Chapter 7

Construction, including surfacing

7.1 Introduction and general issues
Basic construction requirements
Drainage
Construction of kerbs and segregating islands

7.2 Surfacing
Surfacing material options
Asphalt surfacing
Coloured surfacing
Comparison of surface materials
Road marking materials

7.3 Footways and tactile paving
Principles for application of tactile paving
Corduroy tactile paving
Tactiles for shared use: ladder and tramline
Blister tactile paving
Pedestrian guardrailing

7.4 Maintenance and asset management
Landscape growth
Surface defects
Maintenance of signs and markings
Maintenance regimes

7.5 Structures
Bridges and ramps
Tunnels and subways
7.1 Introduction and general issues

7.1.1

Close attention must be paid to construction standards and details to ensure that routes are: safe and comfortable for cyclists, attractive, legally acceptable, easy to maintain and durable.

7.1.2

Quality of construction for cycle infrastructure is covered by the Cycling Level of Service assessment, as shown in figure 7.1.

Figure 7.1 Key construction considerations in CLoS

<table>
<thead>
<tr>
<th>Factor</th>
<th>Indicator</th>
<th>Relates in this chapter to...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directness: Directness</td>
<td>Deviation of route</td>
<td>Major infrastructure such as bridges and tunnels to make direct connections.</td>
</tr>
<tr>
<td>Comfort: Surface quality</td>
<td>Defects: non cycle friendly ironworks, raised/sunken covers and gullies</td>
<td>Surfacing material options, drainage design and road marking materials.</td>
</tr>
<tr>
<td>Coherence: Wayfinding</td>
<td>Construction: asphalt concrete, HRA or blocks/bricks/setts</td>
<td></td>
</tr>
<tr>
<td>Attractiveness: Greening</td>
<td>Green infrastructure or sustainable materials incorporated into design</td>
<td>Use of permeable surfaces as appropriate.</td>
</tr>
</tbody>
</table>

7.1.3

Streetscape issues need to be considered in all aspects of design. Cycle schemes should seek to reinforce the distinctive character of places and neighbourhoods and wherever practical improve environmental quality by lessening the predominance of motor traffic and traffic related street furniture. Street designers are directed to chapter 5 of this document and to the TfL Streetscape Guidance (2009) as well as other national and individual borough’s streetscape guidance documents and streetscape-related supplementary planning documents.

7.1.4

The sections below set out general advice to inform design development. In all cases, the highway authority and its standard details for carriageway and footway construction should be consulted. This is particularly important wherever the authority is expected to adopt the facility: non-compliance with the relevant standards could lead to rejection.
7.1.5
Similarly, the highway authority’s lighting unit will need to be consulted on all lighting proposals. An appropriate level of lighting is important for all cycle routes. This may entail upgrading existing lighting or the provision of new lighting in open spaces, particularly where there are concerns for personal security. For aesthetic and conservation reasons, lighting may not be acceptable through parks and other green corridor areas. If adequate lighting is not feasible on routes away from the highway then alternative night-time routes should be provided.

7.1.6
In some areas lighting units may be targeted and damaged by vandals, so this will need to be taken into account in the provision. It is now possible to obtain solar powered equipment for some installations, although this is only likely be suitable for low-power uses.

Basic construction requirements

7.1.7
Practicalities such as cost, consideration of future maintenance and availability of materials have a significant bearing on decisions about construction of paths, tracks and cycle lanes. However, it is essential to remember that, from the perspective of the user, the riding quality and reliability of the surface are the most important construction considerations (see section 7.2 below).

7.1.8
A standard carriageway construction is appropriate for all cycling infrastructure on carriageway. Some modifications to the surface may be required to incorporate cycle lanes, advanced stop lines, or traffic speed control measures (traffic calming). Dimensional tolerances should follow normal highway standards, and when a new cycle route is installed a check should be carried out to confirm that this is the case.

7.1.9
Off-carriageway, cycle tracks and shared paths will generally have a similar construction to footways or footpaths. Factors to consider include occasional use by motor vehicles (eg. maintenance) and ground conditions.
Chapter 7 – Construction

7.1.10

For all types of construction, the surface is in built up in a number of layers – typically surface course, binder course, base and sub-base. The binder, base and sub-base should be chosen and applied in accordance with the local authority’s highway design standards, and in a manner appropriate to the context. When considering what depth of construction to adopt, it should be borne in mind that one of the most common reasons why some cyclists use the main carriageway in preference to a cycle track alongside the road is that the riding quality of the main road carriageway is better. The riding quality of any cycle track should be at least as good as that of the adjacent road. Further detail is provided in the guidance referred to above.

7.1.11

The depth of each layer will depend on the materials and local ground conditions – indicatively for a cycle track, a surface course may be around 25mm, the binder and base course may be another 50mm and the sub-base 125-225mm.

7.1.12

In all cases, consideration should also be given to:

- the impact of construction and the choice of materials on drainage
- responsible sourcing and re-use of construction products (bearing in mind that certain types and colours of aggregate, for example, may not be local and will need to be transported over a long distance)
- local character, and selection of materials appropriate to the context, which may be covered in local design or streetscape guidance

The porosity of surface, binder and base materials should be a consideration for any integrated approach to sustainable drainage.
7.1.13
For cycle tracks and shared footways, adequate edge restraint should normally be provided in the form of edging to restrict the deformation and erosion of the facility. Standard 50mm wide, 150mm deep concrete edging is normally suitable, which can be laid flush to allow water run-off, or raised as a low (50mm) kerb if adjacent to a pedestrian way if required. Alternatively kerbs (125x150mm) either bull-nose, battered or half-battered can be used. Kerb-faces of 50-100mm should be used, 50mm being preferable for cyclists.

7.1.14
Kerb re-alignment will be needed in many instances. Any new carriageway construction should be to normal highway standards unless there is kerb segregation of the cycle lane. Carriageway construction depth depends on ground conditions and expected loadings – indicatively, this may be around 600mm. This can entail the relaying and/or protection of utilities plant (electricity, gas, water, foul and surface water drainage, telephone, cable TV, tram cables etc.)

7.1.15
Maintenance of the riding surface after construction is essential to ensure the facility delivers a high level of service. This includes proper reinstatement following works by statutory undertakers. Close attention to drainage is necessary so that ponding is avoided as this provides a poor level of service and can result in cyclists moving into positions where conflict with other traffic is more likely to occur.

Problems caused by ponding

Drainage

7.1.16
Gully location and levels are critical for cyclists to ensure good route drainage. This is particularly important where segregation for cycling has been introduced. Acceptable gully characteristics are as follows:

- no gaps between the frame and cover wider than 15 mm
- transverse bars or ‘portcullis’ type bars on the cover
• recessed gully frames raised to be flush (tolerance +/- 5mm) with the surface
• suitable for their location to take public highway loadings
• open in a manner suitable to be cleansed by a normal gulley cleansing or jetting machine under the relevant highway authority contract

7.1.17
Dished and other gratings unsuitable for cycling across should be replaced. Side-entry gullies or perforated kerb type gullies (such as Beany Blocks) may be suitable in some circumstances, particularly where there is restricted width and where cyclists will be close to the kerb. Drainage on cycle lanes and tracks may need additional gullies as well as appropriate falls to facilitate run-off. A minimum grating size of 300 x 300mm is recommended, as the smaller size gully gratings that are sometimes used in off-carriageway situations tend to get blocked.

7.1.18
In any location where there is a possibility that cycle wheels will cross gullies, the grate slots should be at right angles to the direction of travel. Alternatively, non-slot ‘pedestrian style’ gratings should be provided.

7.1.19
Falls of at least 1:40 cross-fall and 1:200 longitudinally are preferred. With non-machine laid surfaces steeper longitudinal falls will be required. Falls on roads (including ‘summit and valleying’) have often been reduced or removed during resurfacing, and so may need to be corrected. Any areas of ponding on a cycle route that will have an adverse effect on cyclists should be addressed, including where splashing from a carriageway onto an adjacent cycleway occurs.
Construction of kerbs and segregating islands

7.1.20
Low kerbs (50-100mm high face) may be appropriate between cycling and pedestrian surfaces. These can allow better use of restricted space by maximising effective width – allowing cyclists to travel closer to them without risk of catching pedals on the kerb. Bullnose, battered (45º faces) or half-battered kerbs can be used to help increase effective width in this way. Red-brick and block-battered units are also available. Kerbs, blocks and edging will normally be laid on a 150mm deep bed and haunchings in lean concrete – refer to local authority's standard details for construction.

7.1.21
Where they are necessary, dropped kerbs should be specified as flush, within a tolerance of +/-6mm of the adjacent surfaces, to provide a comfortable surface for cyclists. Where appropriate, minor upstands can be beneficial as a speed control measure for cyclists. Particular care is needed with channel levels to ensure that ponding does not occur at crossing points.

7.1.22
The edges of cycle tracks and segregated lanes need to be detailed so as to provide clear but safe delineation between carriageways and footways. Depending on width and on context (particularly in conservation areas), suitable materials for the edge strip or segregating island may include: paving slabs, block paving, granite setts, or coloured surfacing.
7.1.23
A strip or island installed to create segregated cycling facilities may also incorporate parking bays, lighting columns and other street furniture. Features such as low walls and planting may be appropriate to either protect the cycling area or improve the ambience. Guard railing and crash-barriers can create dangerous squeeze points, particularly where heavy goods vehicles turn, so they should be used only with caution, and with consideration for impact on cycling provision on-carriageway.

7.1.24
The segregating strip should be visually differentiated from the cycle lane or track by using a contrasting material. Paved strips with granite kerbs may be appropriate in more central urban settings but grass verges may also be suitable. They are relatively easy to maintain and provide suitable space in which to take avoiding action in case of an emergency. Any planting should be designed with consideration of safe and effective operation of the cycling facility. Plant height and growth, for example, should not affect forward visibility, and thorny bushes should be avoided adjacent to the edge of the cycling facility.
7.2 Surfacing

7.2.1

Good surface riding quality is essential for cyclist safety and comfort. This is the case whether cycling is on- or off-carriageway. Cyclists need a smooth riding surface, which should not be undulating and should have skid resistance appropriate to the location.

- The surface should be laid on adequate, well compacted base materials so that subsequent settlement does not occur.
- Sudden changes of level or ‘steps’ should be avoided, and inspection covers and transitions between on and off-carriageway should be flush.
- Potholes, rutting and other surface defects should be rectified.
- Patching or re-surfacing, and deeper trench reinstatements should be carried out as necessary.
- Where anti-skid surfacing is used, it should continue over ironwork particularly where cyclists are likely to be changing direction.

Bituminous surfaces should be well laid, usually by machine, with a finish to highway standards and including vertical tolerances no less stringent than applicable to carriageways.

Surfacing material options

7.2.2

This section sets out the most common materials that are used to create a good quality surface for cycling, whether on carriageway, on a dedicated track or on a shared use path – see figure 7.2 below.

Figure 7.2 Surface construction options

| Surfacing material | 
|--------------------|---|
| Asphalt surfacing: asphalt concrete, hot-rolled asphalt, or thin surface course system | Generally recommended for cycling – see section below. |
| Concrete | Historically used on estate roads, good for cycling if the joints and slabs are in good condition, but surface markings are not clearly visible. |
| Brick or block paving | Acceptable for cycling on, but skid resistance can be low on some brick paving types. Can be beneficial where high cycling speeds are not appropriate. |
Natural stone blocks | May be suitable if bedded on mortar/concrete and surface is not uneven or smooth, and has good skid resistance.
---|---
Granite setts | Too rough for some bikes, but if laid flush can be acceptable in limited areas. Can polish with use and be slippery when wet.

### Surface-applied treatments

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-binding surfaces, e.g. limestone fines to dust, Coxwell gravel (which has a reddish colour) and hoggin (a well-graded mixture of sand, gravel and clay)</td>
<td>Often used for rural paths, but poor skid resistance and not very durable. Requires a 100mm aggregate base. It remains loose-ish and dusty and is suitable only for lightly trafficked, environmentally sensitive areas or anywhere where a bound surface would not be acceptable.</td>
</tr>
<tr>
<td>High-friction surfacing (anti-skid), cold applied</td>
<td>Normally acceptable for cycling but laying methods resulting in ridges should be avoided (ie. lay in longitudinal rips rather than transversely)</td>
</tr>
<tr>
<td>Coloured veneer coat</td>
<td>Specialist coloured surfaces in blue, green, red etc. laid on to wearing courses, normally anti-skid</td>
</tr>
<tr>
<td>Resin-bonded or tar spray and chip dressing</td>
<td>Often used to change the colour or grip of an existing asphalt surface. Has the appearance of loose gravel but the aggregate held firmly in place. It only works on surfaces that are already well constructed and in good condition. Loose aggregate must be swept from the path before use.</td>
</tr>
<tr>
<td>Surface dressing – resin-bound pea shingle (6-8mm stone)</td>
<td>A cheap maintenance layer, suitable for rural/park situations, lower skid resistance, traditionally used on country roads.</td>
</tr>
<tr>
<td>Surface dressing – granite stone</td>
<td>A cheap maintenance layer, acceptable for cycling if the stone size is not too large (10-14mm).</td>
</tr>
<tr>
<td>Slurry sealing</td>
<td>A cheap maintenance layer, suitable for temporary cycling use only</td>
</tr>
</tbody>
</table>

### 7.2.3

Types to be avoided for general cycling use include:
- paving slabs/flags – lower wet skid resistance and risks of trips and rocking
- cobbles (pebbles in concrete) – uncomfortable surface with poor skid resistance
• ungraded aggregate such as shingle, ballast or scalping – poorly graded materials will be too rough and bike wheels will sink in.

Pea shingle paths in Kingston: Skerne Walk (left) and Thames Path (right)

7.2.4

Self-binding surfaces and surface dressings can be used in some circumstances, generally away from the highway, but sealed surfaces (using bitumen or other polymer-bound materials) should normally be chosen for cycling infrastructure. Sealed surfaces tend to more expensive to construct but last longer, so the level of service is significantly better and whole-life costs are usually much lower. See Sustrans, *Cycle path surface options, technical information note no.8* (2012).

7.2.5

For routes across parks or commons, bitumen or polymer-bound materials are preferred, such as pea shingle surface dressing, to ensure that a smooth and durable surface is provided. In these conditions it may be appropriate to omit formal concrete or timber edging and allow the edge to gradually deteriorate and become overgrown by grass. This will result in a loss of edge width of up to 300mm. Alternatively, treated timber edge restraints may help maintain the durability of the path and sub-base but still be sympathetic to the environment.

7.2.6

Unbound surfacing such as gravel or hoggin is only recommended for lower usage recreational routes, due to problems with deterioration of the surface caused by weather and use by traffic. These surfaces will also result in more road grime on cycles. Routes likely to be used by commuters and utility cyclists should always be hard surfaced.
Chapter 7 – Construction

Asphalt surfacing

7.2.7

The typical choice for the carriageway, and for many footways, is an asphalt surface. Asphalt used for roads and paths contain bitumens and aggregates which give a durable, joint-free surface that is relatively straightforward to construct and maintain. Different products are available, each with their own properties. The main variables are the aggregate size, aggregate content, binder content and binder grade, which have an effect on stiffness, resistance to cracking and other physical properties of the asphalt. The smoothness of the riding surface tends to be dictated by the texture depth of the asphalt – the higher the texture depth, the rougher the surface and vice-versa.

7.2.8

Asphalt surface treatments for carriageways, cycle tracks and footways generally come in one of three forms:

**Asphalt concrete** (also known as bitmac or dense bitumen macadam)
A close-graded, 6mm asphalt concrete is typically used on footways and cycle tracks as it gives a consistent and smooth surface finish. Designers should also consider porous asphalt concretes where sustainable urban drainage is of benefit to the area.

**HRA, hot-rolled asphalt.** (with or without pre-coated chippings)
This was the UK surface material of choice before the 2000s. Its use has been in decline especially in urban areas due to the positive textured nature of this material, which means it generates more noise than some other treatments. For HRA with pre-coated chippings, hard-stone (often granite) chippings are rolled into the asphalt surface course while it is still hot. They add texture to the surface and therefore increase its skid-resistance properties. The chippings are pre-coated with a binder, which can contain coloured pigment if necessary. They must be hard-wearing but with a high polished stone value (PSV), so that they are durable and do not polish over time. A typical choice for carriageway surfaces would be HRA 35/14 but other carriageway and footway grades exist.

**TSCS, a thin surface coarse system**
This is often applied to carriageway rather than footway surfaces. It typically uses a 10mm or 14mm aggregate. The advantage of using TSCS is that these materials come in a variety of texture depths and also colours. The use of clear bitumens and coloured aggregates allows these materials to be used as decorative asphalts. Use of such decorative asphalts is not recommended in areas of load unless assurances are sought from material suppliers. Note that proprietary types of TSCS have replaced generic stone mastic asphalt (SMA).

7.2.9

The use of all these materials is described in the European Standard Specification EN13108 and thicknesses should be specified using the British Standard BS594987:
In selecting a suitable type of asphalt for a given location, consideration should be given to the wider approach to sustainable drainage – specifically the extent to which the surface material may contribute to run-off into gullies and drains, or may be capable of holding water in situ during a rainfall event and allowing it to permeate slowly into the ground or on highway drainage systems. Open-graded asphalt concrete (where finer particles are eliminated from the aggregate mix) is more porous, and may therefore be more suitable as part of a SUDS-led approach, but its ability to hold water reduces after application because of accumulation of dust and other particles. It can be cleaned using a high-pressure washing, but it is difficult to reinstate its original appearance. Any porous surface material can be laid on a porous base or installed as part of the highway drainage.

Coloured surfacing

In most situations black bituminous surfacing in conjunction with cycle symbols and appropriate lane markings is satisfactory. This should be the norm except in locations of potential conflict where colour may be considered, such as ASL boxes and feeder lanes (see sections 4.3 and 6.4). For some shared use facilities a different surface treatment may also be beneficial in distinguishing these areas from dedicated cycle facilities though this is usually best achieved by using different materials.

The colour of asphalt surfaces depends largely on the colour of the aggregate used. This can be emphasised by using a clear binder – often a synthetic or vegetable-based binder. Coloured pigment can also be added but the colour of the aggregate endures much longer than any added colour, which tends to fade over time as the bitumen is worn from the riding surface. Coloured aggregate may cost up to twice as much as the standard shades of black/grey.

In conservation or other sensitive areas, natural stone-coloured chippings on HRA or natural stone-coloured asphalt concrete can be used. These colours can have longer life and better colour retention than other colours, but are often less visible.
7.2.14

In London it is generally agreed that where colour is used for marking cycling facilities, it should be Deep Chrome Green (No 267 BS381C: 1988) or blue on Cycle Superhighways (RAL5075).

Comparison of surface materials

7.2.15

Among the most important considerations in choosing an appropriate surface material are cost (and variation by colour), durability and skid resistance. Polished stone value (PSV) gives a measure of skid resistance. A PSV of 55 is normally acceptable for road skid resistance. Figure 7.3 below shows, indicatively, a comparison of different surface materials and treatments according to these criteria. Only materials costs are included here. Laying costs can vary considerably depending on the area (m$^2$) and the required traffic management arrangements – difficult and restricted access, in particular, are likely to increase costs. The cost per square metre will also be higher for smaller areas. In each case, more accurate figures should be obtained from suppliers.

Figure 7.3 Surface treatments and indicative costs

<table>
<thead>
<tr>
<th>Surface Material</th>
<th>Life (years)</th>
<th>Skid resistance (PSV)</th>
<th>Indicative cost per square metre (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>6mm asphalt concrete</td>
<td>20</td>
<td>60+</td>
<td>8</td>
</tr>
<tr>
<td>Coloured TSCS, 30-50mm thick</td>
<td>20</td>
<td>55+</td>
<td>-</td>
</tr>
<tr>
<td>Block paving</td>
<td>20</td>
<td>55</td>
<td>20-30</td>
</tr>
<tr>
<td>Brick paving</td>
<td>20</td>
<td>-</td>
<td>20-40</td>
</tr>
<tr>
<td>Concrete paving flags</td>
<td>10</td>
<td>-</td>
<td>20-30</td>
</tr>
<tr>
<td>Tactile paving</td>
<td>10</td>
<td>-</td>
<td>30-40</td>
</tr>
<tr>
<td>York stone flags</td>
<td>20</td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td>Granite paving flags</td>
<td>20</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Thermoplastic High-Friction Surfacing</td>
<td>4-6</td>
<td>70+</td>
<td>13</td>
</tr>
<tr>
<td>Resin High-Friction Surfacing</td>
<td>8-10</td>
<td>70+</td>
<td>15</td>
</tr>
<tr>
<td>Cycle Track Veneer (thermoplastic slurry)</td>
<td>5</td>
<td>55+</td>
<td>8</td>
</tr>
</tbody>
</table>
### Surface Material

<table>
<thead>
<tr>
<th>Surface Material</th>
<th>Life (years)</th>
<th>Skid resistance (PSV)</th>
<th>Indicative cost per square metre (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle Lane Veneer (polymer binder)</td>
<td>10</td>
<td>55+</td>
<td>Normal 10, Red 12, Blue/Green 12</td>
</tr>
<tr>
<td>Slurry Seal (poor colour and life)</td>
<td>5</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Surface Dressing – Granite Stone (bituminous binder)</td>
<td>20</td>
<td>60+</td>
<td></td>
</tr>
<tr>
<td>Surface Dressing – Granite Stone (clear binder colour enhance)</td>
<td>20</td>
<td>60+</td>
<td></td>
</tr>
<tr>
<td>Surface Dressing – Pea Shingle Stone</td>
<td>20</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

### Road marking materials

**7.2.16**

A consistent standard of road markings is required, as described in TSRGD and the Traffic Signs Manual, chapter 5. For cycle symbols to diagram 1057, pre-formed markings are preferred.

**7.2.17**

Re-surfacing works can be an opportunity to review and address various aspects of construction quality (falls to prevent or address ponding, gulley positions, grating types, chamber covers) and provision for cyclists (lane widths, pinch-points, corner radii, road markings).

**7.2.18**

Depending on the policy of individual highways authorities, resurfacing may be an opportunity to re-mark red and yellow lines in the minimum width, as recommended in the Traffic Signs Manual, chapter 5. This needs to take into account enforcement requirements, maintenance and the need for consistency between boroughs and across London. Narrower line markings reduce visual intrusion, save on materials, can help to visually accentuate the width of cycle lanes or coloured surfacing, and can reduce the risk of two-wheelers skidding on road markings in the wet.
7.2.19

The possible application of raised rib markings to cycle lane markings is a measure currently under trial. The idea would be to give an audible and vibratory warning to motor vehicles that they have encroached into a cycling facility. TSRGD (Schedule 6, Diagrams 1012.2 and 1012.3) describes two types of ribbed marking, used for the edge of carriageways, one with a maximum 11mm upstand, used for motorways, and the other with an 8mm upstand. TSRGD does not recommend applying either to a cycle lane marking: approval would need to be sought from DfT for any proposal to do so.

7.2.20

Road studs, or cat’s eyes, are an authorised marking, primarily a means of illuminating other road markings. These must comply with the requirements of TSRGD (Direction 57 / 58) and may only be used in conjunction with those markings stipulated in direction 31(5). This does not currently include diagram 1049 mandatory cycle lane marking. Any proposal to use them on cycle lane markings would need to be raised with DfT and trialled.
7.3 Footways and tactile paving

7.3.1

The needs of pedestrians must be considered in the design of cycle facilities, in particular the needs of mobility and visually impaired people and people with learning difficulties. The layout of pedestrian facilities should be as simple and logical as possible and be consistent along a route.

7.3.2

Advice on tactile paving – provision of surface textures to assist blind and partially sighted pedestrians – can be found in DfT’s Guidance on the use of Tactile Paving Surfaces (2007). The following documents also provide useful guidance on general issues and those specifically related to integration with cycling facilities.

CABE, Sight Line (2010)
RNIB, Building Sight (1995)

Joint Committee on Mobility of Blind and Partially Sighted People (JCMBP), Adjacent Facilities for Pedestrians and Cyclists (2004)

DfT, TAL 4/90 Tactile markings for segregated shared use by cyclists and pedestrians (1990)

7.3.3

Types of tactile paving likely to be used in the construction of cycle facilities and covered in this section include:

- ‘corduroy’ paving to warn pedestrians of hazards, such as shared surfaces
- longitudinal ribbed ‘tramline’ paving to show cycle only surfaces adjacent to paths
- transverse ribbed ‘ladder’ paving to show pedestrian only areas
- 12-20mm high raised tactile marking (diagram 1049.1) to delineate cycling from walking surfaces
- blister paving adjacent to areas where pedestrians cross at controlled and uncontrolled crossings

Principles for application of tactile paving

7.3.4

It should be noted that there is variation in practice between highway authorities, so specific authority practice agreements will need to be taken into account. However, in principle, consideration for users should be paramount and this means that guidance should not be applied in an overly rigid manner.
Chapter 7 – Construction

Design should be as supportive as it can be for all users, while avoiding over-complication, illegibility or confusion. National guidance on tactile paving needs to be interpreted in an intelligent and balanced way, informed by a good understanding of the purpose of all the elements in any context and of the messages that need to be conveyed to different users.

7.3.5

Signage and tactile paving can never redeem poor design. In all cases, consideration needs to be given to the message they communicate to the intended user. In urban areas where junctions are numerous and movements are complex, it is important to understand what the main pedestrian and cyclist desire lines are and to use tactile paving to clearly alert mobility and visually impaired people to the greater risk.

7.3.6

Tactile paving should be provided so that all users can detect it and therefore needs to be no deeper than the length of the longest likely stride. Research undertaken in 2010 by University College London concluded that ‘the blister profile is readily detectable when it is 800mm wide’, leading TfL to make a recommendation (in Streetscape Guidance design best practice note D4, 2012) that the minimum width for longitudinal blister tactile paving on TLRN should be reduced from the 1200mm recommended in national guidance to 800mm.

7.3.7

On the basis that the same principle applies to other types of tactile paving, it is reasonable to assume where tactile paving is intended to be understood only by pedestrians, the minimum depth should be 800mm, ie. two rows of 400x400mm flags.

7.3.8

Seeking to rationalise the amount of tactile paving used in a scheme makes sense from the perspective of legibility and comfort. Moving across certain types of tactile paving can be uncomfortable for both pedestrians and cyclists and therefore they should, ideally, be used sparingly.

Corduroy tactile paving

7.3.9

According to Guidance on the use of Tactile Paving Surfaces, ‘The purpose of the corduroy surface is to warn visually impaired people of the presence of specific hazards: steps, level crossings or the approach to on-street light rapid transit (LRT) platforms. It is also used where a footway joins a shared route. It conveys the message “hazard, proceed with caution”.’
7.3.10
This national guidance should be consulted for details of how and where corduroy tactile paving should be used. In most instances where cycling and pedestrian facilities at footway level are separated, ladder and tramline tactile should be used to show a transition between separated facilities and a shared use area. Corduroy tactile is only likely to be necessary where another footpath (pedestrian use only) joins a shared area.

7.3.11
Corduroy tactile paving material has ribs that are rounded at the top and spaced closer together (50mm apart) than ladder and tramline tactile paving. It should be accompanied by a shared use sign to diagram 956. Buff, grey or charcoal colour tactile paving is available to match the footway. The depth of 1200mm recommended in Guidance on the use of Tactile Paving Surfaces may be reduced to 800mm in most instances for reasons described above.

7.3.12
Corduroy tactile paving material has also developed a ‘variant’ use (ie one not described in DfT guidance) as substituting for a kerb edge in schemes where a level surface treatment has been applied. This is in order to help blind and partially sighted pedestrians find the edge and is intended particularly to assist cane users. Whether this treatment is appropriate will depend on the overall design for a street. It should not be applied without broader consideration of the needs of all users as part of a scheme and without assurances from user groups that it will convey the intended message.

Tactiles for shared use: ladder and tramline

7.3.13
Guidance on the use of Tactile Paving Surfaces and Traffic Advisory Leaflet TAL 4/90 recommend that corduroy and ladder-and-tramline tactile paving should be applied to shared use areas to allow people, particularly visually impaired users, to detect a transition between a shared area and separate spaces for pedestrian and cycle movement. On the cycling side, the ‘tramline’ tactile is aligned with the direction of movement. On the pedestrian side, it is laid transversely in a ‘ladder pattern’ – that is
across the direction of movement. Raised profiled delineator markings (TSRGD diagram 1049.1) are used to divide the surface.

### 7.3.14

Ladder and tramline tactile paving material ribs are wider and flat across the top, and they are spaced further apart (70mm) than on corduroy type tactile paving. The profiled slabs are available in the normal modular paving size of 400 x 400mm in various colours. These include light or dark grey, buff, or green, so that a consistent colour background can be achieved and also to allow painted markings such as give way or cycle logos to be more visible.

### 7.3.15

It is possible to use tramline tactile paving on its own at the start of a cycle track and accompanied by cycle track sign TSRGD diagram 955, or at the start of a segregated path with sign diagram 957. However, it is preferable that other visual cues should be used to identify a facility as a track or path for cyclists before resorting to tactile paving.

### 7.3.16

A proportionate approach needs to be taken to applying these tactiles, bearing in mind the message that needs to be conveyed. For example, where ladder-and-tramline tactile paving indicates a transition from separated to shared provision, then the key recipients of the message are cyclists. Entering a shared area means, for them, that they are more likely to encounter pedestrians and that there is a much greater obligation to act with courtesy and give way to pedestrians, modifying their speed as necessary.

### 7.3.17

For pedestrians, understanding the message about the shared area, or knowing that they have passed from a dedicated pedestrian space into a shared area, is less crucial because a change in behaviour is not necessarily required from them. It is important, however, that they understand when they are stepping into an area for cycling, so this should be distinguished from the footway using a raised delineator strip and tramline tactile paving.

### 7.3.18

Certain other difficulties arise in instances where guidance suggests that tactile paving is required in order to sign a transition from separated to shared space.

- It is more or less impossible to account for every direction or angle of possible pedestrian movement — this makes it difficult to provide tactile paving that is fit-for-purpose.
- Cyclists can slip on tramline tactile paving, particularly in wet or freezing conditions – their wheels can become deflected by the longitudinal grooves.
- It is recommended that all other alternatives should be explored before relying on tactile paving to distinguish between different areas. Preferably, this should include clear physical and/or visual distinction between an area for cycling and a shared area.

7.3.19

Rather than the depth of 2400mm stipulated in Guidance on the use of Tactile Paving Surfaces, it is recommended that 1200mm should be the minimum depth for ladder and tramline tactiles at the beginning of and end of a separated facility and that 800mm should be required at more minor, repeated transitions along the way. In some cases the 'ladder' paving on the pedestrian side could be omitted to avoid confusion, where there are extensive areas of different tactile paving types.

Where appropriate, 2400mm depth of ladder and tramline may be reduced to 1200mm.

7.3.20

Where guidance indicates that both blister and ribbed tactiles are required, the ribbed paving will normally need to be set back from the kerb-line by 2-3m to avoid confusing blind people when they have crossed a carriageway. This will allow them to reach the comparative safety of a (shared) footway before having to determine on which side of the shared surface to proceed.

7.3.21

Where a cycling scheme appears to require a large amount of corduroy and ladder-and-tramline, this usually indicates that the design solution is not fit-for-purpose and it should prompt a re-design.

If cyclists cannot be accommodated in safety and comfort on the carriageway, or vertically separated from pedestrians off-carriageway, then fully shared use may very often preferable to short, 'stop-start' sections of separated use at footway level.
Blister tactile paving

7.3.22
Blister tactile paving is for use on the footway at carriageway controlled crossings, such as zebra crossings or toucan crossings, and at uncontrolled crossings. This could include the crossing of a cycle track by a footpath/way. As set out in para 7.3.6 above, the minimum depth for blister tactile paving should be 800mm. 800mm wide ‘tails’ are also required, running between the blister paving at the crossing-point and the back of the footway or building line. Appropriate tail lengths should ideally be derived from understanding pedestrian movement at each crossing – ensuring that the tail is perpendicular to the predominant pedestrian flow.

7.3.23
Local streetscape guidance will dictate site-specific requirements but, for the most part, buff or contrasting grey coloured blister tactile paving is used at uncontrolled crossings on the footway adjacent to vehicle ways, including cycle tracks. Both red and buff tactile paving should be of a contrasting colour to the surrounding paving. The use of light or dark grey blister paving may give the appropriate contrast in conservation areas. Visibility can also be achieved with a contrasting band of brick or blockwork.

Pedestrian guardrailing

7.3.24
*The Mayor’s Manifesto* (2012) said: ‘The capital has too many guardrails, restricting the movement of pedestrians and also presenting a hazard for cyclists.’ TfL has produced *Guidance on the Assessment of Pedestrian Guardrail* (2012), based on the experience of analysing and removing pedestrian guardrail at around 150 junctions and 200 staggered crossings in central London.

7.3.25
The assessment procedure should include a road safety audit, starting from the assumption that all the guardrailing is to be removed. Guardrails can be especially hazardous for cyclists as they block a potential escape route in the event of collision.
7.4 Maintenance and asset management

7.4.1
The maintenance of cycle routes and cycle facilities is essential if they are to encourage cycle use. Most of the conditions covered in this section have a greater negative impact on cyclists as compared to motorists, and frequently result in severe hazards for cyclists. Cycle route infrastructure design should include access for the use of maintenance vehicles where appropriate, particularly where the route is off-carriageway.

Sweeping

7.4.2
Appropriate frequencies for sweeping are important and these may only become apparent after a route has opened. Broken glass or other debris often blown across by motor traffic is the most frequent problem. This can cause danger to cyclists trying to avoid it, or inconvenience to detour via an alternative route, or to mend a puncture.

7.4.3
Debris can be a particular problem when cycle lanes are introduced so that debris ceases to be deflected by the normal flow of vehicles. Any changes to the cleansing contractor’s schedule will need to be notified and agreed, and should be recorded in case cleansing problems arise.

Landscape growth

7.4.4
Cycle tracks, adjacent paths and shared paths frequently suffer from problems from the growth of adjacent planting. This can seriously reduce the available width of a path, and reduce sight lines to create blind spots, sometimes giving rise to social safety issues. cyclists can find it harder than pedestrians to avoid branches due to their speed, and their height off the ground, especially when on a bicycle.

7.4.5
Trimmed-back thorn bushes need to be thoroughly removed after cutting to ensure that punctures do not result. Preferably separate cycle tracks from thorn bushes.
7.4.6
In summer, many cyclists, especially children, will be wearing shorts. Stinging nettles and brambles can grow quickly so frequent maintenance is required.

Surface defects

7.4.7
Uneven surfaces can affect the balance and stability of bikes, or generate swerving manoeuvres, and can cause the rider discomfort. Potholes, bumps, ridges, and sunken gully and inspection cover gratings are frequent problems that should be addressed. Steps in excess of 10mm or deformation in excess of 10mm over a 1m straight edge length should be rectified.

7.4.8
Ironwork such as manhole covers should be checked during routine inspections so that skid resistance is compatible with that of the surrounding road surface, particularly where surface coatings have been applied.

7.4.9
Blocked drainage gullies or inadequate drainage are frequent problems on cycle routes, and should be identified and rectified during normal maintenance routines. Any additional drainage will need to be included within the drainage maintenance schedule in conjunction with other asset management.

Maintenance of signs and markings

7.4.10
Clear signs and markings are important both for safety reasons and the legibility and coherence of routes. Signs can be rotated, removed unofficially, not replaced after collision damage, and can be made illegible with graffiti. Problems such as these can give the impression of a route with problems of social safety as well as indicating lack of importance given to cycling by the managing authority.

- Anti-rotational brackets should be fitted to appropriate signs, particularly ‘finger’ direction signposts – see section 6.3.
- Surface markings are likely to become worn, and may be removed by trench digging or by resurfacing. These defects should be rectified as soon as they become illegible.

7.4.11
Where significant lengths of re-surfacing requires the removal of existing red or yellow line markings, highways authorities should consider providing replacement lines at the minimum permitted width. In addition to reducing visual intrusion and saving on
materials, this can help to visually accentuate the width of cycle lanes or coloured surfacing and reduce the risk of cyclists skidding on road markings in the wet. The Traffic Signs Manual, chapter 5 allows for this. 50mm line width is technically acceptable for design speeds of up to 30mph, and 100mm above this. Design teams should take account both of enforcement requirements and reasonable consistency of appearance.

Maintenance regimes

7.4.12
Cyclists’ needs should be taken into account in risk registers and maintenance regimes. On carriageway, defects in certain locations may not cause problems for motor vehicles, but could cause significant risks for cyclists. Off carriageway, there is often a poor understanding of cyclists’ needs on cycle tracks and shared use footways.

7.4.13
The quality, comfort and popularity of designated cycle routes depend on the surface continuing to be of consistently high quality. A regime is required to ensure that defects are picked up and acted on as soon as possible. Visual inspection by bicycle and on foot are the simplest ways to do this but cycle or motor vehicle mounted equipment can be a useful additional tool in measuring surface quality on a regular basis.

7.4.14
TfL has developed the following simply hierarchy based on cycle flows and the relative importance of designated routes:

**Prestige**
Policy priority route, with very high flows (>2500 cyclists/day) and/or part of the Cycle Superhighway network.

**Primary**
High flows (1000 to 2500 cyclists/day) and/or sites that are part of designated cycling routes.

**Secondary**
Medium / low flows (≤1000 cyclists/day) and/or local access and links, as shown on the TfL cycle guide maps.

**Cyclists excluded**
Any section of Highway at which cyclists are legally excluded.
7.5 Structures

7.5.1
Making difficult connections can often only be done by taking cycling facilities over or under other features such as highways, railways and waterways. Because these require cyclists to deal with gradients, and because they are likely to be costly, a strong case will need to be made for their construction: comparison with other reasonable options and a strong benefit-to-cost ratio, for example. However, bridges and subways can play an important role in cycling networks, and they can offer a high degree of safety and directness.

7.5.2
Advice on structures in this section is generally to be found in the Design Manual for Roads and Bridges (DMRB). Individual sections are referenced in the text below.

Bridges and ramps

White House Lane bridge, Hackney – before and after. Conversion to a fit-for-purpose cycling link.

7.5.3
New bridges should allow for comfortable and direct cycle and pedestrian movement and, wherever practicable, some separation should be provided. Consideration should be given to the probable growth in both cyclist and pedestrian numbers from making a new link. New pedestrian/cycle bridges in urban areas should be built with at least 4m clear width.

7.5.4
Bridges for cyclists’ use should be designed so as not to require cyclists to dismount and use steps. Access ramps are the best ways of meeting cyclists’ needs. Ramps should preferably avoid 90- or 180-degree turns, and have a gradient shallow enough to allow most cyclists to continue to ride up the slope. This should be no greater than 1:20, although as steep as 1:12 may be acceptable in some circumstances.
7.5.5

Where steps are unavoidable at bridges and subways, or as a short term low cost measure pending replacement, concrete or steel-section wheeling ramps should be installed. They should be at least 100mm and 50mm deep and can be on one or both sides, at least 0.2m away from the wall and/or banister. Retrofitting wheeling ramps should be considered whenever bridges, railway stations and underpasses are refurbished. Care needs to be taken to avoid compromising the accessibility needs of pedestrians, particularly young children, the elderly and mobility impaired users, through installing such a ramp. Where this is an issue, a ramp on one side only may be the best solution.
7.5.6

The minimum vertical headroom provided for cyclists should be 2.3m (as opposed to 2.1m for pedestrians) to allow for cyclists' higher position when riding. This will also apply to all signs that may obstruct cyclists.

7.5.7

On footbridges intended for shared pedestrian and cycle use the minimum parapet height stipulated by DMRB, section BD 29/04 is 1.4m. Where pedestrian and cycle use is separated, this requirement only applies to the cycle side. On other structures and situations it is recommended that a risk assessment be carried out to inform design options. The Sustrans guide, Parapet heights on cycle routes: Technical information note no. 30 (2012), includes guidance on undertaking such a risk assessment.

Tunnels and subways

7.5.8

A dedicated cycle tunnel or subway, or one shared with pedestrians, may be a viable option as part of an urban cycling network. It can help:

- avoid circuituous, possibly motor traffic-dominated routes
- give protection from weather and, provided it is not used by other vehicles, a good riding surface
- offer consistent provision where the tracks join off-carriageway facilities on either side

7.5.9

A well designed tunnel or subway could become an attractive, distinctive and memorable part of any cycling route. However, this will require good lighting, high standards of maintenance and comfortable ways of getting on or off the facility (ie. ramps), so construction and maintenance costs are likely to be high.

7.5.10

DMRB section BD 78/99 sets out tunnel design requirements for vehicular traffic, much of which also applies to tunnels for cycle and/or pedestrian use only. The DMRB definition of a road tunnel is ‘a subsurface highway structure enclosed for a length of 150m, or more’. Most of the basic design and management requirements set out in DMRB are assumed to apply to tunnels largely dedicated to cycling.
7.5.11
Headroom through subways should be a minimum of 2.4m (DMRB, section TD 36/93). If this cannot be achieved because of structural constraints, then the reduced headroom should be highlighted using an explanatory sign with the text ‘Cyclists beware – low headroom’, and stating the actual height available.

7.5.12
Sustrans’ Technical Information Note No.29, Lighting of cycle paths (2012) provides further information on design considerations for tunnels, underpasses, subways and bridges.