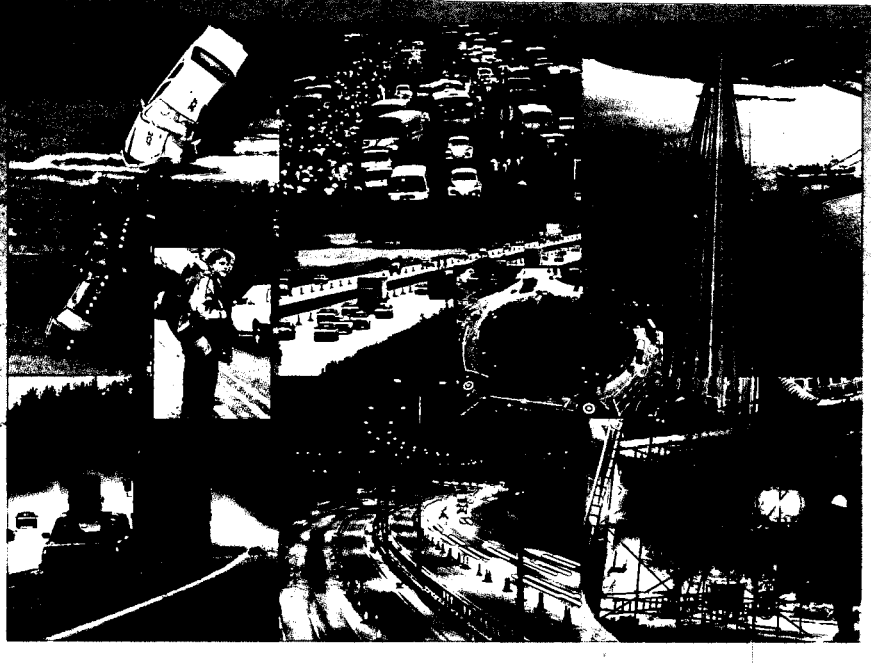

# Trials on platform edge tactile surfaces

by T Savill, G Davies (TRL)
A Fowkes, C Gallon (Cranfield University)
and B Simms (Consultant)

An executive agency of
THE DEPARTMENT
OF TRANSPORT

TRL Report 179

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TRL provides research-based technical help which enables its Government Customers to set standards for highway and vehicle design, formulate policies on road safety, transport and the environment, and encourage good traffic engineering practice.

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It also sells its services to other customers in the UK and overseas, providing fundamental and applied research, working as a contractor, consultant or providing facilities and staff. TRL's customers include local and regional authorities, major civil engineering contractors, transport consultants, industry, foreign governments and international aid agencies.

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TRL covers all major aspects of road transport, and is able to offer a wide range of expertise ranging from detailed specialist analysis to complex multi-disciplinary programmes and from basic research to advanced consultancy.

TRL with its breadth of expertise and facilities can provide customers with a research and consultancy capability matched to the complex problems arising across the whole transport field. Areas such as safety, congestion, environment and the infrastructure require a multi-disciplinary approach and TRL is ideally structured to deliver effective solutions.

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Quality control systems have been introduced across all major areas of TRL activity and TRL is working towards full compliance with BS EN 9001:1994.

**TRANSPORT RESEARCH LABORATORY**
An Executive Agency of the Department of Transport


**TRL REPORT 179**

# TRIALS ON PLATFORM EDGE TACTILE SURFACES

**by T Savill, G Davies (TRL) A Fowkes, C Gallon (Cranfield University) and B Simms (Consultant)**

**Prepared for: Project Record: UG51 Pedestrian Projects**
**Customer: Mobility Unit (S Sharp)**




The Transport Research Laboratory is no longer an Executive Agency of the Department of Transport as ownership was transferred to a subsidiary of the Transport Research Foundation on 1st April 1996

Transport Research Laboratory
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# EXECUTIVE SUMMARY


A tactile surface consisting of 'blisters' is currently advised for use at heavy rail platforms to warn visually impaired pedestrians that they are approaching the platform edge. This surface is similar to the blistered surface used to help people locate road crossing points. However, where the two occur in close proximity, as in the case of street running light rail systems, visually impaired people may confuse the modified blister surface for that used at road crossings.

A lozenge tactile surface has been designed by Cranfield Institute of Logistics and Transportation (CCLT) for use at on-street light rapid transit platforms. This surface warns visually impaired pedestrians that they are approaching the edge of the platform and has been especially designed to avoid confusion with the blister surface used at road crossings.

CCLT were commissioned to compare the performance of the lozenge surface with the blister surface at a heavy railway and light rapid transit environment and to recommend which surface should be used at the two types of platform. They were also asked to establish the appropriate distance to install tactile warning surfaces from the edge of the platform and to ascertain the feasibility of recommending a standard distance. People's views towards the use of the corduroy 'hazard, proceed with caution' surface and the information surface to inform them they are entering a platform area were also investigated. In addition, TRL were commissioned to trial the lozenge surface in a station environment to determine its detectability and whether people would want this surface at heavy rail platforms.

**Cranfield Study**

Two sites were selected for study in Manchester. At Victoria station, a heavy rail and light rapid transit interchange, the blister surface was installed on one platform and the lozenge surface on another. The blister surface was also used to warn of a pedestrian crossing across the light rail track. Ninety eight per cent of the sample each detected the heavy rail blister tactile surface and the lozenge surface. Most of the fifty people said the surfaces were useful, but four people said the heavy rail blister surface could be confused with that used to indicate a road crossing and four people said the lozenge surface was not useful because it was not pronounced enough. A further two people said the lozenge surface was not as good as the blister surface.

Forty four per cent of the sample said they preferred to have one surface used to indicate the platform edge at LRT platforms and a different surface at heavy rail stations. Fifty two per cent said they preferred to have one tactile surface indicating the platform edge at both types of platform. When asked which surface the fifty people would want if there was to be one surface only, most preferred the lozenge surface (52%).

At Moseley, an on-street LRT station, the corduroy surface was installed at the end of the platform ramp and the information surface installed to the side of the platform ramp. People's views were sought on which of these surfaces they would want to inform them they were entering an on-street platform. All but one person detected the corduroy surface and all the subjects detected the information surface.

Views from other disabled people and the general public were also sought. Most of the disabled people did not encounter any difficulties with walking or wheeling over the heavy rail blister and lozenge surfaces.

**TRL Study**

In the TRL study, forty-eight visually impaired people were invited to Earlestown train station, Cheshire, to test the lozenge surface in situ. The participants were asked to approach the lozenge tactile surface at a range of angles (10, 35 and 90 degrees) and to stop if they detected a tactile surface. After they had stopped walking, they were asked to say how they knew when to stop, and how far they thought they were from the platform edge. The participants were also asked to walk towards the platform edge on a control platform where no tactile surfaces had been installed.

At the control platform, eight participants (17%) walked close to the edge of the platform and had to be restrained by the experimenter. Five participants thought they were further from the edge than they actually were. Most of the participants had used their mobility aid to help them decide when to stop walking.

On their first approach to the lozenge tactile surface, 71 percent of participants stopped on the surface and 15 percent stopped before reaching it. Thirteen percent failed to detect the surface and one person stepped over the tactile surface. When all the respondents were asked how they knew when to stop walking, some could detect visual cues such as the contrast of the lozenge surface against the tarmacadam platform.

On the 10 and 35 degree angled approaches, nearly all the participants detected the lozenge surface (90% and 88% respectively). On the 10 degrees approach, nine participants took more than two steps on the surface before they detected it.

After familiarising themselves with the lozenge surface, the participants were again asked to walk towards the platform edge. In this condition, 79 per cent stopped on the tactile surface and a further 17 per cent stopped before reaching it but detected it with their mobility aids.

Ninety-four percent of participants thought the lozenge surface had helped them to locate the platform edge at the station. However, 35 percent said they would like the surface to be modified to make it more detectable. Eight participants wanted the surface to be wider so they would not step over it and four wanted it to start further from the edge of the platform.

A public intercept survey was also carried out with 73 respondents. Three quarters of these said they thought the lozenge surface was acceptable to walk on.

**Recommendations**

The report recommends that the lozenge surface be used at on-street platforms to avoid confusion with the blister surface used to indicate dropped kerbs. It is recommended that the corduroy 'proceed with caution' surface be installed at the beginning of the ramp up to the platform to warn visually impaired people they are entering an on-street platform. This surface should be between 400 and 800 mm in depth.

At heavy rail platforms, it is recommended that the heavy rail blister surface be installed in keeping with current practice in other countries. The use of the corduroy surface to inform people they are entering a heavy rail station should also be considered.

The lozenge and blister surface should be installed between 600 and 1000 mm from the edge of the platform and should be at least 400 mm in depth.

# TRIALS ON PLATFORM EDGE TACTILE SURFACES


## ABSTRACT

Two studies were commissioned by the Department of Transport to determine whether and which tactile surface was needed to warn visually impaired people of their proximity to the edge of a platform. Cranfield University compared the performance of a lozenge with the heavy rail blister surface at both a LRT/heavy rail interchange and at an LRT platform. It was found that both surfaces are detectable and that an additional surface is also needed to warn people they are walking on to an on-street platform. TRL investigated the lozenge surface at a heavy rail station where most of the forty eight participants could detect this surface at a variety of approach angles. However, it was found that some participants thought the surface needed modifying to make it more detectable. It is recommended therefore that the lozenge surface be limited to installations at LRT on-street platforms together with the corduroy 'proceed with caution' surface, and that the heavy rail blister surface should be used on heavy rail platforms and on LRT platforms inside stations in keeping with current practice in other countries.


## 1. INTRODUCTION

During the 1980s the Transport Research Laboratory (TRL) and the National Federation of the Blind investigated the value of a tactile surface to help visually impaired pedestrians to locate zebra and pelican crossings and traffic signalled junctions with a pedestrian phase. This work led to the development of the 'blistered' surface (Department of Transport, 1991, see Figure 1), now in widespread use to indicate a dropped kerb at a road crossing. Around this time, the only other tactile surface in use was that indicating the pedestrian side of a shared cycleway installed away from traffic routes (Williams, 1985). In 1988, TRL commissioned Cranfield University to carry out research to determine how many different tactile surfaces could be reliably distinguished underfoot (or by using a mobility aid) by people with visual impairments. The results of this research indicated that visually impaired people can learn to discriminate between different tactile surfaces. It also showed that, over a period of time, they could remember the patterns and associated meanings of up to six surfaces (Gallon et al, 1991). The study recommended that four further different tactile surfaces be tested in real life situations. The suggested meanings of these surfaces were: proceed with caution, guidance through pedestrianised and platform areas, warning of a railway platform edge and information (e.g. location of a telephone box, bus stop).

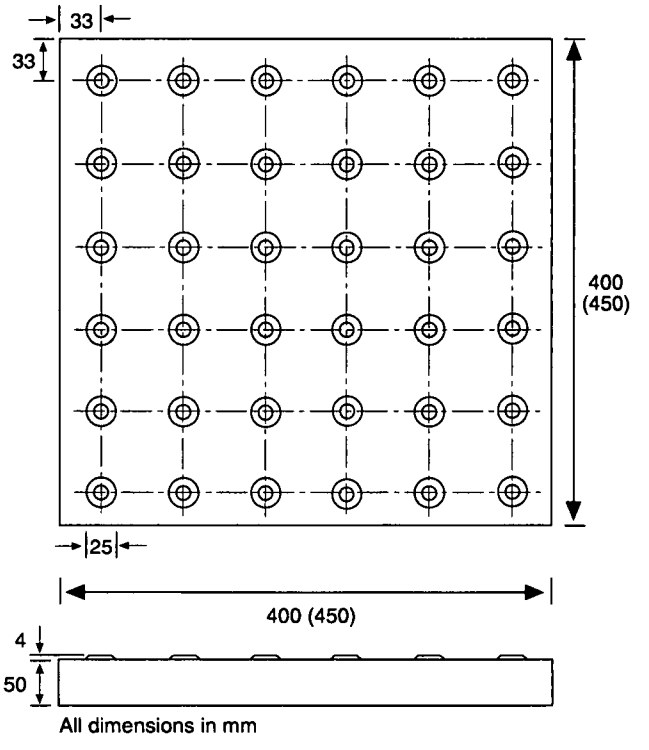


**Fig.1 Blister surface**

Further research confirmed that visually impaired people found tactile footway surfaces helpful in enabling them to travel with greater confidence (Gallon, 1992). However, it was emphasised that structured training techniques to enable people to make full use of the tactile surface is of great importance (Gallon et al, 1993).

The surface currently recommended to indicate the proximity of a heavy rail platform edge is a variation on the blistered paving (referred to as the 'heavy rail blister', see Figure 2). However, with the introduction in some areas of light rail transit systems (trams) accessed by on-street platforms, it was considered that the blistered surface, if used in the street environment, could be confused with the pattern to indicate a dropped kerb at a road crossing. To investigate this further, Cranfield University was commissioned by the South Yorkshire Passenger Transport Executive to identify a tactile surface that could easily be detected by visually impaired pedestrians and which did not create a hazard for other platform users. A further requirement was that this surface should be reliably distinguished from other tactile surfaces currently in use.

In May 1992, four prototype tactile surfaces were installed at Cranfield University, alongside the six surfaces previously recommended. Three were new surfaces and one used a combination of the existing surfaces 'hazard,

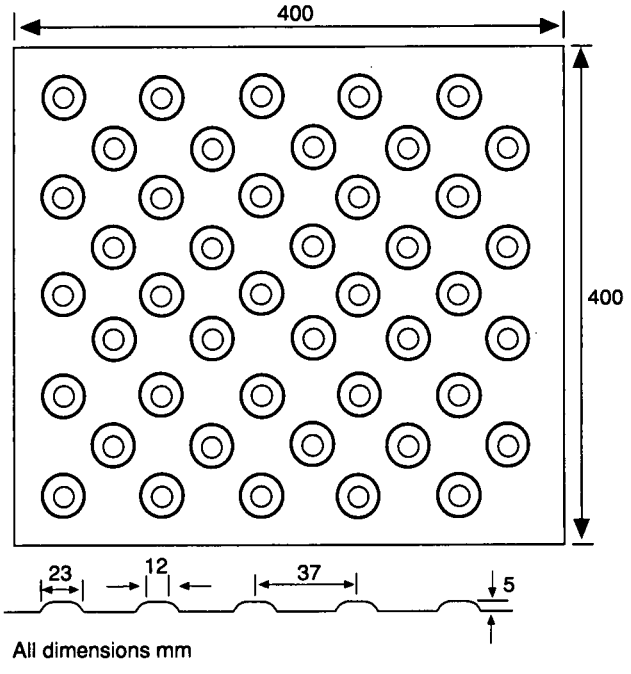


**Fig.2 Heavy rail blister surface**

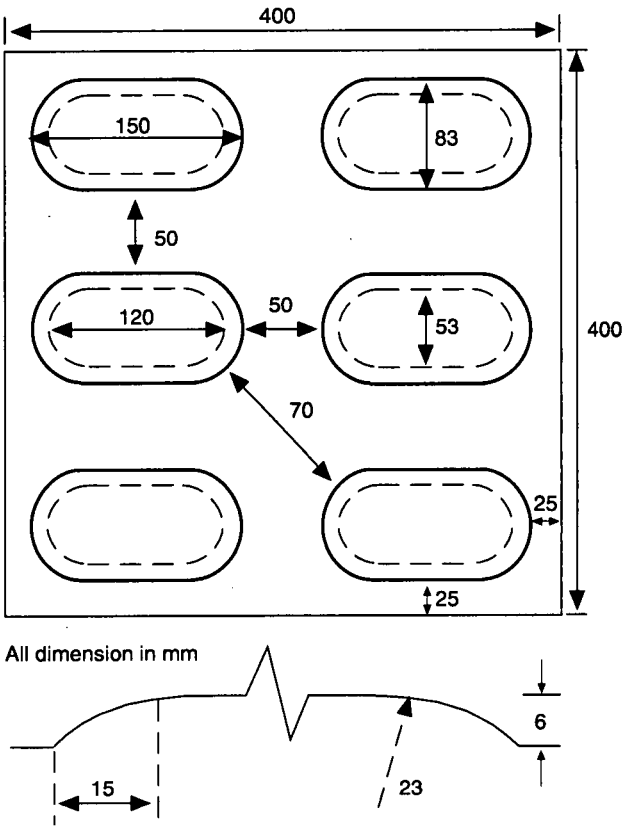


**Fig.3 Lozenge surface**

proceed with caution' and 'warning of a platform edge' (Ayala et al, 1992). The experimental work identified a rounded lozenge shape as the most suitable surface to indicate the edge of an on-street platform (Figure 3). However, with the development of heavy rail and light rapid transit systems using the same interchanges, it was not clear whether the blistered or the lozenge surface should be used to indicate the edge of a tram platform in the station environment. It was not known whether visually impaired travellers would find it confusing to encounter two surfaces both warning of platform edges (the lozenge for light rapid transit and the blister for heavy rail). There was also the possibility that the blistered surface warning of a heavy rail platform would be mistaken for the blistered surface used to indicate a tram line crossing point.

This report discusses the findings of two studies commissioned by the Department of Transport, one carried out by Cranfield University and the other by the TRL. Cranfield University were asked to investigate whether the lozenge or heavy rail blister surface should be used to indicate platform edges and whether the same surface could be used at both LRT and heavy rail platforms. Associated with this problem was the issue of how far from the actual edge of platforms the tactile surface should be installed. At present the railway platform edge surface is installed behind the coping stone. However, LRT platforms tend to be much narrower than British Rail platforms and have coping stones that vary in width from 600 to 750 mm. This raises the question of whether there should be a standard distance between the tactile surface and the platform edge and whether a standard distance is, in practice, feasible.

In addition to the issue of which platform edge warning surface should be installed at interchanges, a further problem was identified following the opening of the Metrolink LRT in Manchester. A number of organisations, including the National Federation of the Blind, expressed concern about the risk that visually impaired pedestrians might walk on to an on-street platform without being aware that they were actually on a platform. Indeed, this issue of visually impaired pedestrians walking unaware into potentially dangerous environments, such as railway stations, had been of concern for some time. It was suggested that a possible solution to this problem would be the use of a tactile surface (the proceed with caution or information surface - Figures 4 and 5 respectively) to indicate to visually impaired people that they are entering an area with a platform. These two surfaces were tested as part of the Cranfield University project.

TRL were commissioned to investigated whether the lozenge surface was detectable in a heavy rail environment, and whether visually impaired participants would want this surface installed to warn them of the platform edge. In addition, people were asked to give information on any accidents or other problems they had experienced in a railway station.

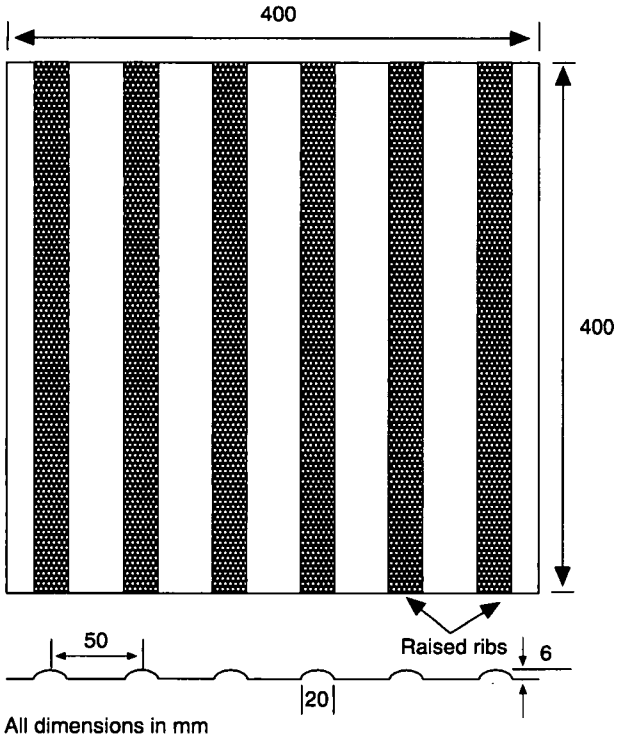


**Fig.4 Proceed with caution surface**

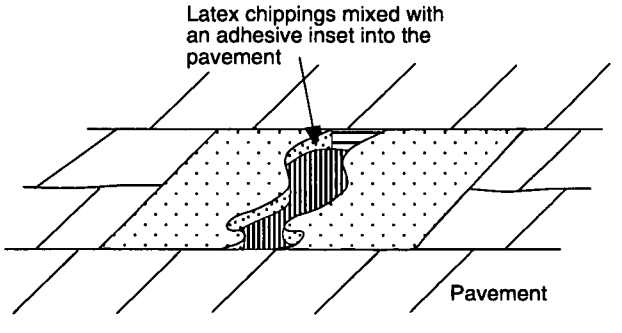


**Fig.5 Information surface**

# 2. CRANFIELD STUDY

## 2.1 OBJECTIVES

The research undertaken by Cranfield had six main objectives:

i) To establish whether visually impaired people find more than one platform edge warning surface useful at a heavy rail and LRT interchange station building.

ii) To establish whether the lozenge patterned LRT platform edge warning surface could be used to warn of all platform edges.

iii) To establish the appropriate distance tactile warning surfaces should be installed from the edge of platforms and ascertain the feasibility of recommending a standard distance.

iv) To establish whether visually impaired people find the recommended rail platform edge warning surface and the blistered paving warning of a dropped kerb at a tram line crossing point useful when both are installed at an interchange station building.

v) To establish whether the lozenge patterned LRT platform warning surface presents a hazard to other groups of LRT and rail travellers, including ambulant disabled people and wheelchair users.

vi) To establish whether visually impaired people find either the latex information surface or the 'proceed with caution' surface useful in providing a warning that they are entering a platform area.

vii)To provide specifications regarding the most appropriate layout for such surfaces and to ensure that they do not present a hazard for other footway users, in particular wheelchair users and ambulant disabled people.

## 2.2 METHODOLOGY

The initial stage of the research involved meetings with representatives of the Department of Transport, the Health and Safety Executive - HM Railway Inspectorate, Greater Manchester Passenger Transport Executive, British Rail Regional Railways North West and Manchester City Council to view the proposed experimental sites and to discuss the appropriate layout and installation of the various tactile surfaces. Once the surfaces had been installed a pilot study was undertaken to assess the effectiveness of the proposed experimental procedures.

A sample of 50 visually impaired people was invited to take part in experimental trials. The sample size of 50 people ensured a reasonable cross section of visually impaired pedestrians representing a range of ages, use of mobility aids and degrees of independent mobility. However, the sample was weighted towards the totally blind since the experiments were primarily concerned with evaluating the tactile quality of surfaces, rather than the visual aspects such as colour and contrast. The experimental trials were designed to assess the use and layout of tactile surfaces in the context of light rapid transit and heavy rail systems.

A sample of 32 ambulant disabled people and 15 wheelchair users was also invited to take part in experiments designed to assess whether any of the tactile surfaces presented a hazard.

In addition, a public intercept survey was undertaken to assess the views of the public regarding the use of the

lozenge patterned surface on the Metrolink light rapid transit system. One hundred and five users of the Metrolink tram were interviewed.

## 2.3 EXPERIMENTAL SITES

The city of Manchester was chosen as the location of the experimental trials because of the presence of the Metrolink light rapid transit system and the suitability of sites. Two sites were used: Victoria Station, a heavy rail and light rapid transit interchange used by British Rail and Metrolink, and Moseley Street where a Metrolink on-street platform was located.

At Victoria Station two different tactile surfaces were installed to warn of the edge of platforms (see Figure 6). On British Rail platform Number 10 the warning of a railway platform edge tactile surface was installed 500 mm from the platform edge, for a distance of approximately five metres. On Metrolink platform B the lozenge patterned surface was installed 750 mm from the platform edge, for a distance of approximately five metres. Already installed at the site, as part of the Metrolink system, was the 'blistered' paving warning of the pedestrian crossing point over the tram rail lines. This surface was designed to be used to warn of a dropped kerb at a road crossing point.

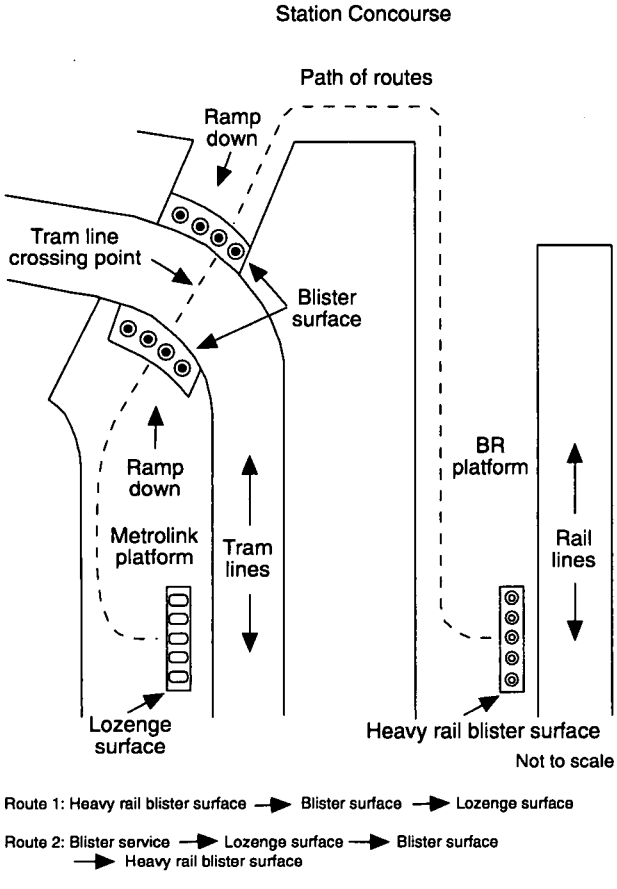


**Fig.6 Victoria Station - experimental site**

At the Moseley Street Metrolink on-street platform two different tactile surfaces were installed to indicate the presence of the on-street platform area, as distinct from the surrounding pavement (see Figure 7). At one end of the platform, at the junction with York Street, the warning, 'proceed with caution', tactile surface was installed at the end of the platform ramp. The surface was 800 mm deep and 1,400 mm wide. At the Parker Street end of the platform, the information tactile surface was installed to the side of the platform ramp, in a 1,200 mm square. The ramp at this point is effectively level with the pavement. It was not possible to install this surface directly at the end of the ramp because of the presence of a dropped kerb at a pedestrian crossing point, immediately adjacent to the end of the ramp.

## 2.4 EXPERIMENTAL PROCEDURE

Of the 50 subjects, 42 were aware of tactile surfaces as 12 months previously they had taken part in a research project aimed at developing training methods to enable visually impaired to use tactile surfaces. Seventeen subjects had some knowledge of the heavy rail warning of the platform edge surface, but only through a tactile diagram. None of the subjects had any experience of the lozenge patterned surface. The subjects were advised that the objectives of the research were to test tactile surfaces and their layout, and it was emphasised that the subjects themselves were not being tested.

Before taking part in the experimental trials, subjects were asked some preliminary questions relating to their personal characteristics and whether they were familiar with Victoria Station and the Metrolink system. Whilst taking part in the experiments, subjects were accompanied at all times by researchers, on a one-to-one basis.

### 2.4.1 Victoria Station site

As the platform edge warning surfaces were installed on two separate platforms, there were two routes that subjects could take to evaluate the surfaces. A consequence of one route was that the blistered paving at the tram line crossing point was encountered twice. The sample was therefore divided evenly between the two routes. The two routes are shown in Figure 6. The following experimental procedure applied to Route 1. The same questions were asked for Route 2, although in a different sequence.

Subjects were escorted on to the British Rail platform, and whilst in a position facing the edge of the platform were advised:

> *You are now on a British Rail platform. A tactile surface has been installed to warn of the edge of the platform.*

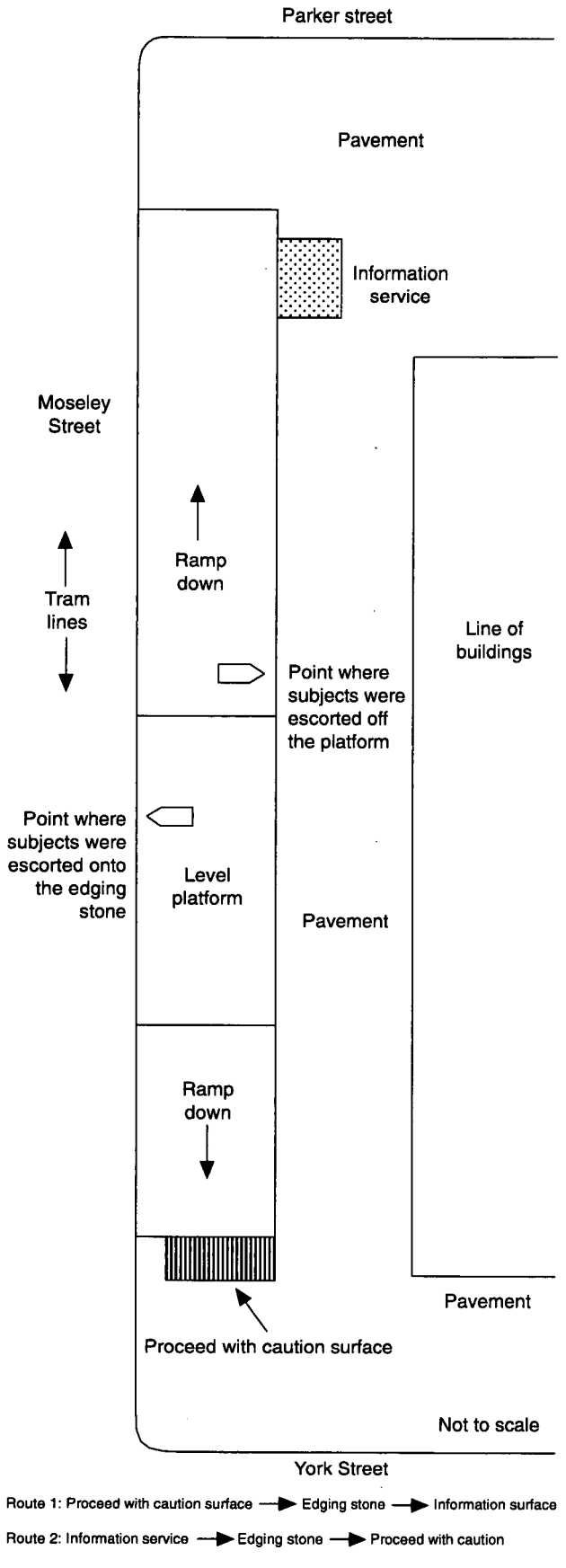


**Fig.7 Moseley Street - experimental site**

*When I ask you to proceed I want you to walk forward. If you detect a tactile surface I want you to stop. If at any time I ask you to stop, please stop immediately.'*

When it was safe to do so, researchers asked subjects to proceed. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked to describe the pattern of the surface and those with residual vision were asked questions about what they could see of the surface. Subjects were asked whether they had encountered the surface before and if it was useful to warn them of the edge of the platform. Subjects were next encouraged to locate the edge of the platform and told what the distance between the tactile surface and the edge of the platform was. Subjects were asked their views concerning this distance. Subjects were then escorted back along the British Rail platform and towards the tram line crossing point.

Whilst in a position facing the tram line crossing point subjects were advised:

*When I ask you to proceed I want you to walk forward. If you detect a tactile surface I want you to stop. If at any time I ask you to stop, please stop immediately.'*

Subjects were not told that they were at a tram line crossing point. When it was safe to do so, researchers asked subjects to proceed. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked to describe the pattern of the surface and those with residual vision were asked questions about what they could see of the surface. Subjects were asked if they knew the meaning of the surface, and whether is was similar or different to the surface previously tested (on the British Rail platform). Subjects were informed that the surface was normally used to indicate a road crossing where a dropped kerb had been installed, but at this site it was being used to indicate a crossing point over the tram lines.

When it was safe to do so, subjects were asked to cross the tram lines and to stop once they had reached the other side. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked if the surface was useful to indicate the tram line crossing point, and whether it was clear that this was a tram line crossing point, and not a road crossing point.

Subjects were then escorted up a ramp and on to the Metrolink platform, and whilst in a position facing the edge of the platform were advised:

*'You are now on a Metrolink platform. A tactile surface has been installed to warn of the edge of the platform.*

*When I ask you to proceed I want you to walk forward. If you detect a tactile surface I want you to stop. If at any time I ask you to stop, please stop immediately.'*

When it was safe to do so, researchers asked subjects to proceed. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked to describe the pattern of the surface and those with residual vision were asked questions about what they could see of the surface. Subjects were asked whether the pattern of the surface felt similar or different to the edge warning surface on the heavy rail platform. Subjects were asked whether they had encountered the surface before and if it was useful to warn them of the edge of the platform. Subjects were next encouraged to locate the edge of the platform and told what the distance between the tactile surface and the edge of the platform was. Subjects were asked their views concerning this distance.

After this procedure subjects were told that the lozenge patterned surface was placed further back from the edge of the platform than the edge warning surface on the heavy rail platform. Subjects were asked which distance they preferred, and what the reasons were for their choice.

After subjects had completed the experimental procedure for either Route 1 or Route 2, a series of concluding questions were asked. Subjects were asked if it was useful that two different tactile surfaces were used to warn of the platform edge on the heavy rail and Metrolink platforms, or whether they would prefer just one surface. They were then asked whether they had a preference if only one of the surfaces were to be used to warn of the edge of a platform.

Subjects were next asked whether they thought the blistered paving installed at the tram line crossing point was similar or different to the warning of the platform edge surface used on the heavy rail platform. If subjects thought these two surfaces were similar they were asked whether this was confusing.

Subjects were then reminded of the respective distances from the edge of the platform that the two warning of the platform edge surfaces were installed. They were asked which distance they preferred, and whether the difference in the distances was obvious. Subjects were asked if they would like the warning of the platform edge surface to be the same distance from the edge for all types of platforms, heavy rail and Metrolink.

To conclude the questionnaire at the Victoria Station Site subjects were told that it might not always be possible to install an edge warning surface at a set distance from the platform edge, because of the varied design and construction of platforms. Subjects were asked if a tactile surface warning of the platform edge would be useful, even if they could not be certain of the distance between the surface and the platform edge.

Subjects were then escorted on to the Metrolink tram for the short journey to the second experimental site at the Moseley Street on-street platform.

### 2.4.2 Moseley Street site

Subjects were escorted off the tram and down the steps at the back of the platform (avoiding the tactile surfaces). Subjects were then escorted back onto the platform, from the direction of Parker Street, and along the ramp where the gradient was at a minimum. Whilst on this section of the platform subjects were asked to describe where they were standing.

Since tactile surfaces were installed at both ends of the on-street platform it was possible to divide the sample evenly between two routes. The two routes are described in Figure 7. The following experimental procedure applied to Route 1. The same questions were asked for Route 2, although in a different sequence.

Subjects were escorted on to the pavement, and whilst in a position facing the 'proceed with caution' surface were advised:

*'You are now in Moseley Street where there is a tram platform. A tactile surface has been installed to indicate where the platform area begins.*

*When I ask you to proceed I want you to walk forward. If you detect a tactile surface I want you to stop.'*

When it was safe to do so, researchers asked subjects to proceed. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked to describe the pattern of the surface and those with residual vision were asked questions about what they could see of the surface.

Subjects were asked if they knew the meaning of the surface, and whether they were aware of what was ahead of them. Subjects were told that the surface had the meaning of 'proceed with caution' and although it may typically be used to warn of steps, in this situation it was being used to warn of the platform area. Subjects were asked whether they were concerned that the surface may warn of steps as well as where a platform in the street begins. Subjects were repositioned in line with the tactile surface and asked to proceed forward and continue on to the on-street tram platform (researchers offered their assistance).

Whilst on the platform subjects were escorted on to the platform edging stone and asked if they could detect a tactile surface. The concrete edging stone had shallow

grooves and is advertised by Metrolink as a tactile surface to warn visually impaired passengers of the edge of the platform. Whilst in this position subjects were asked if they were aware how near the edge they were.

Subjects were escorted off the platform and on to the pavement, and whilst in a position facing the information surface were advised:

> *'A tactile surface has been installed to indicate where the platform area begins.*
>
> *When I ask you to proceed I want you to walk forward. If you detect a tactile surface I want you to stop.'*

When it was safe to do so, researchers asked subjects to proceed. A record was made of whether or not subjects detected the surface and stopped, and whether it was necessary for researchers to intervene. Subjects were asked to describe the surface and those with residual vision were asked questions about what they could see of the surface.

Subjects were asked if they knew the meaning of the surface, and whether they were aware of what was ahead of them. Subjects were told that although the information surface may typically be used to indicate a facility such as a telephone booth or a bus stop, in this situation it was being used to warn of the platform area. Subjects were asked whether they were concerned that the surface may indicate a facility as well as where a platform in the street begins.

After subjects had completed the experimental procedure for either Route 1 or Route 2, concluding questions were asked. Subjects were asked if they found the tactile surfaces useful to indicate that a tram platform was an integral part of the pavement. To conclude the questionnaire subjects were asked whether they had a preference for either of the two surfaces, and what the reasons were for their choice.

## 2.5 PERSONAL CHARACTERISTICS OF THE SUBJECTS

A total of 50 visually impaired people participated in the experimental trials during June 1993. The subjects came from various locations within Greater Manchester including Stockport, Salford, Rochdale and Bolton. The sample was divided evenly between the two routes at each of the experimental sites.

Table 1 shows that the sample represented both sexes, (52 per cent male and 48 per cent female) and a range of ages, including the young and elderly.

Forty-eight subjects were registered blind, and two were registered partially sighted. Of the registered blind, 22 people had no sight at all, and a further seven could only distinguish light and dark. The latter group has been classified as totally blind for the purpose of the analysis.

Table 2 shows that nearly all (95 per cent), of the 21 subjects with residual vision could distinguish contrast, and high proportions were able to see colour and shapes.

The majority of people with residual vision (86 per cent) said their level of vision was affected by variations in light conditions. Two-thirds of people with residual vision said their sight was useful to them when out walking.

Table 3 shows that 21 subjects (42 per cent) reported having a secondary disability, of which diabetes was the most common. Five subjects said they had arthritis and five had a hearing impairment.

Table 4 shows that just over half of the subjects (58 per cent) used guide dogs when taking part in the experimental trials. Most of the other subjects used long canes or white sticks. A totally blind man who had forgotten his long cane was

## TABLE 1

Subjects' age group and gender

| Age | Female | Male | Total |
|---|---|---|---|
| 16 - 49 | 11 | 10 | 21 |
| 50 - 64 | 7 | 11 | 18 |
| 65 - 74 | 2 | 5 | 7 |
| 75 and over | 4 | - | 4 |
| Total | 24 | 26 | 50 |

## TABLE 2

Levels of residual vision

| Residual Vision | No. | % |
|---|---|---|
| Colour | 16 | 76 |
| Contrast | 20 | 95 |
| Shape | 17 | 81 |
| Peripheral | 10 | 48 |
| Tunnel | 5 | 24 |
| One eye only | 12 | 57 |
| Total with residual vision | 21 | 100 |

## TABLE 3

Other disabilities

| Disability | No. | % |
|---|---|---|
| None | 29 | 58 |
| Diabetes | 7 | 14 |
| Arthritis | 5 | 10 |
| Hard of hearing | 5 | 10 |
| Other* | 4 | 8 |
| Total | 50 | 100 |

* Other disabilities comprise: epilepsy and heart trouble.

escorted around the experimental sites but assessed the various tactile surfaces without any aid.

Only eight subjects (16 per cent) said that they were familiar with Victoria Station, although a further 12 said they had used the station in the past. Over half of the subjects (62 per cent) said they had used the Metrolink tram system.

## 2.6 RESULTS - VICTORIA STATION

### 2.6.1 Detection and descriptions of tactile surfaces

As Table 5 shows, most subjects detected all three tactile surfaces. One totally blind long cane user failed to detect both the heavy rail (warning of railway platform edge surface) and lozenge surface. The three people who did not detect the blistered paving comprised: two with residual vision (one long cane user and one guide dog user) and one totally blind person who used a guide dog. None of the people who failed to detect surfaces was diabetic.

The majority of the subjects were able to describe the patterns of the three surfaces correctly. Forty-six people (92 per cent) described the heavy rail surface as comprising 'bumps, dots or blisters' and 44 (88 per cent) provided the same description for the blistered paving. The lozenge surface was described in a variety of ways, ranging from 'rounded oblongs' to 'large cobbles'; however, most subjects (92 per cent) provided a meaningful description of the pattern.

The 21 subjects who had residual vision were asked whether they could see the surfaces. Just over half of these people (52 per cent) were able to see the lozenge surface, whereas only six people could see the heavy rail and blister surfaces. This result could be explained by the fact that the yellow coloured lozenge was the only surface that contrasted with the surrounding platform area.

### 2.6.2 Recognition and meanings of surfaces

Subjects were asked whether they had previously encountered the three tactile surfaces. Table 6 shows that the blistered paving was recognized by most people (82 per cent) and almost two-thirds of the subjects (62 per cent) said they had encountered the heavy rail surface. The majority, (94 per cent) said they had not encountered the lozenge surface. The two subjects who said they had were both totally blind.

## TABLE 4

Mobility aid used

| Mobility aid | Totally blind No. | Residual vision No. | Total No. | Total % |
|---|---|---|---|---|
| None | 1 | 2 | 3 | 6 |
| Guide dog | 21 | 8 | 29 | 58 |
| Long cane | 7 | 6 | 13 | 26 |
| White stick | - | 4 | 4 | 8 |
| Red and white stick | - | 1 | 1 | 2 |
| Total | 29 | 21 | 50 | 100 |

## TABLE 5

Detection of tactile surfaces

| Surface | Detected | Not detected |
|---|---|---|
| Heavy rail | 49 | 1 |
| Blister | 47 | 3 |
| Lozenge | 49 | 1 |

described the blistered paving as warning of a tram line crossing point, and all these people had just encountered the heavy rail surface on Route 1.

### 2.6.3 Similarities and differences between surfaces

Subjects were asked whether the surfaces felt different or similar. The majority of people (94 per cent) said the lozenge and heavy rail surfaces felt 'different'. Thirty-six people (72 per cent) said the blistered and heavy rail surfaces felt 'similar'. Virtually all the subjects on Route 2, who encountered the blistered surface before the lozenge surface (96 per cent) said the lozenge and blistered surface were 'different'.

## TABLE 6

Surfaces encountered before

| Surface | No | Yes | Don't know |
|---|---|---|---|
| Heavy rail | 18 | 31 | 1 |
| Blister | 6 | 41 | 3 |
| Lozenge | 47 | 2 | 1 |

## TABLE 7

Meaning of heavy rail and blistered paving surfaces

| Surface meaning | Heavy rail | Blister |
|---|---|---|
| Road crossing | 18 | 13 |
| Pelican and zebra crossing | 7 | 10 |
| Pavement edge | 4 | 6 |
| Warning to stop | 2 | 4 |
| Tram lines | - | 4 |
| Platform edge | - | 4 |

Whilst they were standing on the tactile surfaces, subjects were asked if they knew the meaning attached to that surface. Only two people provided a meaning for the lozenge surface, describing it as 'warning of steps' and 'guidance path'. Table 7 shows that twenty-nine people (58 per cent) described both the heavy rail and the blistered paving as meaning they were at a 'road crossing', 'pelican or zebra crossing' or 'pavement edge'. Only four subjects

Table 8 shows that 61 per cent of those who thought the blistered and heavy rail surfaces felt similar were totally blind.

When asked whether it was clear that they were at a tram line crossing point, 20 subjects (40 per cent) said it was not clear that they were at a tram line or a road crossing point, and a further ten per cent did not know. There were no differences in the level of vision between those people who were clear they were at a tram line crossing point and those who were not.

Table 9 shows the comments subjects made when asked to explain why they were clear or unclear regarding the type of crossing point. Of the subjects who were not clear as to the nature of the crossing point, ten said that the blistered surface indicated a road crossing. Seven subjects said they

## TABLE 8

Comparison of heavy rail and blistered paving by level of vision

| Comparison | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Similar | 22 | 76 | 14 | 67 | 36 | 72 |
| Different | 7 | 24 | 7 | 33 | 14 | 28 |
| Total | 29 | 100 | 21 | 100 | 50 | 100 |

## TABLE 9

Awareness of the tram line crossing point

| Comment | Yes | No/don't know |
|---|---|---|
| Same as road crossing | - | 10 |
| Same as heavy rail surface | - | 1 |
| Clues in station | 14 | 2 |
| No down slope | 4 | - |
| Not unless told | 3 | 7 |
| No comment | 4 | 5 |
| Total | 25 | 25 |

would not have known unless they had been told. This comment was also made by three people who had said that it was clear they were at a tram line crossing point.

Of the subjects who said that it was clear that the blistered paving indicated a tram crossing 14 said that environmental clues in the station enabled them to make this decision. Four subjects noted that there was not a distinctive down slope, as would normally be the case were a dropped kerb installed at a road crossing. In fact, at this location the blistered paving was installed at the end of a ramp.

### 2.6.4 Confusion between surfaces

After subjects had encountered all three surfaces they were again asked whether they thought the heavy rail and the blistered paving were similar or different. Table 10 shows that almost three-quarters of the subjects (74 per cent) said the surfaces were similar.

Of the 37 subjects who said that the two surfaces were similar, 21 said the similarity was confusing. As Table 11 shows, people who were totally blind were more likely to be confused by the similarity of the two surfaces.

Of the subjects who thought the similarity was confusing, seven said the surface should only have one meaning, five said they could get mixed-up and that this was not safe and five said they would not be sure where they were. Of the subjects who thought the similarity was not confusing, seven said that clues in the railway station would enable them to distinguish the use of the surface.

### 2.6.5 Usefulness and preferences

Table 12 shows that the majority of subjects found all three tactile surfaces useful. However, four subjects said the heavy rail surface was not useful because they might 'mix-up' the surface with the blistered paving. Two subjects said the blistered surface was not useful because they would 'mix-up' the surface with a road crossing. Six subjects said the lozenge surface was not useful: four because it was 'not pronounced enough' and two because it was 'not as good as the other'.

The subjects were asked if it was useful that two different tactile surfaces were used to warn of the platform edge, on the heavy rail and Metrolink platforms, or whether they would prefer just one surface. Table 13 shows that the

## TABLE 10

Further comparison of heavy rail and blistered paving by level of vision

| Comparison | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Similar | 20 | 69 | 17 | 81 | 37 | 74 |
| Different | 9 | 31 | 4 | 19 | 13 | 26 |
| Total | 29 | 100 | 21 | 100 | 50 | 100 |

## TABLE 11

Confusion relating to heavy rail and blistered paving by level of vision

| Response | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Confusing | 13 | 65 | 8 | 47 | 21 | 57 |
| Not confusing | 7 | 35 | 8 | 47 | 15 | 41 |
| Don't know | - | - | 1 | 6 | 1 | 3 |
| Total | 20 | 100 | 17 | 100 | 37 | 100 |

## TABLE 12

Usefulness of surfaces

| Surface | No | Yes | Don't know |
|---|---|---|---|
| heavy rail | 4 | 46 | - |
| Blister | 2 | 47 | 1 |
| Lozenge | 6 | 44 | - |

## TABLE 13

Preference for one or two surfaces by level of vision

| Response | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Two useful | 12 | 41 | 10 | 48 | 22 | 44 |
| Prefer one | 15 | 52 | 11 | 52 | 26 | 52 |
| No preference | 2 | 7 | - | - | 2 | 4 |
| Total | 29 | 100 | 21 | 100 | 50 | 100 |

subjects were divided about whether one or two different tactile surfaces should be used.

When asked for their comments regarding why they preferred one or two surfaces, 17 subjects said that two surfaces would be useful to indicate the type of platform they were on. Eight subjects said it was preferable to learn just one surface, and three subjects said the surface should be used to warn of the edge and not be given any other meaning.

Subjects were asked which surface they would prefer if one were to be used to warn of the edge of all types of platform. Table 14 shows that 52 per cent of the subjects would prefer the lozenge surface, and of these people 62 per cent were totally blind. Six of the seven subjects who had diabetes also preferred the lozenge surface.

Of those subjects who preferred the lozenge surface, ten said that the surface felt different and two said that it was more prominent. Eight subjects who preferred the heavy rail surface said it was more prominent.

### 2.6.6 Distance of tactile surface from the edge of the platform

At both the heavy rail and Metrolink platforms subjects were asked whether they found the distance between the tactile surface and the edge of the platform acceptable. On the heavy rail platform the surface was installed 500 mm from the edge, and on the Metrolink platform it was 750 mm. Table 15 shows that although the subjects were divided about the 500 mm distance, there was a significant difference between subjects according to the route followed. Subjects on Route 2, who had already experienced the 750 mm distance (on the Metrolink platform), were more likely to find the 500 mm distance unacceptable. There were no differences in the level of vision between those people who thought the distance 'acceptable' and those who did not.

## TABLE 14

Preference for one surface by level of vision

| Surface | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| heavy rail | 9 | 31 | 10 | 48 | 19 | 38 |
| Lozenge | 18 | 62 | 8 | 38 | 26 | 52 |
| No preference | 2 | 7 | 3 | 14 | 5 | 10 |
| Total | 29 | 100 | 21 | 100 | 50 | 100 |

## TABLE 15

Comments on surface 500 mm from the platform edge by route

| Comment | Route 1 | Route 2 | All |
|---|---|---|---|
| Accept | 16 | 7 | 23 |
| Too close | 8 | 19 | 27 |

Table 16 shows that the views of the subjects concerning the 750 mm distance (on the Metrolink platform) were not so divided, with 78 per cent considering this distance 'acceptable'.

Subjects were asked whether they would prefer platform edge warning surfaces to be installed 500 mm or 750 mm from the edge. Three-quarters of subjects (78 per cent) expressed a preference for the 750 mm distance, and the majority (82 per cent) said that the difference between the two distances was 'obvious'.

Nearly all subjects (94 per cent) said they would prefer a tactile warning surface to be installed at the same distance from the edge on both heavy rail and tram platforms. However, virtually everyone (98 per cent) said a tactile surface warning of the edge of platforms would be useful, even if they were not sure how far from the edge the surface was installed. Twenty people remarked that providing a warning of the platform edge was of primary importance.

## 2.7 RESULTS - MOSELEY STATION

### 2.7.1 Identification of on-street platform and edging stone

Subjects were escorted off the tram and down the steps at the rear of the platform. Subjects were then escorted back onto the platform, from the direction of Parker Street, up the slope with the minimum gradient. Whilst on the platform, subjects were asked to describe where they were standing. Table 17 shows that just over two-thirds of subjects (68 per cent) said that they did not know, or gave an incorrect answer, such as Moseley Street or outside Lewis's department store. Eleven (69 per cent) of the 16 subjects who correctly stated that they were on a platform had some residual vision.

The 34 subjects who had not said that they were on a platform were all advised that they were standing on a platform and asked whether they were aware of this. With

## TABLE 16

Comment on surface 750 mm from the platform edge by route

| Comment | Route 1 | Route 2 | All |
|---|---|---|---|
| Accept | 18 | 21 | 39 |
| Too close | 1 | 4 | 5 |
| Too far | 4 | 1 | 5 |
| Don't know | 1 | - | 1 |

## TABLE 17

Awareness of platform by level of vision

| Awareness | Totally blind | | Residual vision | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Yes | 5 | 17 | 11 | 52 | 16 | 32 |
| No | 10 | 35 | 2 | 10 | 12 | 24 |
| Don't know | 14 | 48 | 8 | 38 | 22 | 44 |
| Total | 29 | 100 | 21 | 100 | 50 | 100 |

the exception of one woman, who said she had a 'slight idea', all the remaining 33 subjects said that they had no idea they were on a platform.

The 16 subjects who had correctly stated that they were standing on a platform were asked to describe how they knew this. Seven people said that they had felt the gradient or slope, and three subjects said that they could see either the edge and/or the shelter on the platform. Of the remainder, three subjects felt the surface change from ordinary paviours to bricks, two people guessed and one man was familiar with the site because he used it daily whilst travelling to and from work.

Subjects were escorted on to the edging stone located at the edge of the platform. When asked whether they could detect a tactile surface, 40 people (80 per cent) said they could not. Seven of the ten subjects who said that they were standing on a tactile surface had residual vision. When these ten subjects were asked to describe how it felt, only two people correctly described the pattern as comprising horizontal lines. The remaining eight subjects described the edging stone as 'feeling different' with their canes, 'slightly patterned' or were unable to explain why it felt different.

Whilst subjects were standing on the edging stone they were asked whether they knew how near to the edge of the platform they were. Thirty-four subjects (68 per cent) said that they did not know. Of the 16 people who said that they did know how far from the edge they were standing, 12 (75 per cent) had some residual vision. Most of these 16 subjects felt with their cane or feet to establish the distance from the edge and two subjects said that they could see the edge.

### 2.7.2 'Proceed with caution' surface

With the exception of one 71 year old partially sighted man, who had no secondary disabilities, all the subjects detected the 'proceed with caution' surface. When asked to describe the surface, 43 subjects (86 per cent) said the pattern comprised 'ridges', 'strips' or 'corduroy'. The remaining seven subjects gave various descriptions including, 'grid', 'rough', 'studs' and 'oblongs'. Only one of these people was diabetic.

The 'proceed with caution' surface did not contrast with the surrounding area, and not surprisingly only ten of the 21 subjects with residual vision said that they could see it.

When asked, the highest proportion of subjects (40 per cent) said that they did not know what the surface meant. However, as Table 18 shows, a fairly high proportion (38 per cent) said the surface meant 'proceed with caution' or warning of steps (previous application in experimental work conducted in Manchester during 1992).

The majority of subjects (80 per cent) said it did not matter to them if the 'proceed with caution' surface was used to warn of the existence of steps and on-street platforms. Half of the ten people who had concerns were worried that they would confuse the two meanings. One subject said that there ought to be a separate surface specifically to warn of platforms, and the remaining four people did not know, or were unable to express their concerns.

## TABLE 18

Meaning of 'proceed with caution' surface

| Surface meaning | No. | % |
|---|---|---|
| Don't know | 20 | 40 |
| Warning of steps | 11 | 22 |
| Proceed with caution | 8 | 16 |
| Warning of platform | 6 | 12 |
| Other | 5 | 10 |
| Total | 50 | 100 |

### 2.7.3 Information Surface

All 50 subjects detected the information surface, and all described it as feeling 'spongy' or 'rubbery'.

Thirteen (62 per cent) of the 21 subjects with residual vision said that they could see the surface.

As Table 19 shows, just over half of subjects (52 per cent) identified the surface as meaning 'information' or 'indication of a telephone kiosk' (previous application in experimental work conducted in Manchester during 1992).

Just over half the subjects (56 per cent) said that it did not matter to them whether the information surface was used to indicate an amenity, such as a telephone kiosk, or the existence of an on-street platform. However, as Table 20 shows, 20 subjects expressed concern about extending the meaning of the information surface to include the warning of on-street platforms. In particular, ten people said that they would find the use of the information surface to indicate an on-street platform confusing.

## TABLE 19

Meaning of information surface

| Surface meaning | No. | % |
|---|---|---|
| Don't know | 16 | 32 |
| Information | 16 | 32 |
| Telephone kiosk | 10 | 20 |
| Warning of platform | 4 | 8 |
| Other | 4 | 8 |
| Total | 50 | 100 |

## TABLE 20

Comments regarding the use of the information surface to indicate on-street platforms

| Comment | No. | % |
|---|---|---|
| It would be confusing | 10 | 20 |
| Would look for an amenity | 5 | 10 |
| Would have too many meanings | 2 | 4 |
| Would need to be familiar with area | 2 | 4 |
| Does not mean 'proceed with caution' | 1 | 2 |
| No answer/don't know | 2 | 4 |
| No problem if used to indicate on-street platforms | 28 | 56 |
| Total | 50 | 56 |

## TABLE 21

Surface preference by comments

| Comment | Prefer 'proceed with caution' | Prefer information |
|---|---|---|
| More distinct | 2 | 25 |
| Means proceed with caution | 11 | - |
| Keep information for information | 4 | - |
| Proceed with caution for steps only | - | 2 |
| Use information only to indicate the existence of on-street platforms | - | 1 |
| Total* | 17 | 28 |

* Four subjects had no preference and one subject gave no answer.

### 2.7.4 Comparison of 'proceed with caution' and information surfaces

The majority of subjects (88 per cent) said that they found the tactile surfaces useful for indicating the existence of an on-street platform. Only five people said the surfaces were not useful, three of whom wanted a separate tactile surface specifically for this purpose.

When asked which tactile surface should be used to indicate an on-street platform, 28 people (56 per cent) said they preferred the information surface, 17 subjects preferred the 'proceed with caution' surface and four had no preference (one subject did not answer). Table 21 shows that nearly all subjects who preferred the information surface did so because they thought it more distinct than the 'proceed with caution' surface. In contrast, the main reason subjects preferred the 'proceed with caution' surface was because they felt the meaning of this surface was more appropriate for the proposed application.

## 2.8 AMBULANT DISABLED PEOPLE AND PEOPLE IN WHEELCHAIRS

### 2.8.1 Experimental procedure

The 46 subjects who participated in this part of the research had not undertaken any previous trials conducted by Cranfield University regarding tactile surfaces. Before taking part in the experimental trials, subjects were asked questions about the nature of their disability, their mobility and whether and how often they travelled independently. A record was made of any mobility aid used during the tests.

At each of the two sites subjects were advised of the purpose of the tactile surfaces.

Whilst undergoing the experimental trials subjects were accompanied on a one-to-one basis by researchers. Subjects were escorted to each tactile surface and asked to walk or wheel over the surface. Subjects were asked if the surface presented a problem and whether they would choose to avoid standing, walking or wheeling on the surface. At Victoria Station subjects were asked to compare the two warning of platform edge surfaces and at Moseley Street they were asked to compare the two surfaces installed to indicate the platform area.

### 2.8.2 Personal characteristics

Thirty women and 16 men, whose ages ranged from 12 to 88 took part in the experimental trials. All subjects had some of walking difficulty, the main reason being due to arthritis. Other disabilities included cerebral palsy, spina bifida, amputation, stroke, multiple sclerosis and paralysis following accidents. Five subjects were frail elderly and three children had learning difficulties and poor coordination.

Thirty-seven subjects (80 per cent) said that uneven paving caused problems, and 23 of the ambulant disabled people (74 per cent) said that negotiating steps was a problem.

Most subjects (80 per cent) went out on their own at least once a week, and over a third (39 per cent) went out every day. Less than half of the subjects (41 per cent) used British Rail and in the main did so infrequently. The Metrolink tram system had been used by half of the subjects and four people used it at least once a week.

Table 22 shows that half of subjects used no mobility aid, and almost a third used a wheelchair.

### 2.8.3 Results: Victoria Station

Table 23 shows that the heavy rail surface caused problems to the largest number of people, five of whom used manual wheelchairs. When asked the nature of the problem, the predominant answer, for all three surfaces, was that people felt unbalanced. The surfaces most likely to be avoided were the heavy rail and blistered surfaces as shown in Table 24.

Table 25 shows that almost two-thirds of the subjects (63 per cent) preferred to walk or manoeuvre their wheelchairs on the lozenge surface. Eleven ambulant disabled subjects said that the surface was easier to walk on and seven subjects, two in manual wheelchairs, said they did not feel so unbalanced on the surface.

## TABLE 22

Mobility aid used in test

| Mobility aid | No. | % |
|---|---|---|
| None | 23 | 50 |
| Walking stick | 7 | 15 |
| Crutches | 1 | 2 |
| Manual wheelchair | 12 | 26 |
| Electric wheelchair | 2 | 4 |
| Scooter wheelchair | 1 | 2 |
| Total | 46 | 100* |

* Due to rounding figures do not sum to 100.

### 2.8.4 Results: Moseley Street

Table 26 shows that neither surface caused problems to the majority of people. When asked the nature of problems, the predominant answer, for both surfaces, was that people felt unbalanced. Similar numbers of people would choose to avoid both surfaces as shown in Table 27.

Table 28 shows that three-quarters of the subjects (76 per cent) preferred the information surface as an indication of the platform area. Eight subjects using manual wheelchairs said the surface was easier to wheel over or that it was more comfortable. One manual wheelchair user commented that the information surface caused the wheels to 'drag'.

Nine subjects, five using no aid and four using manual wheelchairs, said the tactile surfaces were a good idea in assisting visually impaired people.

## 2.9 PUBLIC INTERCEPT SURVEY

The public intercept survey was designed to find out the views and opinions of the general public with regard to the lozenge patterned surface installed on the Metrolink platform at Victoria Station. Previous research had obtained the views of the public with respect to the other four surfaces. One hundred and five people were interviewed.

Members of the public were approached and asked a general question to find out whether they had any opinions or ideas about the lozenge patterned surface. As Table 29 shows, over half of people interviewed had no idea about the purpose of the lozenge surface.

## TABLE 23

Problems with tactile surfaces

| Surface | Yes | | No | |
|---|---|---|---|---|
| | No. | % | No. | % |
| heavy rail | 16 | 35 | 30 | 65 |
| Blister | 9 | 20 | 37 | 80 |
| Lozenge | 9 | 20 | 37 | 80 |

## TABLE 24

Choose to avoid the tactile surfaces

| Surface | Yes | | No | |
|---|---|---|---|---|
| | No. | % | No. | % |
| heavy rail | 19 | 41 | 27 | 59 |
| Blister | 19 | 41 | 27 | 59 |
| Lozenge | 10 | 22 | 36 | 78 |

## TABLE 25

Surface preference by mobility aid

| Mobility aid | heavy rail | Lozenge | No preference |
|---|---|---|---|
| None | 4 | 16 | 3 |
| Walking stick | 1 | 5 | 1 |
| Crutches | - | - | 1 |
| Manual wheelchair | 3 | 6 | 3 |
| Electric wheelchair | - | 2 | - |
| Scooter wheelchair | - | - | 1 |
| Total | 8 | 29 | 9 |

## TABLE 26

Problems with tactile surfaces

| Surface | Yes | | No | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Proceed with caution | 7 | 15 | 39 | 85 |
| Information | 8 | 17 | 38 | 83 |

## TABLE 27

Choose to avoid the tactile surfaces

| Surface | Yes | | No | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Proceed with caution | 12 | 26 | 34 | 74 |
| Information | 10 | 22 | 36 | 78 |

## TABLE 28

Surface preference by mobility aid

| Mobility aid | Proceed with caution | Information | No preference |
|---|---|---|---|
| None | 3 | 18 | 2 |
| Walking stick | 1 | 5 | 1 |
| Crutches | - | 1 | - |
| Manual wheelchair | 2 | 9 | 1 |
| Electric wheelchair | 1 | 1 | - |
| Scooter wheelchair | - | 1 | - |
| Total | 7 | 35 | 4 |

Members of the public were informed of the purpose and the meaning of the surface and asked whether they thought this was a good idea or not. Table 30 shows that 89 per cent considered the idea good, or very good.

Members of the public were asked if they would object to the surface extending the whole length of the platform, on all tram platforms, including those in the street. Virtually all, (98 per cent) said they had no objections to such installations.

## TABLE 29

Public awareness of the purpose of the lozenge surface

| Comment | No. | % |
|---|---|---|
| No idea | 62 | 59 |
| Warning for visually impaired people | 9 | 9 |
| Non-slip | 8 | 8 |
| General warning | 8 | 8 |
| Point where doors open | 8 | 8 |
| Point where tram stops | 5 | 5 |
| Safety reasons | 5 | 5 |
| Total | 105 | 100* |

* Due to rounding figures do not sum to 100.

## TABLE 30

Public comment on the purpose of the lozenge surface

| Comment | No. | % |
|---|---|---|
| Very good | 48 | 46 |
| Good | 45 | 43 |
| Indifferent | 8 | 8 |
| Bad | 3 | 3 |
| Very bad | 1 | 1 |
| Total | 105 | 100* |

* Due to rounding figures do not sum to 100.

Forty-one members of the public interviewed (39 per cent) commented that the idea of providing a warning of the platform edge for visually impaired people was commendable.

## 2.10 DISCUSSION

Of the visually impaired subjects, 58 per cent were totally blind or had no useful travel vision, that is they could only distinguish a light source. As such, the sample was weighted towards evaluating the tactile qualities of the surfaces as opposed to any visual environmental clues associated with the surfaces, such as colour and contrast.

Prior to taking part in experiments at the on-street platform in Moseley Street, all subjects had participated in experiments, mainly concerned with evaluating platform edge warning surfaces, at Victoria Station. Despite having some awareness of the nature of the experimental work, two-thirds of subjects (68 per cent) were unaware that they were standing on an on-street platform, having been escorted up a low gradient ramp. This finding is of concern given that at the highest point on the on-street platforms there is approximately a three foot drop on to the tram lines.

Forty subjects (80 per cent) were unable to detect the grooved edging stone located at the edge of the Moseley Street platform. Whilst standing on this edging stone, few people had any idea how far they were from the edge of the platform. This finding clearly calls in to question the fact that the grooved edging stone is described as a 'tactile surface' by Metrolink.

The information surface was detected by all subjects and the 'proceed with caution' surface was detected by 49 subjects. The majority of wheelchair users and ambulant disabled people reported having no difficulties manoeuvring wheelchairs or walking over either of these surfaces.

Nearly all the visually impaired subjects said they found the tactile surfaces useful for indicating the existence of an on-street platform. Twenty-eight subjects (56 per cent) said they preferred the information surface to be used for this purpose, whereas 17 (34 per cent) preferred the 'proceed with caution' surface. The main reason subjects preferred the information surface was because they thought it felt more distinct than the 'proceed with caution' surface. However, 20 subjects (40 per cent) expressed concern about extending the meaning of the information surface to include warning of on-street platforms. In the main, subjects thought that they would find this confusing and several people said that if they encountered the information surface they would start looking for an amenity such as a telephone kiosk. In contrast, the majority of subjects (80 per cent) said it did not matter to them if the 'proceed with caution' surface was used to warn them of the existence of on-street platforms, as well as steps. Indeed, eleven people commented that the meaning attached to the 'proceed with caution' surface justified its application to both scenarios.

Taken overall, the findings suggest that on-street platforms do present a hazard for visually impaired pedestrians, and the grooved edging stone does not provide a tactile message indicating the platform edge. As such, in the interests of providing a safer environment for visually impaired travellers, the lozenge patterned tactile surface should be installed to warn of the edge of on-street platforms. In addition, the 'proceed with caution' tactile surface should be installed to warn pedestrians that they are about to walk onto an on-street platform. This surface should be installed at the beginning of the ramp up to the platform.

All subjects, except one, detected both the recommended heavy rail and lozenge patterned tactile surfaces installed to warn of platform edges at Victoria station. Three people failed to detect the blistered paving installed to indicate a tram line crossing point, however, in places the profile of this surface was only 3 mm in height; the standard recommended is ± 5 mm.

Substantial proportions of subjects said that they had encountered the heavy rail and blistered surfaces previously (62 per cent and 82 per cent, respectively). The majority of subjects (94 per cent) said that they had not encountered the lozenge patterned surface before.

Twenty-nine people (58 per cent) described the heavy rail surface as meaning they were at a 'road crossing', 'pelican or zebra' or 'pavement edge'. The same number of subjects described the blistered paving as having the same meaning. Only four people described the blistered paving as warning of a tram line crossing point. Four subjects, who had just encountered the heavy rail surface described the blistered paving as warning of a railway platform edge.

Most people (94 per cent) thought the blistered paving was a useful indication of the tram line crossing point. However, twenty subjects (40 per cent) said that it was not clear that they were at a tram line or road crossing point. Sixteen people commented that environmental clues in the station would enable them to establish that the blistered paving indicated a tram line crossing as opposed to a road crossing. These particular findings are of concern because they suggest that although visually impaired people might well be fully aware that they are in a railway station environment, if they encounter two surfaces which feel similar, in one building, this could result in confusion.

At Victoria Station there is a risk that visually impaired people might believe that the blistered paving indicates a road crossing. Many visually impaired pedestrians listen for traffic noise as an indication of when it is safe to cross. Since the Metrolink vehicles do not make as much noise as other road based vehicles when moving, visually impaired pedestrians could attempt to cross the tram lines when it is not safe for them to do so. Drivers of the Metrolink vehicles do normally sound a horn when moving off, and at other times to warn road users of their presence.

The majority of subjects (94 per cent) said that the patterns of the heavy rail and lozenge surface felt different. In contrast, nearly three-quarters of subjects (74 per cent) said that the heavy rail and blistered paving felt similar. Over half of these 36 people (61 per cent) were totally blind. Twenty-one people said that they found the similarity between the patterns of the heavy rail and blistered paving surfaces confusing, whilst seven said they could distinguish between the two types of blistered paving.

Just over half of subjects (52 per cent) said that they would prefer one tactile surface to indicate all types of platform edge. In the event of one surface being used for this purpose, the highest percentage of subjects (52 per cent) said that they would prefer the lozenge patterned surface. Just over two-thirds (69 per cent) of the 26 people who said that they would prefer the lozenge patterned surface were totally blind, whereas just over half (53 per cent) of the 19 people who said they preferred the heavy rail surface had residual vision.

Six of the seven subjects who had diabetes, and might have had reduced sensitivity in their feet, said that they would prefer the lozenge patterned surface.

Most ambulant disabled people and wheelchair users said that they encountered no difficulties when walking or wheeling over the heavy rail and lozenge patterned surfaces. Of those who did encounter problems, slightly more had difficulties negotiating the heavy rail surface than the lozenge patterned surface.

Virtually all (98 per cent) members of the general public who were asked said that they had no objection to the lozenge patterned surface being installed the full length of platforms, and most (89 per cent) commented that they thought it a good idea.

Taken overall, the findings show that at locations where the heavy rail and blistered paving are both installed there is a risk that visually impaired people might confuse the specific meanings attached to each surface. Moreover, where blistered paving has been installed to indicate a tram line crossing there is a risk that visually impaired people might think that they are at a road crossing.

The results concerning whether visually impaired people would prefer one or two surfaces to indicate platform edges are inconclusive. However, the concerns expressed by visually impaired people, and in particular the totally blind, regarding the possibility of confusing the heavy rail and blistered paving, point to two conclusions:

1) The lozenge patterned surface should be used to indicate all types of platform edge, or

2) that an alternative method to warn of the existence of crossing points within station buildings be adopted.

A further important factor to bear in mind is British Rail's policy of increasing the numbers of de-staffed stations and, consequently, the number of unguarded barriers to platforms. If such developments increase the possibility of visually impaired people entering station environments without realizing, it is essential that any platform edge warning surface be distinct from that used to indicate a dropped kerb at a road crossing point or that the 'proceed with caution' surface be used to indicate the entrance of stations.

The adoption of the lozenge patterned tactile surface to provide a warning for all platform edges does have the advantage of maintaining a single meaning associated with a particular pattern and might also simplify the task of training visually impaired people to use all tactile surfaces. However, the lozenge patterned surface has not been evaluated to the same extent as have blister patterned surfaces.

A further factor which needs to be considered regarding whether a blister or lozenge patterned surface should be

used to indicate the edge of heavy rail platforms is the issue of European and international standardization of tactile surfacing. Ideally, the same types and patterns of surfaces should be used to represent the same meanings in all countries where they are installed. Blister patterned rubber tactile surfaces are currently installed throughout the Paris Metro (3). Similarly, blister patterned platform edge warning surfaces have been evaluated in San Francisco (4), as well as in Australia (5). It would be prudent to take into account international practice regarding platform edge warning surfaces in any recommendations concerning the situation in the United Kingdom. Indeed, future research on tactile surfaces should be based on a pan European approach, with the objective of obtaining standardization of pattern and meaning.

Most subjects (78 per cent) said that they preferred the tactile warning surface to be installed 750 mm from the edge. The majority (94 per cent) said that they would prefer tactile warning surfaces to be installed at the same distance from the edge on both heavy rail and tram platforms. However, virtually everyone (98 per cent) said that a tactile surface warning of the platform edge would be useful, even if they were unsure how far away from the edge it had been installed.

Whilst it would be desirable for all platform warning surfaces to be installed at a standard distance from the edge, in reality this is unlikely given the variation in platform widths and size of existing coping stones. It has been suggested that a platform edge warning surface should also mean that if one does not step beyond it, one is standing in a 'safe area'. Given the problem of ensuring that such surfaces are installed at a standard distance from edge, the extension of the warning message to include 'safe area' is not feasible. Moreover, at stations where yellow turbulence lines have been painted on to the platform, because of high speed through trains, if the platform edge warning surface were installed to indicate a 'safe area', it would be so far back from the edge that its original meaning would be lost. It must be emphasized that the platform edge warning surface means that one is near the edge of a platform and nothing more. As such, the effectiveness of the platform edge warning surface, and all other tactile surfaces, is contingent on visually impaired people being fully informed of the meanings attached to each surface.

# 3. TRL STUDY

## 3.1 METHOD

### 3.1.1 The participants

The participants were local to the Merseyside area. They were recruited through various means including local branches of the National Federation of the Blind, blind and partially sighted societies and a day centre for visually impaired adults. A broadcast was also issued through the Liverpool talking newspaper. The sample was biassed towards people who had very little or no useful vision and travelled alone by train. This was because this group of people would benefit most from a tactile surface warning them of their proximity to the platform edge. The participants took part in one of 11 half-day sessions at Earlestown railway station. They were not informed of the nature of the experiment, but were told that they should bring their usual mobility aid to the station. The reason for this was so that the participants wore their usual outdoor footwear when taking part in the trials.

### 3.1.2 The site

The trials were conducted at Earlestown railway station, near Warrington in Cheshire. Two of the station's five platforms were used. One had no tactile surfaces installed along its length and is referred to in this report as the 'control platform'. The standard white line was painted along the edge of this platform. The second platform had recently been re-opened and did not yet have a white line painted along its length. This platform had a buff coloured lozenge tactile surface installed immediately behind the coping stone 600mm back from the edge of the platform. The tactile surface comprised of a single row of 400 x 400mm slabs (see Plates 1, 2 and 3 and Figure 3). This platform is referred to as the 'lozenge platform'.

### 3.1.3 Experimental procedure

The participants were first asked for personal details such as their level of vision, additional health problems and the mobility aid they had brought with them to the trials. They were also asked how often they travelled by train both alone and accompanied and for details of any problems or accidents they had experienced at a train station. Details were obtained on how they would normally find a place to stand on a station platform.

The participants were first taken to a marked position at a distance of approximately 4.5 metres from the edge of the platform (see Figure 8). Half the participants started at the lozenge platform and half at the control platform. The experimenter read the following instructions (these were identical for the first approach to the lozenge and control platforms):

> *'You are now facing the platform edge. On some platforms, we have laid a special tactile surface to tell visually impaired people that they are near the platform edge. This surface can be felt when you walk on it. This surface may or may not be laid on this platform. I would like you to walk towards the platform edge in your usual way. Please stop where you would normally stand when preparing for the arrival of the next train. If you come across a special*

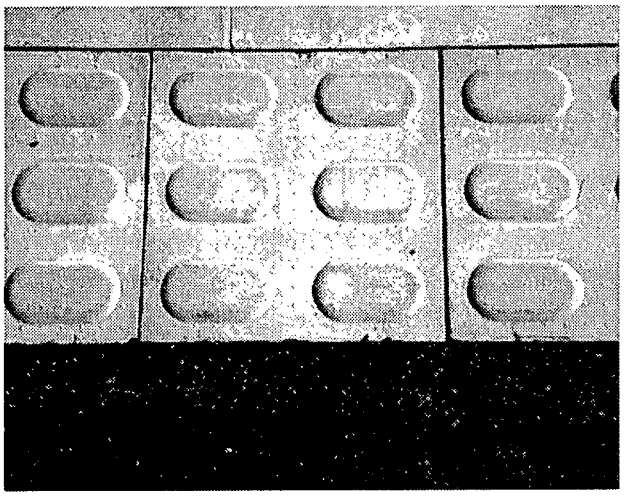

**Plate 1. Lozenge surface**

**Plate 2. Lozenge surface at Earlestown Station**

**Plate 3. Participant approaching lozenge surface**

*tactile surface, please stop on it. But please remember that this surface may not be on this platform. I will wait for you at the platform edge. If at any time I say STOP please stop walking immediately'*

The participants were told to proceed towards the platform edge when ready. To ensure their safety, British Rail 'lookout' men sounded a horn if a train was coming into the platform. Mersey Travel also provided additional staff who stood at the platform edge and were instructed to both put out their arm and say 'stop' if they thought the subject was walking too close to the edge of the platform.

After the participants had stopped walking on their approach to the platform edge, the experimenter noted where they had stopped and whether they had been restrained (defined as told to 'stop'). At the lozenge platform, the experimenter counted the number of steps taken on the tactile surface and asked the participants how many steps they thought they would need to take before reaching the edge of the platform. The experimenter noted whether their answer was about right, or an over or underestimate. The participants were also asked how they knew when to stop walking. At the lozenge platform, those who did not mention the tactile surface in response to this question were asked whether they had noticed a different surface as they approached the platform edge. All participants were asked to describe the tactile surface and to say whether they felt it had helped them to locate the platform edge.

After walking straight towards the platform edge on both the control and lozenge platforms, participants then approached the lozenge surface at two angles, one at 10 degrees and one at 35 degrees (see Figure 8). Half approached at 10 degrees first, from either the right or left-hand side. On these approaches, the participants were guided by the experimenter to ensure they approached the tactile surface at the desired angle. Mobility aids were not used in these conditions because it was difficult to use a mobility aid and be guided by the experimenter at the same time. It also gave an opportunity for all respondents to try to detect the surface underfoot. The instructions were:

*I am now going to lead you along the platform. We will be walking alongside the edge of the platform,. If you detect a tactile surface, I want you to stop immediately. If at any time I say STOP please stop immediately'.*

The experimenter noted whether the subject stopped on the lozenge surface, before they reached it or whether they failed to stop. A record was made of the number of steps taken on the surface before the participants stopped.

The participants were then asked to spend a minute or two familiarising themselves with the tactile surface by walking on the surface or touching it with their hands. They were then instructed to walk towards the lozenge platform at 90

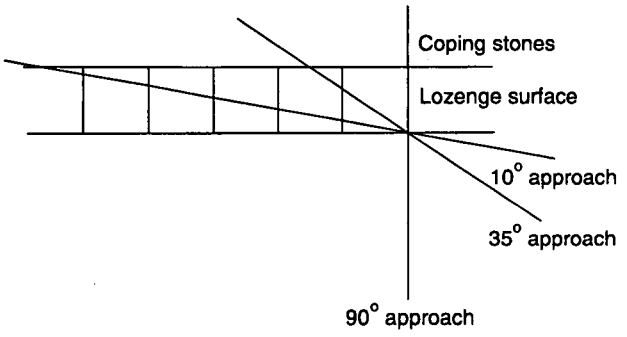


**Fig.8 Angled approaches to the Lozenge surface**

degrees as on their first approach (see Figure 8). In this condition, however, the participants were told the platform had a tactile surface and that they were to stop walking when they detected it. Notes were made of where they stopped, whether they needed to be restrained and how many steps they took on the surface. The participants were also asked how they knew when to stop.

At the end of the experiment, the participants were asked whether they thought the tactile surface had helped them to know where the platform edge was, whether they would want to have this surface at railways stations, and their reasons for their answers. After the first week of trials it became apparent that when the participants said they wanted the lozenge surface, it was often unclear whether they agreed with the principle of a tactile surface or whether they wanted the lozenge design itself. In order to check for this, in the second week, those participants who said they did want the lozenge surface were asked the following question:

> 'Can I just check, would you be happy with this same surface to be installed on platforms exactly as it has been installed here?'

Any suggested modifications to the surface were noted. Finally, the participants were asked for any other comments they wanted to make and whether they had encountered any tactile surfaces before.

## 3.2 RESULTS

### 3.2.1 The participants

Forty-eight visually impaired people took part in the trials. Twenty-seven (56%) were male and 21 (44%) female. Their ages are given in Table 31.

Eighteen people said they had no useful vision and ten said they could only distinguish between light and dark. For the purposes of analyses, these 28 participants have been classed as being 'totally blind'. The remaining 20 participants could see more than light and dark, and are classed here as having 'some useful vision'. Twenty-six of the participants (54%) said they had additional disabilities or

## TABLE 31

Age of respondents

| Age of respondents | Number | Percentage |
|---|---|---|
| 18 - 30 | 4 | 8 |
| 31 - 40 | 8 | 17 |
| 41 - 50 | 9 | 19 |
| 51 - 60 | 10 | 21 |
| 61 - 70 | 12 | 25 |
| 71 - 80 | 1 | 2 |
| 80 or over | 4 | 8 |
| Total | 48 | 100 |

health problems which affected their mobility. Fourteen of these reported having arthritis, seven had a hearing impairment and five had diabetes (see Table 32)

In the trials, 19 participants worked a guide dog (one of these asked to be guided by the experimenter although he normally worked a dog). Fourteen participants used a long or guide cane and 11 a short cane (symbol cane or white stick). Four participants used no vision mobility aids, although one of these walked with a walking stick (see Table 33).

Thirty-nine participants (81%) said they travelled alone by train. Eighteen of these made unaccompanied train journeys at least once a week. Forty-four participants (92%) travelled by train with others such as friends or family.

## TABLE 32

Details of additional disabilities and health problems likely to affect mobility

| Disability or health problem | Number | Percentage |
|---|---|---|
| Arthritis | 14 | 29 |
| Hearing Impairment | 7 | 15 |
| Diabetes | 5 | 10 |
| Angina | 3 | 6 |
| Epilepsy | 2 | 4 |
| Kidney Disease | 1 | 2 |
| Hydrocephalus | 1 | 2 |
| Gout | 1 | 2 |
| Multiple Sclerosis | 1 | 2 |
| Injured Ankle | 1 | 2 |
| Balance Problems | 1 | 2 |
| Circulatory Problem | 1 | 2 |
| Artificial Leg | 1 | 2 |
| Asthma | 1 | 2 |
| None | 22 | 46 |

## TABLE 33

Level of vision by mobility aid used in the trials

| Level of vision | Mobility aid used In trial | | | | |
|---|---|---|---|---|---|
| | Guide dog | Long/ guide cane | Short cane | None | Total |
| Totally blind | 17 | 9 | 2 | 0 | 28 |
| Some Useful Vision | 2 | 5 | 9 | 4 | 20 |
| Total | 19 | 14 | 11 | 4 | 48 |

Eight of these made accompanied train journeys at least once a week. One person said they no longer travelled by train, either alone or with others (see Tables 34 and 35).

Forty-six participants (96%) said they had come across tactile surfaces before. Most of these had encountered the blistered surface at crossing points (43 participants), and a small number had walked on the guidance path and the corduroy 'proceed with caution' surface. Seven of the participants had attended a tactile paving seminar held at MerseyTravel.

## TABLE 34

Frequency of unaccompanied train journeys by level of vision

| Frequency of unaccompanied journeys by train | Level of vision | | |
|---|---|---|---|
| | Totally blind | Some useful vision | Total |
| Once a day or more | 4 | 1 | 5 |
| Several times a week | 5 | 3 | 8 |
| About once a week | 2 | 3 | 5 |
| Several times a month | 4 | 1 | 5 |
| About once a month | 1 | 2 | 3 |
| Less than once a month | 8 | 5 | 13 |
| Never | 4 | 5 | 9 |
| Total | 28 | 20 | 48 |

## TABLE 35

Frequency of accompanied train journeys by level of vision

| Frequency of accompanied journeys by train | Level of vision | | |
|---|---|---|---|
| | Totally blind | Some useful vision | Total |
| Once a day or more | 1 | 0 | 1 |
| Several times a week | 2 | 1 | 3 |
| About once a week | 3 | 1 | 4 |
| Several times a month | 5 | 3 | 8 |
| About once a month | 5 | 3 | 8 |
| Less than once a month | 11 | 9 | 20 |
| Never | 1 | 3 | 4 |
| Total | 28 | 20 | 48 |

The participants were also asked how they would usually find a place to stand on a platform when preparing for the arrival of a train. A third of the participants said they stood with other people, identifying their presence by, for example, sounds or shadows. Eleven people said they stood as far back from the platform edge as possible, standing against a wall or fence if available. In seven cases, the participants said they found the edge of the platform then stepped back, and six participants said they found a seat and waited for the train to arrive. The responses are given in Table 36 (some participants gave more than one response).

### 3.2.2 Accidents and problems experienced by the participants in railway stations

Before testing the tactile surfaces, the participants were asked to give details of any accidents and problems they had experienced at railway stations. Fourteen participants (29%) said they had had at least one accident at a station, although some of these had not occurred recently. Of these, six people had fallen between a train and the platform, four had fallen off a platform, and two people mentioned that their guide dog had fallen off. Two participants had walked into station trolleys, and one of these had also stumbled on some stairs.

Three quarters of the participants said they had experienced problems when on a railway station (see Table 37). One third said they found it difficult to find their way about unfamiliar stations, particularly those that were unstaffed. Included in this category were people who could not easily find a platform or other facilities such as toilets and telephones. One concern was alighting at an unfamiliar and quiet station, and not knowing whether to look for a flight of stairs, an underpass, or whether the exit was directly ahead.

Just under a third of the participants (29%) said there was a lack of clear information at railway stations. This included unclear audible announcements and not being able to read information displays. The main concern in this category was trying to find out which train to catch (particularly at busy platforms) and on what platform. This would again be more of a problem at unstaffed stations where there was no-one to ask.

## TABLE 36

How the participants normally found a place to stand on a platform

| How the participants found a place to stand on a platform | Number of participants | Percentage |
|---|---|---|
| Stand with/near other people | 16 | 33 |
| Stand as far back from platform edge as possible/against a wall or fence | 11 | 23 |
| Arrange for assistance | 9 | 19 |
| Find platform edge then steps back | 7 | 15 |
| Find seat and wait for train | 6 | 13 |
| Judge by where steps come onto the platform | 5 | 10 |
| Can see enough to find a place to stand | 3 | 6 |
| Judge by differing surfaces | 1 | 2 |

## TABLE 37

Problems experienced at railway stations tabulated against level of vision

| Problem experienced | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| Finding way about station | 10 | 6 | 16 |
| Lack of clear information | 4 | 10 | 14 |
| Poor service from staff | 7 | 0 | 7 |
| Gap between train and platform | 4 | 1 | 5 |
| Finding buttons to operate train doors | 2 | 1 | 3 |
| Train doors closing too quickly | 2 | 0 | 2 |
| Steps | 0 | 2 | 2 |
| Overhanging shrubs | 1 | 0 | 1 |
| Scaffolding | 0 | 1 | 1 |
| None | 7 | 5 | 12 |

Seven people said they had received poor service from the rail staff. People mentioned, for example, that when they rang the British Rail timetable service, they were given incorrect information (one person said he always rang twice). There was also a concern about booked assistance failing to meet people at stations, although comments were made that when the staff did arrive, they provided an excellent service. One person said he no longer booked assistance because he had experienced so many problems with this service.

Other problems people mentioned included negotiating the gap between a train and the platform, and a lack of contrast for steps. Three participants said they found it difficult to find the buttons to operate the train doors. In two cases, the participants commented that the automatic doors sometimes closed too quickly - one person said that he had been left on the platform with his guide dog on the train.

### 3.2.3 Tactile surface user trials

**The Control Platform**

When asked to walk towards the platform edge most of the participants stopped in a reasonable position not too close to the edge of the platform (73%). Six stopped quite a distance from the platform edge, which is possibly more likely to be where people would stand in practice, i.e. people would choose to stand as far back from the platform edge as possible rather than walk too close to it. Eight people (seven totally blind) had to be stopped by the experimenter because they walked too close to the platform edge. Two of these eight had said they travelled alone by train at least once a week. All those who had previously said they usually found the edge of the platform then stepped back (Table 36) stopped in a reasonable position on their approach to the Control Platform.

When asked how far they thought they had stopped from the edge of the platform, two participants thought they were closer than they actually were and five thought they were further from the edge. Four of these five (all totally blind) had been restrained by the experimenter on their approach to the platform edge. A further four participants were unable to guess how close they were to the platform edge. Table 38 shows the mobility aids used by those people who either had to be restrained or who had overestimated the distance between themselves and the platform edge.

When asked how they knew when to stop walking, some participants had been able to detect visual cues, such as the edge of the platform (particularly the painted white line), and the reflection from the tracks. A large number of people had used their mobility aid to help them decide when to stop. This includes 13 each who had stopped when their guide dog stopped or who had felt the edge of the platform with their cane. The control platform was worn with age creating an uneven surface. In particular, there was a 'lip' between the coping stone and the tarmacadam platform surface (See Plate 4). Three participants thought this was the 'new' tactile surface they were supposed to stand on, and six others stopped walking when they felt the broken surface. The responses are listed by level of vision in Table 39. It should be noted that the participants could give more than one answer, and that although seven were restrained,

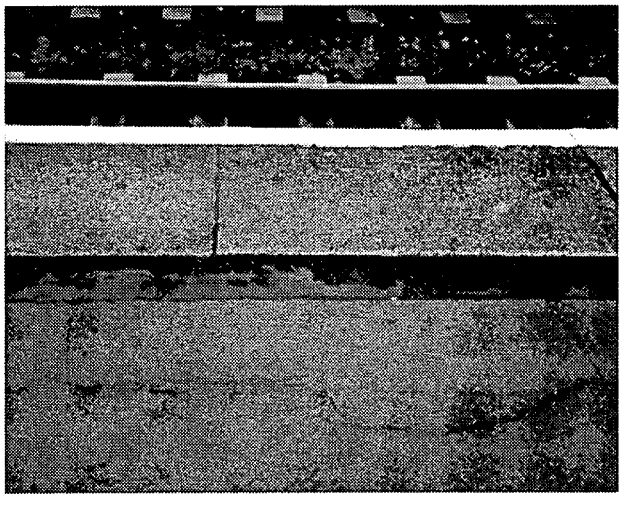

**Plate 4. Control platform**

## TABLE 38

Details of the participants who had to be restrained or who overestimated the distance between themselves and the platform edge (Control Platform)

| Participants who.. | Mobility aid used in trial | | | | |
|---|---|---|---|---|---|
| | Guide dog | Long/ guide cane | Short cane | None | Total |
| Had to be restrained because they were too close to the platform edge | 4 | 2 | 2 | 0 | 8 |
| Overestimated the distance between themselves and the platform edge | 3 | 2 | 0 | 0 | 5 |

## TABLE 39

The reasons given for knowing when to stop walking on the Control Platform

| How the participants knew when to stop walking | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| Used cane to find the edge | 9 | 4 | 13 |
| Dog stopped | 12 | 1 | 13 |
| Could see the edge/white line | 0 | 12 | 12 |
| Could feel broken paving | 3 | 3 | 6 |
| Restrained by experimenter | 4 | 0 | 4 |
| Felt the 'new' surface* | 1 | 2 | 3 |
| Saw the glare from the tracks | 1 | 1 | 2 |

* See text.

only four gave this as the reason they had stopped walking. This is likely to be because they had decided to stop just as they were restrained.

Table 40 compares where the participants stopped with how they knew when to stop walking. It can be seen that some of the participants who were restrained said they had stopped because they had detected the edge with their mobility aid. Two of those who had to be stopped said they had seen the glare from the tracks.

**The Lozenge Platform, first approach at 90 degrees.**

On their first approach to the lozenge surface, the participants were given the same instructions as for the control platform, i.e. they did not know whether a tactile surface had been laid on the platform. When asked to proceed towards the platform edge, and to stop on the tactile surface if they detected it, 34 participants (71%) stopped on the lozenge surface. Seven (15%) stopped before they reached the surface. Six participants (13%) stepped on the surface but did not stop (ie they did not detect it) and one person stepped over the lozenge surface without stepping on it. Three participants had to be restrained from walking any closer to the platform edge. Of the seven people who either stepped over or on the lozenge surface without detecting it, none reported having diabetes (a condition that can lead to a loss of sensation in the feet).

The subject who stepped over the tactile surface was working a guide dog. Of those who stepped on the surface but did not detect it, two each were using a guide dog or long cane, one was using a short cane and one had no mobility aid. Two of those who did not detect the lozenge surface had some useful sight. All those who stopped before they reached the lozenge surface were using canes which could have been used to detect the lozenge surface ahead of them.

Tables 41 and 42 give details of where the participants stopped by their level of vision and mobility aid used.

When asked how far they thought they were from the edge of the platform, most of the participants (90%) gave an

## TABLE 40

Comparison of where participants stopped with how they knew when to stop (Control Platform)

| How the participants knew when to stop walking | Where the participants stopped | | | Total |
|---|---|---|---|---|
| | In reasonable position | Quite a long way short of the edge | Had to be restrained | |
| Used cane to find the edge | 11 | 0 | 2 | 13 |
| Dog stopped | 9 | 2 | 2 | 13 |
| Could see the edge/white line | 10 | 2 | 0 | 12 |
| Could feel broken paving | 4 | 1 | 1 | 6 |
| Restrained by experimenter | 0 | 0 | 4 | 4 |
| Felt the 'new' surface | 3 | 0 | 0 | 3 |
| Saw the glare from the tracks | 0 | 0 | 2 | 2 |

## TABLE 41

Where the participants stopped tabulated by level of vision (Lozenge Platform, First Approach)

| Where the participants stopped | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| On the lozenge surface | 20 | 14 | 34 |
| Before the lozenge | 3 | 4 | 7 |
| Stepped on the lozenge surface but did not stop | 4 | 2 | 6 |
| Stepped over the lozenge surface and not on it | 1 | 0 | 1 |
| Total | 28 | 20 | 48 |

## TABLE 42

Where the participants stopped tabulated by mobility aid used (Lozenge Platform, First Approach)

| Where the participants stopped | Mobility aid used In trial | | | | Total |
|---|---|---|---|---|---|
| | Guide dog | Long/ guide cane | Short cane | None | |
| On the lozenge surface | 16 | 7 | 8 | 3 | 34 |
| Before the lozenge | 0 | 5 | 2 | 0 | 7 |
| Stepped on the lozenge surface but did not stop | 2 | 2 | 1 | 1 | 6 |
| Stepped over the lozenge surface and not on it | 1 | 0 | 0 | 0 | 1 |
| Total | 19 | 14 | 11 | 4 | 48 |

accurate answer. One person thought s/he was closer to the edge of the platform than s/he actually was, and four people thought they were further from the edge of the platform.

Forty-participants (83%) said they knew where to stop because they had felt the tactile surface with their feet or mobility aid. Ten people had used visual cues to decide where to stop with four of these having detected the lozenge surface by its contrast with the surrounding area. Nearly all of those classed as being totally blind (86%) had detected the lozenge surface. Those classed as having some useful sight had detected other visual cues in addition to detecting the tactile surface (see Table 43). It should be noted that the respondents could give more than one reason for knowing when to stop walking.

Table 43 shows that some of those people who had stopped on the lozenge surface could see it or the edge of the

## TABLE 43

The reasons given for knowing when to stop walking on the Lozenge Platform (First Approach)

| How the participants knew when to stop walking | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| Detected the lozenge surface with feet or mobility aid | 25 | 15 | 40 |
| Could see the lozenge/contrast | 0 | 4 | 4 |
| Could see the edge of the platform/grooved lines/track | 0 | 5 | 5 |
| Used cane to find edge of platform | 2 | 1 | 3 |
| Restrained | 3 | 0 | 3 |
| Guide dog stopped | 2 | 1 | 3 |
| Saw people's shadows | 0 | 1 | 1 |

platform (seven comments). One person could see the grooved lines on the edge of the coping stone. This was because it had been raining and the grooves were still wet, but the surrounding light grey concrete was dry, creating a good contrast. Some of those who stopped before reaching the lozenge surface said they had detected it ahead of them with their mobility aid (five people). Of the six people who stepped on the lozenge surface but did not stop (see Table 42), five said they had detected the surface. Two of these five said they had not stopped walking because they thought they were stepping on an uneven surface rather than the tactile surface. It is possible that the remaining three participants were also unsure whether the surface was the tactile paving. This could especially be the case if they had only previously encountered the blistered tactile surface for use at dropped kerbs in their environment. They may therefore have been expecting this same surface or something similar, based on their previous experiences. In Table 44, it should be noted that the participants could give more than one reason for knowing when to stop walking.

Table 44 shows that a total of 40 participants said they had detected the lozenge surface either underfoot or with their mobility aid. When the eight remaining participants were specifically asked if they had felt a different surface as they approached the edge of the platform, five said they had detected something. Of the remaining three participants, one person each had either stopped before reaching the lozenge, on the lozenge or after it, i.e. two people had stood on the lozenge but said they had not noticed a different surface. Therefore, of the 48 participants, two said they had not noticed any change in surface when they walked on the lozenge tactile surface.

Most of those who stopped on the tactile surface took one or two steps on the surface before stopping (31 participants). The remaining three participants took three steps on the surface. Of the six participants who stepped on the lozenge surface but did not stop (see Table 42), three took one or two steps on the surface, and three took three steps.

The participants' first impressions of the lozenge surface were varied. Most could tell that the surface consisted of shapes although some described the surface as 'just bumpy'. Three participants described the surface as being like broken paving and one was unable to give a description (see Table 45).

Thirty-eight participants (79%) said the tactile surface had helped them to know where the platform edge was located. Ten people said the tactile surface had not helped them personally (one because she could see enough without this additional aid). Six of the ten were totally blind and none was diabetic.

**Ten degrees angled approach to the tactile surface**

When asked to stop walking when they felt a tactile surface, 43 participants stopped on the lozenge surface, and two before reaching it. Three participants walked onto the surface but did not stop. None of these three had diabetes. Table 46 shows where the participants stopped by their level of vision. Nine participants took more than two steps on the surface before stopping (see Table 47).

**Thirty-five degrees angled approach**

Forty-two participants stopped on the lozenge surface and two before they had reached it. Four participants walked on the lozenge surface but did not stop. Table 48 shows where

## TABLE 44

Comparison of where participants stopped with how they knew when to stop (Lozenge Platform, First Approach)

| How the participants knew when to stop walking | Where the participants stopped | | | | Total |
|---|---|---|---|---|---|
| | On the lozenge | Before the lozenge | Stepped over the lozenge but did not stop | Stepped over the lozenge and not on it | |
| Detected the lozenge surface with feet or mobility aid | 30 | 5 | 5 | 0 | 40 |
| Could see the lozenge/contrast | 3 | 1 | 0 | 0 | 4 |
| Could see the edge of the platform/grooved lines/track | 4 | 1 | 0 | 0 | 5 |
| Used cane to find edge of platform | 0 | 1 | 2 | 0 | 3 |
| Restrained | 0 | 1 | 1 | 1 | 3 |
| Guide dog stopped | 3 | 0 | 0 | 0 | 3 |
| Saw people's shadows | 0 | 1 | 0 | 0 | 1 |

## TABLE 45

Description of the Lozenge Surface

| Description | Number | Percentage |
|---|---|---|
| Like cobbles/bumpy | 20 | 42 |
| Line of shapes with gaps in between | 11 | 23 |
| Elongated ovals/lumps | 10 | 21 |
| Like broken paving | 3 | 6 |
| Regular undulations | 2 | 4 |
| Bars | 1 | 2 |
| Unable to give description | 1 | 2 |
| Total | 48 | 100 |

the participants stopped by their level of vision and Table 49 shows the number of steps taken on the lozenge surface

**Lozenge platform, second approach at 90 degrees**

On the final approach to the lozenge surface, the participants were told the platform had been installed with a tactile surface and that they were to stop when they detected it. The participants had walked on the lozenge surface previously, and had spent a minute or two familiarising themselves with the surface. Therefore, they should have detected the surface better than on their first approach. Thirty-eight participants (79%) stopped on the surface. Eight participants (17%) stopped before reaching the surface, many of these having detected the surface with their mobility aid. Two participants stepped onto the surface, did not stop until they had crossed it, and had to be restrained. They were both totally blind (one a guide dog owner and one using a long cane). Neither reported having diabetes. This compares to seven people who failed to stop on the first approach . Tables 50 and 51 give details of where the participants stopped by their level of vision and mobility aid used.

## TABLE 46

Where the participants stopped tabulated by their level of vision (10° Approach)

| Where the participants stopped | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| On the lozenge surface | 24 | 19 | 43 |
| Before the lozenge surface | 1 | 1 | 2 |
| Stepped on the lozenge surface but did not stop | 3 | 0 | 3 |
| Total | 28 | 20 | 48 |

## TABLE 47

Number of steps taken on the lozenge surface (10° Approach)

| Number of steps | Number of participants | Percentage |
|---|---|---|
| None | 2 | 4 |
| One | 23 | 48 |
| Two | 14 | 29 |
| Three | 3 | 6 |
| Four | 4 | 8 |
| Six | 2 | 4 |
| Total | 48 | 100 |

When asked how they knew when to stop walking, 43 participants had felt the surface with their feet or cane. When specifically asked if they had noticed a tactile surface, three of the remaining five people said they had. Four people said they had used visual cues to decide where to stop walking, and in five cases the participants stopped because their guide dog had stopped. Of the two people who needed restraining, one said they had stopped because they had detected the lozenge surface and one felt the platform edge with their cane. Only one person took more than two steps on the tactile surface before stopping. Table 52 shows where people stopped by their level of vision. It should be noted that people could give more than one response. Table 53 compares where the participants stopped with how they knew when to stop walking.

Taking together all four conditions where the participants approached the lozenge tactile surface, a total of eight

## TABLE 48

Where the participants stopped tabulated by their level of vision (35° Approach)

| Where the participants stopped | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| On the lozenge surface | 24 | 18 | 42 |
| Before the lozenge surface | 1 | 1 | 2 |
| Stepped on the lozenge surface but did not stop | 3 | 1 | 4 |
| Total | 28 | 20 | 48 |

## TABLE 49

Number of steps taken on the lozenge surface (35° Approach)

| Number of steps | Number of participants | Percentage |
|---|---|---|
| None | 2 | 4 |
| One | 25 | 52 |
| Two | 17 | 35 |
| Three | 3 | 6 |
| Five | 1 | 2 |
| Total | 48 | 100 |

participants stopped before reaching the lozenge surface, and seven stepped on the surface without stopping. One person stepped over the surface.

**General comments**

After the experiment, the participants were asked some general questions about the lozenge surface. Forty-five participants (94%) thought the surface had helped them to locate the platform edge. Of the three who did not think it had helped, one was totally blind. Thirty-eight participants (79%) said they would want the lozenge surface installed at railway stations (see Table 54). It was not possible to ask the participants if they would have preferred the blister surface as this was not installed at Earlestown.

## TABLE 50

Where the participants stopped tabulated by level of vision (Lozenge Platform, Final Approach)

| Where the participants stopped | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| On the Lozenge surface | 20 | 18 | 38 |
| Before the lozenge | 6 | 2 | 8 |
| Stepped on the lozenge surface but did not stop | 2 | 0 | 2 |
| Total | 28 | 20 | 48 |

## TABLE 51

Where the participants stopped tabulated by mobility aid used (Lozenge Platform, Final Approach)

| Where the participants stopped | Mobility aid used In trial | | | | Total |
|---|---|---|---|---|---|
| | Guide dog | Long/ guide cane | Short cane | None | |
| On the lozenge surface | 16 | 8 | 10 | 4 | 38 |
| Before the lozenge | 2 | 5 | 1 | 0 | 8 |
| Stepped on the lozenge surface but did not stop | 1 | 1 | 0 | 0 | 2 |
| Total | 19 | 14 | 11 | 4 | 48 |

## TABLE 52

The reasons given for knowing when to stop walking on the lozenge platform (Final Approach)

| How the participants knew when to stop walking | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| Detected the lozenge surface with feet or mobility aid | 23 | 20 | 43 |
| Could see the lozenge/contrast | 0 | 3 | 3 |
| Could see the edge of the platform/grooved lines/track | 0 | 1 | 1 |
| Used cane to find edge of platform | 3 | 1 | 4 |
| Guide dog stopped | 5 | 0 | 5 |

## TABLE 53

Comparison of where participants stopped with how they knew when to stop (Final Approach)

| How the participants knew when to stop walking | Where the participants stopped | | | | Total |
|---|---|---|---|---|---|
| | On the lozenge | Before the lozenge | Stepped on the lozenge but did not stop | Stepped over the lozenge and not on it | |
| Detected the lozenge surface with feet or mobility aid | 37 | 5 | 1 | 0 | 43 |
| Could see the lozenge/contrast | 3 | 0 | 0 | 0 | 3 |
| Could see the edge of the platform/grooved lines/track | 1 | 0 | 0 | 0 | 1 |
| Used cane to find edge of platform | 2 | 1 | 1 | 0 | 4 |
| Guide dog stopped | 3 | 2 | 0 | 0 | 5 |

## TABLE 54

Whether the participants wanted the lozenge surface installed at railway stations tabulated by level of vision

| Whether the participants wanted the lozenge surface installed | Level of vision | | Total |
|---|---|---|---|
| | Totally blind | Some useful vision | |
| Yes | 24 | 14 | 38 |
| No | 4 | 6 | 10 |
| Total | 28 | 20 | 48 |

The reasons given for wanting the surface installed or not are listed in Table 55. It should be noted that the participants could give more than one answer. The positive comments included a general statement that the surface had helped people to know where the platform edge was or that it would help to have some kind of tactile surface installed. One person said that it was distinctive from other types of tactile surface and others said the contrast was good. The more critical comments included some who said the lozenge surface was not detectable enough, or needed a better contrast with the surrounding surface. Others commented on its layout, in that they felt it was too close to the platform edge or was too narrow.

In the second week, those participants who said they wanted the lozenge surface installed were asked whether they would be happy for the tactile surface to be installed exactly as it had been installed at Earlestown. Of the 23 people asked (ie those in the second week who said they did want the lozenge surface installed), 11 said they wanted it modified in some way. These comments were amalgamated with the general comments made when all the participants were asked whether they had any additional comments they would like to make. Table 56 summarises the criticisms expressed and modifications suggested.

## 3.3 PUBLIC INTERCEPT SURVEY

### 3.3.1 Method

Members of the public either waiting to board a train or who had just alighted were asked their views on the lozenge tactile surface. The respondents were asked whether they thought lozenge surface was acceptable to walk on. Those who said the surface was not acceptable were asked for their reasons. All the respondents were asked what they

## TABLE 55

Whether the participants wanted the lozenge surface and the comments given

| Comments | Whether the participants wanted the lozenge surface | | |
|---|---|---|---|
| | Yes | No | Total |
| It helped me to know where the platform edge was/I felt safer | 30 | 0 | 30 |
| Would need to be familiar with the surface/need training | 8 | 0 | 8 |
| It needs to be more detectable | 2 | 6 | 8 |
| It would need to be uniform throughout the country | 4 | 0 | 4 |
| It would help to have something of this sort | 3 | 0 | 3 |
| It has a good contrast | 3 | 0 | 3 |
| It needs to be more contrasting | 1 | 1 | 2 |
| It needs to be further from the edge of the platform | 2 | 0 | 2 |
| It is a reasonable distance from the platform edge | 1 | 0 | 1 |
| It needs to be wider | 1 | 0 | 1 |
| It is distinctive from other tactile surfaces | 1 | 0 | 1 |

## TABLE 56

Criticisms raised and modifications suggested

| Suggestion | Number of participants | Percentage |
|---|---|---|
| Would prefer a more detectable surface | 17 | 35 |
| Surface needs to be wider | 8 | 17 |
| It was difficult to identify until I got used to it/needs training | 8 | 17 |
| It needs to have a better contrast | 7 | 15 |
| It needs to be further from the edge of the platform | 4 | 8 |
| Thought at first it was just broken paving | 3 | 6 |
| Lozenge shapes need to be closer together to prevent a cane going between them | 2 | 4 |
| It needs a ridge to show where it starts | 1 | 2 |

thought the surface was for. Those people who had said the surface was unacceptable were then informed of its purpose and asked whether they still thought it was unacceptable to walk on. Additional information was also obtained on how often the respondents used Earlestown station, their age and whether they were walking with a mobility aid.

### 3.3.2 Results

Seventy-three rail users took part in the public intercept survey. Thirty-five (48%) were male. Their ages are listed in Table 57 below.

One respondent was using a walking stick. The remaining respondents were not using a mobility aid when interviewed. Table 58 shows the how often the respondents said they used Earlestown railway stations.

Three quarters of the respondents said they thought the lozenge surface was acceptable for them to walk on. Of those who thought the surface was unacceptable, six (8%) said it was uncomfortable to walk or stand on, 13 participants (18%) said they thought the surface was a tripping hazard and one said it could be slippery. Ten respondents (14%) knew what the surface was for (this could be because they had seen people taking part in the trials). In addition, thirty-eight participants (52%) said they knew the purpose of the lozenge surface but gave a wrong answer. Most of these thought the surface was laid to prevent slipping (32 participants), with the remaining respondents thinking it warned children when they were too near to the edge of the platform. Twenty-six respondents (36%) said they did not know what the surface was for. All ten respondents who knew the purpose of the lozenge surface said it was acceptable (see Table 59).

The respondents who originally said they did not think the lozenge surface was acceptable were informed of its purpose. They were then asked whether they still thought the surface was unacceptable. Six of the 18 respondents said they still thought the surface was not acceptable. These six had originally criticised the surface because they thought it was a tripping hazard (five comments) or uncomfortable (one comment).

## TABLE 57

Age of respondents

| Age of respondents | Number | Percentage |
|---|---|---|
| 18 - 30 | 5 | 7 |
| 31 - 40 | 18 | 25 |
| 41 - 50 | 12 | 16 |
| 51 - 60 | 13 | 18 |
| 61 - 70 | 9 | 12 |
| 71 - 80 | 11 | 15 |
| over 80 | 5 | 7 |
| Total | 73 | 100 |

## TABLE 58

Frequency of use of Earlestown station

| How often do you use this station? | Number of participants | Percentage |
|---|---|---|
| Once a day or more | 8 | 11 |
| Several times a week | 12 | 16 |
| About once a week | 13 | 17 |
| Several times a month | 5 | 6 |
| About once a month | 11 | 15 |
| Less than once a month | 24 | 32 |
| Total | 73 | 100 |

## 3.4 DISCUSSION

### 3.4.1 The Lozenge tactile surface

The people who would benefit most from a tactile surface installed on heavy rail platforms are those who make unaccompanied train journeys and have very little or no useful vision. It is therefore important that the views of these people are obtained. In the present study, 58 percent of the visually impaired participants had no useful vision or could only distinguish between light and dark. Eighty-one per cent of the sample made unaccompanied rail journeys, and only one person no longer travelled by train.

It is important to know whether the test method represents how someone would approach the edge of the platform in practice. Only seven participants said they normally found a place to stand on a platform by finding the platform edge and then stepping back from it. A tactile surface would benefit these people as they could locate the tactile surface rather than the edge of the platform. This would be safer especially at stations used by non-stopping high speed trains. Most of the remaining participants said they stood near other people or as far back from the edge of the platform as they could. They would therefore not intentionally approach the platform edge unless their train had arrived. The presence of a tactile surface may allow these people to wait closer to the edge of the platform or to locate its position so that know how far back they are. A tactile surface would, however, aid most of the sample if they inadvertently walked too close to the edge of the platform. This could especially be the case where people intend to walk along the platform, but gradually walk closer to the platform edge without realising.

Eight of the 48 participants (17%) had to be restrained when asked to walk towards the control platform edge. Four of

## TABLE 59

Acceptability of the lozenge surface tabulated against whether the respondents knew its purpose

| Whether the respondents knew the purpose of the lozenge surface | Whether the respondents thought the lozenge surface was acceptable to walk on | | Total |
|---|---|---|---|
| | Yes | No | |
| Right answer given | 10 | 0 | 10 |
| Wrong answer given | 29 | 9 | 38 |
| No idea | 16 | 9 | 25 |
| Total | 55 | 18 | 73 |

these were guide dog owners and four used a cane. Five people also overestimated the distance between themselves and the edge of the platform. These results highlight the need for a tactile surface. Twelve people said they had stopped walking because they could see the edge of the platform, many of these because they could see the painted white line. This highlights the importance of maintaining the white line in a good condition. Twenty-six participants had stopped because they had either used their cane to find the platform edge or because their dog had stopped walking. In both cases, the participants could be very close to the edge of the platform before realising they should not proceed any further. The installation of a tactile surface set away from the platform edge would provide an additional cue and would let people know they were near the edge before they were too close to it.

On their first approach to the lozenge surface, when they were told there may or may not be a tactile surface installed on the platform, 34 participants (71%) stopped on the lozenge surface. Seven others stopped before they reached it (five because they had detected the surface with their mobility aid and two because they could see the platform edge or the lozenge surface). However, six participants stepped on the lozenge surface without stopping and one stepped over the surface. Five of those who failed to stop had actually felt a different surface, but two thought it was just an uneven surface. This implies that, without prior experience of the surface or without training, some visually impaired people would not perceive the lozenge surface as a tactile surface or even as something new and unfamiliar. This is highlighted by the participants' first impressions of the surface where three said it felt like broken paving. If, through training and experience, visually impaired rail travellers know what the tactile surface will feel like, then they are more likely to detect the surface. In the present study, it is possible that some people were expecting to detect a surface similar to the blisters used at dropped kerbs, i.e. people's mental image of the tactile surface is likely to have been based on their previous experiences. Most participants had only encountered the blisters before the study.

When led along the platform at 10 and 35 degree angled approaches to the lozenge surface most of the participants stopped on the lozenge surface (43 (90%) at 10 degrees and 42 (88%) at 35 degrees). Three people walked onto the surface at a ten degree angle of approach without stopping compared with four people at 35 degrees. It should also be noted that, at the ten degrees approach, four people took four steps on the surface before stopping. Two people took six steps on the surface without detecting it underfoot. Thus, some people failed to detect the surface underfoot even after taking several steps on it or having stood on it in a previous condition.

Finally the participants were asked to walk towards the platform edge after having spent a few moments familiarising themselves with the pattern. This was to ensure they knew what they were being asked to detect. At this final approach, 38 participants (79%) stopped on the lozenge surface and eight stopped before it, most having detected the surface with their mobility aid. However, two people walked onto the surface without stopping and had to be restrained. Interestingly, one of these had detected the surface in all the previous three conditions. This may mean that the tactile nature of the surface is influenced by which part of it is stood on. If people think they will detect a tactile surface each time they come across it, they may walk more confidently than if they are not sure they will detect it. If the surface is not always detected, however, it could be argued that this would be less safe than not installing a tactile surface at all.

Although the numbers who failed to detect the lozenge surface are small (seven participants in all) an ideal tactile surface should be detectable almost every time. This is especially the case in an environment where a failure to detect the surface may lead to the person falling off the platform. The present study was carried out in June, so it seems likely that the surface would become less detectable in the winter months when people may be wearing thicker soled shoes. The tactile surface must also feel different so that people who have not encountered it before will stop to

find out what it is, rather than think it is just an uneven surface. Although visually impaired people can be expected to walk with care when on a station platform, it has been shown that, despite this, a significant number still have accidents on station platforms (Fowkes et al, 1995). A person who is at an unfamiliar station may walk along the platform and unwittingly gradually walk towards the platform edge. People may also not realise how close they are to the edge of the platform.

Most participants (94%) said they thought the lozenge surface had helped them to locate the platform edge, and 79 percent said they would want it installed at railway stations. However, when asked whether they would want exactly the same surface installed exactly as it had been installed at Earlestown, a number of participants said they would want it modified in some way. Taking all the critical comments together, 17 participants (35%) said they did not think the lozenge surface was detectable enough.

There were two comments that the lozenge shapes needed to be closer together to prevent the cane going between them and therefore not detecting the lozenge surface. One person said she wanted a ridge to show where the surface started. These are important findings as discovering that participants can detect a tactile surface in an experimental situation does not necessarily imply they think it is detectable enough. In a research setting, people know they are looking for a tactile surface and may walk more cautiously. It is also interesting that, when simply asked whether they would want the lozenge surface, many people said they would. However, with a slightly different wording of the same question, many people said they did not think the current design of the lozenge was ideal. It could be argued that people will always seek improvements when given the opportunity.

Nevertheless, as so many participants would like the detectability of the surface increased, it would be desirable to investigate whether this could be achieved.

Although most participants detected the lozenge surface, it is not possible to know whether they would detect the surface every time they stepped on it. Problems arising from unreliable detection could be addressed by publicity and education. This could both improve people's ability to detect and recognise the surface, and emphasise that they should not rely on always being able to detect it. The surface would have to be introduced gradually and therefore people would need to know that not all platforms would have the tactile surface.

The lozenge surface has a pattern which is very distinctive from the other types of tactile surface. If modifications were investigated, it would be important to retain its distinctiveness. However, the alternative blister surface is not distinct from other tactile surfaces, and could easily be confused with the surface used to indicate the presence of dropped kerbs. Yet the two variations of the blister surface have different meanings. If it were possible for visually impaired people to inadvertently walk onto a station platform, then this could lead to accidents. If the heavy rail blister pattern is used in a heavy rail environment, then it may be necessary to use a second tactile surface to warn people they are entering a station environment. The corduroy 'proceed with caution' surface seems ideally suited for this purpose.

Other criticisms of the tactile surface include eight comments that the surface needed to be wider to allow more steps to be taken on it. This comment is related to the subject's perceptions of the detectability of the surface. In practice, only one person stepped over the surface rather than on it. However, there were concerns that the tactile effectiveness of the surface depended on which part of it was stood on. Thus, allowing for a greater number of steps to be taken on the surface could increase the likelihood of its being detected.

There were four comments that the surface needed to be further back from the platform edge. This was because people felt that, once they had detected the surface, they were quite close to the edge of the platform. Increasing this distance or the width of the surface would, however, create practical difficulties at stations where the platform is not very wide. If the tactile surface were a potential tripping hazard, then it would be advantageous to install it further from the edge of the platform.

Many of the participants said they felt safer knowing a tactile surface had been installed. Three participants thought it had a good contrast with the surrounding area, which would be important for people with some residual vision. One totally blind person also commented that it was distinctive from other tactile surfaces. This is an important prerequisite of any new tactile surface.

To sum up, there is no doubt that a tactile surface would benefit a great many visually impaired rail travellers. Many of the participants in the present study were able to detect the lozenge surface, and would like it to be installed. However, there is the possibility that some people may fail to detect this surface at train stations, and some of those who detected the surface would like to see the surface made more detectable. If it is not possible to investigate means of increasing this detectability (e.g. by offsetting the lozenge shapes as suggested by MerseyTravel), and this surface were selected for use at heavy rail stations, then people would need to be made aware of its limitations. Training would also help people to recognise the surface and its associated meaning, and not to confuse it with broken paving. An alternative would be to install the blister surface. Yet, this is not an ideal solution as there exists the possibility of confusion between this surface and that used to indicate dropped kerbs. This could be resolved by installing the corduroy surface as mentioned above.

The results of the public intercept survey found that most people interviewed (75%) thought the lozenge surface was acceptable to walk on. Six thought it was uncomfortable and 13 thought it was a tripping hazard. All those who thought the surface was unacceptable did not know its purpose. However, some still maintained that it was not suitable when they were informed of why it had been installed, mostly because they thought it was a tripping hazard. It therefore seems unlikely that an increase in the *height* of the lozenge shapes would be acceptable to the general public. It would be important, however, to publicise the purpose of the tactile surface as most respondents thought it had been laid to prevent slipping.

### 3.4.2 Other problems experienced in railway stations

As part of the present study, views were obtained from the visually impaired participants on problems experienced at railway stations in general. This has highlighted a number of areas that need addressing. In particular, people mentioned they had experienced difficulties when finding their way around unfamiliar stations. This problem is likely to increase with the rise in the number of unmanned stations. There were also problems with information displays and audible announcements. Display boards often contain a lot of information written in small characters. Using larger, high contrasting characters would aid many rail travellers as well as those with a visual impairment. It should also be possible to increase the clarity and frequency of audible announcements on both station platforms and trains, by making the staff aware of the need to speak clearly. This again would benefit most rail travellers.

Audible announcements on trains can also be unclear and are not always provided for each station stop before the train leaves the station. Visually impaired people, like other rail travellers, need to know they are on the right train and also when the train is arriving at their destination. These announcements need to be made in advance of arriving at a station so people have time to prepare for leaving the train. Some participants said they would also like to know what side of the train the platform will be on. As well as being less frustrating, this would also avoid accidents occurring where visually impaired travellers have opened the door on the wrong side of the train. This information would also help other travellers who do not have much time to leave the train, such as when they have to meet a connecting train.

Another problem raised was the occasional poor service from rail staff. Some people complained that the prebooked service sometimes failed, meaning that people needed to ask other travellers to direct them to a platform or station exit. Complaints were also made about the accuracy of the timetable information given over the telephone. Both these issues need addressing by the train operators to identify why the communication system is not always working.

Five people were concerned about the gap between the train and the platform edge. The gap varies with differing platform heights and train stock, and can be especially large on a curved platform. The gap needs to be a certain distance to avoid contact between the train and the platform and is therefore a difficult problem to resolve.

Another problem mentioned was the difficulty of locating buttons to operate train doors. Door controls both inside and on the outside of trains are increasingly designed to be flush with their surrounds. This makes them difficult to find and is a source of frustration for some visually impaired travellers. If a person takes time to find the button on the inside of the train, they may miss their stop. Where it is not possible to make the buttons more prominent, they could be highlighted in a contrasting colour to aid people with some residual sight.

Other aspects of the station environment can be particularly hazardous for visually impaired people. Two of the participants had walked into trolleys and one had stumbled on some steps. Any obstacles on the station platform such as trolleys and restaurant 'A' frame notices could be kept away from the platform edge, and the top and bottom of a flight of steps should be marked in yellow paint and the corduroy 'proceed with caution' surface installed.

# 4. RECOMMENDATIONS AND CONCLUSIONS

1. In both studies, the majority of blind and partially sighted participants detected the lozenge tactile surface and many said they would find it useful if it were installed on station platforms. In the TRL study, however, some people mentioned that they would prefer the surface to be more detectable, and seven people failed to detect the surface on at least one approach. It is difficult to know how well a tactile surface should perform before it can be deemed suitable for the intended purpose, and in a railway environment it seems sensible to use a surface that is detected on almost every approach. As such, one option could be to investigate whether the lozenge surface could be made more detectable, for example by offsetting the lozenge shapes. However, it should be borne in mind that a number of British rail stations (e.g. Waterloo International) have already installed the blister patterned platform edge warning surface, and that this type of surface is currently in use in other countries (e.g. France). This latter point is of particular importance because it is desirable that the harmonization of tactile messages is achieved to facilitate blind and partially sighted people's international travel. It is, therefore, recommended , at this stage, that the blister patterned surface currently used to warn of the edge of heavy rail platforms be retained. It is further recommended that internationally based research be undertaken to

evaluate the feasibility of tactile surface European standardization.

2. The Cranfield University study shows that, in stations where blister patterned paving has been installed to indicate platform edges as well as crossing points, there is a risk of visually impaired travellers becoming confused regarding the tactile meanings of the respective surfaces. One possible option to overcome this difficulty would be to install the 'proceed with caution' surface at all crossing points within station buildings. To ensure that visually impaired travellers realise that they are at a crossing point, audio information should also be available. It is recommended that research be conducted to establish whether the use of the 'proceed with caution' surface, as well as audio signage, to indicate crossing points within stations obviates the confusion arising from using two blistered patterned surfaces.

3. Although it would be desirable for all platform edge warning surfaces to be installed at a standard distance from the edge, in reality this is unlikely given the variation in platform widths and size of existing coping stones. It is, therefore, recommended that platform edge warning surfaces (heavy and light rail) be installed no less than 600 mm, and no more than 1,000 mm from the edge of platforms. The platform edge warning surfaces should be at least 400 mm in depth.

4. It is recommended that the 'proceed with caution' surface be used to indicate the existence of platform areas, both off- and on-street.

5. It is recommended that the 'proceed with caution' surface be used where it is possible for visually impaired people to walk onto a platform area without full knowledge of such a platform area, giving due regard to existing facilities and infrastructure. The 'proceed with caution' surface should be at least 400 mm in depth and no more than 800 mm in depth.

The 'proceed with caution' surface should be installed so that pedestrians walk across the rounded bars comprising the pattern.

The layout of the 'proceed with caution' surface will be site specific.

6. It is essential that, if a platform edge tactile surface is introduced in heavy rail stations, visually impaired people are informed that this facility will not be at all stations from the outset. Problems could otherwise be created if a person walks towards an untreated platform edge expecting to stop when they detect the tactile surface.

7. The general public should be informed of the reason for the installation of any new surface to help with its acceptance.

8. Rail platform edges are currently marked with a painted white line. It is recommended that this line be properly maintained so that it has a strong contrast with the platform and the track.

9. A number of other issues were raised in the TRL study concerning problems at train stations. In particular, it is advised that the clarity of display board and audible announcements be addressed. Display information should not be provided in small print, and the characters should have a good contrast (e.g. yellow letters on a black background). On-board announcements should be made before arriving at each station, and if possible, should state on which side of the train the platform will be.

10. The top and bottom step of flights of stairs should be painted yellow, and where possible, the corduroy 'proceed with caution' tactile surface should be installed.

11. The reasons for inaccurate train timetable information and failure of the pre-booked assistance service should be examined.

12. Wherever possible, train door buttons should be in a colour contrasting with the surround, and should be raised rather than flush.

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