



mainroads
WESTERN AUSTRALIA

SPECIFICATION 905

BLOCK RETAINING WALLS

Copyright MAIN ROADS Western Australia

REVISION REGISTER			
Clause Number	Description of Revision	Authorised By	Issue Date
Whole document 905.02 905.03 905.05 905.07	Title changed from "Limestone Retaining Walls" to "Block Retaining Walls" Roads to Reuse (RtR) Product Specification added "CRC" and "RRC" definition added Sustainability consideration clause added Additional note added for colour requirements	SDSE	27/06/2023
905.08.02 905.08.03	Reference changed to AS1012.8.3 and AS1012.9 Number of specimens added	SDSE	06/03/2020
Whole document	Complete review – no change	A/SDSE	11/06/2010
Whole document	Complete revision of Issue 1.0 to new format	MCP	01/08/2006

CONTENTS

Clause	Page No
GENERAL	5
905.01 Scope.....	5
905.02 References.....	5
905.03 Definitions	6
905.04 NOT USED	6
905.05 Sustainability Considerations	6
PRODUCTS AND MATERIALS	7
905.06 Concrete Footings.....	7
905.07 Blocks	7
905.08 Mortar	8
905.09 Reinforcing Steel for Concrete Footings.....	9
905.10 – 905.25 NOT USED.....	9
EARTHWORKS	9
905.26 General	9
905.27 Clearing and Topsoil Removal	9
905.28 Excavation	9
905.29 Acceptance of Bearing Surfaces to Carry Loads	9
905.30 Foundation Improvement	10
905.31 Protection of Bearing Surfaces.....	10
905.32 Backfilling.....	10
905.33 Unsuitable and Excess Material	11
905.34 – 905.40 NOTUSED.....	11
CONCRETE WORKS	11
905.41 General	11
905.42 Strip Footing Control Joints	11
905.43 – 905.50 NOT USED.....	11
BLOCKWORK	11
905.51 General	11
905.52 Joints	12
905.53 Drainage	12
905.54 Facing.....	12
905.55 Finish Tolerances.....	12
905.56 Anti-Graffiti Coating.....	13
905.57 Sample Panel.....	13

905.58 – 905.80 NOT USED.....	13
AS BUILT AND HANDOVER REQUIREMENTS	13
905.81 – 905.90 NOT USED.....	13
CONTRACT SPECIFIC REQUIREMENTS	13
905.91 – 905.99 NOT USED.....	13

SPECIFICATION 905

BLOCK RETAINING WALLS

GENERAL

905.01 SCOPE

1. The work under this specification consists of details as shown on the Drawings including:
 - a. Earthworks for the construction of mass/gravity retaining walls including excavation, foundation improvement and backfilling.
 - b. Concrete works for footings.
 - c. Block works for retaining wall panels.

905.02 REFERENCES

1. Australian Standards, MAIN ROADS Western Australia Standards and MAIN ROADS Western Australia Test Methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are given below:

Australian Standards

AS1012.8.3	Methods of testing concrete – Methods of making and curing concrete – Mortar and grout specimens
AS1012.9	Methods of testing concrete Method 9: Compressive strength tests – Concrete, mortar and grout specimens
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1379	Specification and Supply of Concrete
AS 3700	Masonry Structures
AS 4678	Earth-retaining Structures

Australian/New Zealand Standards

AS/NZS 4671	Steel Reinforcing Materials
AS/NZS 4456.4	Masonry units and segmental pavers and flags – Methods of test - Determining compressive strength of masonry units
AS/NZS 4456.8	Masonry units, segmental pavers and flags – Methods of test Determining moisture content, dry density and ambient density

Other Standards

Waste Authority WA Roads to Reuse (RtR) Product Specification – recycled road base and recycled drainage rock

MAIN ROADS Test Methods

WA 134.1 Dry Density Ratio (Percent)

WA 915.1 Calcium Carbonate Content

MAIN ROADS Specifications

Specification 302 EARTHWORKS

Specification 822 STEEL REINFORCEMENT

Specification 901 CONCRETE – GENERAL WORKS

Specification 908 ANTI-GRAFFITI

905.03 DEFINITIONS

1. Crushed Recycled Concrete (CRC), as used in the waste recycling industry in Western Australia, refers to processed (crushed and blended) materials recovered from construction and demolition waste, predominantly comprising concrete with other secondary materials managed under the Roads to Reuse (RtR) Specification. **CRC**
2. Recycled Returned Concrete (RRC), refers to processed (crushed and blended) materials recovered from returned hardened concrete (with no other secondary materials). **RRC**

905.04 NOT USED

905.05 SUSTAINABILITY CONSIDERATIONS

1. Materials for used for concrete for general works shall be managed under the sustainability hierarchy of REDUCE, REUSE and RECYCLE.
2. Unless defined otherwise, the materials described in this specification shall be sourced from pits or quarries of natural materials, and shall be blended, crushed or processed as applicable to produce a homogenous material. These materials are a finite resource and waste should be reduced to a minimum.
3. The term REUSE refers to the reuse (or rehabilitation or rejuvenation) of end-of-life (or defective or waste) materials in products for the same purpose. Where practical, redundant concrete materials and plant waste should be recovered and reused, or otherwise recycled to the highest level use practical.
4. The term RECYCLE refers to the reprocessing of end-of-life (or defective or waste) materials into new repurposed products. This specification also includes manufactured materials sourced from recycled Construction and Demolition Waste such as Crushed Recycled Concrete (CRC) or Recycled Returned Concrete (RRC). Recycled materials for general concrete shall be blended, crushed or processed as applicable to produce a homogenous

material by a recycling premises. Recycled materials shall only be included in materials which are designated as recycled

PRODUCTS AND MATERIALS

905.06 CONCRETE FOOTINGS

- | | |
|--|-----------------|
| 1. Concrete used in the construction of footings and any other concrete elements of retaining walls shall be in accordance with the Drawings and Specification 901 CONCRETE - GENERAL WORKS. | Concrete |
|--|-----------------|

905.07 BLOCKS

- | | |
|---|---|
| 1. Blocks used for retaining walls shall be manufactured from: | Limestone
or
Recycled
Concrete |
| a. natural or reconstituted limestone, with individual blocks being free from any foreign matter, shakes, pockets, veins or other defects and generally sound and clean and of uniform colour and texture; or | |
| b. Crushed Recycled Concrete (CRC) as part of the coarse aggregate content in accordance with Specification 901 CONCRETE - GENERAL WORKS; or | |
| c. Recycled Returned Concrete (RRC) as part of the coarse aggregate content in accordance with Specification 901 CONCRETE - GENERAL WORKS. | |

2. Limestone blocks shall also be in accordance with the dimensions and colours as shown on the Drawings and conform to the following requirements:

- | | | |
|------------------------------------|--|-------------------------|
| a. Calcium Carbonate Content | 60% minimum by weight in accordance with WA 915.1 for limestone or reconstituted limestone blocks | CaCO₃ |
| | Not applicable for CRC and RRC block | |
| b. Dry Density | 1700kg/m ³ minimum tested by direct measurement, the weight of a known size cube/core after oven drying at 45 degrees Celsius for 12 hours | Density |
| c. Unconfined Compression Strength | 1.7MPa for natural limestone and 2.5MPa for reconstituted limestone, and 3.5MPa for RCC and CRC tested using a core/cube sample cut to normal test size to be tested for crushing strength | Strength |
| d. Dimensions | As indicated on the Drawings with a tolerance of ± 15mm. | Tolerances |
| e. Colour | Colour to be specified on drawings for front blocks, such as earthy red, black, yellow that are visible in finished wall. | |

3. The Contractor shall submit samples of blocks, with the manufacturer's certificate for approval, to the Superintendent before placing orders. Testing certificates for compliance to be 1 per 200 blocks for natural limestone and 1 per 500 for reconstituted limestone, CRC and RRC. The manufacturer's certificate shall show compressive strength, dry density and calcium carbonate content values of the blocks. The samples shall indicate the full range of texture and colour, and consist of at least 6 units. Units built into the Works shall conform to and fall within the range of appearance properties of the approved samples.

HOLD POINT

905.08 MORTAR

905.08.01 GENERAL

1. Mortar shall comply with AS 3700. Mortar shall consist of 1 part of Portland Cement, 1 part of building lime, 6 parts of fine aggregate and colouring pigments as required. The measured parts in mixes shall be mixed mechanically to an even colour and consistency with the minimum amount of water for workability. Admixtures, only when specified, shall be used as specified and in accordance with the manufacturer's published recommendations. Mortar colour shall be in accordance with the Drawings. Colouring pigments shall be thoroughly mixed with the cement before adding other components.
2. Mortar mixed on site shall be used within 20 minutes of mixing. Retempering of mortar shall not be permitted. Any mortar which has begun to set prior to use shall be rejected.

Mortar

905.08.02 SAMPLING AND TESTING

1. The Contractor shall prepare samples of mortar for block jointing for the approval of the Superintendent. Mortar used in the Works shall conform to the approved mix and samples as specified on the Drawings.
2. Mortar cubes prepared in accordance with AS 1012.8.3 and tested in accordance with AS1012.9 shall achieve a compressive strength of at least 2.8MPa for samples taken from site mixes and 4.2MPa for samples taken from laboratory mixes.
3. The Contractor shall undertake a mortar compression test at the laboratory at the beginning of the Works to establish the compressive strength as required by the Specification. The Contractor shall undertake mortar compression tests using site mixes on regular bases to maintain the required compressive strength results. Frequency of testing on site shall be one test every 200m length of wall. For each sample of mortar tested the number of specimens for compressive strength shall be three.

Samples

Test Results

Sampling

905.09 REINFORCING STEEL FOR CONCRETE FOOTINGS

1. Reinforcing steel used in the construction of reinforced concrete footings and any other reinforced concrete elements of retaining walls shall be in accordance with AS/NZS 4671 and Specification 822 STEEL REINFORCEMENT. The Contractor shall store reinforcing steel above ground level and shall protect it from damage and deterioration. Reinforcement placed in the Works shall be clean and free from all loose rust, mill-scale, dirt, grease, and other foreign substances which would impair the bond between steel and concrete. After being placed in position, all reinforcement shall be maintained by the Contractor in a clean condition until it is embedded in the concrete.

Reinforcement

905.10 – 905.25 NOT USED

EARTHWORKS

905.26 GENERAL

1. This Section of the Specification covers earthworks for the construction of the retaining walls and includes excavation, foundation improvement and backfilling. Earthworks item shall be carried out as specified hereafter and as detailed on the Drawings.

905.27 CLEARING AND TOPSOIL REMOVAL

1. The Contractor shall clear a sufficient width of the work site at the wall location prior to starting excavation. Topsoil in the cleared area shall be removed to a minimum depth of 100mm by the Contractor and stockpiled for reuse at a location approved by the Superintendent. The stockpiled topsoil shall be respread by the Contractor over the cleared area to a minimum depth of 70mm and surplus removed from site.

Clearing

905.28 EXCAVATION

1. The Contractor shall excavate to the lines and grades shown on the Drawings. The actual dimensions for excavation shall in all cases be no more than that required for the placement of protective works if necessary and any working space required.
2. The Contractor shall stockpile excavated material for use as back-fill.
3. Any excavated material considered unsuitable by the Superintendent shall be removed to the nominated spoil site.
4. If excavation is required, it shall be backfilled and compacted with embankment quality material in accordance with Specification 302 EARTHWORKS. The back-fill shall be compacted to the density given on the Drawings.

Excavation

905.29 ACCEPTANCE OF BEARING SURFACES TO CARRY LOADS

1. Blocks shall be laid on a compacted sand base of minimum depth as given on the Drawings.

Bearing Surface

2. When foundations have been excavated, all the soil below the base shall be compacted by the Contractor.
3. Undisturbed soil shall be proof compacted by the Contractor with a plate compactor, and base material shall be compacted to a minimum dry density of 95 % to the minimum depth as given on the Drawings and tested in accordance with WA 134.1.
4. When foundations in Perth sands have been excavated, the Contractor shall compact the bearing surface and test the compaction with a Perth sand penetrometer in accordance with AS 1289.6.3.3. The minimum acceptable blow count is 7 blows per 300mm for the whole depth, or as shown on the Drawings.
5. The Contractor shall separately compact each horizontal layer of not more than 300mm uncompacted thickness.
6. Testing frequency shall be 1 test per 10m of wall length, or 1 test per wall panel, whichever is the greater frequency.
7. If the soil does not meet the requirements of this Clause, it shall be compacted by the Contractor until it complies, unless otherwise directed by the Superintendent.

905.30 FOUNDATION IMPROVEMENT

1. If directed by the Superintendent, the soil shall be excavated and either re-compacted by the Contractor if it meets the requirements of Clause 905.32 or replaced by compacted layers of sand fill satisfying the requirements of Clause 905.32. The excavation shall be carried out to a depth as directed by the Superintendent. The thickness of each layer of backfill material shall be limited to enable the specified compaction to be obtained for the full depth of the layer for the equipment being used and in any case shall not exceed 300mm before compaction. The backfilled material shall be re-tested by the Contractor to ensure compliance with Clause 905.29.

Foundation Improvement

905.31 PROTECTION OF BEARING SURFACES

1. The exposed bearing surface at the bottom each of excavation shall be adequately protected from disturbance by the Contractor's operations or by the action of stormwater or ground water.
2. Any material at the bottom of an excavation which becomes unsuitable shall be removed and replaced by the Contractor with fill complying with Clause 905.32 and compacted in accordance with Clause 905.30 or replaced by additional blinding concrete. Alternatively, the disturbed surface may be lightly watered and compacted with a hand operated mechanical compactor.

Protection

905.32 BACKFILLING

1. The Contractor shall backfill around foundations and retaining walls as shown on the Drawings using suitable material excavated from the foundations unless otherwise approved by the Superintendent.
2. The fill shall be placed carefully by the Contractor so as not to damage the retaining wall and concrete foundations.

Backfilling

3. The Contractor shall place fill in continuous horizontal layers of not more than 300mm uncompacted thickness and shall separately compact each layer to a similar density to the surrounding material.
4. Suitable fill material shall meet the requirements of Specification 302 EARTHWORKS.

905.33 UNSUITABLE AND EXCESS MATERIAL

1. All unsuitable and excess material shall be removed from site and disposed of by the Contractor.

905.34 – 905.40 NOTUSED

CONCRETE WORKS

905.41 GENERAL

1. The Contractor shall carry out the construction of concrete elements of retaining walls to the dimensions shown on the Drawings. Concrete Classes used for the construction of the concrete elements shall be as shown on the Drawings, and conform to AS 1379. The concrete construction requirements shall comply with Specification 901 CONCRETE - GENERAL WORKS.
2. **The Contractor shall advise the Superintendent of the time and date of concrete placement not less than 24 hours prior to any placement.**

HOLD POINT

905.42 STRIP FOOTING CONTROL JOINTS

1. The Contractor shall construct construction joints at maximum intervals of 16m or at the locations shown on the Drawings.
2. Materials used for the joints (such as dowels, grease, caps and Fortecon layers) and installation details shall be in accordance with the Drawings.

Footing Joints

905.43 – 905.50 NOT USED

BLOCKWORK

905.51 GENERAL

1. The Contractor shall stack blocks on supports clear of the ground and keep them dry and free from dust, dirt and staining, and shall cover them with tarpaulins or plastic sheeting.
2. Blocks shall not be laid in wet weather.
3. The Contractor shall set out the Works according to the Drawings.
4. The first course of units shall be laid on top of the prepared bedding sand and be levelled and checked for alignment.
5. Additional courses shall be laid in squared work with joints fully mortared and levelled and checked for alignment.

6. The walls shall be laid with a front face batter of 1H to 50V.

905.52 JOINTS

1. The Contractor shall lay blocks on a full bed of mortar and shall fill perpends solidly with mortar.
2. Mortar joints shall be nominally 20mm in width.
3. The joint shall be raked back from the block face so that the joint can be faced at a later date with cream coloured mortar to match the limestone colour.

Wall Joints

905.53 DRAINAGE

1. Drainage weepholes are permitted only where shown on the Drawings.
2. Where required, drainage shall be provided behind the retaining wall as shown on the Drawings.

Drainage

905.54 FACING

1. The Contractor shall prepare trial mortar mixes for facing to match the block colour. Trial mortar mixes shall be prepared until a suitable match is obtained as approved by the Superintendent.
2. The facing shall occur in a single operation after the wall has been completed and all movement has been taken up.
3. The exposed face shall be cleaned of all excess mortar as the work progresses.

Facing

905.55 FINISH TOLERANCES

1. Block retaining walls shall be laid to the following tolerances:
 - a. Horizontal position of any element in plan $\pm 25\text{mm}$
 - b. Maximum deviation from specified batter $\pm 15\text{mm}$ per 3m height
 - c. Maximum horizontal deviation (AS 3700 App F) $\pm 10\text{mm}$ over a 2m edge
 - d. Deviation in any bed joint from horizontal $\pm 10\text{mm}$ in any 10m or $\pm 15\text{mm}$ total
 - e. Deviation in thickness of bed joint or perpend $\pm 10\text{mm}$
 - f. Maximum step between blocks $\pm 10\text{mm}$ block to block

Tolerances

905.56 ANTI-GRAFFITI COATING

1. Anti-graffiti coatings shall be a low gloss, clear, sacrificial coating, applied in accordance with Specification 908 ANTI-GRAFFITI. **Anti-Graffiti**
2. The Contractor shall apply anti-graffiti coatings to all exposed faces of the block wall, except faces abutting private property.

905.57 SAMPLE PANEL

1. The Contractor shall construct an 8m long, full height sample panel of wall as part of the Works and for the approval of the Superintendent. Joints shall be finished in accordance with the Drawings. The Works shall conform to the approved sample panel. Further Works shall not commence until the sample panel has been approved by the Superintendent. The sample panel may be a section of the retaining wall. **HOLD POINT**

905.58 – 905.80 NOT USED

AS BUILT AND HANDOVER REQUIREMENTS

905.81 – 905.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

905.91 – 905.99 NOT USED

GUIDANCE NOTES

FOR REFERENCE ONLY – DELETE GUIDANCE NOTES FROM FINAL DOCUMENT

1. All edits to downloaded Specifications shall be made using *Track Changes*, to clearly show added/deleted text.
2. If **all** information relating to a clause is deleted, the clause number should be retained and the words “**NOT USED**” should be inserted.
3. The proposed documents with tracked changes shall be submitted to the Project Manager for review, prior to printing the final batch of documents. When this final printing is carried out, the tracked changes option is to be turned off.
4. Before printing accept all changes in the document, turn off *Track Changes* and refresh the Table of Contents.
5. The Custodian of this specification is the Structures Design and Standards Engineer.

1. CLAUSE 905.06 CONCRETE FOOTINGS

If concrete footings are not required for mass block retaining walls and only a sand base is detailed on the Drawings, then the clauses relating to concrete footings need to be marked “NOT USED”; specifically Clauses 905.01(b), 905.06, 905.09 and 905.41 - 905.50.

2. CLAUSE 905.29 ACCEPTANCE OF BEARING SURFACES TO CARRY LOADS

NOTE: This is for granular materials. An alternative Specification may be required for other materials.

3. CLAUSE 905.32 BACKFILLING

If reinforced earth retaining walls are specified on the Drawings, geo-straps for reinforcement, as opposed to galvanised steel reinforcing strips are only permitted on non-critical structures. These are defined as < 5m in wall height, without any vehicle surcharge loading. Provision must be written into this clause for any reinforced block retaining walls.

CONTRACT SPECIFIC REQUIREMENTS

The following clauses are to be placed under the CONTRACT SPECIFIC REQUIREMENTS, as required. After inserting the clause, change the clause number and heading to style “H2 SP” so it appears in the Table of Contents.

XXX.XX SUB HEADING (H2 SP)

1. Insert text (Main Table SP)

Keyword SP

2. Insert text (Main Table SP)

XXX.XX SUB HEADING (H2 SP)

1. Insert text (Main Table SP)

2. Insert text (Main Table SP)

AMENDMENT CHECKLIST

Specification No. **905** Title: **BLOCK RETAINING WALLS** Revision No: _____

Project Manager: _____ Signature: _____ Date: _____

Checked by: _____ Signature: _____ Date: _____

Contract No: _____ Contract Description: _____

ITEM	DESCRIPTION	SIGN OFF
<i>Note: All changes/amendments must be shown in Tracked Changes mode until approved.</i>		
1.	Project Manager has reviewed Specification and identified Additions and Amendments.	
2.	CONTRACT SPECIFIC REQUIREMENTS addressed? Contract specific materials, products, clauses added? (Refer Specification Guidance Notes for guidance).	
3.	Any unlisted materials/products proposed and approved by the Project Manager? If "Yes" provide details at 16.	
4.	Standard clauses amended? MUST SEEK approval from Manager Contracts.	
5.	Clause deletes shows as " NOT USED ".	
6.	Appropriate INSPECTION AND TESTING parameters included in Spec 201 (Text Methods, Minimum Testing Frequencies verified).	
7.	ANNEXURES completed (refer Specification Guidance Notes).	
8.	HANDOVER and AS BUILT requirements addressed.	
9.	Main Roads QS has approved changes to SMM .	
10.	Project Manager certifies completed Specification reflects intent of the design.	
11.	Completed Specification – independent verification arranged by Project Manager.	
12.	Project Manager's review completed.	
13.	SPECIFICATION GUIDANCE NOTES deleted.	
14.	TABLE OF CONTENTS updated.	
15.	FOOTER updated with Document No., Contract No. and Contract Name.	
16.	Supporting information prepared and submitted to Project Manager.	
Further action necessary:		

Signed: _____ (*Project Manager*) Date: _____