

C.02 Surfaces

Key Principle

Surfaces should be chosen with due regard to whole-life costs (off-carriageway as well as on). Materials should always be machine laid to ensure a smooth running surface.

For aesthetic, environmental and cost reasons coloured surfaces should only be used at potential hazards and conflict points, or where encroachment by motor vehicles is a problem. Any decision to use coloured surfacing for all cycle facilities will need to balance the potential safety benefits against the future maintenance commitment that will be required.

Design Guidance

Background

The type of surface used on a cycle route affects the comfort and attractiveness of the facility. It also has implications for maintenance. The surface used in on-road routes is largely dictated by the requirement to provide for motor traffic but off-road, decisions regarding the surface type need to take into account the whole-life costs of the project. In many instances, a low whole-life cost will require a high initial capital cost, reflecting the high quality of construction needed to minimise maintenance and repair costs in the long-term.

Manual for Streets:

11.2.1 Developers and local authorities are encouraged to consider the innovative use of materials, processes or techniques. This could be supported by local authorities adopting a wide palette of local and natural materials, bearing whole-life costs in mind.

Surface characteristics and defects which are of little or no consequence for general traffic can pose significant problems for cyclists. For example, a 10mm pothole presents no problems to a car driver but to cyclist it can be uncomfortable. It is important to ensure that not only are construction details and materials for the cycle facility appropriate but also that a suitable maintenance regime is established (see [C06 Maintenance](#)) before the facility is brought into use.

When deciding on the surface to be employed, the designer will need to consider its suitability for purpose, construction methods and maintenance costs, and balance these against any aesthetic considerations that may apply. Detailed guidance on the construction and maintenance of cycle routes, both on and off road may be found in *Application Guide AG26 (Version2)* UK Roads Board 2003 (available from TRL).

For off-road routes, the choice of surface material will depend on;

- Suitability for purpose
- Aesthetic considerations

- Construction and maintenance costs
- Level of use

Similarly, construction layer thickness will depend on;

- The strength of the subgrade
- Drainage and frost susceptibility
- Type of surfacing
- Design life
- Level of motorised traffic and horses

Within The Carriageway

As a general rule, the geometry, including longitudinal profile, and surfaces employed on all-purpose carriageways create an acceptable running surface for cyclists. The exception to this rule is the use of raised granite sets. These provide a very unpleasant cycling experience due to the uneven surface, particularly where poorly maintained. This may prove hazardous to the frail and the young, especially when turning manoeuvres require hand signals. These problems can be mitigated by providing a smooth path for cyclists through the use of larger slabs.



Slabs used to provide a smooth ride for cyclists – historic area of Trondheim, Norway

Picture: Alex Sully

Block pavements provide a less smooth ride than the preferred bituminous surfacing. They can also trap glass, water and ice in the joints along with debris which in turn can lead to weed growth in lightly trafficked areas. Where pavements can prove useful is in more limited areas such as traffic calming features or in areas shared with pedestrians. They are preferred over paving slabs, which have relatively poor skid resistance when wet. Both blocks and sets can respond poorly to trench and other reinstatements unless a high level of care is taken when re-laying them.

Coloured surfaces

Detailed guidance of the use of signs and markings, including coloured surfaces, may be found in the draft Local Transport Note, *Signs and Road markings for Cycle Routes* LTN 3/04, DfT (yet to be published). This document states, "Coloured surfaces are not covered by TSRDG and have no legal meaning. ... However, they are useful for emphasising cycle lane markings and help to remind motorists that the surface is either primarily or exclusively for the use of cyclists".

Circumstances in which the use of coloured surfacing is considered to be beneficial include:

- ASL reservoirs and lead-in lanes including central and right hand turn cycle lanes (strongly recommended)
- Priority cycle crossings at side roads (strongly recommended)
- Contra-flow cycle lanes
- Lanes beside parking bays
- Cycle lanes beside narrow (under 2.5m wide) vehicle lanes or where the central lane markings have been removed
- At junctions particularly where there are exempted cycle movements
- Through zig-zag markings at zebra and pelican crossings and at bus stop markings
- 2-way cycle lanes
- Other locations where cyclists may be put at risk, e.g. short cycle lanes through pinch points.

These surfaces are expensive to use and maintain and for this reason the decision to employ them should be taken bearing in mind the whole-life costs of a project. They can look shabby with age, either due to wear and/or weathering. It may prove to be necessary replace them on a comparatively regular basis due to a relatively short life-span at, for example, a site where the surface is subject to large volumes of turning traffic.

The expense of using these surfaces means that if funds are limited, they should only be employed where they will have the greatest effect. Typical examples where they are most useful are advanced stop line layouts (especially if the feeder lane is away from the kerb), at the start of cycle lanes and where the latter pass side road entrances.

When choosing to employ coloured surfacing an authority should adopt a single colour throughout its area, both on and off-road. It is recommended that one of the most common colours be used, i.e. red, green or buff. Colour should not be over-used as this will devalue its impact and it can be visually intrusive. The use of red surfacing should be avoided in the presence of red tactile paving at controlled crossings as this reduces the contrast between materials to the detriment of the partially sighted. Where this has happened, a contrasting section surrounding the tactile paving, such as a white line, can mitigate this but it tends to be visually intrusive.

There are two basic methods of achieving a coloured carriageway surface:

- The use of coloured aggregates, fillers and binders in the wearing course; and
- Surface application of a coloured material

A range of materials is available to create coloured surfaces including:

- Thermoplastic paint;
- Resin based materials with coloured chips;
- Coloured macadam; and
- Slurry seal.

It is essential that these materials have an adequate skid resistance and are laid without ridges or any discernable upstand. Guidance on their use, including their advantages and disadvantages may be found in AG26. Further advice on the general use of coloured surfacing may also be found in *Design manual for Roads and Bridges* Chapter 6.3.4 TA 81/99 Highways Agency 2004

Away from the Carriageway

Within urban areas and where subject to high cycle flows, the preferred surface is a bound construction similar to that of footways, with additional thickness provided in areas subject to vehicle over-run. In rural areas, sensitive areas, and where subject to low flows, unbound surfaces may be employed. Guidance on the suitability of a range of surface types and their suitability for pedestrians, cyclists and equestrians may be found in *Provision for Non-Motorised Users* DMRB Vol. 5 Section 2, Part 4 TA 91/05.

Whether bound or unbound, urban or rural, cycle tracks should be machine laid whenever possible. This is essential to ensure the longitudinal profile is as good as that of a carriageway. The surface of a cycle track should be of a higher standard than that normally provided on pedestrian-only routes. Hand-laid materials are less satisfactory and when poorly applied may produce a surface that is unacceptable to cyclists. Detailed advice on the design, construction and maintenance of off-road cycle tracks may be found in *National Cycle Network - Guidelines and Practical Details*.

Un-bound surfaces can be dusty when dry and subject to unpleasant spray when wet. As an alternative, the surface may be sealed with tar spray and chippings on a suitable base. In addition to the use of Type 1 granular material as a base course for rural cycle tracks and paths, it is worthwhile considering suitable recycled surfacing materials, e.g. planings, arising from highway maintenance activities. Apart from the environmental benefits, this may also result in valuable savings from reduced haulage and disposal costs. Some highway authorities carry out a cycle audit of their structural maintenance projects. If so, the availability of this material can be identified by examining the audit.

Where additional strength or wearing resistance is required this can be achieved through the use of fibre-reinforced surfacing techniques. Since these are usually machine-laid the construction thickness should be increased to carry the weight of the machinery involved. Where these surfaces are used it is essential that their presence is recorded. This is so that maintenance activities, and in particular excavation, are carried out in a manner which avoids damage which can otherwise arise due to the mat-like nature of the finished product.

Typical cycle track construction in urban areas

Surface	Comment
Machine-laid asphalt or bituminous surface	Preferred surface: suitable for high flow routes, allows use of coloured surfacing
In situ concrete	Costly
Concrete block or clay pavements	Tendency to trap glass and debris, requires edge restraints
Raised granite sets	Not recommended

Typical cycle track construction in rural areas

Surface	Comment
Machine-laid asphalt or bituminous surface	Preferred surface for high flow sections: allows for coloured surfacing, including surface dressing, through choice of chipping. Lower long term maintenance costs
Surface dressed base course	Preferred to unbound surfacing: allows for colour variation through choice of chippings. Fibre-reinforced surfaces add strength.
Concrete	Costly but may be useful in localised areas such as cattle crossings
Unbound	Can be dusty when dry and subject to unpleasant spray when wet. Prone to erosion caused by poor drainage. Can have higher long term maintenance costs

Crossfall and other safety issues

Cycle tracks should have a crossfall of between 2.5% and 3% to ensure there is adequate drainage. Falls below this range may not drain the track properly and those exceeding it can be uncomfortable for some pedestrians and people in wheelchairs. Excessive crossfall can also create difficulties for cyclists in icy conditions. On straight sections, the track should ideally fall to either side from the centre. On bends, the track should always fall from the outer edge towards the inside of the curve. Additional superelevation to assist cyclists to manoeuvre around bends is generally unnecessary. On no account should the track fall to the outside of a bend (negative camber).

The presence of leaves, standing water or ice, other surface defects, gratings or slippery road markings can make curves and corners difficult for cyclists to negotiate. These hazards should be addressed through a suitable maintenance regime (see also [C06 Maintenance](#) and [C08 Drainage](#)) and proper initial design.

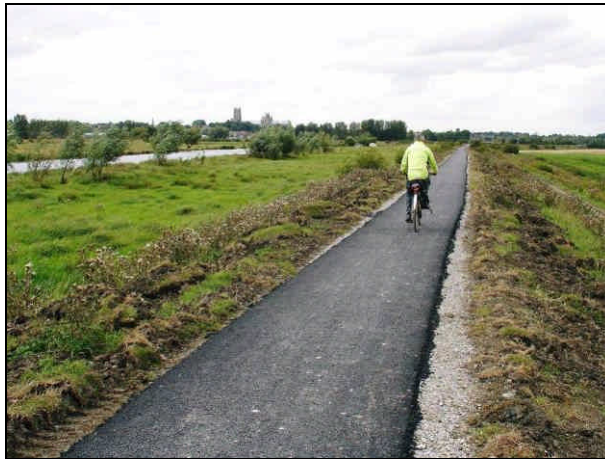
As cyclists lean into a bend, the dynamic envelope can extend over the inner edge of the cycle track. This should be borne in mind when considering the location of poles, fences or any other vertical obstructions on the inside of bends. Designers should always ensure that obstacles in the cycle track are either removed or made more visible through the use of reflective material, or paint in high visibility colours. Routes likely to be used during the hours of darkness should therefore be audited during both day and nighttime to identify any potential hazards.

Rural routes shared with horses

Where equestrians share rural off-road routes with cyclists and walkers it may be appropriate to provide parallel tracks for horses. This is because their hooves can damage unbound surfaces and bound surfaces are generally unsuitable for horses except for short lengths. Where a bound surface has to be used, tar spray and a suitable chipping can provide some grip for horses. The nature of any facility created and the surfaces employed should be determined through local consultation with all user groups.

Edging kerbs

The use of edging kerbs is rarely necessary, instead the cycle track base should be extended an additional 300 – 500mm either side of the surfacing courses. This is particularly useful where the cycle track is likely to be used by maintenance vehicles. Where this occurs, the base course depth should be increased to take account of the extra loading (thicknesses will vary according to likely traffic and the nature of the surface courses).



Note the widened
base course

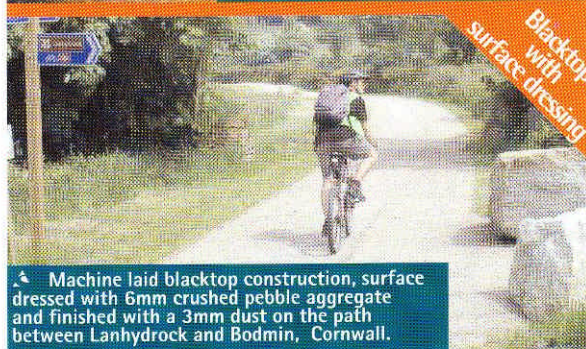
Picture: Sustrans

Rolling machine laid
wearing course

Picture: Sustrans



Network
NEWS



DENSE BITUMEN MACADAM BASECOURSE (machine laid only)

This is our preferred material for quality cycle routes and it is usually a 60mm thick layer of bituminous material with a nominal stone size of 14 or 20mm. The material is normally produced with a 20mm nominal size you would have to ask specifically for 14mm nominal size and not all suppliers will provide as it does not conform to standard gradings. Commonly referred to as either "blacktop" or "Bitmac". Normally this material is used as a base layer and overlain with a wearing course material, and not as a surface layer as we use it. Our method is entirely appropriate and provides value for money. Hot Rolled Asphalt is a different material to Dense Bitumen Macadam and is more commonly used as a wearing course layer for roads and footpaths.

Advantages: ● Sealed surface, low maintenance costs. ● Surface profile is smooth leading to comfortable ride. ● Inherently strong. ● More sympathetic surface dressing can be overlaid onto material in environmentally sensitive areas. ● Does not suffer erosion easily. ● Material colour will fade from black to light grey naturally within 6 months. In addition haunching and early completion of the edges will soften the affect of colour of the material. ● On disused railway corridors material can be applied directly to the ballast, which has been profiled, this leads to a cost saving in the formation layer. ● Material can be laid without edgings on subbase layer. Gives a more relaxed and informal look while significantly reducing the cost.

Disadvantages: ● When first laid can look intrusive especially in rural or sensitive areas. ● Surface texture can appear very open. Overcome by using smaller size nominal stone. Or additionally overlaying with a wearing course material which would be more closely textured.

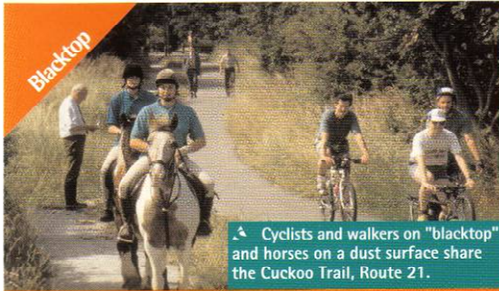
SURFACE DRESSING

This is the application of a layer of stone chippings using a bituminous spray onto a foundation layer. The bituminous spray acts as the adhesive, which holds the chippings in place. Commonly referred to as "Tar Spray and Chip". The chippings are normally washed gravel but can be other manufactured chippings i.e. angular rather than smooth. The foundation layer onto which the chippings are laid can

On

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TECHNICAL TIPS from the Sustrans Construction Team



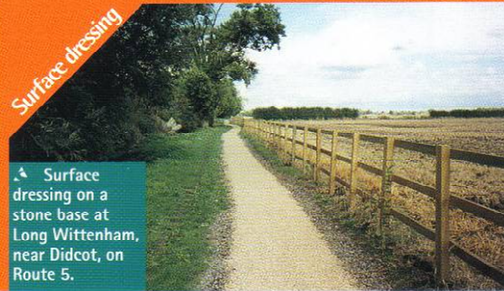
▲ Cyclists and walkers on "blacktop" and horses on a dust surface share the Cuckoo Trail, Route 21.



▲ Route 1 between Canterbury and Fordwich sees the use of Fibredec.



▲ Limestone dust on Route 5 on the Stratford Greenway, Stratford on Avon.



▲ Surface dressing on a stone base at Long Wittenham, near Didecot, on Route 5.

the surface

be either a stone base or a Dense Bitumen Macadam Basecourse.

Advantages: ● Semi sealed surface. ● Not so intrusive as usually sourced locally so is in keeping with the environment you are working in. ● Fibreglass shards can be used in the adhesive to reinforce the dressing, gives it some limited inherent strength. This is provided by a Company called Colas as a proprietary product called Fibredec. ● This material can be used on routes, which are used by horses because the material is slightly flexible and "gives" which horses appreciate. This only applies when the base layer is stone not a Dense Bitumen Macadam. ● Surface profile is normally good leading to a comfortable ride. However this is dependent on adequacy of foundation layer, which must be strong enough, and careful construction that is best done via a drag box or paver machine. ● In environmentally sensitive areas a clear adhesive rather than a bituminous one could be used, which is black.

Disadvantages: ● Chippings can be worn away by flow of water, especially if high flows are expected. This usually relates to the underlying formation being eroded, which results in damage occurring to the top surface. ● Not as durable as Dense Bitumen Macadam. ● Requires adequate foundation layer.

LIMESTONE DUST

This is a thin layer of dust usually 30mm in depth, which is a graded material 0-3mm,

RECYCLED MATERIALS: A range of recycled materials is available to be used instead of the primary aggregates described above and should be used wherever possible. A couple of examples of this are the use of both Crushed Concrete and Road Planings (material arising from roads which are replaced or dug up) as Subbase. Crushed brick dust and certain shales have also been used as surface materials. Self Binding Gravels, sometimes referred to as Coxwell Gravel or Breendon Gravel, are commonly used in public areas e.g. Parks. These materials are a grading of naturally occurring sands, gravel and clay. The material is more expensive to use than both the surface dressing and limestone dust described above. Block or Brick Paving is an option but a very expensive one and only usually specified when Local Authorities are dealing with Developers and discussing Section 106 agreements.

ening process to be completed. No adhesive is used to bind the dust to the stone layer. Whindust is a similar material but derives from Granite and performs in a similar way.

Advantages: ● Very unobtrusive especially if locally sourced material is used. Colour can vary depending on source from a pink tinge to a light grey ● Surface profile is normally good leading to a comfortable ride. However, this is dependent on adequacy of foundation layer, which must be strong enough ● Very easy to lay. ● Is self-leveling to a certain degree in that high spots fill the low areas.

Disadvantages: ● Not inherently strong. ● Suffers erosion very easily. ● Maintenance can be problematic. ● The material is frost susceptible. ● Horses can cause serious damage to the integrity and profile of a path. Especially if they use a path from new. If the path is allowed sufficient time for the hardening process to complete then this damage is much reduced. ● Depending on where you are geographically in the UK it may be difficult to source this type of material, for example in Cornwall and the South-East. ● Material is lost annually, through erosion, for example wind, resulting in thinning of layer thickness. Resurfacing required between five to 10 years after initial laying.

Publications

[Design Manual for Roads and Bridges TA 81/99 Coloured Surfacing in Road Layout \(Excluding Traffic Calming\)](#) (pdf – 303kb) Highways Agency 1999

[Design Manual for Roads and Bridges TA 91/05 Provision for Non Motorised Users](#) (pdf – 562kb) Highways Agency 2005

[Manual for Streets](#) DfT, Communities & Local Government 2007

[Policy, Planning and Design for Walking and Cycling](#) – Local Transport Note 1/04, Public consultation Draft, DfT 2004

[Adjacent and Shared Use Facilities for Pedestrians and Cyclists](#) – Local Transport Note 2/04, Public consultation Draft, DfT 2004

[Traffic Signs Regulations and General Directions](#) DfT 2002

[CRN 96 - On the right track: surface requirements for shared use routes](#) Countryside Agency 2005 – summary

[CRN 213 - On the right track: surface requirements for shared use routes](#) (pdf – 1133kb) Countryside Agency 2005 – full guide

[Cycling England Gallery](#) pictorial examples

[London Cycling Design Standards – A guide to the design of a better cycling environment](#) (Sections 3.4, 3.5, and 3.6) TfL 2005

[Lancashire - The Cyclists' County](#) (pdf - 5.45Mb) (Section 3) – creating pleasant road conditions Lancashire County Council, 2005

[CTC Benchmarking – Best practice case studies](#)

[Making Ways for the Bicycle](#), Sustrans, 1994

[National Cycle Network – Guidelines and Practical details, Issue 2](#) Sustrans 1997

Other references

[Cycle Friendly Infrastructure - Guidelines for Planning and Design](#), Bicycle Association et al 1996