

The Design of Streets with Older People in Mind

This I'DGO design guidance relates to tactile paving. It is part of The Design of Streets with Older People in Mind; a toolkit for those who plan, design and maintain the public realm. It can be used as an aid to assessing the 'walkability' of local neighbourhoods, particularly with regards to the safety and comfort of footways. Based on the views of over 1,400 pedestrians, street audits, laboratory tests and key sources of existing UK guidance, it includes advice on the siting, laying and maintenance of blister and corduroy paving, including which colours and materials to specify.

DSOPM003

Tactile Paving Design Guide 003

I'DGO design guides are based on evidence from the Inclusive Design for Getting Outdoors (I'DGO) research project. They have been cited by the World Health Organization as being of global importance in planning, designing and maintaining Age-Friendly Cities and by the UK Department for Transport. The research was undertaken by the *SURFACE Inclusive Design Research Centre* and *Centre for Health Sciences Research* at the University of Salford. Details of context, findings and methodology are provided within, with recommendations on the back.

Tactile Paving



Image © John McGonagle. With thanks to Irene Garden.

Being outdoors enhances the physical, social and emotional wellbeing of older people.
I'd go outdoors if I could: wouldn't you?

Tactile paving indicates, through differences in the look and feel of underfoot surfaces, that pedestrians should expect a change in the street environment. I'DGO has studied the two most common types of Tactile Ground Surface Indicators (TGSIs): blisters; and corduroys. Blisters are used on the footway side of pedestrian crossings (controlled and uncontrolled) to help blind and vision impaired people to both find the crossing and negotiate the hazard of using it. Corduroy paving is used to warn of other hazards.

The most definitive source of guidance on tactile paving in the UK is *Guidance on the use of tactile paving surfaces* by the Department for Transport and the Scottish Executive (now the Scottish Government). First published in 2005, this document was revised in 2007. It addresses the purpose, definition, application, maintenance and layout of seven different types of tactile paving – including blister and corduroy – and provides guidance on which colour(s) should be used where. Its main points are summarised in Section 4 of *Inclusive Mobility* (DfT, 2005 revision), which is cited in British Standard BS 8300:2009+A1:2010 Design of buildings and their approaches to meet the needs of disabled people. Code of Practice (BSI, 2010).

Tactile paving made of precast concrete, clay or natural stone must comply with various British Standards. These are detailed in DD CEN/TS 15209:2008 *Tactile paving surface indicators produced from concrete, clay and stone* (BSI, 2008). The latter supersedes BS 7997:2003 *Products for tactile paving surface indicators. Specification* (BSI, 2003). There is, as yet, no guidance and / or regulation for thermoplastic Tactile Ground Surface Indicators and brass or steel studs.

A good source of visual guidance on tactile paving is the 2005 report by Dr Marianne Loo-Morrey, *Tactile Paving Survey Report Number HSL2005/07*, published by the Health and Safety Laboratory, which includes photographs of the different types in-situ.

The benefits of tactile paving for blind and vision impaired people have been well established through empirical research involving people with and without impairments. Yet many participants in early I'DGO studies expressed concerns about falling or feeling unstable on tactile surfaces. Falls risk is a key disincentive to going outdoors for older people, for whom fall-related injuries are associated with loss of independence, morbidity and death. Our study of the effects of tactile paving on older people follows up a 2005 report by the Health and Safety Laboratory which suggested that there is a need to better understand the extent and implications of incorrectly designed and laid tactile paving and the toe clearance of an individual in negotiating paving 'blisters' and potential slip hazards.



“ Each type of tactile paving surface should be exclusively reserved for its intended use and consistently installed in accordance with these guidelines. ”

- *Guidance on the use of tactile paving surfaces (UK Department for Transport and Scottish Government, 2005, revised 2007)*

National guidelines; local interpretation

The aim of *Guidance on the use of tactile paving surfaces* (DfT 2005, 2007) is to “provide consistency in the use of the tactile paving surfaces throughout the country”. However, the document is clear that the installation of tactile paving should always be site-specific and involve an assessment of the surrounding environment, especially in Conservation Areas (where colour guidelines may be relaxed). Where adherence to guidelines is challenging, the Department advises close consultation with users, from local groups to national bodies, and its own Mobility and Inclusion Unit. It also recommends seeking advice from the Royal National Institute for the Blind (RNIB) and Guide Dogs, particularly where local authorities consider implementing policies which deviate from its own advice.

Most local authorities which provide guidance on tactile paving quote from, and refer readers to, either *Guidance on the use of tactile paving surfaces* or the edited version in *Inclusive Mobility*. One of the most comprehensive and independent sources, however, is Transport for London’s *Technical guidance 7: Footways and carriageways* (TfL, 2009). While citing *Inclusive Mobility* as an “important reference document”, this publication **does** deviate from DfT advice in certain areas. It offers, for example, an alternative use for corduroy paving (as a hazard warning at the foot of a ramp), suggests grey as an alternative to buff colouring for corduroys and states that borders should not be provided around areas of tactile paving (whereas this is advised in *Guidance on the use of tactile paving surfaces* for areas where red tactile paving adjoins other red surfaces).

Do pedestrians know what tactile paving is for?

When I'DGO spoke to over 1,400 people about tactile paving (see Methodology 1), we found a general lack of understanding as to why it is provided, specifically blister paving at road crossings. A few participants thought that it might be anti-skid paving and even many of those who knew it identified a crossing wondered why it had to be profiled, as well as coloured. Although studies¹ have shown that blind and visually impaired people can recall and understand the seven different types of tactile paving used within the UK, few of our participants with vision impairments could do so. Many referred to either never having been offered mobility training or of not having undertaken any.

¹ Gallon et al, 1991. Savill & Whitney, 2000. Both cited in RSSB, 2005



Do pedestrians notice tactile paving?

Our participants were more likely to notice the tactile paving at the crossings we surveyed if they had a health condition. However, just 61.9% of participants with reduced vision noticed the tactile paving compared to 66.6% with good vision. This shortfall could be because people with reduced vision may also have reduced sensation in their feet. It might also be due to poor colour contrast on site or the inappropriate use of red road surfaces. We found that women were more likely to notice the tactile paving due to the blister profile, probably due to variation in typical footwear between genders, whereas men were more likely to notice it on the basis of colour.

“ It is important that textures warning of potential hazards, for example a road crossing or a staircase, are rigorous enough to be detectable by most people but without constituting a trip hazard or causing extreme discomfort. ”

- Guidance on the use of tactile paving surfaces (UK Department for Transport and Scottish Government, 2005, revised 2007)



“ You feel as if you are going to twist your ankle... I prefer to walk around them... I don't feel safe, I feel I might trip, and they hurt my feet ”

-quotes from participants in earlier I'DGO studies

Methodology 1

The findings on this page are taken from a total of 972 self-completed questionnaires and 430 interviews exploring factors such as participants' use of, and preferences, for crossings, their health and history of falls and their experiences of tactile paving. The questionnaires were handed out at 48 road crossing sites throughout the UK; the sites at which the interviews also took place. The majority of sites (41) were controlled crossings in urban locations, with 31% being in the lowest 20% of UK deprived areas and 25% in Conservation Areas. Of the 972 people who completed the questionnaires, 53% were over 65, 52% were overweight or obese, and there was a wide range of health conditions, including arthritis in the lower limbs (26.7% of respondents), reduced vision (16%) and asthma or breathlessness (16.5%).

The data was analysed in two principal stages. Initially, descriptive statistics were used to explore the sample characteristics, as measured both by quantitative items within the survey and through respondents' comments; these were coded into categories representing underlying themes. Secondly, regression models were built to assess the effects upon three specific outcome variables (related to feeling safe) of both individual perceptions of crossing facilities and objective data on their design, maintenance and road/traffic environment. Multilevel regression modelling was used due to the naturally hierarchical structure of the data (with 972 respondents nested within 48 distinct crossings), and the subsequent likelihood of 'clustering' by respondents at each distinct crossing.

Do pedestrians feel safe on tactile paving?

Our participants were more likely to be concerned for their safety walking across tactile paving if they had balance problems, arthritis in their lower limbs, reduced mobility, a fear of falling or crowds or an injury that interferes with walking. Many people felt that there was an increased risk of slipping on tactile paving if it was wet, icy or laid on a slope, and concerns were raised about the trip hazards posed by blisters. 16.8% of questionnaire participants had fallen outside their home at least once within the previous 12 months; between them totalling 286 falls, of which 17 were attributed to tactile paving. Additionally, 30 of the participants had fallen on tactile paving at some time in the past.

Is tactile paving being correctly installed and maintained on Britain's streets?

In our questionnaire survey, less confident pedestrians told us that the correct configuration of tactile paving at a crossing gave them additional reassurance about both approaching and using the crossing safely. During fieldwork (see Methodology 2), we found incorrect configuration to be widespread and several instances of blister paving being used at the top and bottom of steps or at the foot of a ramp, thus alerting pedestrians to the wrong hazard. In line with British Standards, blisters are designed to be 5mm high ($\pm 0.5\text{mm}$) and the Department for Transport regards their effectiveness as 'significantly reduced' if they fall below 4.5mm. Of the 93 tactile paving sites I'DGO tested, 60% (52) had significantly reduced detectability, with an average blister height of 3.0mm to 4.49mm.

Is guidance on colour and tonal contrast being observed?

In the UK, less than 4% of people with serious sight loss are totally blind and colour and tonal contrast are routinely used by people with reduced vision to differentiate, from a distance, between different parts of the footway and the carriageway. None of the 30 sites I'DGO studied for tonal (colour) contrast met the Light Reflectance Value recommended in BS 8300:2009+A1:2010 (30 points), meaning that the tonal contrast difference between tactile and surrounding paving was insufficient, especially in wet conditions. Additionally, it was common to see the wrong colour of tactile paving laid at a particular type of crossing - e.g. buff instead of red at zebra crossings - or an arbitrary mix of colours used. Some local authorities used the same red colour on the crossing area of the carriageway as on the waiting area pavement-side, without the contrasting border recommended in *Guidance on the use of tactile paving surfaces* (DfT 2005, revised 2007).



“ The use of certain colours in the surface is recommended as many partially sighted people have sufficient residual vision to detect strong contrasts in colour and tone. ”

- *Guidance on the use of tactile paving surfaces* (UK Department for Transport and Scottish Government, 2005, revised 2007)

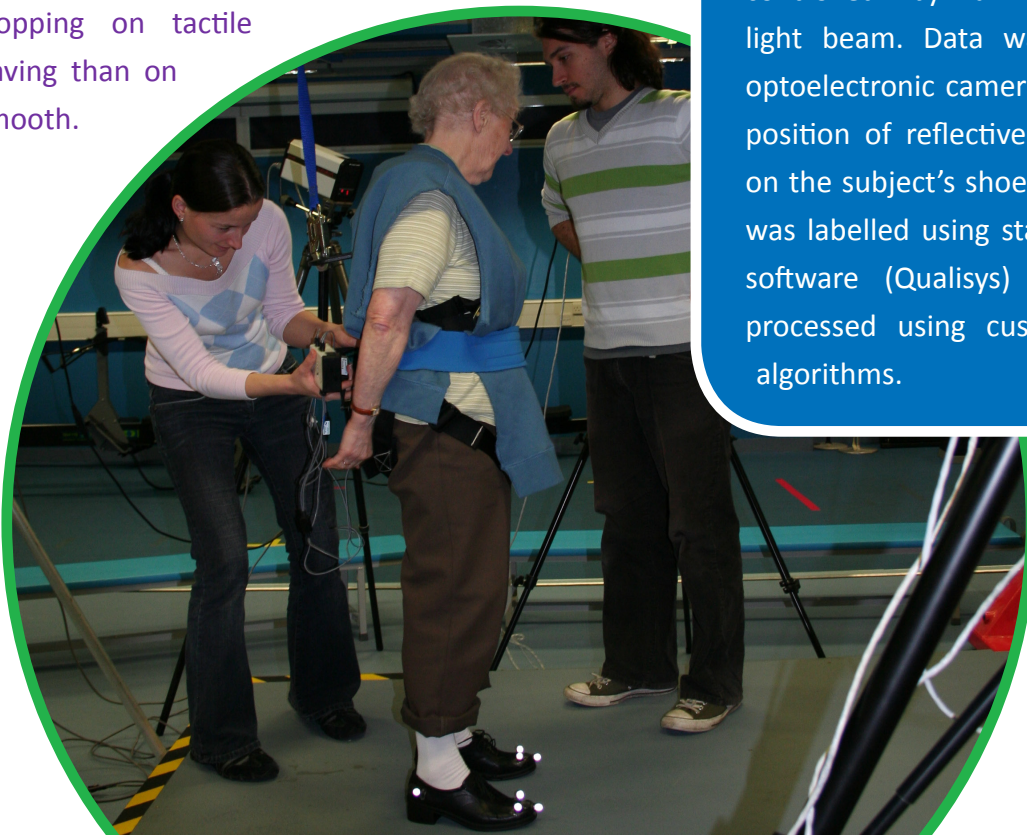
Methodology 2

The findings on this page are taken from an audit of the 48 road crossing sites mentioned in Methodology 1. As well as observing people both approaching and using the sites, to note potential hazards and enabling features, we visually assessed the extent to which any tactile paving had been designed and laid in accordance with *Guidance on the use of tactile paving surfaces* (DfT 2005, revised 2007). Using between four and eight of the paving blocks (dependent on width and condition of the site), we measured the height of the blisters on both sides of the 48 road crossing points (applicable to 93 of the 96 sites). Thirty sites were also tested for Light Reflectance Values (LRVs), with both tactile and surrounding paving tested in wet and dry conditions and the difference in mean LRV noted.

Do tactile surfaces pose a slip and trip hazard for older people?

Using two scientific tests (see Methodology 3), I'DGO tested the slip resistance of 30 'real world' blister tactile paving sites under wet conditions. We used the UK Slip Resistance Group's classification system of Low, Moderate and High Slip Potential (UKSRG, 2011). Sites with Low Slip Potential (SP) were predominantly those paved in concrete, clay and sandstone, although some TGSIs, which were in the same three materials but had a smoother finish, had a Moderate SP. Granite TGSIs ranged from Moderate to High SP and brass studs, stainless steel studs and thermoplastic sheets all had a High Slip Potential.

In a human performance laboratory, we undertook biomechanical analysis on 32 healthy older adults walking along a simulated controlled pedestrian crossing with different types of paving, all laid according to guidelines. On tactile paving, as compared to smooth, people's rhythmic gait became more variable and the timing of their foot placement increased by 20%, indicating that their balance was challenged. Participants lifted their feet higher when walking on tactile paving, by as much as 9%, which takes physical effort if done repeatedly. When asked to stop by a 'red man' signal at the crossing, 28% of participants had more difficulty stopping on tactile paving than on smooth.



Methodology 3

The findings on this page are taken from two studies: one in the 'real world'; one in the laboratory. For the 30 UK real world sites, we developed a new protocol for coefficient of friction testing, measuring the Pendulum Test Value (PTV) of tactile paving slabs both on top of and between the tactile elements, using a standard Stanley-Munro pendulum and two different sizes of rubber heel. After consulting the UK Health and Safety Laboratory, and to evaluate more fully the role of wet weather in surface slip resistance, we then performed a surface roughness test on the same paving, using a Mitutoyo SJ201P meter. The results have been validated through comparison with PTV's from a reviewed Australasian database using regression analysis.

In the laboratory, our nine metre long walkway could be configured to test each participant's gait on a combination of smooth, tactile, ramped and flat paving. Both continuous and interrupted journeys across the walkway were studied (30 journeys in total per person); the crossing controlled by an invisible infrared light beam. Data was collected using optoelectronic cameras that tracked the position of reflective markers mounted on the subject's shoes and waistband. It was labelled using standard commercial software (Qualisys) and filtered and processed using customized MATLAB® algorithms.

Recommendations

Few pedestrians are aware what the different types of tactile paving signify; a challenge exacerbated by inconsistency in provision and, frequently, by incorrect installation. This can make many pedestrians, including those with vision impairments, uncertain about a street feature that is designed to be reassuring; diminishing its perceived benefits. Public awareness-raising as to what people should expect to find where, and for what purpose, may improve this outcome, as might training for people not registered blind but with vision impairments. Providers also need to adhere closely to guidelines and strive for consistency across their area of jurisdiction and nationally, in consultation with others.

- Always ensure the tactile paving used at a particular site is sending out the right 'message' e.g. use blisters at road crossing points and nowhere else.
- Check that the paving is configured correctly. At crossing sites, the right layout guides people towards the crossing point, as well as defining the safe waiting area.
- At controlled crossings, avoid making the crossing area of the carriageway red. On the footway, accurately determine that there is sufficient tonal contrast between the red tactile surfaces and the surrounding paving. Differences between red, greys and browns can be difficult to detect.
- At uncontrolled crossings, the choice of colour for both tactile and surrounding paving should be determined, in the first instance, by the tonal contrast between the two. Never use red tactile paving at an uncontrolled crossing point.
- Avoid laying tactile paving on a steep slope. Assess the environment beforehand and modify the profile of the site, if necessary, not the material.
- A policy review on discrete TGSi systems is recommended, with resultant guidance on suitability and installation. Until this takes place, minimise the use of brass studs, stainless steel studs and thermoplastic sheets when installing tactile paving. When tested, they had a High Slip Potential, especially in wet conditions, and are not currently subject to British Standards.
- Regular maintenance checks by local authority inspectors should include measuring the height of blisters and replacing units where this falls below minimum levels of detectability.

About this guidance:

This version of DSOPM003: Tactile paving dates from September 2012 and is available in both hard copy and pdf format. All queries should be addressed to Marcus Ormerod (m.ormerod@salford.ac.uk), who retains the copyright.

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