# Condition Indicators in footway maintenance

## Prepared for Pavement Engineering Group, Highways Agency

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# CONTENTS

# Executive Summary

The report is a record of research carried out within a project, commissioned by the Highways Agency, to investigate current footway maintenance practices and put forward proposals for best practice for the consideration of Highway Authorities. The findings have been used in the newly published document 'Delivering Best Value in Highway Maintenance – Code of Practice for Maintenance Management' (The Institution of Highway Maintenance 2001). Proposed Condition Indicators may be used to gauge the overall performance of a footway category from engineering and user satisfaction aspects. They can also be used in maintenance management, in benchmarking, in the development of Key Performance Indicators and in determining the performance of an authority in the provision of Best Value.

*The proposals of the report are purely advisory and do not represent Highways Agency policy. They have no prescriptive values and cannot be used to define liability in any way.*

At present, Highway Authorities maintain their footways, making decisions on the basis of engineering and aesthetic criteria subject to accepted practices, to ensure that they remain safe for pedestrians and maintain their asset value. Furthermore, in order to support the Government's proposals for integrated transport and to encourage walking, it is necessary to take greater account of the needs of pedestrians, and ensure that they are satisfied with the safety and serviceability of footways.

Increased maintenance resources and/or a more effective use of existing resources are needed if the condition of the national footway network is to be improved and the walking environment made safer, and generally more acceptable. Moreover in many cases Highway Authorities need an increase in resources just to maintain footways to current standards let alone improve standards. The work programme has involved defining a hierarchy for pedestrian routes and the categorisation of defects within these routes into two broad groups, namely:

- User related surface defects which fit within the current inspection categories and highway authorities maintenance programme.
- Personal security, user satisfaction and comfort related defects. These defects are non-maintenance related but have an impact on the modal choice of travel and attitude towards walking.

This report reviews the defects in the first group in detail and categorises them into four user-related defects (i.e. Safety, Accessibility, Comfort and Environment) with threshold levels for each footway category. An attempt is also made to categorise defects within the second group with suggested threshold levels for personal security and user satisfaction related defects.

A range of provisional indicators are discussed in the report, and an example is given of the formulation of possible Condition Indicators for various footway categories, making use of previously suggested threshold levels and defect definitions.

The Footway Maintenance Working Group (FMWG), whose members are drawn from government departments, a range of Highway Authorities and consultants, provided guidance throughout the research project. The current Footway Maintenance Working Group members are:

Mr P E Dickinson - Leeds City Council (Chairman).

Mr P L Scott - TRL (Project Manager and Secretary).

Mr T Clark - City of Edinburgh Council.

Mr W Duerden - Department for Transport, Local Government and the Regions.

Mr K Fuller - Hampshire County Council.

Mr L G Hawker - Highways Agency.

Dr A Murray - Department of Regional Development (Northern Ireland) Road Service.

Mr L Kaderbhai - Rhonda Cynon Taff County Borough Council (Wales).

Mr D I Pearson - Consultant.

Mr G Prangnell - London Borough of Hammersmith and Fulham.

Mr C C Spong - W S Atkins.

Mr A Pickett - Chris Britton Consultants.

# 1 Introduction

In the past, planners have focused on the needs of walkers at two levels - pedestrianisation schemes and safety improvements (mainly for recreation). In addition, there have been various policy initiatives like 'walking-to-school'. The focus of policies over the years has been in favour of safety issues and recreational walking rather than encouraging walking as a means of travel. Despite increasing central government policy to encourage walking, the majority of current planning and transport policies still lack a coherent approach towards walking and the pedestrian environment. Clearly, there is a need for a comprehensive, strategic approach to tackle pedestrianisation in urban environments with the overall aim of encouraging walking as a means of travel. One of the key elements of any strategy is the quality of the pedestrian environment. People will be inclined to walk further and more frequently where conditions are favourable, they feel secure and the principles of good urban design are taken into account.

Walking will always form a part, however small, of every journey. The underlying challenge is to persuade people to increase that part, wherever there is scope for so doing and, indeed, to make walking the preferred sole means of personal travel for short journeys.

An improved pedestrian environment will require the following key elements:

- Setting standards for design and quality audits.
- Identifying key walking routes (the 'network approach').
- Identifying locations where facilities need improvement to ensure network continuity.
- Identifying key destinations, such as rail stations and main bus stops, and auditing the quality of access by foot (the 'walking catchment approach').
- Identifying local areas where pedestrians should be given high priority.
- Improving the pedestrian environment by encouraging good quality urban design.
- Selecting and developing demonstration projects to carry out improvements to the pedestrian environment.
- Providing for the needs of people with some form of mobility impairment.

The infrastructure input to this process are footways whose condition is such as to be seen as not just user-friendly but positively attractive so that walking along them is a pleasurable experience. In terms of improving the walking environment, it is important to go beyond the network approach, as used successfully for bus priority schemes and cycle routes. Defining broad networks for walking is probably of value for long distance recreational walking, as well as for short distance walking to local amenities and schools.

The overall aims of the research project are:

1 To define a hierarchy of routes for pedestrians and categorise defects within these routes into two broad groups, namely:

2 User related surface defects which fit within the current inspection categories and highway authority maintenance programmes.

3 Personal security, user satisfaction and comfort related defects. These defects are non-maintenance related but appear to have an impact on the modal choice of travel and attitude towards walking.

4 To define possible thresholds for defects within the two groups that quantify the degree of defect. The defects in the first group are dealt with in this report. An attempt is also made to categorise defects within the second group with suggested thresholds for various footway categories.

5 To formulate Condition Indicators within each route hierarchy in order to quantify the performance of the various footway categories.

6 To provide worked examples of the proposed method of calculating Condition Indicators. The method gives an overall Condition Indicator for selected sections of a route as well as an average Condition Indicator for the whole pedestrian route.

*The formulation of thresholds and the necessary weighting factors for each user related category are for guidance only and do not form a platform for any national levels or liability defence.*

Individual highway authorities, as well as The Audit Commission, will need to review the defect lists and their corresponding threshold values within each user-related category in order to formulate their own set of defects and threshold levels deemed important within each category. The proposed formulation has also suggested some weighting multipliers for various user-related categories that are also for guidance only. They are aimed at simplifying the numerical formulation of the method of quantifying defects into single Condition Indicators for given routes.

A draft version of this report was previously circulated to members of the Footway Maintenance Working Group (FMWG) for consultation. The views of the consultees have been included in this report.

# 2 Pedestrian routes

Over the past 50 years, most planning decisions relating to the wider transport network have been based on improving conditions for vehicle travel. The needs of people on foot have usually taken second place. Some local authorities have made good progress towards redressing the balance, particularly in town centres. In a sustainable transport network, however, the full range of urban and rural situations needs to be considered. This requires reallocating road space to footway users or taking capacity away from motor transport. In practice, this would mean:

- wider pavements;
- introducing pedestrianisation schemes or areas where vehicle access is restricted;

- providing separate and improved facilities for pedestrians and cyclists; and
- implementing measures to reduce the impact of traffic on pedestrians in pre-designated walking routes.

It is generally accepted that a good walking environment should connect:

- places where people want to go, such as shops, services, entertainment, schools, parks, business and places of interest;
- other modes of transport, such as buses, trains and car parks; and
- a wide variety of walking routes, offering choice and the ability to travel extensively on foot.

Walkers should find it easy to go from place to place without meeting dead ends, long stretches of road with no side turnings, or having to use roads that are difficult to cross. Good walking routes are clear, connected and well sign-posted. Ideally they will be linked into networks, connecting several key destinations in the neighbourhood.

Enhancing the overall footway environment, with its implications of higher engineering and aesthetic standards, will, however, be costly and may not be feasible across the entire footway network, no matter how well planned the scheme might be. In busy urban areas there will be competing demands for road space. A number of local authorities have found it helpful to adopt road user hierarchies so that their transport plans have explicit guidance on priorities. Local highway authorities are encouraged to identify key pedestrian routes as part of the development of their local walking strategy. These routes are related to the function of the area that they connect with and the potential of those areas to attract pedestrian activity. This may be applied to strategies on reallocation of road space and pedestrianisation schemes. These hierarchies normally apply to central areas although the principle could be applied to other areas, such as local residential areas, streets around schools and shopping centres.

There is positive scope in adopting pedestrian routes where substantial benefits could be obtained from modal shift to walking. Pedestrian routes should have the same function as the roads have for journeys connected with work, shopping, leisure and tourism and accessing services.

Planners of pedestrian routes will need to identify important journey origins and destinations, including access to public transport or bus stops, stations and other interchanges. The facilities for key walking routes also need to be reviewed. It is important to consider that high levels of latent demand for walking routes can exist without showing up in current travel patterns. However, there are footways and footpaths not associated with travel to identified destinations as well as those at the destinations themselves.

In recent years, town centre pedestrianisation schemes have become popular and economically successful. Well-designed and managed schemes have returned vitality to town centres in the UK, making them more interesting and attractive places. It is, however, important that town centre pedestrianisation is not seen as the only change necessary to encourage walking or improve living spaces. Residential areas can benefit from restrictions on vehicles, and carefully planned and executed schemes in rural locations. Access routes into town centres have often been neglected. Wider improvements are needed to ensure that people are able to walk to, as well as within, town centres.

### 2.1 Categorisation of pedestrian routes

As far as the function of pedestrian routes is concerned, there is a broad range of categorisations between local highway authorities and strategists. The walking pattern in a complex urban environment, for example, could be different from that in a historic town. The current pattern in London requires identification of all components and sub-components of the walking mode in order to understand the full range of pedestrian movement and to cater for it in a strategic approach. With the objective of concentrating on pedestrian usage and the prioritisation of resources, it is necessary to consider categories which are footway-related and which differentiate sufficiently between the varying usage and traffic flow. A summary of some of the categorisations proposed in the literature is shown in Appendix A. Of the pavement management systems currently in widespread use, only five use categories that are relevant to footways. Of these, four, the United Kingdom Pavement Management System (UKPMS, 2001), the Local Authorities Association (LAA) Code (1989), MARCH (City Engineers' Group 1975) and CHART (Wingate and Peters 1975) have four categories and one (DRD Roads Service [Northern Ireland]) has three categories.

In order to achieve integration of management and continuity in the system, it is recommended that there should be a total hierarchy of four categories, as shown in Table 1.

Each of the route categories mentioned in Table 1 requires a suitable standard to be set and the structure to be maintained. The standards for each category should derive in part from engineering standards used for maintenance management and safety/liability purposes, as well as the user perception of these surfaces. In the past, maintenance of footways has largely concentrated on a set of engineering parameters, identified by the highway authorities. Recent initiatives to involve the public in the management of the walking environment has revealed other problems which were previously either ignored or not considered important enough to be included in regular footway inspections. Total user satisfaction may, however, require these engineering considerations to be applied at more demanding threshold levels for some of the most heavily used routes. In addition, in order to ensure user satisfaction, assessment should include other defects, such as appearance and security.

### 2.2 Inspection of pedestrian routes

The inspection of footways, as part of the highway network, is fundamental to the planning of maintenance works. It is part of a highway authority's statutory duty to demonstrate that the needs of the highway user are being addressed in a 'reasonable' manner.

The inspection regimes for footways may be different from those used on the carriageway of the roads on which

**Table 1 Proposed footway hierarchies**

| *Category No.* | *Category name* | *Brief description** |
|---|---|---|
| 1 | Prestige walking zones. | Prestige areas in towns and cities with exceptionally high usage, such as Princes Street in Edinburgh and Oxford Street in London. |
| 1(a) | Primary walking routes. | Busy urban shopping and business areas, and main pedestrian routes linking interchanges between different modes of transport, such as railway and underground stations and bus stops etc. |
| 2 | Secondary walking routes. | Medium usage routes through local areas feeding into primary routes, local shopping centres, large schools and industrial centres etc. |
| 3 | Access walking routes. | Linking local footways through urban areas, and busy rural footways. |
| 4 | Local footways. | Footways associated with low usage, estate roads to access routes and cul-de-sacs. |

* *A Highway Authority has discretion in placing a footway into any group appropriate to its purpose and usage. Specific guidelines on pedestrian volumes are not currently available. However, the following should be taken into account when assigning footways to categories:*
  - *Pedestrian volume.*
  - *Usage and proposed usage, eg busy shopping areas.*
  - *Risk analysis, risk management and level of accidents.*
  - *Age/type of footway, eg old flagged footways may require more frequent inspection than when newly laid, so they could be placed in a higher category.*
  - *Footways alongside busy roads.*

they are situated, because their importance to users is different. A central shopping street, with pedestrian–priority, would be an obvious example.

*It should be emphasised that the proposals put forward in this report form an initial approach and represent the ideal situation. As inspections and condition surveys of carriageways will increasingly be carried out by vehicle, there will need to be dedicated footway surveys on foot.*

The inspections must always include adopted footways away from carriageways. An inspector on foot should undertake all footway inspections. This is normally held to be necessary in litigation. There are two types of inspection – safety and detailed inspections (sometimes called routine inspections). The purpose of the latter is to gather specific information to help evaluate design and plan routine maintenance work. There are several systems of inspection, a review of some of the main systems is given in Appendix B.

In practical terms, not all defects can usefully be recorded in a single inspection. The following three inspection types are therefore proposed; the first two are already well established in current practice:

1 Safety inspections - principally to identify individual defects in need of urgent or immediate attention. This inspection is normally carried out at very short intervals.

2 Detailed inspections - to record items necessitating maintenance works within a short- to medium-term programme.

3 Provision inspections - to monitor progress on achieving longer-term improvements in serviceability, which are achieved through traffic management, new works or higher-profile enforcement of relevant legislation. This type of inspection, relating largely to the facilities provision dealt with above, falls outside the maintenance brief and will not be addressed in further detail at this stage.

All three types of inspection provide potential input to the performance assessment process and should be geared to the frequency of that overall assessment. The overall assessment would probably be annual. On that basis, the provision inspection will need to be carried out annually, in sufficient time for the data collected to be fed into the performance assessment for the current year.

In one county, safety and routine inspections (used interchangeably) are carried out in accordance with a fixed schedule. Safety inspection intervals on footways and footpaths vary between 1 and 4 months, so it could not be said that they take place at very short intervals. The detailed inspections are annual and they record items necessitating planned maintenance works. They are carried out on the worst footways, i.e. those under consideration for some form of treatment. This differs from the safety inspections, which identify items necessitating reactive maintenance works

In addition to these inspections, two further inspections may be necessary to review the appropriateness of routes for user comfort.

1 Total review audit for walking routes – to improve key walking routes to key destinations.

2 Special inspections - to test the walking routes for social inclusivity.

The frequency of detailed and safety inspections should also be timed to fit into the performance assessment programme. Therefore, where the normal interval between detailed inspections is longer than 12 months, consideration should be given to shortening the interval so that, by using current data, the performance assessment fully reflects the conditions in the current year.

It is not possible at present to mechanise footway inspections. The traffic-speed condition survey (TRACS) principle of rapid automated inspection followed by detailed investigation at defective sites will be very difficult to apply to footways but it should be considered in future research.

It could be argued that the proposed system is quite complex and would involve extra cost. However, authorities should not be put off as they should be free to adopt as many of the proposals as they need to satisfy their obligations and budgets.

There is a need to ensure that footways on routes that are used by people with disabilities are of a suitable standard.

### 2.3 User perception issues

Results of earlier studies on the users' perception of footway serviceability (Leake *et al.,* 1991) suggested the possibility of deriving a relationship between actual, measured footway condition and users' satisfaction with the walking surface. The consultation process associated with Local Transport Plans, the preparation of local walking strategies and service reviews as part of the Best Value initiative, have stimulated interest in such surveys (DETR, 1999a). The local information that these surveys reveal can indicate the extent to which users feel satisfied with the quality of the pedestrian environment. Such information can help determine the priority with which scarce resources are allocated. A summary of some of these surveys is shown in Appendix C.

Attitude surveys often reveal that substantial proportions of pedestrians are unhappy or dissatisfied with the general condition of footways. The National Road Maintenance Condition Survey (DETR, 1999d) uses the occurrence of trips to rate the condition of footways. A trip is a spot condition of specific danger to pedestrians. NRMCS showed that the number of footway trips per 100m fell fairly steadily from 1987 to 1996 but, since 1997, the condition of footways has deteriorated. This deterioration was continued in 1999 when trips increased to 1.6 per 100m (as compared to approximately 0.9 trips per 100m in 1996). The average is largely determined by the incidence of trips on urban roads. Footways on trunk and rural roads have a lower incidence of trips than those on urban roads, but they make up only a small proportion of the national footway network.

A pedestrian perception survey could act as a systematic process in order to identify the positive and negative aspects of transport network for walking, and to assess ways in which those networks can be improved in order to encourage walking. Public consultation and involvement will be an essential part of the review process, which is also required by Best Value. However, customer satisfaction surveys are notoriously difficult to interpret because of different levels of expectations. It is, on the other hand, likely to pick up the more subjective issues, such as personal security that are hard to assess objectively. Local pedestrian groups, residents' organisations, disability groups and other community groups or individuals are sometimes willing to undertake pedestrian reviews themselves. Some information will already be available to the local authorities, such as street lighting standards, footway condition surveys, traffic flows and casualty data. Other information will require site visits and inspections to check, for example, footway widths and parking problems.

### 2.4 Categorisation of footway defects

Unpublished TRL work carried out earlier on footway maintenance standards and serviceability identified in excess of 60 potential maintenance, as well as user satisfaction related, defects that could be encountered on pedestrian routes. Not all of these defects have safety implications, which require immediate response and remedial work. Hence, the user considerations of these defects were divided into four categories, namely Accessibility, Comfort, Environment and Safety. A hypothetical example of this categorisation is given later in the report, which includes both surface related defects and those related to user comfort. However, only defects relating to footway surface conditions have been extracted and are dealt with in this report.

A further category, Security, has also been added to account for personal safety. A general definition of these categories is given below in a suggested order of priority:

1 Safety: the reasonably achievable elimination of exposure to physical hazards.

2 Accessibility: those conditions that ensure the footway is appropriately accessible and convenient.

3 Security: the sense of 'feeling safe' and indeed of being safe from fear, as distinct from safety from personal injury arising form engineering-type defects.

4 Comfort: those standards that ensure that walking is physically comfortable.

5 Environment: those conditions that provide and maintain an attractive appearance.

Security is an important issue. There are social and cultural barriers to walking which are largely unrelated to physical and infrastructure issues. They include crime and, more particularly, the fear of crime and violence, lack of confidence in walking in open spaces, getting lost, cultural values associated with walking, feelings of isolation and cultural or religious codes of conduct. Crime, or the fear of crime, stops many people from walking more and using public transport, especially after dark. A recent study by DETR (1999c) illustrates the relationship between fear of crime and the choice of not walking. Women, children and elderly people feel most vulnerable, but it is a feeling shared by many. These real and perceived problems need to be addressed if more people are to be encouraged to walk. Some of the non-engineering solutions could include:

- Promotional campaigns.
- Involving the community in the planning, design and monitoring of the walking environment. This is often successful in adopting a marketing strategy to walking to influence behaviour. This will require the identification of the target audience with respect to travel behaviour, health behaviour, stages of behavioural change, receptiveness to change and communication with that audience.
- Organising guided walks. This could be helpful in overcoming the fear of walking alone which is often the barrier for elderly people, women and those from ethnic communities.

### *2.4.1 Maintenance related surface defects*

In order to assess the condition of walking surfaces more coherently, Tables 2 to 5 categorise maintenance related surface defects under the four user related categories, including Accessibility, Comfort, Environment and Safety. The other issue that has had a great impact on the modal shift from walking is Security and Table 6 highlights those personal security issues that have greatest impact on walking. The information given in Table 6 has been gathered from the study on personal security (DETR, 1999c). Though important, security in this sense lies outside the maintenance of footway surfaces. Considering people's concern about crime necessitates provision of additional measures and facilities. For instance, connecting alleyways between roads should be convenient walking routes. If they are too narrow, dark and winding, people may avoid them out of fear. Where additional measures are adopted as a means of improving security, these may well give rise to ongoing maintenance concerns and would then need to be added to the system of inspections proposed. The security related concerns given in Table 6 provide an added justification for the use and promotion of priority routes for personal travel.

**Table 2 Proposed accessibility related maintenance defects**

| | | | | *Threshold* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Footway category** | | | | | |
| *Defect* | *Defect No.* | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
| Excavation. | 1 | Estimated or known duration. | Days | 1 | 2 | 3 | 14 | S/D | NRSWA |
| | 2 | Unattended site. | Item | 1 | 1 | 1 | 1 | S/D | Inspection |
| Overhanging vegetation. | 3 | Usable footway width. | m | 2 | 2 | 1.5 | 1 | S | |
| | 4 | Reduced capacity. | Deflects pedestrians into carriageway | | | | | | |
| Displays and advertising boards on footway, as opposed to posters, etc on walls. | 5 | Present and unlicensed. | Item | 1 | 1 | 2 | 3 | S | & Police |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

*Inspection type: S = Safety P = Provision D = Detailed*

**Table 3 Proposed comfort related maintenance defects**

| | | | | *Threshold* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Footway category** | | | | | |
| *Defect*** | *Defect No.* | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
| Standing water from poor provision of, or inadequate maintenance of carriageway drainage. | 1 | Plan size or equivalent area. | m x m | 0.3x0.3 | 0.3x0.3 | 0.3x0.3 | 0.3x0.3 | D | |
| Splashing from carriageway depressions within 1m of the footway. | 2 | Plan size or equivalent area. | m x m | 0.5x0.5 | 0.5x0.5 | 0.5x0.5 | 1.0x1.0 | D | |
| Weeds or moss on surface. | 3 | Percentage surface affected. | % | 1 | 1 | 5 | 20 | D | |
| Uneven surfaces. | 4 | Plan size (or equivalent area) *less* than .... | m x m | 1.0x1.0 | 0.6x0.6 | 0.6x.0.6 | 0.3x.0.3 | | |
| | | Depth more than .... | mm | 25 | 25 | 25 | 50 | D | |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

** *It was suggested that slip resistance and uneven surfaces (but at a different intervention level from the safety threshold) should be included. The mechanics of slipping is complex and depends upon a wide range of variables. Good adhesion is important but the effective assessment of slip resistance is difficult. The pendulum tester is probably not the best method. More research is needed.*

*Inspection type: S = Safety P = Provision D = Detailed*

**Table 4 Proposed environment related maintenance defects**

| Defect | Defect No. | Parameter | Unit | Threshold: Footway category* 1+1a | 2 | 3 | 4 | Insp. type | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Damaged, deteriorated, or misaligned kerbs.** | 1 | Length. | m | 0.5 | 0.5 | 1.0 | 3.0 | S & D | |
| Major crazing. | 2 | Percentage surface affected. | % | 10 | 20 | 30 | 50 | D | |
| Cracked surfaces. | 3 | Percentage surface affected. | % | 10 | 20 | 30 | 50 | D | |
| Uncut verges. | 4 | Plan size (or equivalent area) .... Height .... | m x m mm | 0.5x.0.5 150 | 0.5x.0.5 200 | 0.5x.0.5 200 | 0.5x.0.5 300 | D | |
| Shrubbery and planting in need of maintenance. | 5 | Area. | m² | 5 | 10 | 15 | 50 | D | |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

*It was agreed that this Indicator could form the basis of a good indicator of how the overall asset is being managed.*

** *Suggestions on damaged, deteriorated or misaligned kerbs: The number of such defects per 100m length should replace the length of the damaged/misaligned kerbs.*

*It is important to replace defective kerbs for safety reasons, but it is difficult to delineate in length terms for comfort considerations.*

*Many kerbs in 'environmental' schemes are designed with an upstand of less than 75mm. A number of claims associated with this issue have been dealt with and it has been accepted that a contrast in colour between the surfaces is appropriate to highlight the differences in level.*

*Inspection type: S = Safety P = Provision D = Detailed*

The aim in these tables is to:

- list all defects identified;
- show the parameter(s) that could be used to define each defect;
- suggest threshold levels relevant to each category for a selected sample length; and
- give the inspection type used to identify the defect (i.e. safety and detailed).

For consistency purposes, the suggested threshold levels in these tables are compatible with (i.e. no more demanding than) intervention levels identified in the earlier work.

> *It cannot be emphasised too strongly that threshold levels are intended to be advisory and not prescriptive values defining any legal liability.*

The tables contain as full a range of defects as possible. Hence, some defects are weather, seasonal or time-of-day dependent. Some authorities may feel that these should be removed, rather than just taking them out of the equation when they are not present, although some of them have a part to play. The views of the FMWG on the defects and their thresholds have also been incorporated into each table.

The defects described in the tables would may have to be identified on the basis of some form of sample surveys. In this case, statistical significance would have to be considered. It would probably not be practical to collect the data on a whole network basis.

### *2.4.2 User satisfaction related defects*

Creating an attractive environment is important both in encouraging people to walk and as part of the drive to improve the general urban environment. Consultation exercises regularly reveal the importance of relatively small issues, such as too much street furniture, absence of seats, obstructions and the lack of legible signposts and street name signs. Provision of various facilities to create an attractive walking environment at appropriate levels is not, however, a maintenance issue, although the ongoing upkeep of these facilities will be. An attempt has been made in Tables 7 to 10 to identify user satisfaction related defects and to categorise them in relation to the four surface maintenance related defects. These are, however, open to discussion and their relevance will need to be assessed for each community.

The defect categorisation and the threshold levels suggested in Tables 2 to 5 will be used later in Chapter 3 of the report to develop maintenance related Condition Indicators for each route category and user related conditions.

## 3 Formulation of Condition Indicators

This chapter only deals with the surface related maintenance defects, given in Tables 2 to 5 and, at this stage, does not include user satisfaction and personal security related defects, given in Tables 6 to 10.

The model for combining defects into ratings or indicators remains a useful way of handling a number of different defects. However, a single overall rating of all defects would fail to reflect the major concerns separately and would thus make impossible the measuring of the authority's performance against policy issues derived from those concerns. Therefore, it is proposed that user

**Table 5 Proposed safety related maintenance defects (including comments by FMWG)**

| *Defect* | *Defect No.* | *Parameter* | *Unit* | *Threshold* *Footway category** *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|
| Exposed electrics. | 1 | Present. | No | 1 | 1 | 1 | 1 | S | |
| Missing Ironwork. | 2 | Present. | No | 1 | 1 | 1 | 1 | S | |
| Safety of excavation. | 3 | Inadequate signing, lighting and guarding. | Item | 1 | 1 | 1 | 1 | S | & NRSWA inspection |
| Missing handrail on steps. | 4 | Length. | m | 2 | 5 | 15 | 30 | S | |
| Steps unsafe. | 5 | Present. | Item | 1 | 1 | 1 | 1 | S | Note reason |
| Potholes/Missing paviors. | 6 | Height. | mm | 10 | 10 | 20 | 50 | S | |
| Would rather categorise as NRSWA intervention based on surface profile for intervention. | | | | | | | | | |
| Trips. | 7 | Height. | mm | 3 | 10 | 20 | 25 | S | |
| The incidence of trips and the distribution of the characteristic trip height are relevant but mechanised surveys are really needed. One also needs to be careful not to put impossible targets here. For example the as-built tolerance is 6mm for reinstatements under NRSWA. The pedestrian is more likely to trip over a transverse 'step' than a longitudinal one. Transverse unevenness is more uncomfortable for pedestrians but is it more of a safety hazard. | | | | | | | | | |
| Rocking slabs. | 8 | Maximum deflection. | mm | 3 | 10 | 20 | 25 | S | |
| It could be argued that it is not the actual movement, rather the fact that it rocks and provides an insecure platform for the pedestrian. The upstanding edge of a rocking slab in its rest position is more of a safety hazard than the rocking movement. | | | | | | | | | |
| Rocking ironwork. | 9 | Maximum deflection. | mm | 3 | 10 | 20 | 25 | S | |
| Extent of snow and ice. | 10 | Footway covered. | % | 5 | 15 | 50 | n/a | S | |
| There is an issue here about treatment as currently in the UK footways are only treated after prolonged ice or snow. This treatment takes place on a priority basis across whole footway lengths so differentiating between percentage covered is not ideal. Snow and ice on the footway should not be incorporated into Condition Indices, as it is seasonal. | | | | | | | | | |
| Extent of leaves on the surface. | 11 | Footway covered. | % | 10 | 20 | 45 | n/a | S | |
| Consideration of this and other similar criteria is needed to determine the practicalities of such an indicator and intervention. The extent of leaves should not be incorporated into Condition Indices, as their presence is seasonal. | | | | | | | | | |
| Slippery surface. | 12 | Footway slip resistance assessment test. | | | | | | P | Develop use of pendulum or specialist test kit |
| The effective assessment of slip resistance is complex and there are no standards. The pendulum tester is probably not the best method. More research is needed. | | | | | | | | | |
| Loose stones on the surface (e.g. from fretting or poor surface dressing). | 13 | Percentage of surface affected. | % | 0.5 | 1 | 5 | 25 | S | |
| A threshold figure here would be hard to gauge. | | | | | | | | | |
| Standing water. | 14 | Area. | $m^2$ | 0.25 | 0.5 | 1 | 5 | S | |
| | 15 | Usable footway width. | m | 2 | 2 | 1.5 | 1 | | |
| | 16 | Reduced capacity. | % of width | 10 | 20 | 30 | 50 | | |
| Most of the footway network would fall above the suggested intervention level after heavy rain. Standing water for prolonged period after rainfall and a depth would be a useful measure. | | | | | | | | | |
| Poor/broken street lights or columns. | 17 | Present. | Items per sample length | 1 | 1 | 2 | 3 | D | |
| These are something which the normal highway safety inspector would not be expected to report on. This would be the function of the street lighting inspector. This may well provoke the debate - could not the street lighting inspector do both? National indicators already exist here relating to the percentage of working street lights etc. It might be better to use these. | | | | | | | | | |
| Inadequate kerb upstand. | 18 | Length. | m | 5 | 10 | 10 | 20 | | |
| | | Minimum height. | mm | 75 | 75 | 75 | 50 | D | |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

*Inspection type: S = Safety P = Provision D = Detailed*

**Table 6 Proposed security related defects for all footway categories**

| *Security related causes* | *Parameter* | *Remark* |
|---|---|---|
| Poor lighting improve. | Back streets and alleyways. | Revisit Best Value Performance Indicators on street lighting to improve street lighting. |
| Potential hideout places for strangers. | Unused garages, passages, recesses or corners. | Avoid isolated routes; CCTV installation; more effective policing. |
| | Behind dense bushes on walkways. | Cut bushes regularly. |
| Lonely places. | Back streets or alleyways. | Avoid isolated routes; more effective policing. |
| | Shopping centres at night. | Avoid isolated routes; CCTV installation; more effective policing. |
| | Commons at night. | Avoid isolated routes; installation of notice signs to indicate safe passage times during the day. |
| Subway conditions. | Wall graffiti. | Cleaned/replaced by alternative pictures; CCTV surveillance to deter. |
| | Invisibility of subway prior to approach. | Re-design subways to provide good visibility prior to entrance. |
| | Feeling of being trapped despite being well lit. | CCTV surveillance. |
| Alleyways. | Sense of unease due to self-consciousness. | An advantage over subways is that they are above ground. Avoid use of the subways at night. |
| | Long and isolated. | City-wide CCTV surveillance. |
| Areas near housing estates. | Sense of unease. | Avoid public/travelling in group. |
| Areas around pubs and clubs at night. | | CCTV surveillance and priority route patrolling. |
| Begging and other anti-social behaviour on street. | Feeling of being attacked. | Action on begging; more effective policing. |
| People hanging about. | Sense of unease. | On-street assistance and priority route patrolling and effective policing. |
| Personal crime. | Sense of unease in home environment. | Crime and disorder audits under the Crime and Disorder Act 1998. |
| Property crime and vandalism. | | |
| Minority communities. | Lack of social integration. | Increase local activity to involve all social classes and ethnic groups. |

*It could be argued that security related defects are outside the direct responsibility of the maintenance team. However, the concept of 'objective' safety and 'subjective' security fits in well with the wider Best Value Agenda, and both should be taken into consideration.*

*The perceived level of security may vary by season. Leaves could be a problem in the Autumn and poor street lighting during the hours of darkness.*

considerations be measured by Condition Indicators which relate to the five user related conditions identified in Chapter 2. Condition Indicators can be used to define the permissible proportion of the network in a condition worse than an agreed threshold of acceptability. Highway Authorities will have to define their policies regarding the proportions of the network they agree to keep in a condition better than that threshold so that their performance may be assessed.

For consistency, all highway authorities will need to use the same set of indicators, but thresholds could vary from place to place according to local conditions and the type of service that can be reasonably expected by the public, considering restrictions such as limited budget and resources. It is important that definitions of Condition Indicators and targets are set realistically at a local level, so they may be achievable within the available budget and yet may be monitored for performance by the Audit Commission and others.

The suggested formulation needs to be tested by a number of different authorities to get a balanced weighting between parameters. It will be necessary to assess the effectiveness of any proposal in trials with local authorities.

Due to the difficulty in defining the parameters related to security and the setting of thresholds against which to monitor them, security related defects have not been included in this study.

### 3.1 Condition Indicators

Condition Indicators are a measure of condition at a given instant, usually at the time of an inspection. They can be combined into an overall Condition Indicator to gauge the performance of individual highway authorities. Performance could also be judged in terms of the proportion of a network with condition Indicators corresponding to a less than acceptable condition.

There should be a simple method of representing condition both at network and project levels. Bar charts, pie charts, coloured strip maps etc. could be used.

Condition Indicators can be used to represent the state of different unit lengths of footway, varying from say 10m to maintenance reference section lengths and network lengths. It would probably be best to use the same reference system as used on the carriageway, sub-dividing sections into 20m or 100m lengths.

## Table 7 Proposed user satisfaction related accessibility defects

| | | | Threshold | | | | |
|---|---|---|---|---|---|---|---|
| | | | Footway category* | | | | |
| *Defect* | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* |
| No or inadequate dropped kerbs at crossing.** | Present. | Item | 1 | 1 | 1 | 1 | P |
| Location of crossing. | Distance or location. | m | 20 | 30 | 75 | 200 | P |
| Steps inappropriate for users. | Present. | Item | 1 | 1 | 1 | 1 | P |
| Steps present - no alternative ramps. | Present. | Item | 1 | 1 | 1 | 1 | P |
| Excessive gradient. | Gradient. | % | 5 | 5 | 10 | 15 | P |
| Tactile paving not provided. | Present. | Item | 1 | 1 | 1 | 1 | P |
| Lack of route sign posting. | Junction without sign where needed in accordance with policy for the route. | Item | 1 | 1 | 1 | 1 | P |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

** *Inadequate dropped kerb: It was suggested that definition(s) are needed to accommodate various users groups (to have a level surface or a 10mm water check at the channel line). Visually impaired may argue for a 10m10mm check. Those in wheelchairs may argue for a completely level surface.*

*Inspection type: S = Safety P = Provision D = Detailed*

## Table 8 Proposed user satisfaction related Comfort defects

| | | | Threshold | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Footway category* | | | | | |
| *Defect* | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
| Footway too narrow. | Width. | m | 3.0 | 2.5 | 2.0 | 1.0 | P | |
| Driveway crossing with bias to vehicle. | Present. | Item | 1 | 1 | 1 | 1 | P | |
| High levels of traffic. | Flow in lane adjacent to footway. | Vehicles per ¼ hour | 25 | 50 | 75 | 150 | P | Time of day flow assessed. |
| Speed of traffic. | Estimated 85%ile speed. | mph | 15 | 20 | 35 | 50 | P | To allow for the present situation with footways along busy roads. |
| Proximity of traffic to footway edge. | Minimum distance between vehicle sides and edge of footway. | m | 1.5 | 1.0 | 1.0 | 0.5 | P | |
| Excessive numbers of heavy commercial vehicles. | Flow. | No. per ¼ hour | 1 | 5 | 10 | 30 | P | Time of day flow assessed (based on 24 hour clock). |
| Lack of seats.** | Number. | No. per 100m (or policy level) | 1 | 0.5 | 0.2 | 0.1 | P | |
| Lack of shelters.** | Number. | No. per 100m (or policy level) | 0.5 | 0.2 | 0.2 | 0.1 | P | |
| Playing area for children. | Level of suitability. | Assess suitability | | | | | | |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

*User satisfaction is very subjective in terms of comfort and depends on a large number of variables. Thresholds are difficult to define.*

** *Lack of seats and bus shelters: Noting the lack of these defects is not always appropriate, i.e. on narrow footways or non-bus routes, respectively.*

*Inspection type: S = Safety P = Provision D = Detailed*

**Table 9 Proposed user satisfaction related environment defects**

| | | | *Threshold*** | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | *Footway category** | | | | | |
| *Defect* | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
| Vehicular overrun | Area or equivalent | m x m | 1x0.5 | 2x0.5 | 7.5x1 | 15x1 | P | Advise Police |
| Visual intrusion detracting from amenity. | Present. | Item | 1 | 1 | 1 | 1 | P | |
| Litter. | Approximate number of items. | No. per 10m length of footway | 2 | 2 | 10 | 10 | P | |
| Dog faeces. | Approximate number of items. | No. per 10m length of footway | 1 | 1 | 1 | 1 | P | |
| Lack of visually attractive surface. | Not provided in accordance with policy for the route. | Item | 1 | 1 | 1 | 1 | P | |
| Lack of horticultural landscaping. | Not provided in accordance with policy for the route. | Item | 1 | 1 | 1 | 1 | P | |
| Excessive level of noise from moving vehicles or those waiting at junctions/signals. | Noise level. | Db | 50 | 60 | 70 | 80 | P | |
| Excessive level of fumes from moving vehicles or those waiting at junctions/ signals. | Emission of $NO_2$.<br>Emission of CO. | pp<br>ppb | 25<br>7.5 | 25<br>7 | 20<br>6.0 | 20<br>5 | P<br>P | |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

** *Little is known about the effectiveness or practicality of the proposed thresholds. More information is needed.*

*Inspection type: S = Safety P = Provision D = Detailed*

### *3.1.1 Safety Condition Indicator*

The public is not being served well if a significant proportion of the network is in a potentially unsafe condition. Similarly, the public is not being well served if they are experiencing a less than acceptable degree of comfort whilst walking. Proposed thresholds for acceptability will have to be stated by the authority in a policy document and, as with all indicators, will vary according to the locality, usage policy and available resources.

### *3.1.2 Comfort Condition Indicator*

It is probable that comfort Condition Indicators will be determined mainly from the results of detailed inspections. However, unevenness criteria relating to safety will also be included but with lower (more demanding) threshold levels.

### *3.1.3 Accessibility and Environment Condition Indicators*

Accessibility and Environment Condition Indicators are more difficult to define but are important in making footways more attractive to the public. However, it is clear, and there is plenty of supporting evidence, that encouraging people not to use their car will take much more to achieve than the provision of a network of attractive and safe footways. Even if the footways were perfect, many people would still prefer to use their car rather than walk.

There may not be universal agreement on the order of importance of the proposed user related conditions; hence, any weighting factors used in combining Condition Indicators will be dependent on this order. A generally accepted order of importance might be:

1 Safety.

2 Accessibility.

3 Security.

4 Comfort.

5 Environment.

## 3.2 Thresholds

Currently, most thresholds appear to be set at the ‘intervention’ level, and as such are an extreme value

**Table 10 Proposed user satisfaction related safety defects**

| | | | *Threshold* | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | *Footway category** | | | | | |
| *Defect*** | *Parameter* | *Unit* | *1+1a* | *2* | *3* | *4* | *Insp. type* | *Remarks* |
| No kerbs. | Length. | m | 0 | 0.5 | 1.5 | 2.0 | P | |
| No footway. | Length required.<br>Width required. | m<br>m | 0<br>(same as footway too narrow) | 0 | 0 | 0 | P<br>P | |
| No refuges where needed at crossing. | Present. | Item | 1 | 1 | 1 | 1 | P | |
| Parked vehicles obscuring visibility at crossing. | Length of parking. | m | 1.0 | 2.0 | 10.0 | 15.0 | P | |
| Street furniture placement obstructive. | Present.<br>Type. | Item<br>Report type | 1 | 1 | 1 | 1 | P | |
| Cars parked on footway. | Length affected. | m | 1.0 | 2.0 | 10.0 | 15.0 | P | Advise Police |
| Cycling on footway. | Present. | Item | 1 | 1 | 1 | 1 | P | Advise Police |

* *Footway categories as identified in Table 1 of Section 2.1 as: Cat.1 - Primary walking routes and prestige zones; Cat. 2 – Secondary walking routes; Cat. 3 – Access walking routes; Cat. 4 – Local footways.*

** *Moss, weeds and algae are safety defects and perhaps should be included here, but thresholds for the accumulation of moss and algae will be difficult to define, and may depend on seasonal factors.*

*User satisfaction is possibly the most difficult to define and measure.*

*Inspection type: S = Safety P = Provision D = Detailed*

when something needs to be done immediately [or at least within a planned remedial work timetable]. The possibility of using graded thresholds, such as 'target' and 'warning' or 'investigation' (as already considered in Codes of Practice) as well as 'intervention' or 'action', should be considered, giving the opportunity for proper planning and prioritisation of treatment.

'Target' thresholds could be defined as those that should be achieved considering all limiting factors such as funding and resources, and taking into account public expectation. Alternatively, they could be conceived as those obtained in an ideal situation with no restraints. This latter definition is not a good one because it probably can never be obtained.

'Warning' or 'investigatory' levels are principally those associated with the timing of maintenance treatments. The footway is at a state where it is economically sound to treat it before its condition becomes too bad. This may be a suitable threshold to use in indicators because it is not in a dangerous state, but it is approaching a state where treatment could soon be needed and it may become dangerous if left untreated. Also, in terms of economics and whole life costs, it is an important threshold. Warning levels could be considered to be the same as investigatory levels, where further investigation is needed to assess the extent of deterioration.

'Intervention' levels are too high to be used for comfort or safety condition indicators because it is 'too late' when the condition gets to this level. They are important in allowing defence against litigation and can be used in performance indices to assess how well emergencies are dealt with but, when used in this context, they may give a misleading indication on the comfort, or overall condition of the network. It is very important that, as far as possible, a better condition than this level is achieved at all times in practice.

At present, footway Condition Indicators are not used in exactly the manner outlined in this report, but the underlying principle is used by most good maintenance systems such as that of Department of Regional Development (DRD) of Northern Ireland, and Somerset. The DRD (Northern Ireland) system employs safety and detailed inspections; the Somerset system uses detailed, safety and condition inspections. Threshold criteria are given in both systems but no indices are defined as such, although they may well be used indirectly to assess performance.

The threshold levels proposed in Tables 2 to 10 will be judged by inspectors in a subjective manner. It is imperative however that inspections are carried out to set standards and that an inspector is trained to a uniform national level. Previous unpublished work carried out by TRL indicates that a road inspection by different inspectors can result in reporting varying degree of defects on the road surface.

However, there may well be a need for a national NVQ for inspectors. From a practical aspect, this will not necessarily solve the problem, since part of the issue is about management control. In addition to the training of inspectors there is the need for regular back-to-back monitoring of inspectors. Essentially it needs to be part of a Quality Assurance system with built-in monitoring.

### 3.3 Derivation of a Condition Indicator

The Condition Indicator could be regarded as a score that shows the state of a given section of a footway. Current Local Transport Plans adopt a scoring system that implies a higher score for the worst condition under UKPMS assessment. This implies that a 0 score could represent a perfect surface and one of 100 corresponding to one in the worst possible condition. This system, however, has not been adopted in the calculation of Condition Indicators in this report. Hence, a higher score for Condition Indicator implies a better quality footway (analogous to a five star hotel being the best and no star being the worst).

Separate Condition Indicators are first derived for Accessibility, Comfort, Environment and Safety categories using the defect items identified in Tables 2 to 5. Each table has a column showing the defect number proposed for the given category. The total number of defects for Accessibility (Table 2), Comfort (Table 3), Environment (Table 4) and Safety (Table 5) categories, are 5, 4, 5 and 18, respectively.

It is assumed that each individual defect within any of the four user categories will have equal weighting. For example, if there is one defect per sample length within the Accessibility category above the threshold value, then the Condition Indicator will be 80% (i.e. only one out of five thresholds are exceeded). Alternatively, each defect per sample length within Environment category (with a total of 5 defects) will have a 20% negative mark. Hence, a total of three defects within this category will have a Condition Indicator value of only 40% for the sample length.

The safety category contains the most number of defects. Hence, the mark for each defect is considerably smaller than that within other categories. About 18 safety related surface defects have been identified in Table 5, some of which are of a temporary nature, such as surface conditions during snow and ice and the presence of leaves on the surface. These are not considered for inclusion in the formulation of a Condition Indicator. Thus a total of 16 defects need to be considered and any weighting will need to be proportioned to this total value (an approximate 6% mark to be deducted from 100% for every defect).

Since not all of the footway hierarchies will have the same threshold level, the Condition Indicator for each footway hierarchy will be based on different threshold levels, and hence it could be different. It is suggested that Condition Indicators for the Accessibility, Comfort, Environment and Safety categories are obtained for selected sections of a footway, say for every 100m. An average score could then also be obtained for a scheme on each pedestrian route.

Subtracting the calculated score from 100 so that a Condition Indicator value of 0 represents a perfect surface and one of 100 corresponds to one in the worst possible condition could constitute an alternative method of rating. This system, however, has not been adopted in the calculation of Condition Indicators in this report. Hence, a higher score for Condition Indicator implies a better quality footway. However, current Local Transport Plans adopt a scoring system that implies a higher score for the worst condition under UKPMS assessment. Under the 1998 Audit Commission directive, all Local Authorities have to record defects as a percentage of the network, and should achieve a score of less than 70, based on UKPMS Coarse Visual Inspection (CVI) defect scores (DETR, 1999b).

#### *3.3.1 Calculation of the overall Condition Indicator*

Once the four Condition Indicators are determined, they could be combined using a weighted multiplier to give an overall Condition Indicator for the given footway category, as shown in the following equation:

$$\text{Overall CI} = a.CI_{\text{Safety}} + b.CI_{\text{Environment}} + c.CI_{\text{Comfort}} + d.CI_{\text{Accessibility}} \quad (1)$$

Where a, b, c and d are the weighted multiplier applied to each Condition Indicator.

The weighting of each Condition Indicator will not be the same because the importance of each indicator is different as far as the maintenance of footway surface is concerned. As safety is of paramount importance the overall CI is most likely to be governed by the Safety multiplier (a) rather than any of the other three. A multiplier of 0.70 (i.e. 70%) maybe be a good starting figure for (a) with the other three multipliers each being 0.10.

The weighting factors will need to be tried out and developed in conjunction with practitioners.

The overall Condition Indicator will be a unique value for the selected footway length. It is important that all the Condition Indicators are determined for the same length of the footway. The calculated Condition Indicator for the total length of a network is a useful tool that can indicate the maintenance requirements. The results could be reported in various formats, indicating an average value and the degree of variance throughout the route as well as the network.

The average Condition Indicator for a route, will be the average of individual overall Condition Indicators for each 100m of the route, without any special multipliers for any length of the route.

Threshold values can also be set to the overall CI value for a given route category. A Category 1 priority route (Zones, such as shopping areas, recreational centres, business and industrial concentrations) will demand a higher threshold value than a Category 2 route, and so on. These threshold values together with the multiplier values for each Condition Indicator could be set at national as well as local highway authority levels.

The determination of the necessary parameters listed in Tables 2 to 5 to calculate Condition Indicators is dependent upon inspection timing and its frequency. Hence, the overall Condition Indicator could only be determined once the results of both safety and detailed inspection are obtained. However, safety condition, the most important, can be determined separately at more frequent intervals if desired.

Calculation of each Condition Indicator, as well as the overall Condition Indicator, would be carried out automatically when the data is input to ‘hand-held’ data capture devices on site for downloading into a PC, and will be a relatively straightforward process.

An example of the working model is presented below for a Category 1 footway, and the calculations are carried out manually to identify the overall Condition Indicator value.

### 3.4 Worked example for the calculation of a Condition Indicator

A hypothetical footway approaching a busy shopping centre area was surveyed and found to have the following defects over a 200m length, following the results of both safety and detailed inspections.

***First 100m***

1 Overall grass height of 230mm.
2 A total of 3 missing hand rails on the footway.
3 Trip height of 5mm.
4 A total of 10 unsafe steps.
5 A total of 3 cracked surface, with the maximum crack width of 3.5mm.
6 Inadequate kerb upstand of about 50mm in a 5m length.
7 Standing water of 0.25m$^2$ area.
8 2 broken street lighting columns.

***Second 100m***

1 1 missing hand rail on steps.
2 Snow and ice on about 3% of the total footway.
3 Excavation lasting 2 days.
4 Overall grass height of 120mm.
5 A total of 5 unsafe steps.
6 3 rocking slabs with a maximum deflection of 6mm.
7 Exposed electrics.
8 Misaligned kerbs of 1.2m long.
9 2 potholes with a maximum depth of 5mm.
10 5% of surface covered with weeds or moss.

***Calculate***

The Condition Indicators in each 100m length for each user condition.

The overall Condition Indicator for each 100m length.

The average Condition Indicator for the total 200m length.

***Answer:***

Each 100m length will be treated separately. Firstly, each of the Condition Indicators relating to Accessibility, Comfort, Environment and Safety categories will be determined separately using the threshold values given in Tables 2 to 5. Then, the overall Condition Indicator will be determined using Equation (1) and the weighting multipliers suggested. This will provide a single figure for each 100m of the route. Note that a higher score implies a better quality footway (100% being the best and 0% the worst).

***First 100m Indicator***

The route category around a shopping centre relates to Category 1 footways. Hence, the corresponding threshold values in Tables 2 to 5 will apply.

*Safety Condition Indicator*

In the first 100m length, the defective items are nos. 2, 3, 4, 7 and 8 (a total of 5 items). Item 6 passes the criterion for kerb upstand.

The total defect items in Table 5 (ignoring snow and ice) are 16. Hence, the Condition Indicator is:

$$Safety\ CI = \frac{16-5}{16} \times 100 = 69\%$$

*Environment Condition Indicator*

Items 1 and 5 relate to the environment condition, as given in Table 4, with a total number of defects equal to 5. Then:

$$Environment\ CI = \frac{5-2}{5} \times 100 = 60\%$$

No defects relate to Accessibility and Comfort conditions; hence each will have a Condition Indicator value of 100%. Using Equation (1) in Section 3.3.1 with multipliers of a = 0.70 and b = c = d = 0.10 will give:

$$Overall\ CI = 0.70 \times (60) + 0.10 \times (60) + 0.10 \times (100) + 0.10 \times (100) = 74.3\%$$

This length also relates to a Category 1 footway. Hence, the corresponding threshold values in Table 2 will apply.

*Safety Condition Indicator*

In the second 100m length, the defective items are nos. 1,2, 5, 6, 7 and 9 (a total of 6 items).

The total number of defect items in Table 5 is 16 (disregarding snow and ice). Hence, the Condition Indicator is:

$$Safety\ CI = \frac{16-6}{16} \times 100 = 62.5\%$$

*Environment Condition Indicator*

Item 4 is below the threshold given in Table 4. Item 5 is the only defect above the threshold value in this category. Then the success rate is 4 out of 5; hence:

$$Environment\ CI = 80\%$$

*Accessibility Condition Indicator*

There are five defect items present in Table 2. Item 3 in the second 100m shows a duration of 2 days which is above the threshold value for defect 1, hence a failure. Therefore, with only one item failing:

$$Accessibility\ CI = \frac{5-1}{5} \times 100 = 80\%$$

*Comfort Condition Indicator*

Item 10, presence of weeds or moss on the surface relates to comfort category and is above the threshold value.

Table 3 shows a total of 4 defects in this category. Hence, the success rate is 3 out of 4, giving

*Comfort CI = 75%*

Using Equation (1) in Section 3.3.1 with multipliers of a = 0.70 and b = c = d = 0.10 will give:

$$\textit{The overall CI} = 0.70\times(62.5) + 0.10\times(80) + 0.10\times(75) = 67.3\%$$

***Total length of 200m***

The average overall CI = (The overall CI for first 100m + the overall CI for the second 100m)/2

Then,

*The average overall CI = (74.3% + 67.3%)/2 = 70.8%*

The performance of the authority can then be compared with the target values published in their policy document.

### 3.5 General comments on Condition Indicators

- The degree of detailing and the complexity of the evaluation and calculation system could be viewed unfavourably by some local authorities. However although the calculation could be complex it would be carried out by computer and, provided the concepts used in the calculation were well understood, and data readily available, it should not present any problems.
- There could be problems with allowing LAs to choose which parameters and thresholds they propose to utilise in the calculation of indicators. It could lead to cost cutting and a consequent lowering of standards by some. It could be better to have a consistent, easily understood and computed set of indicators nationally.
- Easy application of a manageable Condition Indicator depends on the extent of the regime of measurements (either physical or public opinion) and its consistency in scale and complexity with that for the rest of the network.
- The use of 100m sections is probably desirable but location referencing will need to be compatible with that used for the carriageway. If this is not the case, then one must accept two parallel management systems, one for the footway and one for the carriageway.
- There could be a requirement for a number of different types of condition indicators to measure different aspects of performance. For instance, a Best Value Performance Indicator (BVPI) should be based on the defined inspection regime which provides an overall Condition Index similar to that for carriageways which is used to develop BVPI 96 and 97 (condition of principal and non-principal roads, respectively). It should be as comparable as possible to that of the carriageway indicators.
- Benchmarking for Best Value would also be difficult to apply without consistent standards.

# 4 Conclusions

The work undertaken has shown that it is feasible to organise inspection data into Condition Indicators that can be used to quantify the relative performance of footways. In particular, the following conclusions can be drawn:

- The approach suggested to calculate Condition Indicators for various footway categories is a uniform method and may prove to be a good means of gauging footway performance.
- The threshold values identified for each of the four user-related defects (i.e. Safety, Accessibility, Comfort and Environment) need to be looked at carefully by each highway authority as well as the Audit Commission to determine values that are tailored to the specific requirements of each authority. These could possibly be used to defend claims in court.
- It is possible that Condition Indicators could be adapted to the monitoring of the performance of an authority, in the provision of best value. All highway authorities are now required to monitor their own performance in various areas and these Condition Indicators could provide a useful tool, if they are suitably developed.
- Since reaching a certain threshold level is subjective and is dependent on the judgement of an inspector, it is imperative that inspections are carried out to a uniform, repeatable standard and that inspector training is at a recognised national level.
- A single BVPI indicator for footways should be developed and tested on ‘real’ data for inclusion in the revised Code of practice.

# 5 Recommendations

It is strongly recommended that the following areas should be investigated:

- Determine the effectiveness of the proposed Condition Indicators. As the proposals of this report are at the preliminary stage, consideration will need to be given to the selection of defects and thresholds. No attempt has been made to select the most important or relevant defects, thresholds and weightings. As it is important that different authorities are able to tailor the Condition Indicators to their own requirements, they should be encouraged to make their own selection according to budget and the requirements of their footway network. For continuity, it may be advisable to specify a minimum set of indicators; this report attempts to put forward the optimum conditions.
- Formulate Condition Indicators for personal security and user satisfaction related defects, as identified in Table 6 to 10, and compare them with the maintenance related Condition Indicators identified in Chapter 3. These could ultimately be combined as the data for the two sets of indicators are collected.
- Determine the performance of an individual highway authority in providing Best Value using the suggested indicators – i.e. this allows each authority to fulfil the requirements of monitoring its performance.

- Obtain footway inspection data from a sample of nearby local authorities and compare predictions, based on inspection data/comfort relationship obtained in 2 above, with subjective impressions of user comfort. Carry out a controlled experiment with a sample of pedestrians if considered worthwhile.
- Investigate traditional methods of footway condition assessment to quantify repeatability and reproducibility and determine the possible effects of variability. Evaluate potential improvements to the inspection system with particular emphasis on automated methods.
- Revisit data from previous work in Worthing and Barnet (Spong and Cooper, 1994) and Reading and Leeds (unpublished 1998). Examine the correlation between inspection results and user satisfaction.
- There needs to be further research on sample sizes for surveys, methods of selecting sites for the sample surveys and the practicalities and costs of carrying the surveys out. Because of the wide range of conditions likely to be encountered, the statistical variability associated with sampling surveys of footways needs to be taken into account. Guidance on the handling of sample surveys can be found in any of the National Road Maintenance Condition Survey Reports, published yearly by the Government Statistical Office.
- In order to make realistic comparisons between Local Authorities, a consistent minimum set of indicators needs to be agreed upon. Potential users should be consulted.

## 6 Acknowledgement

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# Appendix A: Route hierarchy and categorisation

### A.1 London Walking Forum (2000) categorisation

London Walking Forum (2000) advises the following to be taken into consideration in developing walking networks:

1 Select routes rather than adopting an area based approach.

2 Identify a network of routes with significant pedestrian flows (or potential for high levels of flow, e.g. routes connecting to journey generators such as schools, shopping centres and large employers.

3 Prioritise major or spin routes, then fan out to include firstly distributor routes and then the local minor routes. In this, the pedestrian's total journey needs to be considered. If the route from the house (minor route) to the main route (spin route) is dangerous, convoluted or unattractive then the pedestrian may decide not to walk at all.

4 Establish major routes connecting the city centre, suburbs and countryside.

5 Consider the multi-functional nature of footpaths.

### A.2 London Planning Advisory Committee (LPAC) categorisation

LPAC (1997) identifies the following four key categories of walking in London:

1 Access Mode – where walking is used for all or most of the way between two places, for example home and the workplace, shop or school (i.e. walking as the main means of travel).

2 Access Sub-Mode – walking to support a journey by another mode of transport, for example getting to and from bus stops, stations or car parks.

3 Circulation/Exchange – carrying out a range of activities on foot in public spaces, including window shopping, meeting people in the street, and the interfaces between shops and cafes, and the street.

4 Recreation/Leisure – including long distance walking and local activities such as children playing in the street.

The walking categories listed above would need to satisfy the following conditions for walking, as devised by LPAC (1997) and recommended by DETR (2000):

1 Connected - easy to get from place to place without meeting dead ends; long stretches of road with no side turnings or busy roads that are difficult to cross; easy to get to the nearest station or bus stop.

2 Convenient - direct routes without unnecessary detours, restrictions, underpasses or footbridges.

3 Comfortable - smooth, wide and unobstructed footpaths; avoidance of steep hills and steps; no wind tunnels or suntraps; good lighting and safety from traffic.

4 Convivial - friendly, busy streets that are interesting to walk in, meet people go shopping or have a sit down.

5 Conspicuous - easy-to-read street and 'you are here' signs, clear bus stops and shop names.

### A.3 The Institution of Highways and Transportation (IHT) categorisation

IHT (2000) gives the following hierarchy for footway routes as an example of a hierarchy for pedestrian routes:

1 within or close to the town centre;

2 leading to the railway station or bus station;

3 between large residential areas and local shops, schools, hospital, employment area;

4 between smaller residential areas and the above locations;

5 within residential areas;

6 between nearby villages; and

7 in the countryside.

### A.4 Highway Maintenance Handbook's (Atkinson, 1997) categorisation

Atkinson (1997) gives a detailed hierarchy with six footway categories, as shown below:

1 Extremely heavily used footways:
- City centre shopping streets.
- Main central access ways.
- Pedestrian precincts.

2 Very heavily used footways:
- Other local business areas.
- Local shopping area.

3 Heavily used footways:
- Near schools, hospitals, libraries, community centres, shopping locations and those not covered in 2, residential access ways.

4 Frequently used footways (in the residential streets).

5 Little used footways:
- Footways in residential areas.
- Rural areas.

6 Little used industrial or rural footways.

# Appendix B: Inspection of pedestrian routes

### B.1 IHT (2000) and LAA Code of Good Practice (LAA, 1989) categorisation

The work identified by the safety inspection is allocated to one of three categories (IHT, 2000), namely:

***Safety***

Where a dangerous defect exists which should be repaired within a very short period. The cost of the work is usually limited and the objective is to remove danger in a defined response period, which is associated with the importance of that section within the overall hierarchy. The work is essentially responsive.

***Routine***

The work is essentially of relatively lower unit cost and in many cases can be based on a defined return period to achieve a consistent level of service. Sweeping, the removal of weed growth and non-safety patching are examples of routine maintenance. The work is undertaken as part of a larger rolling programme.

***Structural***

The work is usually of relatively higher unit cost with defects that require more fundamental repairs than the two previous categories. This may include reconstruction, retread works and slurry sealing which forms part of a larger rolling programme.

Through these inspections, the condition of defects in the footway could be identified. These defects need to be assessed and the appropriate action in relation to each defect identified. In this context, two parameters are normally used to make judgement on the condition of defects, namely warning level and intervention level. IHT (2000) defines these as:

*Warning level*: that level of deterioration where good management requires that an action should be included in a works programme to remedy the defect or defective area and, if necessary, to rectify the underlying cause.

*Intervention level*: that level of deterioration where a defect requires urgent attention in order to ensure that the highway authority has taken reasonable care that the highway is safe for the public to use.

The use of warning levels for future remedial action is useful when establishing a planned maintenance programme for the footway network. The warning levels for different types of footway defect as extracted from LAA Code of Good Practice (LAA, 1989), are shown in Table B1.

Maintenance of kerbs also falls within the footway category whose objective is to protect the pedestrians as well as preventing overriding, where other means are not suitable, which has pedestrian related implications. The LAA Code of Good Practice (LAA, 1989) sets out the warning levels for defective kerbs (Table B2), which needs to be considered in their maintenance on an annual programme in association with footway or carriageway works. In addition to the loss of upstand, kerb deterioration can take any of the following forms:

- Longitudinal cracking.
- Broken/generally disintegrated.
- Badly aligned and/or tilted and/or sunken.
- Spalled.

The intervention levels for safety inspections, suggested by the IHT (2000), which have been drawn from the LAA Code of Good Practice (LAA, 1989) and the Kindrds Associans (n (1998), are shown in Table B3.

The response time (the period between the identification of an unsafe defect by an inspector and the start of the remedial work) is also a key factor in the footway hierarchy. The LAA Code of Good Practice (LAA, 1989) suggests that the speed of response should be a function of the intensity of footway use and the degree of danger. The recommendations of this Code for safety maintenance intervention level and the response time are given in Table B4.

### B.2 Highway Maintenance Handbook's categorisation

Atkinson (1997) recommends the inspection frequency given in Table B5 for various footway categories.

### B.3 DRD Road Service (NI) Road Maintenance standards' categorisation

The inspection frequency and the response time for different categories of footways and footpaths in Northern Ireland are shown in Table B6.

### B.4 Somerset Highway Inspection Manual's categorisation

A priority is applied to each defect to determine how quickly inspections should be carried out on defects in the Somerset Highway Inspection Manual (Somerset County Council, 1996), with response times given as below:

| | |
|---|---|
| Priority 1 | Make safe within 24 hours. |
| Priority 2 | Repair within 28 days. |
| Priority 3 | Repair within 3 months or during the next available programme. |
| Priority 4 | Review condition at next inspection or repair during next available programme. |

The footway related defects and the priority order for their treatment are shown in Table B7 for the Somerset Highway Inspection Manual.

### B.5 New Roads and Street Works Act 1991 (NRSWA) categorisation

The Code of Practice Specification for the Reinstatement of Openings in Highways (DOT *et al.*, 1992) of the 1991 New Roads and Street Works Act (NRSWA) sets out performance requirements for newly reinstated excavations in footways and carriageways. A summary of the requirements is given in Table B8.

### B.6 Footway and kerb deterioration categorisation by CHART (DoT, 1986).

CHART (DoT, 1986) treats flexible and flagged footways and kerb deterioration separately as shown in Tables B9a to B9d.

## Table B1 Warning levels proposed by LAA Code of Good Practice (LAA, 1989)

| *Footway category* | *Limitation or severity* | *% of area* | *Treatment* |
|---|---|---|---|
| 1 Main shopping area. | Coarse cracking of the surface.<br>Coarse crazing.<br>Depressions more than 25mm deep in 500mm.<br>Upstands greater than 6mm but less than 10mm. | 20 | Restore surface. |
| 2a Busy urban/shopping (flexible). | Coarse cracking of the surface.<br>Coarse crazing.<br>Depressions more than 25mm deep in 500mm.<br>Upstands greater than 13mm but less than 20mm. | 30 | Restore surface. |
| 2b Busy urban/shopping (rigid). | Upstands greater than 13mm but less than 20mm.<br>Cracks or gaps more than 20mm wide and more than 6mm deep.<br>Depressions more than 25mm deep in 500mm.<br>Rocking flags. | 30 | Restore surface. |
| 3a Less used urban and busy rural (flexible). | As for busy urban (flexible). | 40 | Restore surface. |
| 3b Less used urban and busy rural (rigid). | As for busy urban (rigid). | 40 | Restore surface. |
| 4 Less used rural. | When potentially dangerous upstands are greater than 20mm. | | Patch or restore surface. |

*Choice of treatment will depend on the failure mode, type of construction and importance of the footway. Generally, less used footways would only require surface treatment and heavily used ones reconstruction of the surface.*

## Table B2 Warning levels for kerbs (LAA, 1989)

| *Defect* | *Group to which applicable* | *Limitation or severity* | *% of length* | *Treatment* |
|---|---|---|---|---|
| ***Rural and urban*** | | | | |
| Inadequate kerb upstand. | All. | Total loss of upstand. | 0-20 | Restore upstand if appropriate for location. |
| | Busy protected footway. | Upstand ≤ 30mm. | 100 | |
| | Busy unprotected footway. | Upstand ≤ 75 mm. | 100 | |
| | Little used footway or no footway. | Upstand = 30mm. | 100 | |
| ***Urban*** | | | | |
| Kerb deterioration. | Busy footways. | Any of the forms defined above. | 10 | Replace kerb. |
| | Other sites. | | 20 | |
| ***Urban and rural*** | | | | |
| Need for kerbing. | Unprotected footway. | Overriding of footway, carriageway drainage discharging across footway, surface water not reaching gullies and edge deterioration of carriageway. | 20 | Provide kerb. |

**Table B3. Intervention levels for safety defects drawn from the LAA Code of Good Practice (IHT, 2000)**

| *Defect and intervention level* | *Comment* |
|---|---|
| Dangerously rocking flags. | No precise definition given in LAA (1989). Kindred Associations (1998) suggests 20mm faulting. Leake *et al*. (1991) indicated that the user could consider all rocking flags dangerous. |
| Projections greater than 20mm high (including manhole frames and boxes). | The 20mm upstand ('trip') height results from case law. If the upstand is less than 20mm a successful claim is unlikely. Leake *et al.* (1991) found that some users had difficulties when upstands exceeded 10mm. |
| Cracks and gaps between flags greater than 20mm wide and more than 6mm deep. | Leake *et al.* (1991) found that users had difficulties when gaps exceeded 10mm wide. |
| Isolated potholes – none. | Usually occurs in a bituminous surface and is an indicator of the onset of wearing course failure. In a modular or paved surface, this may be a missing element or paving. No precise definition given in LAA (1989). All potholes are unacceptable regardless of depth. |
| Depressions and bumps more than 25mm deep or high in a length of 500mm. | Leake (1991) suspected that transverse depressions were more difficult to the user than longitudinal ones. This has subsequently been confirmed by further work undertaken by TRL (Spong *et al.*, 1995). |
| Loose surface – none. | No precise definition given in LAA (1989). No loose surface is safe. |
| Standing water – none. | No precise definition given in LAA (1989). No standing water is acceptable. |
| Utility reinstatements – a 10mm upstand or depression indicates the reinstatement to be unacceptable under the New Roads and Streetworks Act 1991. | The requirements are more discriminating than has normally been applied to a 'safety' upstand on the footway (DOT *et al.*, 1992). |

**Table B4 Safety maintenance intervention levels and response times (IHT, 2000)**

| | *Location* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *a* | | *b* | | *c* | | *d* | |
| *Defect* | *Intervention level* | *Response time* | *Intervention level* | *Response time* | *Intervention level* | *Response time* | *Intervention level* | *Response time* |
| Rocking flags. | All | 1 | All | 2 | All | 2 | All | 3 |
| Upstand (mm). | >20<br>13-20<br>6-13 | 1<br>2<br>3 | >20<br>13-20 | 2<br>3 | >20<br>13-20 | 2<br>3 | >20<br>13-20 | 2<br>3 |
| Horizontal gaps (mm). | >20 | 2 | >20 | 2 | >20 | 3 | >20 | 3 |
| Isolated potholes. | All | 2 | All | 3 | All | 3 | All | 3 |
| Depressions (mm). | >20 | 2 | >25 | 3 | >25 | 3 | >25 | 3 |
| Puddle. | | | >1m$^2$ (area) and >6mm (depth) | 2 | | | >1m$^2$ (area) and >10mm (depth) | 3 |
| Loose surface. | All | 2 | All | 2 | All | 3 | All | 3 |
| Loose kerb. | All | 2 | All | 2 | All | 3 | All | 3 |
| Missing kerb. | All | 2 | All | 2 | All | 3 | All | 3 |

*Response time codes: 1 within 24 hours, 2 within 2 weeks, 3 within 3 months*

*Location categories: a main shopping area, b busy urban area, c less used urban or busy rural area, d little used rural footway*

**Table B5 Recommended footway hierarchy and frequencies of safety inspections by Atkinson (1997)**

| *No.* | *Location* | *Frequency* |
|---|---|---|
| 1 | Extremely heavily used footways:<br>● City centre shopping streets.<br>● Main central access ways.<br>● Pedestrian precincts. | Weekly |
| 2 | Very heavily used footways:<br>● Other local business areas.<br>● Local shopping area. | Every two weeks |
| 3 | Heavily used footways:<br>● Near schools, hospitals, libraries, community centres, shopping locations not covered in 2, residential access ways. | Monthly |
| 4 | Frequently used footways:<br>● Footways in residential streets. | Every three months |
| 5 | Little used footways:<br>● Footways in residential areas.<br>● Rural areas. | Annually |
| 6 | Little used industrial or rural footways. | Annually |

**Table B6 Inspection frequencies and response time to footway defects in Northern Ireland (DoE (NI), 2000)**

| | | | *Defect response time* | | |
|---|---|---|---|---|---|
| *Footway category* | *Traffic flow* | *Inspection interval* | *Cat 1 (>100mm)* | *Cat 2 (50-100mm)* | *Cat 3 (20-50mm)* |
| High traffic. | Town and city centres (as indicated on Area Plan). | 1 month | R1 | R1 | R2 |
| Medium traffic. | Busy urban footways leading from housing estates and car parks to town and city centres. Main streets in villages. | 2 months | R1 | R2 | R3 |
| Low traffic (high risk).* | Housing estates with a high incidence of defects due to age of the footway, construction of footway, extensive utility reinstatements or vandalism. | 2 months | R1 | R2 | R3 |
| Low traffic. | Housing estates, other urban footways and rural footways. | 4 months | R1 | R2 | R3 |

** Where the footways in an urban estate have been classified as low traffic (high risk), then it will be normal to inspect the associated carriageways at the same interval.*

*R1 - repair or make safe before the end of the next calendar day.*

*R2 - repair or make safe within 5 working days.*

*R3 - repair within 4 weeks.*

*Cat 1 - abrupt level differences in the surface >100mm (measured vertically) or potholes >100mm deep.*

*Cat 2 - abrupt level differences in the surface >50mm up to 100mm (measured vertically) or potholes > 50mm up to 100mm deep.*

*Cat 3 - abrupt level differences in the surface >20mm up to 50mm (measured vertically) or potholes > 20mm up to 50mm deep.*

**Table B7 Inspection frequencies and response time to footway defects in Somerset (Somerset County Council, 1996)**

| *Defect type* | *Priority for treatment* | *Notes* |
|---|---|---|
| Footway overgrown by vegetation. | 2<br>3 | Dependent on footway usage. |
| | 2 | Pedestrians forced into carriageway. Serve notice on landowner. |
| | 3 | Weeds affecting structure of footway if not attended to. |
| Bituminous fretting. | 3 | Urban footway less than 20mm difference in level. |
| | 4 | Rural footway. |
| Slab profile. | 1 | Trips/uneven footway over 20mm in a busy urban area. |
| | 2 | 20mm trip in a lightly pedestrianised area. |
| Minor cracking. | 4 | |
| Major cracking. | 2<br>3 | Action dependent on pedestrian usage. |
| | 1 | Gap wider and deeper than 15mm. |
| Potholes. | 1 | Depression > 25mm deep and < 600mm in plan direction. |
| Defective trench. | 3 | 10mm trip on a raised trench. Report to statutory undertaker. |
| Standing water. | 3 | Could be a Priority 1 if on a busy urban footway and freezing conditions anticipated. |
| Kerb upstand. | 1 | Vertical projection > 20mm on a busy urban footway. |
| Damaged kerb. | 1 | Footway behind kerbing. |
| | 3/4 | Verge behind kerbing. |
| Injurious weeds - ragwort. | 2 | Would normally only be treated in response to complaints. |
| Other injurious weeds including: broadleaf docks, creeping thistle, and spear thistle. | 3 | Would normally only be treated in response to complaints. |
| Overhanging foliage. | 2 | Inform adjacent landowner. Arrange to be cut if no action within 14 days. |
| Condition of signs. | 1 | Sign liable to fall on pedestrian. |
| Condition of lamppost. | 2 | Post almost corroded through. |
| | 4 | Unsightly but not dangerous. |

**Table B8 Intervention level in newly reinstated footways by NRSWA 1991 Act (DOT *et al.*, 1992)**

| *Category* | *Allowable tolerance / Intervention level* |
|---|---|
| As-laid profile. | Maximum allowable tolerance at the edge of the reinstatement between the levels of the reinstatement and the adjacent surface ≤ ± 6mm. |
| Edge depression. | Intervention level is required where the depth of any edge depression > 10mm over a continuous length of more than 100m. |
| Surface depression. | Intervention level is required where the depth of any area of surface depression spanning more than 100mm in any plan dimension exceeds the limits shown in Note 1. |
| Surface crowning. | Intervention level is required where the height of any area of surface crowning spanning more than 100mm in any plan dimension exceeds the limits shown below in Note 1. |
| Combined defect. | The intervention limits shown in note 1 are reduced by 20%, subject to a minimum of 10mm, where edge depression and/or surface depression and/or surface crowning overlap. |
| Fixed features: kerbstones and related concrete products, channel blocks. | |
| As-laid profile. | Maximum allowable tolerance at the edge of the reinstatement between the levels of the reinstatement and the adjacent surface ≤ + 6mm. Intervention level is required when the mean level of the fixed features does not coincide with the mean level of the immediately adjacent surfaces within a tolerance of 10mm. In the case of a drainage feature the tolerance for intervention level is +6mm to -15mm. |

*Note 1. Intervention limits for surface depression/crowning:*

| *Reinstatement width, mm* | *Intervention limit, mm* |
|---|---|
| *Up to 400* | *10* |
| *Over 400 to 500* | *12* |
| *Over 500 to 6* | *14* |
| *Over 600 to 700* | *17* |
| *Over 700 to 800* | *19* |
| *Over 800 to 900* | *22* |
| *Over 900* | *25* |

**Table B9a CHART defect assessment of flexible footways**

| Defect type | Assessment of defect |
|---|---|
| Cracking.<br>Crazing.<br>Fretting. | Assess as defective if present in any length or form or at any degree of severity. |
| Deformation accompanied by another defect. | Check for the other defect. |
| Deformation on its own. | If likely to cause less able pedestrians to trip or stumble, record as defective. |
| Longitudinal undulation. | Disregard if long and gentle. If closely spaced and pronounced, assess as defective. |
| General irregularity. | Assess as defective if there are abrupt changes of level. |
| Local bumps. | Record those, whilst not dangerous, are likely to affect users. |
| Local hollows. | Record those, whilst not dangerous, are likely to hold water. |
| ***Dangerous defects*** | |
| Potholes. | Present. |
| Depressions. | >25mm deep. |
| Bumps. | >25mm high. |
| Loose stones on hard surfaces. | Present. |
| Manhole covers and stop-cock. | Loose, upstanding, sunken or damaged. |
| Isolated dangerous defects within larger recorded lengths. | Report; do not record. |

## Table B9b CHART defect assessment of flagged footways

| Defect type | Assessment of defect |
|---|---|
| Settlement of whole flags.<br>Settlement of cracked flags at the cracks.<br>Cracked flags with no settlement. | Result in stepping and depression, given rise to uneven surface, causing discomfort and an element of danger to pedestrians. |
| Rocking flags.<br>Wide gaps at joints and cracks. | Being constructed of very small, discrete units, they tend to have more local defects than do flexible footways. So local and general deterioration are dealt with separately. |
| ***Local deterioration*** | |
| *Dangerous conditions*: Assess and report locally deteriorated areas where: | |
| Steps. | >20mm. |
| Depressions. | Deeper than 25mm. |
| Rocking. | One or more. |
| Gaps at joints or cracks. | Wider than 20mm. |
| Stop-cock and manhole covers. | Loose, upstanding, sunken or damaged. |
| *Defective conditions*: Assess and report locally deteriorated areas where: | |
| Steps. | 13 - 15mm. |
| Depressions. | 20 - 25mm deep. |
| *Non-defective conditions* | |
| Steps. | <13mm. |
| Depressions. | <20mm deep. |
| Cracked flags (single or multiple). | Negligible or no settlement. |
| **General deterioration** | |
| *Dangerous conditions*: substantial lengths are rare. Usually result from poor trench reinstatement or from particularly severe overriding. Dangerous local defects very likely to be found within generally defective lengths (e.g. rocking flags, missing flags and severe steps due to appreciably depressed cracked flags). Report such defects in addition to recording the whole defective length. | |
| Steps. | >20mm. |
| Depressions. | Deeper than 25mm. |
| Rocking. | One or more. |
| Gaps at joints or cracks. | Wider than 20mm. |
| Stop-cock and manhole covers. | Loose, upstanding, sunken or damaged. |
| *Defective conditions*: assess and record as defective lengths generally uneven as to be uncomfortable to walk on, whilst not immediately dangerous, might cause pedestrians to stumble or trip, i.e. lengths containing: | |
| Steps. | 13mm or more. |
| Depression. | 20-25mm deep. |
| Footway surface. | Generally settled, deformed or undulated; unevenness resulting from settlement of whole flags or from a combination of defective whole and cracked flags. |
| *Cracked only flags*: disregard cracked flags with little or no settlement unless there are so many as to be visually unpleasant. Broad guidelines are: | |
| All single cracks. | Not less than 50%. But follow local instructions if they differ. |
| All multiple or mixed. | Not less than 40%. But follow local instructions if they differ. |

## Table B9c CHART defect assessment of kerb deterioration and upstand

| *Defect type* | *Assessment of defect* |
|---|---|
| Disintegration. | Almost invariably resulting from the action of frost. Recognisable as a crumbling effect at joints and cracks and also over the whole kerb. Early onset of disintegration can be observed as a granulated appearance of the kerb and can be ignored. |
| Spalling. | Differs from disintegration in that material usually breaks away in substantial pieces as opposed to crumbling effect. In stone kerbs (not granite) often evident as layering or spalling along planes of cleavage. In concrete kerbs the appearance is more as though pieces have been knocked away with a hammer. |
| Tilting. | Movement in relation to the transverse contour. Any developed slant great enough to be a positive hazard to pedestrians should be regarded as a defect. |
| Misalignment. | Resulting from vertical or horizontal (outward) movement of kerbs. A small amount of misalignment may normally be acceptable (follow local instructions) but jutting ends in particular will present hazards, and where they occur kerb deterioration should be recorded. |
| Cracking. | Occurring singly can be ignored but multiple cracking of a kerb should be entered as kerb deterioration. |
| Kerb upstand. | Measuring and recording should be done to the nearest 5mm at 20m intervals unless the upstand is clearly uniform over greater lengths, where local instructions are followed. |

## Table B9d CHART defect assessment of verge deterioration

| *Defect type* | *Assessment of defect* |
|---|---|
| Dealing with:<br>i verges, metalled and grassed, between kerb and footway.<br>ii more extensive damage to unkerbed verges than that dealt with under edge deterioration, i.e. with damage requiring mainly or wholly work on the verge itself. | |
| Metalled verges. | Assess deterioration as for footway. Record the length defective. |
| Grassed verges. | Assess and record as deterioration – denuding, potholing, rutting and serious deformation caused by the overriding or parking of vehicles. Evidence of the occasional passage of vehicles need not be regarded as deterioration. |

# Appendix C: User perception surveys

### C.1 Pedestrian review approach – IHT model

The Institution of Highways and Transportation (IHT, 2000) lists issues, as shown in Table C1, which can be addressed by a pedestrian review.

### C.2 Walk mode inventory – LPAC approach

London Planning Advisory Committee, LPAC (1997) in a draft walking strategy suggests local authorities use 'walk mode inventory.' This would start by looking at the existing amount of walking in particular areas and the potential for any increase in the future. It would then identify how and where improvements to the pedestrian environment could be made. The inventory list for the five general categories is shown in Table C2.

### C.3 Walkability checklist – US DOT Guidelines

The U.S. Department of Transportation Federal Highway Administration has devised a checklist for pedestrians to review their neighbourhood and rate the pedestrian routes for their friendliness (DOT (US), 2000). The route condition checklist is shown in Table C3.

Although important, attitude surveys need to be coherent enough to investigate the user perception to the problems already identified by the local highway authorities. On the other hand, they also need to complement the categories that are included in an inspection programme. In this respect, both the public perception and the highway authority's views on the same problem could be identified.

**Table C1 Pedestrian review: assessing existing conditions**

| *Issue* | *Question* | *Suggested criterion* |
|---|---|---|
| Directness. | How direct are principal pedestrian routes? | Walking distances relative to crow-flies distance. |
| Comprehensiveness. | Do pedestrian routes serve all significant destinations? | Locations not served. |
| Width. | Are routes wide enough to enable pedestrians to proceed? | Usable footway width. Pedestrian flow/density. |
| Obstruction/misuse. | Are there problems of pavement parking, pavement cycling, illegal signs or other obstructions? | Negligible/slight/regular/serious. |
| Surfaces. | Are surfaces firm, even, non-slip, clean and well drained? | Footway maintenance survey data. Frequency of inspection and sweeping. |
| Crossings. | Are footways linked to be safe and convenient crossings? | Location on known desire lines where crossing is slow or hazardous. |
| Personal security. | Are pedestrian routes well lit, surveilled and otherwise safe in term of personal security? | Streets with lighting below standard. Footways not overlooked. Presence of vandalism or graffiti. |
| Pleasant. | Are levels of traffic noise and fume excessive? Is the immediate environment attractive for pedestrians? | Traffic flows and speed. |
| Signing. | Are street names and destinations clearly signed. Are local map boards provided? | Number missing or damaged. |
| Suitability. | Are the different needs and abilities of users provided for? | Dropped crossings, tactile paving, etc. |

**Table C2 Walking inventory (after LPAC, 1997)**

| *Category* | *Walking inventory* |
|---|---|
| Walking activity. | - Extent of walking activity in each of the walk categories (Access Mode, Access Sub-Mode, Circulation/Exchange and Recreation/Leisure).<br>- Walk share in the modal split, for both Access Mode and Access Sub-Mode categories.<br>- Breakdown by journey purpose, person type.<br>- Analyse goods carrying, pedestrian vehicle activity and the needs of the disabled. |
| Route connectedness. | - Identify gaps in the network and detour necessary.<br>- Identify breaks in the network due to vehicle cross-over, junctions. |
| Route convenience. | - Convenience of crossing roads (e.g. at will, with help, with protection).<br>- Is it direct, or are there deviations from desired lines?<br>- Convenience for the disabled.<br>- Is there priority over vehicles at junctions and how long people have to wait.<br>- How much time people have when waiting.<br>- How much control people have (e.g. do they have to apply to cross)? |
| Route comfort. | - Is the footway level, smooth, non-slip?<br>- Is the rout at a continuous level?<br>- Suitability of the pedestrian environment for the disabled?<br>- Air quality.<br>- Proximity to moving traffic.<br>- Absence of footway parking/enforcement of footway parking bans.<br>- High quality maintenance, e.g. street cleansing and pavement repairs.<br>- Uncrowded, a margin of quality over and above bare capacity.<br>- Is the route broad enough for its use, and unobstructed?<br>- Lighting quality.<br>- Micro-climate.<br>- Weather protection.<br>- Litter bins.<br>- Public toilets.<br>- Seating. |
| Route conviviality. | - Diversity of activity to promote vitality and security.<br>- Times at which there is activity.<br>- Ground floor interest and activity (e.g. units per 100 metres).<br>- Effective street lighting and urban design to improve pedestrian security.<br>- Cleanliness.<br>- Quality of design and landscaping.<br>- Furniture and equipment, for walking, and for staying (e.g. seating, litter bins, public toilets). |
| Route conspicuousness. | - Street names comprehensive, visible from eye level, well lit.<br>- Property numbers comprehensive.<br>- Public buildings and other key locations signposted.<br>- Bus stops and stations signposted.<br>- Local and service information provided at bus stops and stations.<br>- Bus stops and stations at local focal points (with kiosk, telephone, public conveniences, etc).<br>- Recreation routes waymarked.<br>- Less obvious routes signed (e.g. through housing estates to local centres or routes to schools). |

**Table C3 Walkability checklist for route condition**

| *Route condition* | *Possible problems* | *Location of problem* |
|---|---|---|
| Enough room to walk safely. | Sidewalks* or paths started and stopped.<br>Sidewalks were broken or cracked.<br>Sidewalks were blocked with poles, signs, dumpsters, etc.<br>No sidewalks, paths, or shoulders.<br>Too much traffic.<br>Something else? Specify. | |
| How easy to cross the streets. | Road was too wide.<br>Traffic signals made us wait too long or did not give us enough time to cross.<br>Needed striped crosswalks or traffic signals.<br>Parked cars blocked our view of traffic.<br>Trees or plants blocked our view of traffic.<br>Needed curb ramps or ramps needed repair.<br>Something else? | |
| Drivers' behaviour. | Drivers ...<br>Backed out of driveways without looking.<br>Did not yield to people crossing street.<br>Turned into people crossing streets.<br>Drove too fast.<br>Sped up to make it through traffic lights or drove through red lights.<br>Something else? | |
| How easy to follow safety rules. | Could you and your child ...<br>Cross at crosswalks or where you could see and be seen by drivers?<br>Stop and look left, right, and left again before crossing streets?<br>Walk on sidewalks, or shoulders (if no sidewalks), facing traffic?<br>Cross with the light? | |
| Pleasantness of the walk. | Some unpleasant things:<br>Needs more grass, flowers, or trees.<br>Scary dogs.<br>Suspicious activity.<br>Not well lit.<br>Dirty, lots of litter or trash.<br>Something else? | |

** Sidewalk is the US terminology for footway.*

## Abstract

TRL Limited was commissioned by the Highways Agency to investigate the potential use of route hierarchies and Condition Indicators for pedestrian routes in the management of footway maintenance. With the total number of defects identified being in excess of 60, the defects have been categorised into user-related surface defects and personal security, user satisfaction and comfort defects based on Safety, Accessibility, Comfort and Environment parameters. An attempt has been made to combine defects with user related parameters to formulate possible Condition Indicators for Safety, Accessibility, Comfort and Environment. Proposals are made for a method of combining these Condition Indicators into an overall Indicator for sub-lengths of footway, as well as for the whole route of a single footway category. The Indicators may be suitable for use at network and project levels. They may also be derived from sample surveys undertaken on part of a footway route.


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