

Aggregate from Inert Waste: Resource Framework

Recycled Aggregates for use in Hydraulically Bound Mixtures (HBM)

Guidance & Testing Requirements
Specification for Highway Works (SHW) 2025
Clause CC 201 (Section 9)
(formerly SHW Series 800)

Applications

- Capping, subbase and base

Focus

- Performance and durability





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CC 201 Explained

CC 201 is part of the 2025 Specification for Highway Works (SHW) that covers how to construct pavement foundations i.e. the layers between the subgrade (earthworks) and the road base.

CC 201 replaces older prescriptive rules (from Series 600/800) with a performance-based specification aligned with DMRB design standards (CD 225 / CD 226).

CC 201 is responsible for turning prepared ground into a tested, reliable, load-bearing foundation ready for construction.

What CC 201 is responsible for

CC 201 is responsible for ensuring the pavement foundation is properly constructed and proven to perform. This includes:

- Building the foundation layers
- Checking the ground (subgrade)
- Controlling construction
- Delivering performance
- Setting levels and tolerances
- Testing and proving compliance

Where CC 201 fits in the SHW

Within the 2025 SHW structure, CC 201 builds the foundation layers (capping and subbase). It sits directly above earthworks and below the specifications for pavement layers.

How CC 201 differs from SHW Series 800

Series 800 approach

- Specification driven where designer selects materials
- Prescriptive approach to fixed layers formations
- Limited direct link to design standards



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CC 201 approach (2025)

- Outcome-driven with broad material options as long as performance is met
- Performance-based, where layers can be designed to meet performance target
- Fully aligned with DMRB CD 225 / CD 226

Summary:

Series 800 governs earthworks and formation preparation, while CC 201 governs the construction and performance verification of the pavement foundation layers built above that formation.

Aspects of CC 201 (high-level)

1. Purpose

CC 201 defines:

- How to construct and verify pavement foundations
- Ensure a stable, load-bearing platform

2. Scope

CC 201 gives clear requirements for foundation layers above formation level.

- Capping, both bound and unbound
- Sub-base, both bound and unbound
- Foundation surface

3. Construction Controls

- Layer thickness
- Compaction
- Moisture control
- Surface levels and tolerances



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4. Performance Requirements

Foundation requirements must achieve:

- Strength
- Stiffness
- Load distribution capability

*Focus is on what it **does**, not what it is.*

5. Testing and Verification

Mandatory proof of performance is required via:

- Compaction tests
- Thickness checks
- Stiffness testing

No proof means non-compliance and rejection.

CC 201 and Recycled Aggregates

CC 201 explicitly allows recycled aggregates, especially in unbound capping and subbase layers. They are treated the same as natural materials, provided they meet specification and performance requirements.

What are Hydraulically Bound Materials?

Hydraulically Bound Materials (HBM) are construction materials used in road and pavements works where aggregate is mixed with a hydraulic binder and water to produce a stiff, cemented layer.

Typical Components of HBM

1. Aggregates

- Natural aggregates
- Recycled aggregates (RCA, crushed concrete etc.)



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2. Hydraulic binders

- Cement (most common)
- Lime
- Ground granulated blast furnace slag (GGBS)
- Fly ash
- PFA
- Blended binders

2. Water

- Triggers the chemical reaction

Where Hydraulically Bound Materials are used under CC 201

Under CC 201 Section 9, recycled aggregates HBM's are only used in the pavement foundation zone.

These specifically relate to:

1. Sub-base (primary application)
2. Bound capping layers
3. Performance foundation solutions

Can recycled aggregates be used in HBM's?

Yes. As CC 201 is performance-based, recycled and secondary aggregates can be used in HBM's provided that they meet the specified material, quality and performance standards.

Where are recycled aggregates are NOT permitted with HBM's

Under CC 201 Section 9, recycled aggregates are not permitted for use in HBM's when they fail:

- Material specification tests
- Material performance requirements
- Environmental contamination/content tests
- Foundation performance requirements are not met
- When Resource Framework compliance cannot be demonstrated



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What CC 201 Section 9 expects from recycled aggregates

Under CC 201 Section 9, recycled aggregates are fully acceptable if they perform to the same strict requirements as natural aggregates.

1. Meet full performance-based requirements

- Deliver the required stiffness
- Contribute to the Target Foundation Class (F1-F4 under CD225)

Recycled aggregates must achieve the required foundation performance, not just comply with a grading.

2. Consistent and well-controlled materials

- Must be uniform in composition
- Free from variability typically associated with mixed demolition waste
- Produced under Factory Production Control (FPC)

They must have:

- Traceable origin
- Documented processing
- Reliable, repeatable properties

In effect they must be a processed product, rather than simply a site-won waste.

3. Comply with strict material quality limits

Recycled aggregates must meet the same materials standards as natural aggregates, including:

Physical properties

- Correct grading
- Limited fines content
- Good particle strength and durability



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Chemical/environmental limits

- Controlled sulphate/sulphur levels
- No harmful contaminants
- Inert behaviour in the ground

Materials exceeding permitted limits are unacceptable for use.

4. Be free of deleterious materials

Recycled aggregates should contain minimum levels of:

- Wood, plastic and glass
- Gypsum/plasterboard
- Clay lumps, asphalt fragments or weak particles

Excess deleterious material causes reduced durability and leads to material rejection.

5. Achieve frost resistance

Recycled aggregates must:

- Not be susceptible to frost
- Have controlled fines and moisture behaviour

Recycled aggregates must not retain excessive water or break down under freeze/thaw cycles.

6. Be suitable for construction and compaction

Recycled aggregates are expected to:

- Compact to required density
- Maintain layer thickness and integrity
- Not degrade excessively under rolling

Recycled aggregates must have controlled moisture levels and be stable during placement.



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7. Pass in-situ verification testing

This is critical under Section 9. Recycled aggregates must pass:

- Stiffness testing (LWD, FWD or plate load)
- Density/compaction tests
- Surface regularity and level tolerances

Acceptance is based on in-situ performance on site, not just on lab results.

8. Be compatible with ground conditions

- Not react adversely with subgrade soils
- Be suitable for local chemical conditions e.g. sulphate
- Comply with additional testing requirements or use restrictions if the ground is chemically aggressive

9. Contribute to a durable pavement foundation

- Recycled aggregates are expected to:
- Provide uniform load distribution
- Protect the subgrade
- Ensure long-term pavement performance

Recycled aggregates must behave as a structural layer, not just a fill material.

What CC 201 Section 9 expects from recycled aggregates

Recycled aggregates are not allowed under CC 201 Section 9 if they are:

- Contaminated
- Poorly processed or inconsistent
- Contain excessive deleterious materials
- Outside grading limits
- Frost-susceptible
- Unable to be compacted properly
- Failing stiffness/performance tests



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- Environmentally incompatible
- Excluded by project specification
- Uncertified or untraceable

Summary:

CC 201 Section 9 does not allow recycled aggregates that introduce risk to pavement performance, durability or compliance. Recycled aggregate use is permitted provided the material behaves like an engineered subbase layer rather than a waste.

Mandatory Tests for Recycled Aggregates (Section 9)

For SHW 2025 CC 201 (Pavement Foundation Construction), recycled aggregates used in Hydraulically Bound Materials must meet a combination of:

- Classification tests (what the material is made of)
- Physical/mechanical performance tests (how it behaves)
- Chemical/environmental compliance tests
- In-situ performance verification (installed performance)

Below is a practical, audit-ready list of mandatory, critical tests aligned to SHW / BS EN standards and how they are typically applied under CC 201 Section 9.

Material Classification

1. Constituent classification (critical)

This is mandatory for all materials used in highways works.

Test	Standard
Classification / constituents	BS EN 933-11

Purpose:

- Identify and quantify material types to ensure compliance with limits e.g. Class X $\leq 1\%$



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2. Grading / Particle Size Distribution

Essential for workability, compaction and final strength.

Test	Standard
Grading / PSD	BS EN 933-1

Purpose:

- Grading is required on the final HBM mix, however a PSD is useful on the constituent aggregates to help calculate the correct mix proportions to comply with the overall PSD requirement. Depending on the mix, it is a requirement to confirm the percentage of crushed or broken particles and totally rounded particles in coarse aggregate.

3. Physical properties testing

Not required, although water content and water absorption/particle density can be useful for both mix design and the HBM production process.

4. Mechanical strength and durability

These are critical for HBM performance and durability.

Test	Standard
Los Angeles (LA) Abrasion	BS EN 1097-2

Purpose:

- Assess resistance to crushing, degradation and fragmentation.

5. Fines and cleanliness tests

Not required for HBM.



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6. Chemical testing

Test	Standard
Acid Soluble Sulphate	BS EN 1744-1
Total Sulphur	BS EN 1744-1

Purpose:

- To prevent chemical attack and hindrance of binder performance.

7. Freeze/Thaw durability (if required)

Only required for unbound materials within 450mm of the final surface or 350 mm if the Mean Annual Frost Index (MAFI) of the site is less than 50, normally confirmed by frost heave testing.

Summary

Section 9 is a compliance gate of CC 201. You must test, measure and prove that the recycled aggregates proposed for use in Hydraulically Bound Mixtures meet the same performance and quality standards as natural aggregates.



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