

Aggregates for Path Construction

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About Sustrans

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Introduction

Aggregates are stones and rocks for construction. Different types of aggregate are further described by their size, angularity, type of rock etc.

Aggregates are normally sold as mixes of certain sizes, where each mix is intended for a particular purpose. Generally in the world of Civil Engineering aggregate descriptions are either traditional (e.g. “75mm down”) or formalised following the “Specification for Highway Works” (SHW) (e.g. “Type 1”). In addition, aggregates are also defined by their compliance to British Standards or European Norms.

Sizes

Aggregate sizes are determined by sieving, using a standard range of sieves. By nature of this method, only two dimensions of the aggregate are of the actually known size, whereas the third dimension can be smaller or larger than the sieve mesh size used. Because of this, aggregate that is said to be of uniform size seldom is so – elongated, round and flat pieces may all fit through the same sieve openings.

Standard sieve sizes are: 80mm, 62.5mm, 40mm, 31.5mm (32 is used when specifying), 20mm, 16mm, 14mm, 10mm, 8mm, 6.3mm, 4mm, 2.8mm, 2mm and smaller up to 0.063mm.

Aggregate mixes are determined (under European Norms) by the sieve size the aggregate does not fit through (lower end, d) and the sieve size where all aggregate must fit through (upper end, D). The standard form to write a range is d/D. By nature of the sieving operation, a small percentage of the aggregate in a mix described in this format may exceed the limit sizes.

In commercially available aggregate mixes (following the SHW) several aggregate sizes are mixed together in known proportions. Such size distributions are described by their “grading”: “Well-graded” means that the mix contains a good range of differently sized aggregates that interlock and form a solid surface when rolled. “Uniformly graded” means most aggregate in the mix will be of the same size and there will be lots of voids between the aggregate (railway ballast is an example).

The following sections list appropriate mix designs using the SHW that are commonly available from suppliers.

Aggregates for earthworks

The following aggregates are generally used for earthworks, not the actual path construction, i.e. as capping layer to fill sub-grade undulations, to replace weak soils or to build up embankments, etc. These aggregates are typically angular, of mixed size within a specified range, and can easily include recycled materials. Generally in these circumstances road planings, glass or recycled aggregate from other construction sites can be used. Using material that already exists on site (by excavating a borrow pit where possible) is always best before importing any new material.

Useful designed mixes from the SHW are:

Class 1A fill is a bulk fill earthworks material. The aggregate size range is between 90mm and fines, however there is no limit on how much of the material is large or small. Thus it can approximately equate to the colloquial description “75mm down” (under Euro Norms 0/80), but actually may be closer to “40mm down” (0/40). Some suppliers offer 100% recycled class 1A aggregate.

Class 6F5 fill is a capping layer material that typically contains crushed concrete, recycled asphalt and maybe crushed brick. The aggregate sizes are defined as “80mm down” (0/80) and there is a good size distribution between larger and smaller aggregate, thus ensuring some interlocking and less voids. When rolled this material will generate a stronger base than class 1A fill material.

Class 6F3 fill has the same size distribution as 6F5, but consists to 100% of recycled bituminous road planings and granulated asphalt. Using 6F3 as specification rather than “road planings” excludes uniformly graded materials, therefore using 6F3 should be the preferred material specification rather than just “road planings”. Bituminous road planings may bind if rolled in hot weather.

Railway ballast is a uniformly sized aggregate used for good drainage under railway tracks. Where it is still in place on abandoned railway lines it forms a strong sub-grade and therefore usually allows reducing the thickness of the upper layers of the path construction. As the aggregate is single size it is not normally used to build up embankments, however recycled ballast can be used to fill voids in the ground. For path construction it should be covered by a well-graded aggregate to create a smoother surface.

There are many other options for earthworks materials, which include reusing all kinds of materials that would otherwise be waste. It is most appropriate to use locally available materials. Glass, demolition waste and tyre bales have been used in the past for footpaths, bridleways and cycle routes. Path designs need to be adapted to suit the underlying materials. Sustrans staff should consult the National Cycle Network Director for further information.

Aggregates for path base

These materials are similar to earthworks materials, but generally of higher quality. Specified mixes should be used. Where recycled contents are locally available, these should be preferred. The actual stone material will depend up the source and thus if a particular material (e.g. limestone) is required it may need to be specified. The quality of even standardised materials can vary and therefore it can be worth obtaining a sample to ensure it is satisfactory prior to bulk order or delivery.

These materials are used to form the path base below the final surfacing. Depending on the condition of the underlying ground, they can often be laid directly on top of the cleared ground, with a geotextile membrane where appropriate.

Useful designed mixes for use in path bases from the SHW are:

Type 1 – this is the most commonly used path base material, and contains a good mixture of angular aggregate sized between 63mm (max) and sand, although most of the aggregate in the mix is less than 32mm in diameter. The European Norm description is therefore 0/32. The mixture may contain some or only recycled materials, but not from a single source: not more than 25% of the content may be glass and not more than 50% asphalt. Wood, plastic and metal must be less than 1% of the mix, but is an inevitable constituent from house demolitions.

Type 4 is the technical designation for recycled aggregate containing between 50 – 100% asphalt arisings (planings), mixed in some instances with crushed rock or crushed concrete. Recycled type 4 will be 100% recycled materials. The size distribution is well graded and the same as that for type 1 materials. Where type 4 is available this can be used alternatively to type 1.

“3mm to dust” – simply describes the range of sizes in the aggregate mixture. For path construction use, this should be angular. Under EU Norms this is now called 0/2mm. This is not normally used for a path base, but is used for surfacing on ‘unbound’ dust paths.

Recycled and reused aggregate

The best information on recycled aggregate can be found on www.aggregain.org.uk. Use the “specifier” tool to determine suitable recycled alternatives for quarried aggregates, or follow the information below.

The use of recycled aggregates is becoming more common in road and path construction. Typical recycled aggregates may be crushed concrete (i.e. demolition waste), road planings (from road re-surfacing work), crushed glass (made from recycled bottles), and heavy industry wastes. Unless specified aggregates are obtained (using the SHW) as with all reused or recycled products the general rule is “buyers beware”. Specifying recycled or reused aggregate safely however is easy when certain ground rules are followed:

- The merit of industrial by-products that do not form a standard mix design (e.g. pure road planings, scalpings or 100% recycled glass used instead of type 1) must be individually assessed. Some materials might be prone to leaching or unsuitable by some inherent characteristics.
- According to WRAP (the waste and resources action programme, www.wrap.org.uk), crushed glass can be used as unbound aggregate in all situations where type 1 stone aggregates would otherwise be used. While the description of “type 1” only permits 25% glass content, crushed glass with the same grading (sizing) as type 1 could be used instead. Frost heave and strength characteristics are comparable to stone aggregates.
- Crushed concrete is a possible constituent of type 1 (up to 100% of type 1 may be crushed concrete), and perfectly suitable for subbases. Check for a well-graded size distribution when obtaining “crushed concrete” rather than type 1.
- Crushed brick should generally be a suitable subbase material, provided it is well graded (use size distribution as type 1 mix). Crushed brick absorbs water better than type 1 and is therefore well suited to wet conditions.
- Road planings are generally a suitable subbase material, provided they are well graded (see 6F3 in previous section).
- Slate waste is suitable in strength, but tends to have sharp edges that create problems for cycle tyres. Where slate waste is a local material it could be considered to be incorporated into the path subbase. Crushed slate waste can also be used as a path dressing material.
- Tyre rubber (unless in very small quantities) is usually considered unsuitable for path construction.
- “Scalpings” is the waste material from quarry explosions that was sieved out before larger boulders were crushed to the required aggregate sizes. Therefore the stone strength is usually suitable for path construction, however the grading of each individual delivery may vary considerably and must be checked before use. Suppliers do not guarantee that the material is well graded.
- “Crusher run” is another waste material from quarry operations. It is the material that comes off the crusher after the first crushing, but is not carried forward to sieving. As with scalpings,

the strength of the material is usually suitable for path construction, however the grading of each batch might vary and should be checked before use. Suppliers do not guarantee that the material is well graded.

- “Hogging” is ‘as-dug’ sand and gravel waste from gravel or sand pits. Sometimes it is very good in quality, sometimes it contains a lot of clay impurities. Small quantities of clay may help with the material binding.
- Material left over from other construction sites or that is available from local farmers may be contaminated or weak. Taking over spoil material from another construction site is nowadays considered as “receiving and storing waste” (unless you are receiving a previously unused “product”) and therefore waste management licences might be required. Sustrans staff should consult the National Cycle Network Director for advice. Note: where material is reused within the boundaries of a construction site then this does not become “waste” and therefore no licences are required, it is the movement of materials from one site to another that can be problematic.

Implications for Sustrans

Choosing materials to SHW specifications is generally the safe option when specifying aggregates, as minimum standards in grading and material quality are maintained.

Sustrans generally supports the use of recycled aggregate or of material that would otherwise be considered waste. This should only be done however when aggregate has been carefully chosen, and delivery routes are not much longer than for quarried aggregate. Finding out what local quarries can provide is most useful in decision making.