



# **Aggregate & Cementitious Binders**

## **Road Building Model Specification**

July 2022



## Disclaimer

This road building specification has been prepared by GHD for the Western Australia Local Government Association (WALGA) for the purpose of outlining the requirements for the supply of **Aggregate and Cementitious Binders**. To the extent permitted by law, GHD and WALGA exclude all warranties as to, and responsibility for, the accuracy, completeness or suitability of the information in the Specification or for any error or omission in the information.

To the extent permitted by law, GHD and WALGA disclaim all liability to the user for loss, injury or damage, arising out of, or related to, use of information and data in the Specification. Prior to applying the information presented herein, approval should be sought from the relevant Local Government or appropriate Road Authority.

While every care has been taken in preparing the Specification, GHD and WALGA do not guarantee the currentness of the information and have no ongoing obligation to inform users of changes, revisions or updates. Users of the Specification should apply, and rely upon, their own skills and judgement to the issue they are considering.

## Copyright

This document is copyrighted. Apart from any fair dealing for the purpose of private research, criticism or review, as permitted under the Copyright Act, no part may be reproduced by any process without the written permission of the publisher.

## Acknowledgments

Main Roads Western Australia (Main Roads WA) specifications and guidelines and the Institute of Public Works Engineering Australia, Western Australia Division (IPWEA-WA) **Local Government Guidelines for Subdivisional Development** have been heavily referenced in preparing this road building specification.

The work of Reg Leach, Senior Consultant, Golder Associates Pty Ltd, in assembling the previous (2012) version of the Specification upon which this document is based, is gratefully acknowledged.

# Document Updates

The **Aggregate and Cementitious Binders** road building model specification was originally published in July 2022. Subsequent document updates are shown in the table below:

Date	Updates	Contents and purpose	Edition No.	Amended Modules

Each update will be listed above with the model specification, as amended, available from the WALGA website.

**GHD Pty Ltd | ABN 39 008 488 373**

999 Hay Street, Level 10

Perth, WA 6000, Australia

**T** +61 8 6222 8222 | **F** +61 8 6222 8555 | **E** [permail@ghd.com](mailto:permail@ghd.com) | **ghd.com**

© GHD 2022

*This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.*

# Table of Contents

<b>Disclaimer</b>	<b>i</b>
<b>Acknowledgments</b>	<b>i</b>
<b>1. SCOPE</b>	<b>2</b>
<b>2. REFERENCES</b>	<b>2</b>
<b>3. SEALING AGGREGATE</b>	<b>3</b>
3.1 General	3
3.2 Source Rock	3
3.3 Coarse Aggregate	3
3.4 Fine Aggregate	4
<b>4. CONCRETE AGGREGATE</b>	<b>5</b>
4.1 General	5
4.2 Durability	5
4.3 Fine Aggregate	5
4.4 Coarse Aggregate	6
<b>5. CEMENT</b>	<b>7</b>
<b>6. LIME</b>	<b>7</b>
<b>7. MATERIAL QUALITY</b>	<b>8</b>
<b>8. SUPPLY OF MATERIALS</b>	<b>8</b>
8.1 Aggregate	8
8.2 Cement	9
8.3 Lime	9
<b>9. REGULATORY REQUIREMENTS</b>	<b>9</b>
<b>ANNEXURE A - SCHEDULE</b>	<b>10</b>

## Table index

Table 1	Weathered Rock Inclusion Limits	3
Table 2	Source Rock Properties	3
Table 3	Coarse Aggregate Properties	3
Table 4	Coarse Aggregate Particle Size Distribution Limits	4
Table 5	Fine Aggregate Properties	4
Table 6	Fine Aggregate Properties	5
Table 7	Fine Aggregate Particle Size Distribution Limits	6
Table 8	Coarse Aggregate Properties	6
Table 9	Coarse Aggregate Particle Size Distribution Limits	6
Table 10	Minimum Testing Frequency for Sealing Aggregate	8
Table 11	Minimum Testing Frequency for Concrete Aggregate	8

# 1. SCOPE

This road building specification details the requirements for supply of **Aggregate and Cementitious Binders**, for use in the manufacture and/or construction of sprayed bituminous surfacing, stabilised pavement and concrete.

Specifications for the supply of cover aggregate and bituminous binder, in addition to construction are provided in the Western Australia Local Government Association (WALGA) **Sprayed Bituminous Surfacing** road building model specification.

Specifications for the supply of centrally stabilised (plant-mix) pavement materials are provided in the WALGA **Granular Pavement Materials** road building model specification.

Specifications for the supply of in situ stabilised pavement materials are provided in the WALGA **Pavement Rehabilitation** road building model specification.

# 2. REFERENCES

Australian Standards and Main Roads Western Australia (Main Roads) test methods are referred to in abbreviated form (e.g. AS 1234 or WA 123). For convenience, the full titles are given below.

Equivalent Australian Standard test methods may be substituted for the Main Roads test methods quoted in the Specification.

## Australian Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1152	Specification for Test Sieves
AS 1672	Limes and Limestone – Part 1 Limes for Building
AS 1726	Geotechnical Site Investigations
AS 2758	Aggregates and Rock for Engineering Purposes – Part 1 Concrete Aggregate
AS 3582	Supplementary Cementitious Materials
AS 3972	General Purpose and Blended Cements

## Australian Technical Infrastructure Committee

SP43	Cementitious Materials for use with Concrete
------	----------------------------------------------

## Main Roads Test Methods

WA 0.1	Random Sample Site Location
WA 200.1	Sampling Procedures for Aggregates
WA 212.1	Aggregate Moisture Content: Convection Oven
WA 212.2	Aggregate Moisture Content: Microwave Oven

## ASTM International

C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
------	------------------------------------------------------------------------

## WALGA Road Building Specifications

Aggregate and Cementitious Binders  
Earthworks and Pavement Construction  
Erosion Control and Foreshore Protection  
Granular Pavement Materials  
Pavement Rehabilitation  
Sprayed Bituminous Surfacing  
Supply and Laying of Asphalt Road Surfacing (IPWEA / AAPA)  
Supply of Recycled Road Base (IPWEA / WALGA)

## Acts and Regulations

Aboriginal Heritage Act 1972  
 Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007  
 Environmental Protection Act 1986  
 Environmental Protection Regulations 1987  
 Environmental Protection (Clearing of Native Vegetation) Regulations 2004  
 Health (Pesticide) Regulations 2011  
 Main Roads Act 1930  
 Occupational Safety and Health Act 1984  
 Occupational Safety and Health Regulations 1996  
 Rail Safety National Law (WA) Act 2015  
 Road Traffic Code 2000  
 Wildlife Conservation Act 1950

### 3. SEALING AGGREGATE

#### 3.1 General

Sealing aggregate shall be clean, hard, durable, angular fragments of natural stone produced by crushing sound, unweathered rock and shall not include materials which break up when alternately wetted and dried. Aggregate shall be free from vegetable matter, lumps of clay, overburden or any other deleterious matter.

#### 3.2 Source Rock

Source rock shall be selected from an approved quarry site such that the feed to the primary crusher is fresh, hard and durable rock, free from clay, organic matter, weathered (except as allowed below) or friable material, and is consistent in appearance. A classification system for rock material weathering is defined in AS 1726. The proportions of weathered material in the source rock shall not exceed the limits in Table 1.

Table 1 Weathered Rock Inclusion Limits

AS 1726 Classification	Limit
Slightly Weathered Rock (%) [max.]	10.0
Distinctly Weathered Rock (%) [max.]	0.1
Extremely Weathered Rock (%) [max.]	0.1
Residual Soil (%) [max.]	0.0

Source rock shall also conform to the properties shown in Table 2.

Table 2 Source Rock Properties

Rock Property	Test Method	Limit
Polished Aggregate Friction Value (PAFV) [min.]	AS 1141.42	45

#### 3.3 Coarse Aggregate

Coarse aggregate shall conform to the requirements shown in Table 3. The aggregate shall be of consistent quality, clean, hard and durable and shall be free from clay, organic matter and elongated particles. The aggregate shall be of a uniform colour and appearance for the whole of the works.

Table 3 Coarse Aggregate Properties

Aggregate Property	Test Method	Limit
Moisture Content (%)	WA 212.1 or 212.2	Report <sup>1</sup>
Los Angeles Abrasion Value (%) [max.]		

Aggregate Property	Test Method	Limit
Moisture Content (%)	WA 212.1 or 212.2	Report <sup>1</sup>
Basalt	AS 1141.23 <sup>2</sup>	25
All Other Rock Types	AS 1141.23 <sup>2</sup>	35
Flakiness Index (%) [max.]	AS 1141.15 <sup>2</sup>	35
Average Least Dimension	AS 1141.20.1 or 1141.20.2 <sup>3</sup>	Report <sup>1</sup>
Water Absorption (%) [max.]	AS 1141.6.1 (coarse) AS 1141.5 (fine)	2.0
Wet Strength (kN) [min.]	AS 1141.22	100
Wet/Dry Strength Variation (%) [max.]	AS 1141.22	35
Stripping Test Value (%) [max.]	AS 1141.50 <sup>4</sup>	10
Degradation Factor [min.]	AS 1141.25.2	50
Secondary Mineral Content (%) [max.]	AS 1141.26 <sup>5</sup>	25
Petrographic Examination	ASTM C 295	Report <sup>1</sup>

Notes:

- 1) To be included with conformance certification.
- 2) Not applicable for aggregate  $\leq 5$  mm nominal size.
- 3) Applicable to the mean of at least three results for each Lot (maximum Lot size 1000 m<sup>3</sup>).
- 4) The aggregate shall be clean, dry and without pre-coating. The binder shall include 0.5% by volume approved adhesion agent.
- 5) Only applicable for basic igneous rock types (e.g. basalt).

The particle size distribution (PSD) of each nominal size aggregate shall conform to the requirements shown in Table 4.

Table 4 Coarse Aggregate Particle Size Distribution Limits

AS 1152 Sieve Size (mm)	% Passing by Mass for Each Nominal Size Aggregate <sup>1</sup>						
	20 mm	16 mm	14 mm	10 mm	7 mm	5 mm	3 mm
26.50	100						
19.00	80 - 100	100					
16.00	0 - 20	80 - 100	100				
13.20	0 - 2	0 - 20	80 - 100	100			
9.50	-	0 - 2	0 - 20	80 - 100	100		
6.70	-	-	0 - 2	0 - 20	80 - 100	100	
4.75	-	-	-	0 - 2	0 - 25	80 - 100	100
2.36	-	-	-	-	0 - 2	0 - 30	80 - 100
1.18	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 1.0	0 - 30
0.60	-	-	-	-	-	-	0 - 5

Notes:

- 1) Applicable to the mean of at least three results for each Lot (maximum Lot size 1000 m<sup>3</sup>).

### 3.4 Fine Aggregate

Fine aggregate shall be of consistent quality, clean, hard and durable and shall be free from clay, organic matter and elongated particles. The maximum particle size shall be 4.75 mm, with oversize material removed by screening. Cover sand shall also conform to the requirements shown in Table 5.

Table 5 Fine Aggregate Properties

Aggregate Property	Test Method	Limit
Moisture Content (%)	WA 212.1 or 212.2	Report <sup>1</sup>

Aggregate Property	Test Method	Limit
Water Absorption (%) [max.]	AS 1141.5	2.0
% Passing 6.70 mm [min.]	AS 1141.11.1	100
% Passing 0.60 mm [max.]	AS 1141.11.1	20
% Passing 0.075 mm [max.]	AS 1141.11.1	4
Coefficient of Uniformity (C <sub>u</sub> ) [min.]	-	4

Notes:

1) To be included with conformance certification.

The coefficient of uniformity (C<sub>u</sub>) shall be calculated as shown in Equation 1.

$$C_u = \frac{D_{60}}{D_{10}} \quad \text{Equation 1}$$

where: D<sub>60</sub> is the particle size in millimetres at which 60% of the sample is smaller in size; and  
D<sub>10</sub> is the particle size in millimetres at which 10% of the sample is smaller in size.

## 4. CONCRETE AGGREGATE

### 4.1 General

Unless otherwise specified by the Local Government, aggregate for use in concrete shall conform to AS 2758.1 and this specification. Concrete aggregate shall be clean, hard, durable, angular fragments of natural stone and shall not include materials which break up when alternately wetted and dried. Aggregate shall be free from vegetable matter, lumps of clay, overburden or any other deleterious matter.

Unless otherwise specified by the Local Government, aggregate supplied under this specification shall have a particle density between 2.1 and 3.2 t/m<sup>3</sup>.

The Contractor shall provide proper means of storing concrete aggregate. Each nominal size of coarse aggregate and fine aggregate shall be kept separated and suitable precautions shall be taken to prevent the aggregates from being contaminated by the ground or by wind-blown dust or other foreign matter.

### 4.2 Durability

The durability of coarse aggregate shall be assessed according to AS 2758.1. Unless otherwise specified by the Local Government, the acceptance criteria for these tests shall be concrete exposure classification C.

The durability of fine aggregate shall be assessed according to Clause 9.2 of AS 2758.2. Unless otherwise specified by the Local Government, the acceptance criteria for these tests shall be concrete exposure classification C.

All aggregates proposed for use in the Works shall comply with the requirements of the "Alkali-Reactive Materials" clause of AS 2758.1. Aggregates that are classified as slowly reactive or reactive shall not be used.

### 4.3 Fine Aggregate

Fine aggregate for concrete shall be natural sand, manufactured sand or a combination complying with the requirements of AS 2758.2. Fine aggregate for concrete shall also conform to the requirements shown in Table 6.

Table 6 *Fine Aggregate Properties*

Aggregate Property	Test Method	Limit
Moisture Content (%)	WA 212.1 or 212.2	Report <sup>1</sup>
Water Absorption (%) [max.]		



Aggregate Property	Test Method	Limit
Natural Sand	AS 1141.5	1.5
Manufactured Sand	AS 1141.5	2.5
Sodium Sulphate Soundness (%) [max.]	AS 1141.24	12

Notes:

- 1) To be included with conformance certification.

The PSD of fine aggregate for concrete shall conform to the requirements of AS 2758.2 as shown in Table 7.

Table 7 Fine Aggregate Particle Size Distribution Limits

AS 1152 Sieve Size (mm)	Uncrushed Aggregate		Crushed Aggregate	
	% Passing (by mass)	Maximum deviation (%)	% Passing (by mass)	Maximum deviation (%)
9.50	100		100	
4.75	90 - 100	± 5	90 - 100	± 5
2.36	60 - 100	± 5	60 - 100	± 10
1.18	30 - 100	± 10	30 - 100	± 15
0.600	16 - 100	± 15	15 - 80	± 15
0.300	5 - 50	± 10	5 - 40	± 10
0.150	0 - 20	± 5	0 - 25	± 5
0.075	0 - 5		0 - 20	± 5

## 4.4 Coarse Aggregate

Coarse aggregates for concrete shall be crushed igneous rock or crushed and screened river gravel conforming to the requirements of AS 2758.1.

Coarse aggregate for concrete shall be defined as aggregate having a nominal size equal to or greater than 5 mm. All coarse aggregates shall be single-sized. Unless otherwise specified by the Local Government, graded coarse aggregates shall not be used.

Coarse aggregate for concrete shall conform to the requirements shown in Table 8.

Table 8 Coarse Aggregate Properties

Aggregate Property	Test Method	Limit
Moisture Content (%)	WA 212.1 or 212.2	Report <sup>1</sup>
Los Angeles Abrasion Value (%) [max.]	AS 1141.23	30
Flakiness Index (%) [max.]	AS 1141.15	35
Water Absorption (%) [max.]	AS 1141.6.1	2.5
Wet Strength (kN) [min.]	AS 1141.22	100
Wet/Dry Strength Variation (%) [max.]	AS 1141.22	25
Sodium Sulphate Soundness (%) [max.]	AS 1141.24	6
Petrographic Examination	ASTM C 295	Report <sup>1</sup>

Notes:

- 1) To be included with conformance certification.

The PSD of each nominal size aggregate shall conform to the requirements shown in Table 9.

Table 9 Coarse Aggregate Particle Size Distribution Limits

AS 1152 Sieve Size (mm)	% Passing by Mass for Each Nominal Size Aggregate				
	28 mm	20 mm	14 mm	10 mm	7 mm

37.5	100				
26.5	85 - 100	100			
19.0		85 - 100	100		
13.2	0 - 20		85 - 100	100	
9.50		0 - 20		85 - 100	100
6.70			0 - 20		85 - 100
4.75	0 - 5	0 - 5		0 - 20	
2.36			0 - 5	0 - 5	0 - 20
0.075	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2

The limits of deviation from the submitted sample grading shall be as specified in AS 2758.1. Sampling of coarse aggregate for the purpose of carrying out tests shall be in accordance with AS 1141 or Main Roads WA 200.1.

## 5. CEMENT

Unless otherwise specified by the Local Government, all cement used in the Works shall comply with the requirements of Type GP cement, Type GB blended cement or Type LH cement as specified in AS 3972 and ATIC SP43. The Contractor shall provide manufacturer's test certificates showing all cement has been sampled, tested and conforms in all respects with AS 3972 and ATIC SP43.

Blended cement shall be a combination of Type GP cement and ground granulated iron blast-furnace slag complying with AS 3582.2 and ATIC SP43. The densified silica fume to be added to the blended cement shall be finely divided and comply with AS/NZS 3582.3 and ATIC SP43.

The Cementitious Material Registration Scheme (CMRS) shall be used to confirm that the cement complies with ATIC SP43.

The Contractor shall use cement in approximately the chronological order in which it is delivered from the manufacturer. Transportation units and storage bins for bulk cement shall be weatherproof and shall be constructed so that there is no dead storage. Cement delivered in bags shall be stored in weatherproof structures having floors raised above the ground. Cement that is more than three months old shall not be used.

Concrete manufactured from cement not conforming to this Specification or from cement that has deteriorated and become unsuitable for use shall be rejected.

## 6. LIME

Unless otherwise specified by the Local Government, all lime used in the Works shall comply with the requirements of AS 1672.1. Lime shall be hydrated lime or quicklime. The Contractor shall provide manufacturer's test certificates showing all lime has been sampled, tested and conforms in all respects with AS 1672.1.

The Contractor shall use lime in approximately the chronological order in which it is delivered from the manufacturer. Transportation units and storage bins for bulk lime shall be weatherproof and shall be constructed so that there is no dead storage. Lime delivered in bags shall be stored in weatherproof structures having floors raised above the ground. Lime that is more than three months old shall not be used.

Lime shall be sufficiently dry to flow freely during application.

## 7. MATERIAL QUALITY

The Contractor shall implement a quality management system to ensure aggregate and cementitious binder supplied under the Contract complies in all respects to the specified requirements for the material or product purchased.

Testing shall be carried out in accordance with the relevant Main Roads or equivalent Australian Standard test method. Sampling methods shall be random and unbiased. Random site selection must be undertaken in accordance with WA 0.1.

The frequency of tests shall always be adequate to demonstrate that the material complies with the Specification. As a minimum, testing frequencies shall be as shown in Table 10 and Table 11. Prior to supply, the Contractor shall certify that the material complies in all respects with the specified requirements and shall provide NATA endorsed test certificates to demonstrate compliance.

Unless otherwise specified, all testing shall be performed by a Laboratory holding current NATA accreditation for the methods undertaken. NATA accreditation shall be maintained until the completion of the Contract. All test reports shall be NATA endorsed by a current approved signatory for the Laboratory conducting the testing.

The Contractor shall allow, or cause to allow, the Local Government ready access to the quarry, pit, production and/or manufacturing site to inspect the works and/or to collect material samples.

**Table 10** Minimum Testing Frequency for Sealing Aggregate

Method	Material Type	Minimum Frequency
AS 1141.11.1 Particle Size Distribution	Coarse Aggregate; Fine Aggregate	3 : Lot
AS 1141.15 Flakiness Index	Coarse Aggregate	3 : Lot
AS 1141.20.1 or 1141.20.2 Average Least Dimension	Coarse Aggregate	3 : Lot
AS 1141.23 Los Angeles Abrasion	Coarse Aggregate	3 : Lot
WA 212.1 or 212.2 Moisture Content	Coarse Aggregate; Fine Aggregate	1 : Lot

**Table 11** Minimum Testing Frequency for Concrete Aggregate

Method	Material Type	Minimum Frequency
AS 1141.15 Flakiness Index	Coarse Aggregate	3 : Lot
AS 1141.23 Los Angeles Abrasion	Coarse Aggregate	3 : Lot
AS 2758.1 or 2758.2 Particle Size Distribution	Coarse Aggregate; Fine Aggregate	3 : Lot
WA 212.1 or 212.2 Moisture Content	Coarse Aggregate; Fine Aggregate	1 : Lot

## 8. SUPPLY OF MATERIALS

The Contractor shall nominate the source of any aggregate or cementitious binder to be supplied with the quotation.

### 8.1 Aggregate

Unless otherwise specified, the Contractor shall deliver aggregate to the nominated stockpile sites on the date and time specified. The Contractor shall confirm all necessary arrangements concerning load size, rate for supply, timing of the delivery and documentation prior to delivery. Different nominal size aggregate shall be placed in separate, clearly identified stockpiles.

Where the Contract includes cartage, the Contractor shall remove and replace any aggregate that becomes contaminated during transport, delivery or stockpiling at no cost to the Local Government.

Where the Contract excludes cartage, the Contractor shall allow, or cause to allow, the Local Government or nominated third-party ready access to the quarry, pit, production and/or manufacturing site and shall provide any assistance necessary to ensure satisfactory load-out of the specified material.

## **8.2 Cement**

Unless specified otherwise, the Contractor shall be responsible for arranging cement delivery. The Contractor shall confirm all necessary arrangements concerning load size, rate for supply, timing of the delivery and documentation prior to delivery.

Any contamination, wetting up or other problem occurring during delivery shall be corrected at no cost to the Local Government.

## **8.3 Lime**

Unless specified otherwise, the Contractor shall be responsible for arranging lime delivery. The Contractor shall confirm all necessary arrangements concerning load size, rate for supply, timing of the delivery and documentation prior to delivery.

Any contamination, wetting up or other problem occurring during delivery shall be corrected at no cost to the Local Government.

# **9. REGULATORY REQUIREMENTS**

The Contractor shall conform to all relevant statutory and regulatory requirements including environment, aboriginal heritage, wildlife conservation, dangerous goods, occupational safety and health, rail safety and road safety.