted as a supplementary material in some crushed rock, crushed concrete and cementitiously treated pavement materials.

Crushed brick formally commenced being used in Victoria in 2009 through its introduction into roadwork specifications. Allowable percentages of crushed brick are specified in the Department of Transport and Planning (DTP) Code of Practice RC 500.02 *Registration of Crushed Rock Mixes*.

5.3 Crushed Glass

Recycled crushed glass sand (RCGS), sometimes referred to as glass fines or fine glass aggregate depending on application, is produced from container glass cullet (refer Figure 3) and involves removing contaminants and crushing the glass to a required grading (refer Figure 4). Since 2011, RCGS has been permitted to be used as a sand replacement in intermediate and base course asphalt mixes. In 2023 its permitted use was extended from asphalt wearing courses for light to medium traffic to all asphalt dense graded wearing courses.

In 2018, the use of fine glass aggregate in general concrete paving was introduced.

Glass fines are also allowed to be used as a supplementary material in many crushed rock mixes and as a granular filter material for subsurface drains.



Figure 3 – Glass raw feed



Figure 4 – Recycled Crushed Glass Sand

5.4 Reclaimed Asphalt Pavement

Reclaimed Asphalt Pavement (RAP) is asphalt removed from an existing road pavement and re-processed by crushing and/or screening for use into new asphalt or other approved materials, such as some crushed rock mixes.

The use of RAP is well established in Victoria, having been introduced into roadwork specifications in the early 2000's. The amount of RAP that can be incorporated into asphalt mixes is dependent on the mix type and is specified in DTP Code of Practice RC 500.01 *Registration of Bituminous Mix Designs*.

5.5 Crumb Rubber

Crumb rubber is manufactured from end-of-life tyres (refer Figure 5). Victoria has been a significant user of crumb rubber (refer Figure 6) in road surfacing using spray seals since the 1970s.



Figure 5 – End of life tyres



Figure 6 – Crumb Rubber

In the early 1990s, Victoria published its first crumb rubber asphalt specification. In 2020, the use of crumb rubber in light traffic asphalt applications became available. Opportunities to use crumb rubber in a wider range of asphalt mixes e.g. Open Graded Asphalt, Gap Graded Asphalt, is being investigated.

5.6 Emerging Materials

Several asphalt suppliers and representatives from the recycling and plastics industries are pursuing the use of recycled plastic and other materials in road construction. Extensive research has been undertaken by Austroads to determine road grade recycled plastic that can be used in asphalt applications. DTP have previously provided conditional approval for the use of selected asphalt mixes containing recycled plastic and continue to work with industry to identify further opportunities to utilise recycled plastics.

5.7 Registration of Mixes

All road pavement material mixes, including crushed rock, asphalt and concrete must be registered in accordance with the relevant DTP Code of Practice (CoP) or specification. The registration process ensures the mix design is compliant with the specification requirements and hence suitable for use.

Note, only materials from a DTP accredited source can be used for DTP works, or for any works on arterial roads or freeways.

6 Recycled Product Use in Road Pavement

Table A *Summary of the Allowable Use of Recycled Products in Road Pavement Material* provides a guide on how recycled products can be used as an alternative to conventional road pavement materials and related works. It also notes the relevant DTP Code of Practice and/or Standard Specification Section.

7 DTP References

Note, any reference made to 'VicRoads' or 'Department of Transport' are taken to mean Department of Transport and Planning.

- Code of Practice RC 500.01 Registration of Bituminous Mix Designs
- Code of Practice RC 500.02 Registration of Crushed Rock Mixes
- Standard Specification Sections for Roadworks and Bridgeworks:
 - Section 407 Dense Graded Asphalt
 - Section 408 Sprayed Bituminous Surfacing
 - Section 421 High Binder Crumb Rubber Asphalt
 - Section 422 Light Traffic Crumb Rubber Asphalt
 - Section 626 Installation of Precast Concrete Crown Unit Culverts
 - Section 702 Subsurface Drainage
 - Section 703 General Concrete Paving
 - Section 801 Material Sources for the Production of Crushed Rock and Aggregates
 - Section 812 Production of Crushed Rock for Pavement Base and Subbase
 - Section 813 Base and Subbase for Lower Trafficked Roads
 - Section 815 Cementitious Treated Crushed Rock for Pavement Subbase.

Document Information

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Document History

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1.0	September 2011	First Release
2.0	September 2019	Rewrite
3.0	July 2023	Editorial changes and update to use of recycle crushed glass

Interpretation

In this document, except where the context otherwise requires—

- The word “must” is to be understood as denoting a requirement which is mandatory.
- The word “should” is to be understood as denoting a requirement which is not mandatory but recommended.
- The word “includes” in any form is not a word of limitation. Mentioning anything after “includes” or similar expressions (including “for example”) does not limit what else may be included.
- A reference to a section, clause, schedule or appendix is a reference to a clause of or schedule or appendix of this document.

Nomenclature

Where any of the following symbols are used within this document, the textual description provided to the right is its intended meaning:

① This symbol intends the accompanying text to be read as INFORMATION. Common information accompanying this symbol includes RATIONALE and GUIDANCE for the associated requirement.

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Appendix A - Summary of the Allowable Use of Recycled Products in Road Pavement Material

Material Application	Material Designation	Permissible Crushed Concrete Content	Permissible Supplementary Materials ¹ to Recycled Material Sourced from Recycled Product	DTP Document Reference ^{2,3}
Unbound Granular Pavements <i>Class 1, 2, 3 Crushed Rock (CR)</i> <i>The required class of CR depends on the pavement design requirements.</i>	Class 1 CR	Nil	Maximum 5% supplementary material	CoP 500.02 Section 812
	Class 2 CR	10% ⁴	Maximum limits for supplementary materials: 10% ⁴ in Class 2 CR 15% in Class 3 CR 50% in Class 4 CR	
	Class 3 CR	100%		
	Class 4 CR	100%		
<i>Lower Trafficked Base (LTB) and Lower Trafficked Subbase (LTS).</i>	LTB & LTS	Varies	20% in LTB and 50% in LTS	Section 813
Subbase <i>For Deep Strength Asphalt Pavements</i>	Cement Treated CR (utilising Class 3 CR)	100%	Mixes containing supplementary materials are limited to light duty pavements ⁵	CoP 500.02 Section 812 Section 815
Miscellaneous <i>Bedding for footpaths, kerbs, channels, culverts and culvert backfill under pavements</i>	Class 3 or Class 4 CR	100%	Additions vary with CR class (refer to limits above)	Section 703 Section 626 Section 812
Granular Filter for Subsurface Drainage	Granular Filter	Not Applicable	100% glass fines	Section 702
	Permitted Recycled Material			
General Concrete Paving	Concrete for shared use paths may contain up to 30% fine glass aggregate as a replacement of the total mass of fine aggregate in the concrete mix.			Section 703
Sprayed Seal Surfacing	Crumb rubber content (by mass of binder) varies with sprayed seal type e.g. Unmodified seals – up to 5%, Initial Seal & High Stress Seal - 9%, Extreme Stress Seal - not less than 15%			Section 408
Crumb Rubber Asphalt	Crumb Rubber - 2.5 to 3% (by mass of mix)			Section 421
	Crumb Rubber – 0.5% min. (by mass of mix)			Section 422
Dense Graded Asphalt	RAP is permitted in varying proportions (0 to 40%) depending on the asphalt type. RAP is not permitted in asphalt types containing polymer modified binder. Recycled crushed glass sand is permitted in all Dense Graded Asphalt.			CoP 500.01 Section 407

Notes to Table:

1. *Supplementary Material - a durable material added to a crushed rock to improve its workability and physical properties. A recycled material (e.g. RAP, glass fines, crushed brick) may be used as a supplementary material.*
2. *Documents refer to DTP Standard Specification Sections for Roadworks and Bridgeworks and Codes of Practice.*
3. *Section 801 applies to all sources of crushed rock including recycled materials.*
4. *Contents greater than 10% may be used in light duty pavements.*
5. *Light duty pavements are roads carrying less than 3,500 Average Annual Daily Traffic and less than 10% heavy vehicles.*