A4 – Unbound Aggregates

Aggregates used in road construction are specified using the BS EN Standards in combination with the Specification for Highway Works (SHW). This Topic page gives details of aggregates used in:

- Drainage trenches (SHW Series 500)
- Earthworks and capping (SHW Series 600)
- Subbase (SHW Series 600).

Full details are given in:

Standard:	BS EN 13242, Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
BS Guidance:	PD6682-6
Standard:	BS EN 13285, Unbound mixtures - specification
Guidance:	Notes for guidance to the SHW, Series NG600 and NG800

BS EN 13242 defines aggregates that can be used in unbound mixtures for capping layers and subbase. BS EN 13285 defines the grading of the unbound mixtures.

Aggregates for drainage

SHW Series 500 gives details of aggregates used in drainage trenches by reference to BS EN 13242.

SHW Clause 503, Table 5/3 gives details of graded and single sized aggregates that can used for pipe bedding, haunching and surround. The permitted aggregate sizes depend upon the diameter of the pipe:

Graded aggregate	2/14	4/20	4/40	
Single-sized aggregate	4/10	6/10	10/20	20/40

The maximum % passing the 0.063mm size sieve is also specified:

- Gravel – 1.5% maximum
- Crushed rock – 4% maximum.

SHW Clause 503, Table 5/4 gives equivalent details for fine and all-in aggregates:

Fine aggregate	0/1	0/2	0/4	
All-in aggregate	0/6	0/10	0/20	0/40

The maximum % passing the 0.063mm size sieve is also specified:

- Sand and gravel – 3% maximum
- Crushed rock – 11% maximum.

SHW Clause 505, Table 5/5 gives details of aggregates used as filter material. Three general Types are specified:

Type A	A 0/20 mm size unbound mixture to a grading based on BS EN 13285
Type B	20/40 single size aggregate to BS EN 13242
Type C	A specialist product with a 'designed' grading – often a blend of aggregates.

The choice of a particular type is part of the design procedures for the drainage system. Type B filter material is routinely used in simple sub-soil drainage systems.

Earthworks and capping layers

SHW Series 600 specifies earthworks materials in a way that tries to make best use of materials excavated from the site. Whilst aggregates are often purchased for use in earthworks, they are specified using a system of Classes that reflect the use of the aggregate within the earthworks.

Aggregates are routinely used in:

- Class 1 – General granular fill
- Class 6 – Selected granular fill.

Details are set out in:

- Table 6/1 – Classification of acceptable earthworks materials
- Table 6/2 – Grading requirements for Class 1
- Table 6/5 – Grading requirements for Class 6 (sourced off-site).

A capping layer is used to improve the strength of a road foundation. Unbound mixtures for use in capping are specified by reference to BS EN 13285:

% passing sieve size, mm	Glass 6F4 Fine grading (0/32)	Class 6F5 Coarse grading (0/80)
125	–	100
80	–	75–99
63	100	–
40	–	50–90
31.5	75–99	–
20	–	30–75
16	50–90	–
10	–	15–60
8	30–75	–
4	15–60	–
2	–	0–35
1	0–35	–
0.063	0–15	0–12

Class 6F1 and Class 6F2 are equivalent materials from on-site excavations.

Aggregates are often purchased for use as:

Class 6A, 6B and 6C	Starter layers below embankments
Class 6H to 6M	Fill to reinforced earth and corrugated structures
Class 6N and 6P	Fill to (concrete) structures

Unbound mixtures used in subbase

SHW Series 800 specifies the materials and methods used to construct road foundations. Unbound mixtures for use in subbase are specified by reference to BS EN 13285.

Aggregates are routinely used in:

- Type 1 unbound mixture for subbase — SHW Clause 803 and Table 8/5
- Type 2 unbound mixture for subbase — SHW Clause 804 and Table 8/6.

For particular end-uses, the SHW also details three other unbound mixtures for subbase:

- Type 3 (open graded) — SHW Clause 805
- Category B (close graded) — SHW Clause 806
- Type 4 (asphalt arisings) — SHW Clause 807.

The overall grading requirements for Type 1 and Type 2 unbound mixtures are:

% passing sieve size, mm	Type 1	Type 2
63	100	100
31.5	75–99	75–99
16	43–81	50–90
8	23–66	30–75
4	12–53	15–60
2	6–42	0–35
1	3–32	0–9
0.063	0–9	100

SHW also has requirements that control:

Type 1	Grading against values declared by the producer
Type 1 and Type 2	Percentage of particles in the 4/8mm and 8/16mm size fractions
Type 1 and Type 2	Plasticity (clay content).

Additional information

The producer must provide information that confirms the physical properties of the aggregate used in drainage, earthworks, capping and subbase:

- Los Angeles Value (LA) (fragmentation)
- Magnesium sulfate soundness (durability).

The required values are set out in SHW Clauses 503, 505, Table 6/1 and 801.

Sulfur compound content

The SHW clauses for unbound aggregates contain complex requirements to control the sulfur compound content of aggregates. This is because sulfur compounds - in many forms - can become soluble in ground water and react with concrete and metal.

The required values are set out in SHW Clauses 503, 505, 601 and 801.

The range of test data required is based on:

BS EN 1744-1	Chemical tests for aggregates Water soluble sulfates Acid soluble sulfates Total sulfur
TRL Report 447	Sulfate specification for structural backfills Water soluble sulfate (WS, Test 1) Total potential sulfate (TPS, Test 4) Oxidisable sulfides (OS, Tests 2 and 4)

The actual data required depends upon the scope of the roadworks.