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Tactile Paving Survey

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EXECUTIVE SUMMARY

A survey of the installation and use of tactile paving was carried out in three city centres in England:

- Sheffield
- Chester
- Birmingham

The aims of this survey was to determine:

- What proportion of the tactile paving had been installed in line with current guidance?
- What were the commonest mistakes

Main Findings

The survey showed that overall in 4.2% of cases the tactile paving installed involves the incorrect use of a warning pattern. This is the most serious problem that can be encountered with tactile paving as the incorrect use of a pattern can give misleading and potentially dangerous information to blind and partially sighted people.

Upto 12% of tactile paving is the wrong colour. Either the specified colour was not used, or where a colour is not specified in the guidance, the tactile colour chosen had little or no colour contrast with the surrounding paving.

Lack of colour contrast between the tactile warning surfaces and the surrounding paving was the most commonly encountered mistake during this survey, despite the emphasis in the guidance that is placed on good colour contrast being a valuable aid to the partially sighted.

Overall up to 58% of the tactile paving assessed for this survey had one or more problems associated with its installation.

Recommendations

The Disability Discrimination Act (DDA) will result in increasing use of tactile paving, decisions need to be taken now about how to ensure tactile paving is correctly installed merely giving guidance on good practice appears to be insufficient and is unenforceable. In order to ensure that the different patterns of tactile paving are reliably and consistently installed and that good colour contrast is provided it may be necessary to regulate the installation of tactile paving by some means such as building regulations.

1 INTRODUCTION

This work was carried out at the request of Mr. Stephen Taylor of the Construction Division Technology Unit.

Tactile paving began to be introduced in 1990 to provide a tactile warning for visually impaired individuals to aid their independent mobility. In the years since its introduction tactile paving has become a key design feature in improving the accessibility of public spaces and city centres. The advent of the Disability Discrimination Act with its requirements for inclusive design and equality of access to services is likely to increase the rate at which tactile paving is being installed.

Recent research conducted by the HSE into trip accidents has indicated that the toe clearance among healthy able bodied individuals is of the same order as the height of the profiles currently being proposed for use tactile paving in draft British Standards [Loo-Morrey, BSI]. This raises the possibility that tactile paving, which is being widely installed in an attempt to increase accessibility, may potentially pose a trip hazard to a significant proportion of the population.

At the time of writing there is currently no agreed British standard for tactile paving, but guidance on the use of tactile paving is available from the Department of Transport [Department for Transport].

The aims of this current survey are:

- Determine what types of tactile paving are being installed?
- Gain a better understanding of how tactile paving is being installed.
- Determine guidance is being used?
- Assess percentage of tactile paving is being installed inline with current guidance?

2 BACKGROUND INFORMATION

2.1.1 Mobility of Visually impaired people

There are approximately 1 million blind and partially sighted adults in the United Kingdom. Approximately 5% of these people are completely blind, having no sight at all. The remainder have varying degrees of residual sight, which may enable them to function visually to differing degrees.

The nature of visual impairment varies widely between individuals, however generally a wide range of different eye conditions will lead to the following types of impairment:

- A limited field of vision – being unable to see to the sides or up and down.
- Some loss of central vision – limiting the ability to see fine detail.
- Acute short sightedness – seeing the world as a continuous blur.
- Uncontrollable oscillations of the eyeball – leading to the inability to see objects clearly.
- Night blindness – a sensitivity to light and a tendency to be dazzled by glare.
- Loss of vision in one eye – resulting in the loss of depth perception.

2.1.2 Mobility Techniques

Visually impaired people will either move around independently or with the aid of a sighted person to act as a guide. Individuals who move around independently will do so either solely by using their residual vision or by using a mobility aid.

The most common mobility aid used by visually impaired pedestrians is a long white cane, which is used to scan the ground in front of the person. The cane is swept in an arc from one side to the other just beyond the width of the body. This technique will usually locate potential obstructions and distinct changes in level such as a kerb of step. Once any feature has been located and possibly identified, the pedestrian will decide how to proceed.

Alternatively, a visually impaired person may have the assistance of a guide dog. According to the Guide Dogs for the Blind Association there are currently approximately 5000 guide dog owners in the U.K., but this is likely to increase in the future. Guide dogs are trained to lead their owners around obstructions and to stop at distinct changes in level such as kerbs or stairs. Generally guide dogs are unable to respond to changes in texture or colour underfoot.

2.1.3 Key Design Principles

There are certain key design principles, which make it easier and safer for visually, impaired pedestrians to move around:

- Layout should be simple, logical and consistent.
- Colour contrast should be used to accentuate the presence of key features.
- Orientation and way finding information should make use of high visibility and tactile signing.
- Lighting levels should be even, adequate and should minimise glare.

2.1.4 Use of Tactile Information

When navigating around the pedestrian environment, visually impaired people actively seek and utilise tactile information underfoot, particularly detectable contrasts in surface texture. The ability to detect contrasts in texture underfoot can vary between individuals. People who have lost their eyesight through various medical conditions may have other physical impairments. For example, chronic diabetes sufferers experience progressive damage to capillaries and minor

blood vessels which can result in both loss of eyesight and reduced sensitivity in their extremities, including their feet. It is therefore important that the textures warning of potential hazards are rigorous enough to be detectable by most people without constituting a trip hazard or causing extreme discomfort.

Visibly impaired people who use mobility aids are likely to have received training in mobility skills, including instruction in the interpretation of tactile paving.

2.2 WHAT IS TACTILE PAVING?

"Tactile paving" is the term used for a range of paving units that bear distinctive, raised surface profiles which are designed to be detectable by both sighted and visually impaired pedestrians. Tactile paving can be used to convey important information about the environment to visually impaired people, for example hazard warning, directional guidance, or the presence of an amenity. Research has shown that visually impaired people can reliably detect, identify and remember a limited number of different tactile paving surfaces and the meanings assigned to them.

Visually impaired people are becoming increasingly mobile and it is therefore very important that conflicting or confusing information is not conveyed. *Each type of tactile paving surface should be exclusively reserved for its intended use and consistently installed in accordance with available guidance.* Six distinct profile patterns are produced, each of which is intended to convey a specific message to visually impaired pedestrians.

2.2.1 What do the patterns mean and how should they be installed?

Blister Tactile for Pedestrian Crossing Points

"The purpose of the blister surface is to provide a warning to visually impaired people who would otherwise, in the absence of a kerb upstand > 25 mm, find it difficult differentiate between where the footway ends and the carriageway begins. The surface is therefore an essential safety feature for this group of road users at pedestrian crossing points where the footway is flush to the carriageway to enable wheelchair users to cross unimpeded."

The profile of the blister tactile surface consists of rows of flat topped blisters in a square pattern, see Figure 2.1.

The blister tactile is intended for installation in the absence of an upstand at both controlled and uncontrolled crossings where:

- The footway has been dropped flush to the carriageway.
- The carriage way has been raised to the level of the footway.

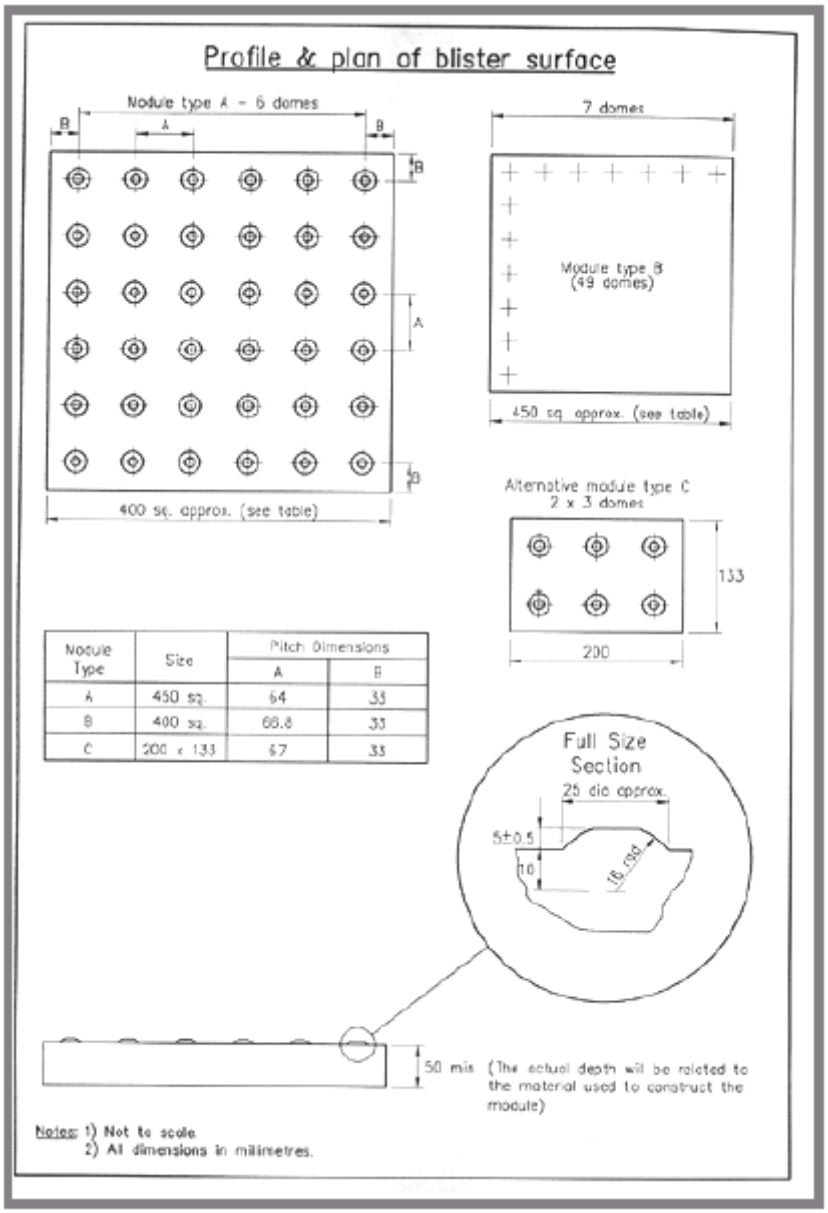

Figure 2.1 Schematic diagram showing details of square blister tactile.

Blister tactiles can be made from any material suitable for pedestrian pavements. It is most commonly supplies as 400mm x 400mm concrete units or smaller block paviours, see Figure 2.2, but is also available in natural stone, or as metal studs in set into existing paving.

a) Block paviour blister tactile

b) Pre-cast concrete blister tactile

c) Natural stone blister tactile

d) In-set brass stud blister tactile

e) “Stick-on” tactiles [After McCormack]

Figure 2.2 Photographs illustrating some of the wide range of tactile paving materials being used.

Current guidance recommends the use of certain colours as many partially sighted people have sufficient residual vision to detect *strong* contrasts in colour and tone. Guidelines state that red blister tactiles should be used at controlled crossings and buff blister tactiles should be used at uncontrolled crossings. Where the surrounding paving or carriageway is the same colour as the tactile paving to be used a contrasting border, a minimum of 150mm wide, around the tactile paving surface should be used.

Examples of the correct use of the blister tactile surface at controlled and uncontrolled crossings are given in Figures 2.3 and 2.4.

Figure 2.3 Photograph showing correct use of blister tactile paving at a controlled pedestrian crossing.

Figure 2.4 Photograph showing the correct use of blister tactiles at an uncontrolled pedestrian crossing.

Offset Blister Tactile

The offset blister tactile is also known as the "Platform Edge (Off-Street) Warning Surface".

"The purpose of this surface is to warn visually impaired people of the edge of all off-street railway platforms." [Department for Transport].

The off-set blister tactile surface consists of flat-topped domes (blisters), spaced 66.5mm apart from the centre of one dome to the next, see Figure 2.5.

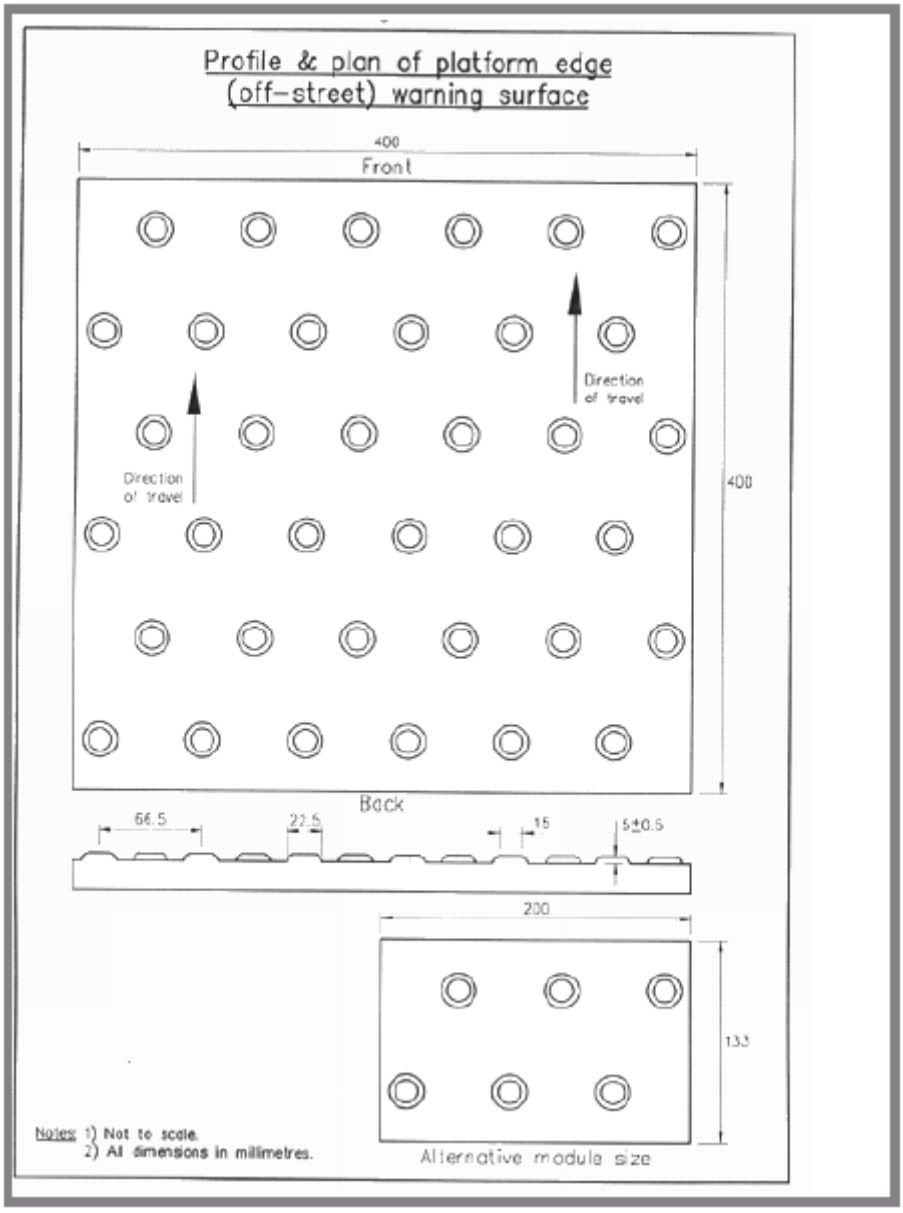

Figure 2.5 Schematic diagram showing details of off-set blister tactile.

The tactile paving units can be manufactured in any suitable paving material and may be any colour that provides a good contrast with the surrounding area to assist partially sighted people. The current guidance recommends that the off-set blister tactile surface be used for all off-street rail platforms including:

- Heavy rail platforms.
- Off-street light rapid transit (LRT) platforms.
- Underground platforms.

*It should **not** be used for on street (LRT) platforms.*

The tactile paving units should be installed to a depth of 400mm parallel to the platform edge and a minimum of 500mm back from the edge. It should never be installed closer to the edge than this because pedestrians may not have sufficient time to stop walking once they detected the tactile warning surface. An example of correctly installed offset blister tactiles is shown in Figure 2.6.

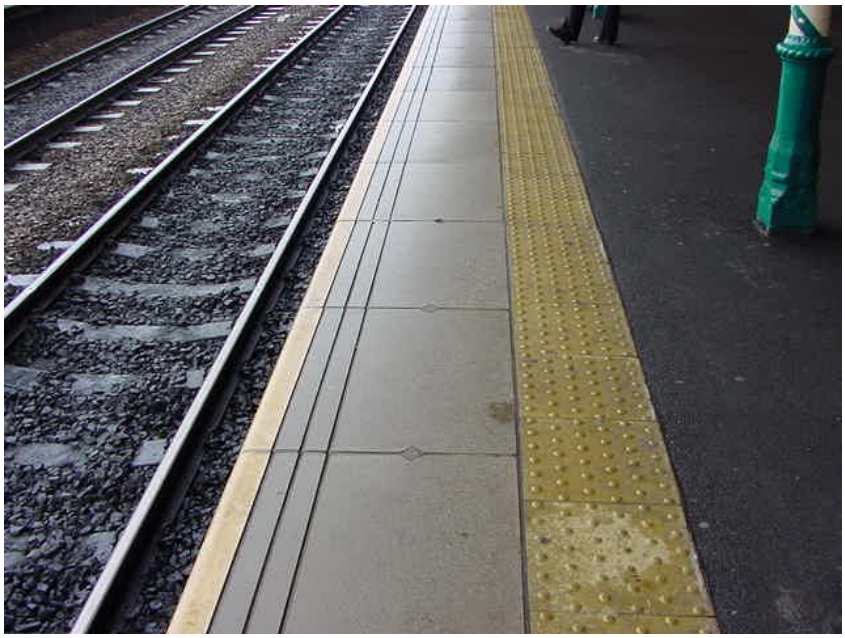

Figure 2.6 Example of correctly installed off-set blister tactiles at a main line railway station.

Lozenge Tactile

The lozenge tactile is also known as the platform edge (on-street) warning surface.

"The purpose of the platform edge (on-street) warning surface is to warn visually impaired people that they are approaching the edge of an on-street light rapid transit (LRT) platform."

The widespread reintroduction of trams and other LRT systems into British city centres in recent years means that is now possible for pedestrians to encounter a platform whilst walking along a pavement or footway. The off-set blister warning surface which is the recommended warning surface for use in off-street situations such as railway stations is clearly unsuitable for use at on-street platforms as it might be readily confused with the blister tactiles used at pedestrian crossings. The lozenge tactile was developed as an alternative.

The profile of the lozenge tactile warning surface comprises rows of 6mm (± 0.5mm) high lozenge shapes, which have rounded edges so as not to cause a trip hazard, see Figure 2.7. The tactile paving units can be manufactured in any suitable paving material. The surface is usually buff coloured, but can be any colour, other than red that provides a good contrast with the surrounding area to assist partially sighted people.

The lozenge tactile paving units should be installed to a depth of 400mm parallel to the platform edge and a minimum of 500mm back from the edge. It should never be installed closer to the edge than this because pedestrians may not have sufficient time to stop walking once they have detected the tactile warning surface.

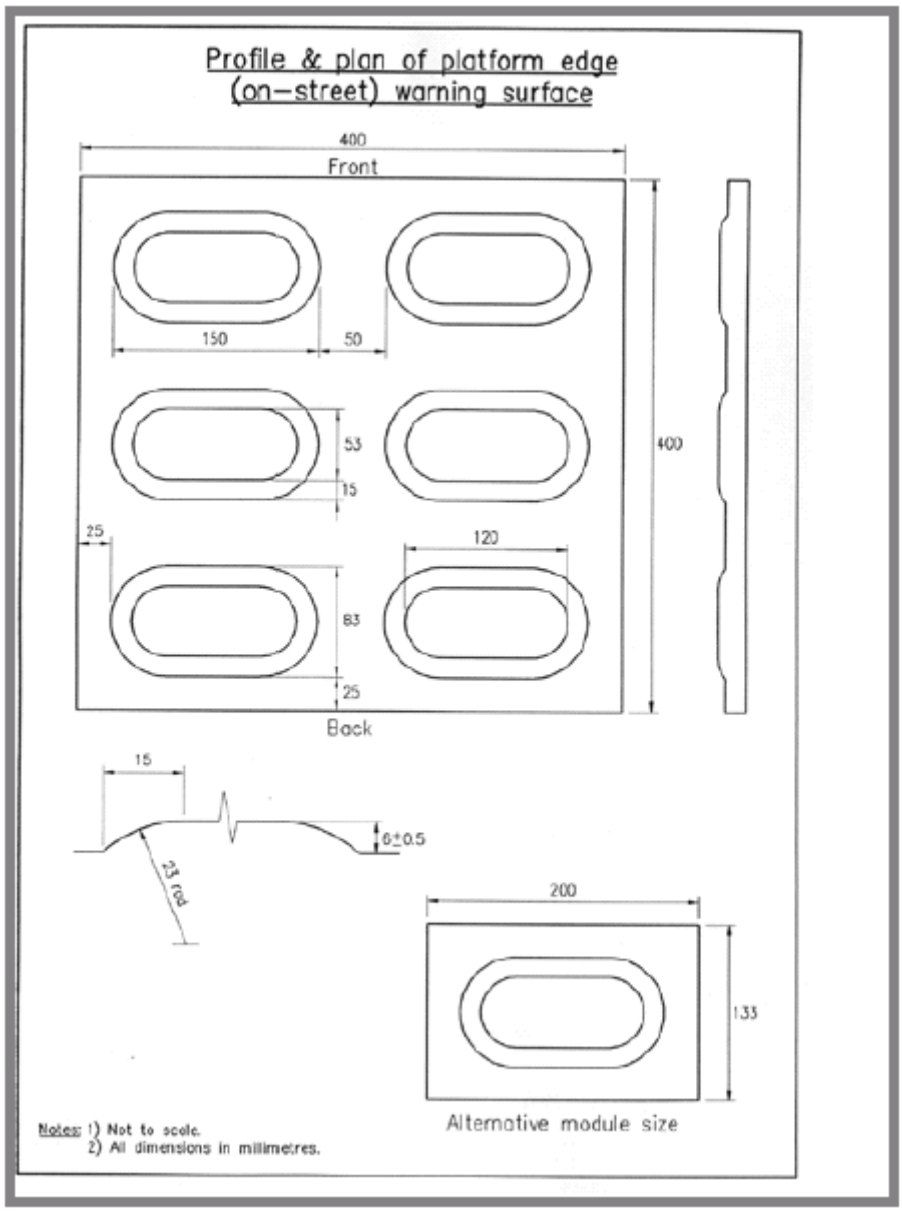

Figure 2.7 Schematic diagram showing details of lozenge blister tactile.

An example of correctly installed lozenge tactiles is shown in Figure 2.8.

Figure 2.8 Example of correctly installed lozenge tactile paving at a tram stop.

Corduroy Hazard Warning Tactile

"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 the 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.'"

The profile of the corduroy tactile surface comprises rounded bars running transversely across the direction of pedestrian travel. The bars are 6mm (±0.5) high, 20mm wide and spaced 50mm from the centre of one bar to the centre of the next, see Figure 2.9. The tactile paving units can be manufactured in any suitable paving material. The surface is usually buff coloured, but can be any colour, other than red, that provides a good contrast with the surrounding area to assist partially sighted people.

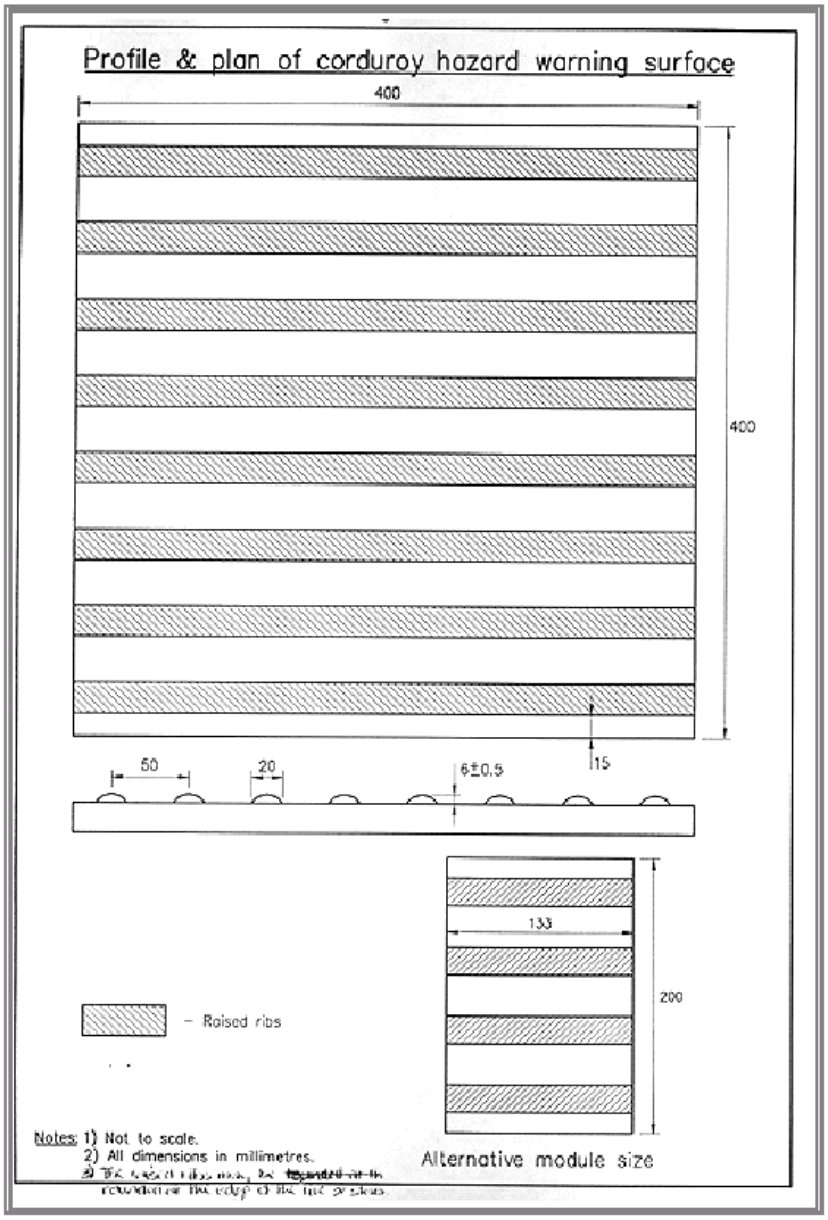

Figure 2.9 Schematic diagram showing details of corduroy tactile.

The corduroy tactile can be used for any situation (other than pedestrian crossings) where visually impaired individuals need to warned of a hazard, such as:

- The top and bottom of stairs
- At the foot of a ramp
- At level crossing
- Where people may unintentionally walk directly on to the platform at a railway station
- Where a footway joins a shared route.

For use with steps

Corduroy tactile should be laid at right angles to the direction of pedestrian traffic and the warning surface should extend across the full width of the stairs at both the top and bottom of the flight. Whenever possible the tactiles should be placed 400 mm from the first nosing, if the

surface is installed closer to the nosings than this there maybe insufficient time for visually impaired pedestrians to adjust their walking speed.

If the steps are in the direct line of pedestrian traffic it is recommended that the tactiles be laid to a depth of 800 mm, but if a pedestrian has to make a conscious turn in order to encounter the steps, corduroy tactiles laid to a depth of 400 mm are deemed sufficient.

For use with ramps

Corduroy tactiles may also be used to indicate the presence of a ramp at an on-street LRT platform. In this case the warning surface should be installed across the full width of the ramp, 400 mm from the bottom of the ramp and to a depth of 800 mm.

For use with level crossings

When used as a warning surface at level crossings the corduroy surface should extend the full width of the footpath (or 1200 mm in the absence of a footpath). The tactiles should start 400 mm from the barrier or from the projected line of the barrier on the open side. If the tactiles are installed closer to the hazard than 400 mm pedestrians may not have time to alter their walking speed after encountering the warning surface. At a level crossing where there are barriers present the tactile paving should be laid to a depth of 400 mm and where there are no barriers the paving should be laid to a depth of 800 mm.

An example of correctly installed hazard warning tactiles at the top of a flight of stairs is shown in Figure 2.10.

Figure 2.10 Picture of correctly installed corduroy tactile with good colour contrast with the surrounding floor.

Cycleway Tactile

"The purpose of the tactile surface used in conjunction with a segregated shared cycle track/footway is to advise visually impaired people of the correct side to enter. The purpose of the central delineator strip is to help visually impaired pedestrians to keep to the pedestrian side."

The cycleway tactile comprises of a series of continuous raised, flat-topped bars, each 5mm (±0.5mm) high, 30mm wide and spaced 70mm apart see Figure 2.11.

The central delineator strip should be 12 – 20mm high, 150mm wide with sloping sides and a flat top of 50mm, see Figure 2.11. The delineator strip should be made of a white material.

The tactile surface should be used on any segregated shared route where the pedestrian side is not physically separated from the cyclist side. The tactile surface should be laid at the beginning and end of the shared segregated route, at regular intervals along its length and at any junctions with other pedestrians or cyclist routes.

It is recommended that at entrances and junctions the tactile surface should extend across the full width of the cycle track and pedestrian footway and should be laid to a depth of 2400mm. For the repeater strips the paving should be laid to a depth of 800mm.

On the pedestrian side, the tactile surface should be laid such that the bars run perpendicular to the direction of travel, and on the cycleway the paving should be laid with the bars parallel to the direction of travel.

No examples of correctly installed cycleway tactile paving, including the use of a central delineator strip were identified in the course of the current survey.

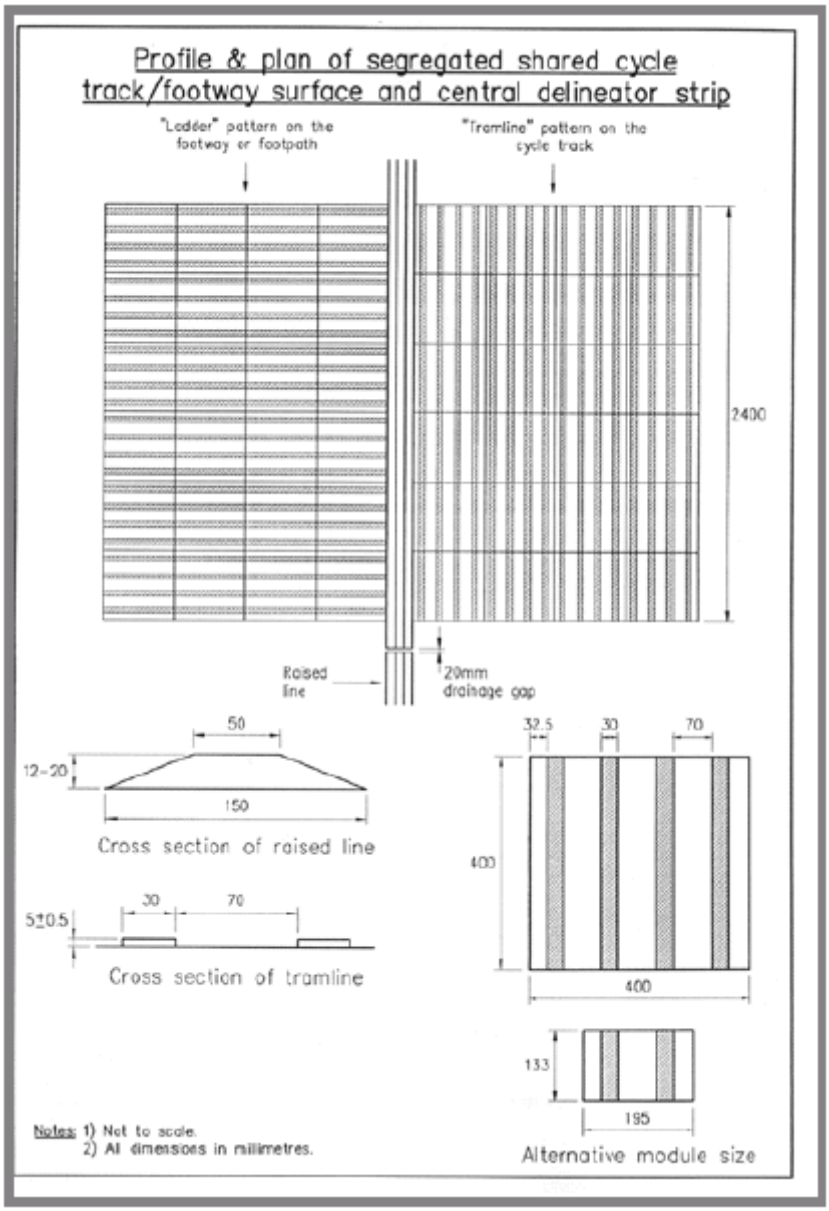

Figure 2.11 Schematic diagram showing details of cycleway tactile warning surface and delineator strip.

Directional or Guidance Tactile

"The purpose of the guidance path surface is to guide visually impaired people along a route when the traditional cues, such as a property line or kerb edge, are not available. It can also be used to guide people around obstacles, for example street furniture in a pedestrianised area. The surface has been designed so that people can be guided along the route either by walking on the tactile surface or by maintaining contact with a long cane."

The guidance tactile compromises a series of raised, flat-topped bars running in the direction of pedestrian travel. The bars are 5.5mm (±0.5) high, 35mm wide spaced 45mm apart, see Figure 2.12. It is recommended that the guidance path tactiles be in a contrasting colour to the surrounding area so as to assist partially sighted people.

The guidance surface is recommended for use in the following circumstances:

- Where the traditional guidance given by a standard footway between the property line and carriageway does not exist.
- Where pedestrians need to be guided around obstacles.
- Where a number of visually impaired people need to find a specific location and in transport terminals to guide people between facilities.

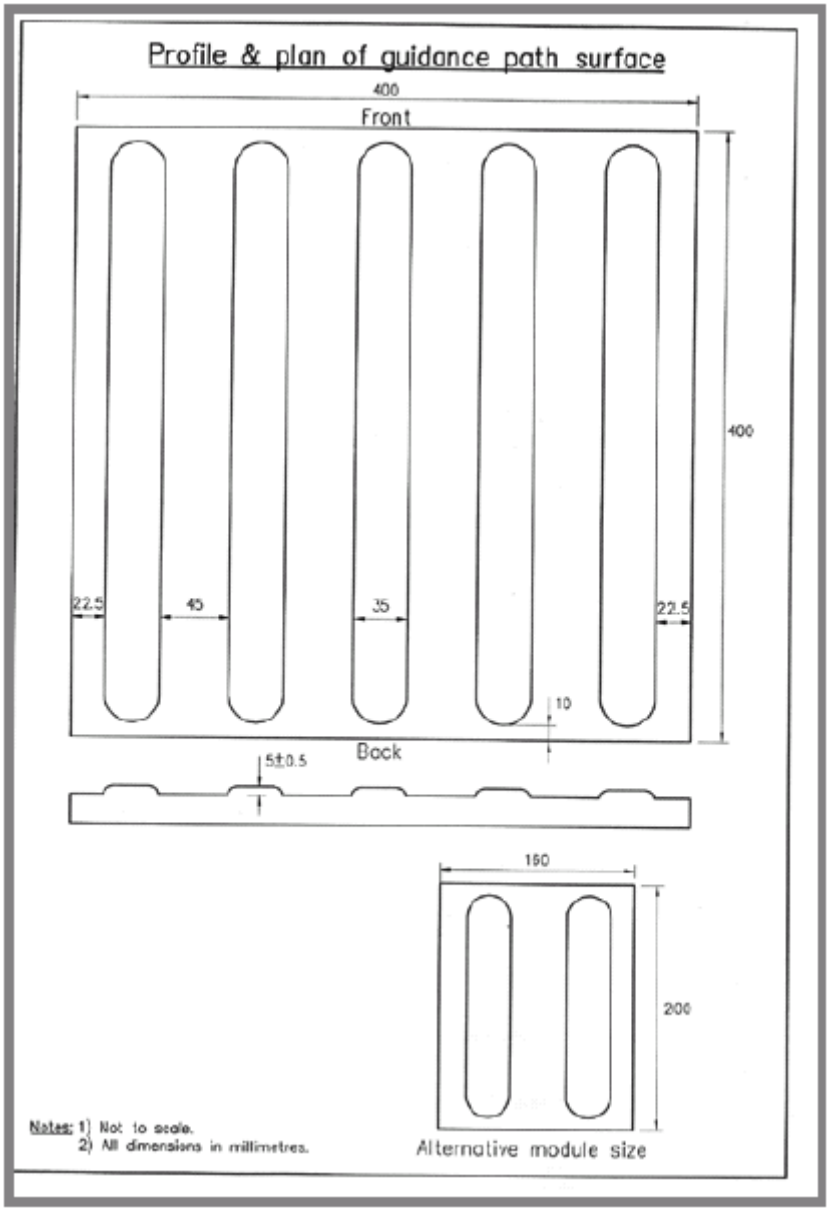

Figure 2.12 Schematic diagram of guidance tactile.

More than any other form of tactile paving the layout of guidance tactiles is site specific, but the general guidelines are as follows:

- The tactile paving should be installed with the bars running parallel to the direction of pedestrian travel.

- The guidance path should be 800mm wide, if it is laid to a width less than this visually impaired individuals using mobility aids may have difficulty maintaining contact with it.
- The path should be kept as straight as possible.
- The path should be laid so that it takes people along a safe and unobstructed route. Generally there should be at least 800mm unobstructed space on either side of the guidance path.
- In busy shopping centres, a minimum width of 2000mm unobstructed space should be provided between the path and the property line.
- Sharp bends should be avoided wherever possible as they make it difficult to maintain contact with the guidance path.
- Where a junction is necessary to give pedestrians a choice of routes the guidance path should be installed with the bars running at right angles to the direction of travel for 1200mm before the intersection.

An example of correctly installed guidance path tactiles is shown in Figure 2.13.

Figure 2.13 Example of correctly installed guidance path tactile, showing how easy it is to achieve good colour contrast with the surrounding flooring. In this example the tactile paving has been installed internally in a train station foyer.

2.3 THE ROLE OF COLOUR AND CONTRAST

The Department of Transport guidance on the installation and use of tactile paving places a heavy emphasis on the role of contrast. The guidance repeatedly states that tactile paving should be chosen to provide strong colour contrast with the surrounding paving material as studies have shown that this aids partially sighted individuals. Most tactile paving is available in range of colours and materials making good colour contrast easy to achieve with appropriate choice of tactile paving.

There are only two cases where the colour of a tactile has a specific meaning:

- Red is reserved for use with blister tactiles to denote a controlled pedestrian crossing.
- Buff blister tactiles are reserved for use at uncontrolled pedestrian crossings.

Where installation of tactile paving of a specified colour e.g. red blister paving at a controlled crossing, would result in the tactile paving being of a similar colour to the surrounding paving a contrast strip of at least 150mm should be installed to clearly demark the tactile area.

2.4 MINIMUM TOE CLEARANCES

Information in the literature on the minimum toe clearance of healthy younger people is limited as research activity has concentrated on the elderly and other vulnerable populations [Pavol et al. 1999b, Pavol et al. 2001, Owings et al., Bogert et al., Davis et al.]. A review of the available literature showed, that there is a considerable discrepancy between the reported values of minimum toe clearance, see Table 1.

Author	Minimum Toe Clearance (mm)	Sample Size
Bunterngchit et al.	12.9	10
Pijanappels et al.	21.9	15
Winter	8.7	11

Table 1 Table comparing reported values of minimum toe clearance for healthy young adults.

In the studies referred to in Table 1 gait kinematics were recorded by means of high speed video cameras, and the subjects motion was tracked by means of markers placed on key anatomical landmarks. The minimum toe clearance was calculated by plotting the trajectory of the toe marker, and averaging it over a number of walking trials, and a number of subjects.

A possible explanation for the factor of two difference in the reported values of toe clearancein healthy young adults is differences in the positioning of the toe marker. No precise description, or figures showing how the position of this key marker was determined was given in any of the papers, and it is not possible to know if the markers can be considered equivalent across all three studies [Bunterngchit et al., Pijanappels et al., Winter].

Of these three studies into toe clearance Bunterngchit et al. were the only ones to impose a cadence (100 steps/min) on their subjects. In the other research volunteers were allowed to self-select a natural comfortable walking pace, however this appears to have had no significant effect on the measured toe clearance values.

Given the spread of toe clearance values available in the literature, it would appear that it is reasonable to assume an average toe clearance of 14.5 mm for healthy young adults. *Given the small sample sizes used in all of these studies and the different values of toe clearance obtained it is clear that further research is required in this area to establish a value for minimum toe clearance with greater confidence.*

Although there is disagreement in the literature regarding the value of toe clearance among the fit and healthy, researchers are generally agreed that toe clearance decreases with increasing age [Bunterngchit et al., Winter et al., Austin et al., Davis et al., Woolley et al.]. Studies comparing the gait of health young and old individuals showed that age could reduce the toe clearance by up to 13% [Winter et al.]. The precise rate of decline in toe clearance with age in healthy individuals is unclear and is a potential area for future research. It is unclear for example if the onset of decreased toe clearance corresponds to the increase in trip accidents seen among women after the age of 45 [Davies et al., Manning].

2.5 CONFLICT WITH TACTILE PAVING

There are a number of draft standards for tactile paving currently under development [BSI2002a, BSI2002b]. The aim of tactile paving is to convey information to visually impaired people about their environment, specifically to warn them of a hazard such as a kerb or platform edge immediately ahead. It is intended that the type of profile on the paving, such as blisters or corduroy banding, would provide disabled individuals with information about the type of hazard ahead.

In the draft standards currently under discussion the proposed height of the tactile profiles varies between 5 and 6 mm. The estimates for the average toe clearance available in the literature varied widely see Table 1. It should be remembered that the values reported were averages and that a proportion of the test subjects may have toe clearances significantly smaller than these average values. This would be of particular concern if the 8.7mm value for average toe clearance determined by Winter is an accurate representation of the general public. This would imply that the proposed 5 to 6 mm height of the tactile profiles could potentially interfere with the normal walking gait of a significant number of individuals and would be of particular concern for those people who are unable to pick up the visual colour warnings designed to alert pedestrians to the paving's presence.

It is therefore possible that the tactile paving may pose a significant trip hazard specifically to those individuals it has been designed to aid. This is especially concerning as biomechanical studies have shown that tripped individuals tend to fall forwards and this may result in pitching a pedestrian into the path of the hazard they are being warned about. Given the increasing use of such paving materials a better understanding of the mechanics of how obstructions of this size interfere with the gait of both impaired and unimpaired individuals is required.

3 EXPERIMENTAL

The were a number of considerations that were taken into account in choosing the sites to be surveyed in this study:

- The study sites had to be controlled by different local authorises to allow the effect of differences in policy to be investigated.
- The study sites had to have reasonable geographical separation to more reasonably reflect England as a whole.
- The sites had to have different “characters” to determine the effect of considerations such as conservation areas.

Three city centres were chosen for the survey:

1. Sheffield
2. Chester
3. Birmingham

48 examples of tactile paving were identified and photographed. Each use of tactile paving was then assessed to see if had been installed in line with the guidance available from the Department of Transport website:

- Was the correct pattern used?
- Was the colour correct?
- Was there good colour contrast with the surrounding paving?

4 RESULTS AND DISCUSSION

4.1 SHEFFIELD CITY CENTRE

20 examples of installed tactile paving were identified. The location, type of paving and analysis are summarised in Table 1.

Tactile example and Location	Right Pattern?	Right Colour?	Other Problems and Comments
1. West Street. Uncontrolled Crossing	Right	Right	
2. Carver / West St. Controlled crossing	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
3. West Street. Controlled crossing	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
4. West Street Tram Stop Platform Edge	Right	Wrong	Contrast with surrounding paving poor. Insufficient contrast strip
5. West Street Tram Stop Guidance Path	Right	Wrong	Contrast with surrounding paving poor. Insufficient contrast strip
6. West Street / Holly Street. Controlled crossing.	Right	Right	
7. Holly Street / West Street. Uncontrolled crossing.	Right	Right	
8. West Street / Leopole Street. Controlled crossing.	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
9. High Street / Fargate. Controlled crossing.	Right	Right	
10. Arundel Gate Bus Stop Edge	Wrong	Right	This Lozenge pattern is **not** recommended for bus stops.
11. Arundel Gate Bus Stop Guidance Path	Right	Right	
12. Cambridge Street	Right	Right	
13. Division Street. Controlled crossing	Right	Right	
13. Division Street / Backfields. Uncontrolled crossing	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
15. Cambridge Street. Uncontrolled crossing.	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip

16. Peace Gardens . Uncontrolled crossing	Right	Right	No contrast with surrounding paving.
17. Peace Gardens stairs.	Right	Wrong	No contrast with surrounding paving. Hazard warning should be continuous half rods, there are gaps in these.
18. Winter Graden Stairs	Right	Wrong	No contrast with surrounding paving. Hazard warning should be continuous half rods, there are gaps in these.
19. Tudour Square. Uncontrolled crossing	Right	Right	No contrast with surrounding paving. No contrast strip
20. Surrey Street. Uncontrolled crossing.	Right	Right	No contrast with surrounding paving. No contrast strip

Table 1 Summary of Sheffield city centre tactile paving survey.

A total of four different tactile paving patterns were found in use at various locations in Sheffield city centre:

1. Blister surface for pedestrian crossing points
2. Corduroy hazard warning surface
3. Platform edge (on-street) warning surface
4. Guidance path surface

4.1.1 Blister Surface for Pedestrian Crossing Points

The blister surface used to indicate pedestrian crossing points with dropped curbs was the most commonly installed tactile surface, and all the pedestrian crossings examined in this survey had tactiles with the correct blister surface installed.

The colour of the warning surface plays a significant role at pedestrian crossings, red is used to denote a controlled crossing point and buff coloured tactiles are used to denote uncontrolled crossing points. Although all the controlled crossings had correctly installed red blister warning surfaces, there were three cases where the warning tactiles had little or no colour contrast with the surrounding paving, see Figure 4.1.

The guidance on how to install tactile paving clearly states, “Where the surrounding footway or carriageway material is also red then it will be necessary to provide a contrasting border, a minimum of 150mm wide, around the tactile surface.”.

At all three controlled crossings identified above the contrast strip recommended in the guidance was missing.

Figure 4.1 Controlled crossing at junction of West Street and Leopol Street. Red blister tactiles have been laid to indicate dropped kerbs. Right pattern and colour, but no colour contrast with surrounding paving and there is no contrast strip between the tactile surface and the surrounding paving.

Seven uncontrolled pedestrian crossings with installed tactile paving were assessed for this survey. In all cases the correct pattern of blister tactile had been installed. However in five of the seven cases there was little or no contrast with the surrounding paving. The situation was worst around the redevelopment of the Peace Gardens and the Winter Gardens. Here the installed tactile paving is made from exactly the same stone as the surrounding paving, see Figure 4.2.

Figure 4.2 Peace Gardens uncontrolled pedestrian crossing. Tactiles used to indicate dropped curb. Tactiles made of the same stone as the surrounding paving so have no colour contrast.

Although it could be argued that the sand stone used is the correct buff colour for an uncontrolled pedestrian crossing there is no contrast at all with the surrounding pavement, nor is there a contrast strip installed. This clearly ignores the advice given in the guidance document, which repeatedly emphasises the use of colour contrast to aid partially sighted individuals and even raises the possibility that the tactile paving may pose a trip hazard to unwary members of the general public.

4.1.2 Corduroy Hazard Warning Surface

Two examples of hazard warning tactiles were found during the survey of Sheffield city centre. They were used to denote the top of stairs in the Peace Gardens and the Winter Gardens, see Figure 4.3.

a) Peace Gardens b) Winter Gardens

Figure 4.3 Corduroy hazard warning tactile paving installed at the top of stairs.

In both cases the tactile paving units used were made from the same stone as the surrounding paving and therefore had no colour contrast. This is a clear contradiction of the advice given in the guidance document which recommends, “the surface should be in a contrasting colour to the surrounding area to assist partially sighted people.”. Corduroy hazard tactile paving units are available in a wide variety of colours and materials, alternative tactiles which provided good colour contrast with the surrounding pavement could easily have been selected.

All the examples of tactile paving found in and around the Peace Gardens / Winter Gardens redevelopment were made from the same stone as the surrounding paving and therefore had no colour contrast despite the clearly stated advice given in the available guidance document. It must therefore be concluded that the decision to install tactile paving that blends with the surrounding pavement was taken purely on aesthetic grounds to blend in with the overall design scheme rather than with regard to maximising the effectiveness of the tactile paving.

4.1.3 Platform Edge (on-street) Warning Surface and Guidance Path Surface

Sheffield city centre is served by a tram network and as such has a number of on-street tram platforms. The tram platforms assessed as part of the survey had the correct platform edge (on-street) lozenge tactile warning surface installed and guidance path tactiles to lead visually impaired individuals the platform edge, see Figure 4.4. The contrast between the tactile paving units and the surrounding paving is poor; selection of tactile paving units of a different colour would have been better.

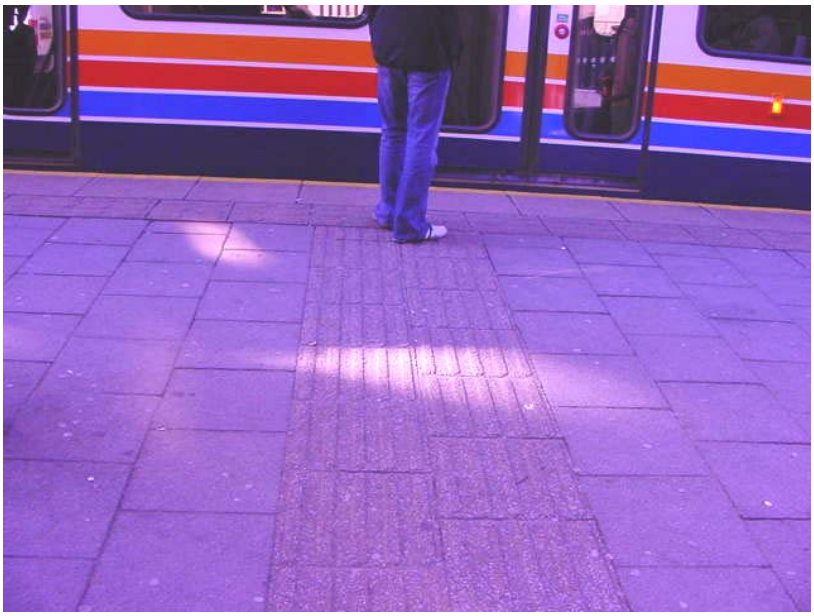

Figure 4.4 City Hall tram stop. Buff lozenge tactiles have been installed to indicate on street tram platform, directional guidance tactiles have been installed leading to the platform edge, right patterns and low colour contrast.

The most serious problem that can be encountered with tactile paving is the incorrect use of a pattern as this can give misleading and potentially dangerous information to blind and partially sighted people. Only one example of the improper use of a tactile paving pattern was found during the survey of Sheffield city centre, see Figure 4.5.

Figure 4.5 Bus stop on Arundel Gate. Buff lozenge tactiles have been incorrectly installed to indicate on street bus stop, directional guidance path tactiles have been installed leading to the bus stop.
The lozenge tactile has been installed at a raised bus stop. It is specifically stated in the guidance document that this warning surface is **not** recommended for use at bus stop locations.

4.1.4 Summary

In total 20 examples of tactile paving were examined in the survey of Sheffield city centre.

- 5% of the paving examined was found to be the incorrect use of a tactile paving pattern
- 20% of the paving examined was found to be of the wrong colour
- In total 55% of the tactile paving examined in the study was found to have one or more problems with the way it had been installed

4.2 CHESTER CITY CENTRE

Chester was chosen because it was felt that the historic nature of the city centre with its Tudor buildings, medieval cathedral and city walls and Roman remains would give the local authority different considerations when approaching the installation of tactile paving. Determining the effect of local considerations on the way the tactile paving is installed was a major aim of this survey.

The area within Chester city walls was surveyed for this project, 16 examples of installed tactile paving were identified. The location, type of paving and analysis are summarised in Table 2.

Tactile example and Location	Right Pattern?	Right Colour?	Other Problems and Comments
1. Castle Drive/Nuns Road. Controlled crossing	Right	Right	
2. Grosvenor Street roundabout. Controlled crossing	Right	Right	
3. Grosvenor Street / Bunce Street. Uncontrolled crossing	Right	Right	Poor contrast with surrounding paving. Insufficient contrast strip.
4. Grovsenor Street / Bridge Street. Controlled crossing	Right	Right	
5. Upper Bridge Street. Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
6. Upper Bridge Street. Outside shopping centre, uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
7. Bridge Street / Watergate Street. Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
8. Watergate street / Trinity Street. Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
9. Watergate street / Crook Street. Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
10. Wurberg Street / Eastgate Street. Uncontrolled crossing	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.

11. Eastgate street . Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
12. Eastgate street / St. John Street. Uncontrolled crossing.	Right	Right	Brass studs inset into existing pavement. No contrast with surrounding pavement.
13. Newgate Street / Pepper Street. Uncontrolled crossing.	Right	Right	
14. Park Street. Uncontrolled crossing.	Right	Right	Poor contrast with surrounding paving on one side of the crossing.
15. Pepper Street car park entrance. Uncontrolled crossing.	Right	Right	Poor contrast with surrounding paving. Insufficient contrast strip.
16. Pepper Street / Volunteer Street. Uncontrolled crossing.	Right	Right	Insufficient paving laid.

Table 2 Summary of the Chester tactile paving survey.

The survey identified only one form of tactile paving in use within the city walls. The blister surface used to indicate pedestrian crossing points with dropped curbs was in widespread use, and all the pedestrian crossings examined in this survey had tactiles with the correct blister surface installed.

All three controlled crossing examined had correctly installed red blister tactile paving units which had good colour contrast with the surrounding paving, see Figure 4.6.

Figure 4.6 Junction of Grosvenor Street and Bridge Street. Tactiles installed to indicate controlled crossing. Correct use of tactile paving, good colour contrast with surrounding paving.

The remaining examples of tactile paving identified in the survey were at uncontrolled pedestrian crossings. The survey identified two types of blister tactile being used at uncontrolled crossing points see Figure 4.7 and 4.8:

- Buff concrete tactile paving
- Inset brass studs

Figure 4.7 Junction of Newgate Street and Pepper Street. Example of buff concrete blister tactiles installed at an uncontrolled pedestrian crossing point.

Figure 4.8 Uncontrolled crossing on Watergate Street. Brass studs have been installed into existing pavement. Right blister pattern, but no colour contrast with surrounding pavement.

Away from the more historic city centre its predominantly buff concrete blister tactile paving that is installed at uncontrolled pedestrian crossing points, see Figure 4.7. Five examples of crossings with the concrete blister tactile paving were identified during the survey. The condition of the paving was found to be generally good, the condition of the crossings may be summarised as follows:

- One crossing where the condition of the tactile paving is a cause for concern, remedial repair work will be required in the near future.
- With one exception, tactile paving installed at the crossings had low levels of colour contrast with the surrounding paving and would benefit from the installation of a contrast strip.
- Two crossings were identified where the tactile paving had been laid to a depth of only 400mm. Generally it is recommended that blister tactiles at crossings should be laid to a depth of at least 800mm to given visually impaired pedestrians a chance to stop walking after detecting the tactile surface. These crossings would benefit from the installation of an additional course of tactile paving.

The historic centre of Chester has many listed buildings and is a conservation area. Within this area a different form of blister warning surface has been used at uncontrolled pedestrian crossing points, see Figure 4.8. Brass metal studs have been retrospectively set into the existing paving, details of this type of installation are shown in Figure 4.9.

Figure 4.9 Detail of Upper Bridge Street uncontrolled crossing, showing brass studs set into existing stone paving.

The brass studs have been set into the correct blister pattern used to denote pedestrian crossing points. While it might be argued that stone paving used in Chester city centre is the correct buff colour specified for use at uncontrolled crossing points, the only colour contrast between the tactile area and the surrounding paving is provided by the brass studs themselves. It can be seen from the wider view of the Watergate crossing shown in Figure 4.8 that the colour contrast provided by the brass studs is limited compared to that achieved by other types of tactile paving.

In addition to reservations about the level of contrast provided be the metal studs there is also a concern that they could pose a potential slip risk in wet conditions. It is well known that the slip resistance of a flooring material is closely related to the level of surface roughness it possesses [HSE]. Visual inspection of the metal studs clearly showed that they had a tendency to wear smooth. Previous experience with smooth metal floors has shown that they pose a high slip risk when wet suggesting that the brass studs being used in may pose a slip risk during wet weather. A full forensic investigation of the inset brass stud tactile warning surface would be necessary to determine what level of slip risk they posed to pedestrians.

Eight examples of such crossings were identified during the survey. The condition of the paving was found to be generally good with only one crossing give cause for concern with regard to the condition of the paving, see Figure 4.10.

Figure 4.10 Detail of the pedestrian crossing at the junction of St. Wurberg Street and Eastgate Street. Installation of the studs appears to have weakened paving, causing a potential trip hazard.

The drilling carried out to install the brass studs appears to have damaged the structural integrity of the existing paving. As a result the slab has cracked and pieces have come away resulting in the production of a potential trip risk.

The current guidance on the installation and use of tactile paving does recognise that there may be concerns regarding the use of tactile paving in conservation areas or in the vicinity of listed buildings. It recommends that some relaxation of the colour requirements for blister tactiles at uncontrolled crossings may be acceptable and that in "…these limited circumstances only, the tactile surface may be provided in a colour which is in keeping with the surrounding material". It should also be noted that this relaxation *does not* extend to the use of the red blister tactile surface at controlled crossings.

The decision to use the brass studs appears to have been an aesthetic one. Given the sensitive nature of the Chester city centre conservation area the brass stud tactile warning surface can be considered to be in line with the more relaxed version of the guidance. However brass studs may pose an unacceptable slip risk in wet conditions, and other solutions that would have been equally aesthetically sensitive to the surrounding environment without posing a potential hazard are possible. Stone blister tactile paving unit could have been used to match the exiting flags with the contrast strip of a different coloured stone being used the give clear visual cues to partially sighted individuals.

4.2.1 Summary

In total 16 examples of tactile paving were examined in the survey of Chester city centre.

- None of the paving examined was found to be the incorrect use of a tactile paving pattern

- 100% of the paving examined was found to be of the right colour if the more relaxed guidance of conservation area and listed building is used
- In total 56% of the tactile paving examined in the study was found to have one or more problems (such as levels of colour contrast) with the way it had been installed

4.3 BIRMINHAM CITY CENTRE

12 examples of installed tactile paving were identified. The location, type of paving and analysis are summarised in Table 3.

Tactile example and Location	Right Pattern?	Right Colour?	Other Problems and Comments
1. Corporation Street/New Street. Controlled crossing	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
2. Corporation Street/New Street. Delineator Strip.	Right	Right	
3. Corporation Street / Bull Street. Guidance to amenities.	Wrong	Wrong	Contrast with surrounding paving poor. Insufficient contrast strip
4. Corporation Street / Bull Street. Controlled crossing	Right	Right	
5. High Street / Bull Street. Uncontrolled crossing	Right	Right	
6. Carr Lane. Controlled crossing	Right	Right	
7. High Street. Hazard warning surface used to indicate walkway	Right	Wrong	Contrast with surrounding paving poor. Insufficient contrast
8. New Street / Bennetts Hill. Uncontrolled crossing.	Right	Right	
9. Temple Row. Uncontrolled crossing.	Right	Right	
10. Temple Row. Uncontrolled crossing.	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip
11. Just off Temple Row. Uncontrolled crossing.	Right	Right	
12. Lower Temple Street. Controlled crossing.	Right	Right	Contrast with surrounding paving poor. Insufficient contrast strip

Table 3 Summary of the Birmingham city centre tactile paving survey.

A total of two different tactile paving patterns were found in use at various locations in Sheffield city centre:

1. Blister surface for pedestrian crossing points
2. Hazard warning surface

4.3.1 Blister Surface for Pedestrian Crossing Points

The blister surface used to indicate pedestrian crossing points with dropped curbs was the most commonly installed tactile surface, and all the pedestrian crossings examined in this survey had tactiles with the correct blister surface installed.

The colour of the warning surface plays a significant role at pedestrian crossings, red is used to denote a controlled crossing point and buff coloured tactiles are used to denote uncontrolled crossing points.

All three of the controlled crossings assessed in the survey had correctly installed red blister warning surface, however there were three cases where the warning tactiles had little or no colour contrast with the surrounding paving, see Figure 4.11.

Figure 4.11 Controlled crossing on Corporation Street. Clearly showing lack of contrast between the tactiles and surrounding paving, note the lack of the contrast strip recommended in the guidance document.

In the above example red brick blister paviours have been set into red block paving. The level of colour contrast with the surrounding pavement is low, the guidance on installation and use of tactile paving recommends the use of a contrast strip in such situations, but none has been installed at the above crossing.

Five uncontrolled pedestrian crossing point were assessed for the survey, see Figure 4.12.

Figure 4.12 Uncontrolled crossing at the junction of New Street and Bennetts Hill, good colour contrast

In only one of the five uncontrolled crossings surveyed was the installed tactile paving found to have poor colour contrast with the surrounding paving.

4.3.2 Incorrect Use of Blister Tactiles

The most serious problem that can be encountered with tactile paving is the incorrect use of a pattern as this can give misleading and potentially dangerous information to blind and partially sighted people. Only one example of the improper use of a tactile paving pattern was found during the survey of Birmingham city centre, see Figure 4.13.


Figure 4.13 Junction of Corporation and Bull Street. Red block paving blister tactiles have been laid leading to a number of amenities.

In the above example blister tactile paving units have been laid in paths leading to a number of amenities, the telephone and building entrance. This is completely the wrong use for this

warning surface, which is reserved for use at controlled pedestrian crossings. The guidance path surface should have been used in this situation. This misuse of a tactile warning surface could easily send misleading and potentially dangerous messages to blind and partially sighted individuals who would assume that these tactiles were leading them to crossing point.

4.3.3 Corduroy Hazard Warning Surface

One example of the use of the corduroy hazard warning surface was identified in the course of this survey, see Figure 4.14. In this example the warning surface as been laid as a delineator strip to denote where two main pedestrian thoroughfares cross within a larger pedestrianised area.

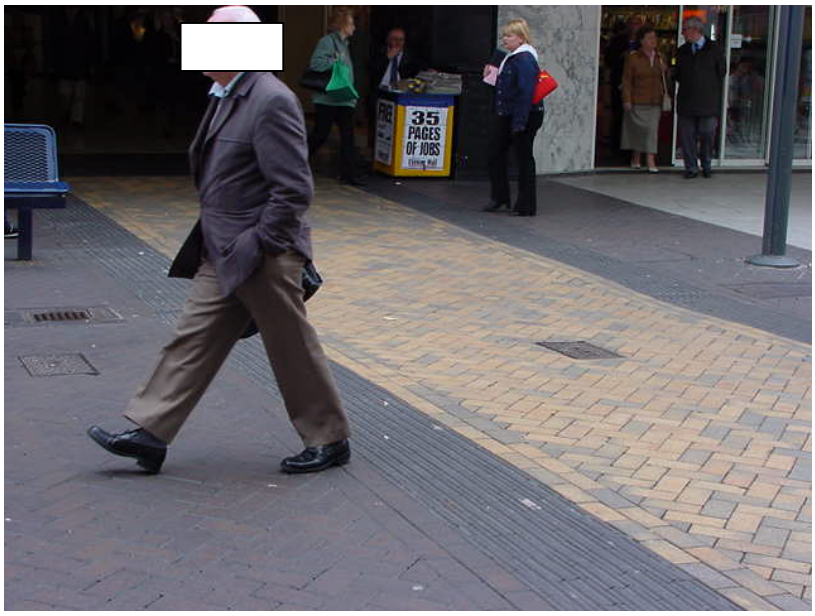

Figure 4.14 High Street corduroy tactile used to demark walkway into shopping centre crossing the pedestrianised area.

In the guidance this warning surface is recommended for use in conjunction with stairs, ramps and level crossing, however it makes sense for it to be used in this situation. There is clearly a potential hazard for blind or partially sighted individuals who would be unaware they were about to cross another major pedestrian route. Unfortunately the colour contrast between the tactile paving and the paving in the main pedestrainised area is poor, use of a contrast strip or a different colour corduroy tactile paving would have been a better choice.

4.3.4 Summary

In total 12 examples of tactile paving were examined in the survey of Birmingham city centre.

- 8% of the paving examined was found to be the incorrect use of a tactile paving pattern
- 17% of the paving examined was found to be of the wrong colour
- In total 42% of the tactile paving examined in the study was found to have one or more problems with the way it had been installed

5 CONCLUSIONS

A survey of the installation and use of tactile paving was carried out in three city centres in England. The aims of this survey were to determine what proportion of the tactile paving had been installed in line with current guidance and what were the most common mistakes being made.

Overall the survey showed that in 4.2% of cases the tactile paving installed involves the incorrect use of a warning pattern. This is most serious problem that can be encountered with tactile paving as the incorrect use of a pattern can give misleading and potentially dangerous information to blind and partially sighted people.

12.5% or 1 in 8 examples of tactile paving is the wrong colour. Either the specified colour was not used, or where a colour is not specified in the guidance, the tactile colour chosen had little of no colour contrast with the surrounding paving.

Overall up to 58% of the tactile paving assessed for this survey had one or more problems with its installation.

Lack of colour contrast between the tactile warning surfaces and the surrounding paving was the most commonly encountered mistake during this survey despite the emphasis in the guidance that is place on good colour contrast being a valuable aid to the partially sighted. Contrast strips that are recommended for use with blister tactiles at pedestrian crossing points were routinely omitted and tactile paving units with minimal colour contrast appear to have been installed not by oversight but through conscious choice.

More often than not the choice of colour of tactile paving appears to be made for aesthetic reasons intended to make the tactile paving blend in rather than with any regard to the needs of the visually impaired. As a result an important part of the information that tactile paving is intended to convey is being lost. With the growing emphasis on accessibility of our public spaces and city centres it seems odd that designers, architects and specifiers appear to be intent on minimising the visual impact of tactile paving when colour contrast is held to be a key design principle in inclusive design.

The current guidelines on the installation and use of tactile paving have now been available for several years, however incorrect installation of tactile paving is widespread. Whether these mistakes are a result of the guidance being knowingly disregarded or through ignorance is unclear. The fact remains though; that mistakes are commonplace and where patterns are misused potentially dangerous misinformation is being given to blind and partially sighted individuals.

The DDA will result in increasing use of tactile paving. Decisions need to be taken now about how to ensure tactile paving is correctly installed; merely giving guidance on good practice appears to be insufficient and is unenforceable. In order to ensure that the different patterns of tactile paving are reliably and consistently installed and that good colour contrast is provided it may be necessary to regulate the installation of tactile paving by some means such as building regulations.

6 FURTHER WORK

The aim of the survey presented here was to provide a snapshot of the way in which tactile paving is currently being installed in a range of locations around England and to determine how much of it complied with the current guidance. Unfortunately the survey has shown that at least half of the tactile paving inspected contravenes the guidance in some way. Before decisions on if and how the installation of tactile paving should be more closely regulated a significantly larger survey should be undertaken.

The survey also identified the use regular use of some forms of tactile paving that the author believes are liable to pose a slip risk to pedestrians in wet conditions. Upon further investigation of manufacture's literature and research previously undertaken by HSL it became apparent that very little is know about the slip characteristics of the various tactile paving materials. This is of considerable concern as these materials are routinely used at the head of stairs, besides busy roads and on inclined surfaces where the consequences of a fall are more likely to be serious. Currently there is a dearth of data on which to base informed advice to duty holders.

The use of tactile surface inside buildings is also becoming more common, this was outside the scope of the currently study. It should be investigated in the future as the current guidance was formulated for use in the outside environment and may not be appropriate for use inside buildings.

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