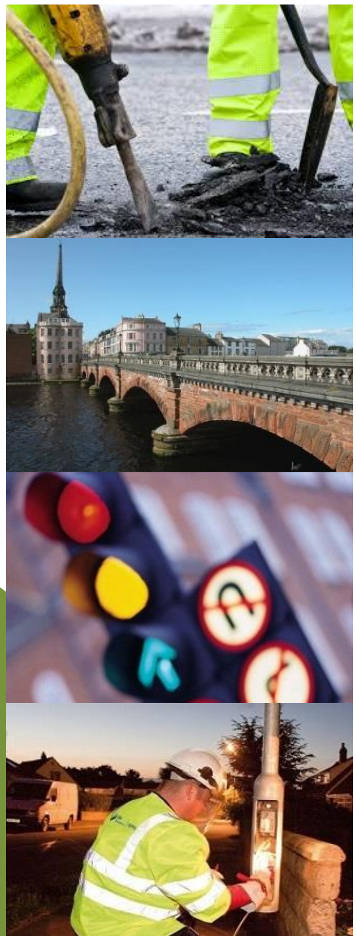
Cymdeithas Syrfewyr Sirol Cymru

County Surveyors' Society Wales

Highway Asset Management Planning:

Risk Based Approach to Highway Management

Rationale Behind the Approach



1. Introduction

CSSW is advocating a nationally consistent approach to the management of local highways. A method has been developed under CSSW's HAMP project designed to allow all authorities to adopt the risk-based approach recommended by the new code of practice (Code of Practice). This paper sets out the rational that was adopted in developing that approach.

Common Needs

The national local road network is varied, ranging from heavily trafficked major routes to barely used rural lanes. There is however commonality between groups of roads and assets. It is appropriate that the travelling public can expect similar standards to apply to roads that are equivalent in their function and level of use nationally. This principle underpins CSSW's desire to create a nationally consistent response to the Code of Practice.

Code of Practice Risk-Based Approach

The new Code of Practice recommends that authorities apply a risk-based approach to highway management. In doing so authorities must acknowledge the fact that risk varies across the asset and between asset groups. Managers have always considered risk in their decision making about inspections, repair priorities and works programming. The new code creates a need to formalise such decision making and to ensure that such decisions are, to the extent that such is possible, fact based.

Current Approach

The current code of practice already advocates the use of risk assessment via the use of a risk matrix as shown. The method is conceptually simple and requires identification of the impact of an event and evaluation of the probability of that event occurring. The difficultly is that the table does not specify to what event it refers. If it refers to the risk of a fatality, then the impact is very high and the probability low. If it refers to the risk of 3rd party property damage the impact is low and the probability considerably higher. Both of these events, and others, are possible as a result of a highway defect. The current method therefore requires highway inspectors to concurrently analyse a range of potential events and a range of probabilities to arrive at an appropriate response to a defect. This would be a difficult task if data were available. Without data on impacts and probability this becomes an exercise in individual judgement alone.

Table 5 – Risk Matrix

Probability → Impact ↓	Very low (1)	Low (2)	Medium (3)	High (4)
Negligible (1)	1	2	3	4
Low (2)	2	4	6	8
Noticeable (3)	3	6	9	12
High (4)	4	8	12	16

Response Category				
	Category 2(L) response	Category 2(M) response	Category 2(H) response	Category 1 response

Proposed Approach

The proposed approach to CSSW's risk-based method is to use asset data to inform risk assessment. The intent is to allow decisions to be supported by factual data. It is possible to acquire and analyse data on the events that occur at defects, to collect data on the type, size and location of the defects themselves and to use this as a reference when establishing the key elements of a highway management approach; setting a hierarchy, setting inspection and repair regimes and using the records collected from these to influence budget allocation.

Annual Risk Review

The method proposed by CSSW has been integrated into the CSSW HAMP recommended practices. The updated HAMP practice now recommends completion of a **risk review at least every 2 years.** The risk review assesses all relevant data to assist authorities to refine their hierarchies, inspection and repair regimes based upon analysis of the records generated from their performance records (PIs and operational performance measures).

Refinement and Improvement

There are many areas where improved data will enable better risk assessment. It is expected that the method will be refined as authorities collect and analyse relevant data and are able to document more refined risk assessments. This process will be managed by CSSW using the national HAMP project.

CSSW's Risk-Based Method:
- **is based on using asset data to enable a fact-based assessment of risk** - **uses available asset data** - **will be refined as better data is collected and analysed** - **uses regular reviews of risk data to inform refinement of hierarchies and inspection and repair regimes.**

The basis upon which the key steps of the method have been created are explained below.

2. Establishing Risk-Based Hierarchies

The requirement to split the asset into hierarchies exists in the current code. It has been retained in the new code but with the onus placed upon authorities to determine how best to apply the risk -principle in determining appropriate hierarchies. The new code states that *"Carriageway hierarchy will not necessarily be determined by the road classification, but by functionality and scale of use."* and provides a table, an extract from which is shown below.

Secondary Distributor	B and C class roads and some unclassified urban routes carrying bus, HGV and local traffic with frontage access and frequent junctions	In residential and other built up areas these roads have 20 or 30 mph speed limits and very high levels of pedestrian activity with some crossing facilities including zebra crossings. On-street parking is generally unrestricted except for safety reasons. In rural areas these roads link the larger villages, bus routes and HGV generators to the Strategic and Main Distributor Network.

This is a reference but does not include the most significant factor that affects risk; use. Roads that carry 10,000 vehicles a day have a much greater potential for an adverse event to occur than ones carrying 500 vehicles a day. Simple fact.

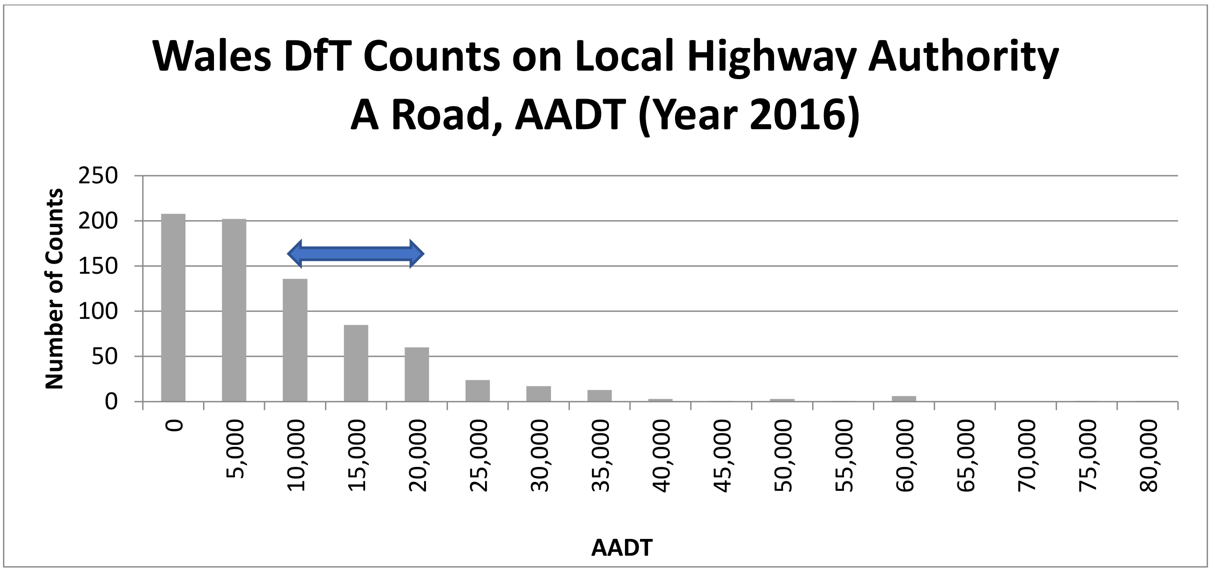
It is possible to estimate use for all roads based upon available traffic count data. CSSW has chosen to recommend that a risk-based hierarchy should be set predominantly based upon use. This does not preclude authorities making necessary adjustment to consider particular local use patterns and issues.

Other Considerations

Additional consideration may influence the choice of hierarchy level. The principle advocated however is that any adjustment is justified by reference to appropriate data.

Road Class

All local roads are already ascribed a class; A, B or C if classified or unclassified. Road class has been used by many authorities to date either as their de facto network hierarchy or as the basis for establishing it. Road class is broadly indicative of use and thus risk. However. There are major variations nationally that means the creation of a hierarchy based solely on road class is not appropriate. The traffic count data collected by the Department for Transport includes 761 counts on local authority managed Welsh A roads. The most recent figures for these sites show a range of average annual daily traffic (AADT) from 83,000 to 431. 29% of the counts fall in the range 10,000 to 20,000 vehicles per day. All authorities except Powys and Anglesey have roads in this usage band. The very heavily trafficked roads are predominantly in areas around Cardiff and are atypically high. The results are shown in the graph below



The graph illustrates the range of traffic volume represented in the DfT data. There are many A roads with volumes in the 10,000 to 20,000 range. There are almost double that with volumes below this. The proposed method of establishing hierarchy is recommending that authorities differentiate between road based on their use and as such should for example adopt a different regime of inspection and repair for roads carrying 15,000 vehicles a day to roads carrying 5,000 a day regardless of whether they are designated as an A road.

To establish a means of referencing hierarchy by traffic volume the following table was developed. The range of 10,000 to 20,000 vehicle per day has been adopted as the starting point. This range was taken to represent a type of busy road that exists in most authorities. These have been allocated as “CH1”. CSSW has adopted a nomenclature for hierarchy based on codes as shown below. This is to avoid potential confusion that could be created from the descriptions used in the code, which are only provided as guidance.

Code of Practice Hierarchy Level Names	**CSSW Hierarchy Level**	**Traffic Volume Band (approx.)**
Strategic Route	CHSR	Based on local importance rather than traffic flow but often in the range >20,000 [30,000 for calculations]
Main Distributor	CH1	10,000 to 20,000
Secondary Distributor	CH2	5,000 - 10,000
Link Road	CH3	1,000 - 5,000
Local Access Road	CH4	200 – 1000
Minor Road	CH5	< 200

a figure of 30,000 has been adopted for calculations later in this method. This represents the busiest level of roads nationally. It is accepted that there are a small number of roads that have volumes that exceed this level. The authorities with these roads shall need to specifically assess the risk associated with these roads to warrant if they require inspection and repair regimes that exceed those ascribed to CHSR.

The risk-based method recommends that authorities document their carriageway hierarchies by considering predominantly traffic volume. Secondary/local considerations can also be applied but should be supported with appropriate justification for variances from table above. In reality factors referred to in the Code, such as access to hospitals, would often be a factor of usage level and should be considered when estimating traffic flows.

CSSW's Risk-Based Method: Carriageway Hierarchy:
- is based predominantly upon use/traffic volumes - can be adjusted to reflect local conditions - is intended to create national consistency - is to be documented with reasons for any variances from the method

Footway Hierarchy

The same principle has been adopted for the establishment of footway hierarchy. There is substantially less data available for footfall. As with carriageways the method uses a benchmark of the most heavily used footways. A "FHVHU" level has been used as the common starting point. It is known that Cardiff, Newport and Swansea may have footway areas in the city centre that fit into this band of use and other authorities may have too. A limited amount of footfall data was available to inform the choice of levels of use. Two footfall counts were available for FH1 level, which is expected to be the smaller towns across Wales e.g. such as Pontypridd (population 33,000), Port Talbot (population 36,000) and Aberdare (population 32,000).

Street	Town	Footfall Count
Canon Street	Aberdare	6376
Taff Street	Pontypridd	9235
Shopping Centre (Main Entrance)	Port Talbot	7250 –(8am - 6pm)

On the assumption that these locations are representative of many towns around Wales a banding of 5,000 to 10,000 footfall has been assumed for FH1 "Town Centre Pedestrian Area".

Other available data has been used to create the table shown below. CSSW has adopted a code-based nomenclature that relates broadly to the categories used in the code of practice as shown below. The names used in the code are for guidance only and this method does not use them in order to be clear that the primary determinant of hierarchy level is its use. (footfall)

Code of Practice Footway Network Hierarchy Category	CSSW Footway Hierarchy	Footfall Level (indicative)
City Centre Pedestrian Area	FHVHU	> 10,000 (15,000 used for calculations)
Town Centre Pedestrian Area	FH1	5,000 - 10,000
Footway Outside Public Facilities	FH2	1,000 - 5,000
Link Footway (between estates / areas)	FH3	500 - 1,000
Housing Estate Footway	FH4	< 500
Little Used Rural Footway	FH5	< 100

It is expected that officer judgement will be used to estimate footfall for different footways in order to apply the method. It is recommended that where estimates are used authorities should undertake sample surveys to validate their assumptions. Reference can also be made to a range of sample count data undertaken by RCT to inform the bandings. This data is available to authorities via CSSW's HAMP khub website.

Other considerations

The Code of Practice contains a list of a number of criteria that may be relevant to establishing a footway hierarchy including pedestrian composition, proposed usage etc. No evidence was available when developing this guidance to indicate that these factors are habitually associated with increased risk. It has therefore been decided to exclude them from the method unless and until evidence is collected that warrants their inclusion. It is planned to carry out targeted data collection by authorities coordinated by the HAMP project to improve the data available. Such evidence would most likely be in the form of statistical evidence of the increased incidence of adverse events at locations with these features.

CSSW's Risk-Based Method: Footway Hierarchy
- **is based predominantly upon use/footfall volumes** - **can be adjusted to reflect local conditions** - **Is intended to create national consistency** - **to be documented with reasons for any variances from the method**

Structures Hierarchy

Structures require a slightly different approach to carriageways and footways and the hierarchy should be based more on risks to the functionality of the network. Whilst use is a key consideration it is important to consider the consequences of a structure being out of service or restricted (weight or use restrictions introduced). It is possible for example for there to be 3 bridges over a river in a town each on a different road hierarchy road but each equally important in terms of potential traffic disruption. Closure of any of these structures would cause equally significant traffic disruption. It is important that the structures hierarchy is able to include such considerations and to allocate them as equally important.

Some structures on roads at the lower end of the road hierarchy may be on the only route into a rural community while restricted use of others may involve very long diversion routes or impacts on public transport. Closure of the structure would represent a major disruption albeit to a relatively small number of people, they however require managing with this in mind. Structure hierarchy has been defined as below:

1. **Vital:** a structure that is vital to the network i.e. if restricted or out of service it would cause a very significant adverse effect such as major traffic delays with the potential to affect other important services or community severance
2. **Important:** a structure that is important to the functioning of the network, i.e. if restricted or out of service would have an adverse effect on the operation of the network
3. **Standard:** all other structures

To derive the hierarchy all structures are to be assigned an initial hierarchy category based on the hierarchy of the road or footway that the structure carries or crosses. The initial structure hierarchy should be based on the table below using the highest hierarchy for either carriageway or footway. For footbridges and other structures that are solely associated with a footway or footpath the initial structure hierarchy should be based on relating it to the footway hierarchy of the adjacent footway

Road Bridges, Culverts, Retaining Walls etc	
C-way Hierarchy	**Structure Hierarchy**
CHSR, CH1, CH2	Important Structure
CH3, CH4, CH5	Standard Structure
F-way Hierarchy	**Structure Hierarchy**
FHVHU, FH1	Important structures
FH2, FH3, FH4, FH5	Standard Structure

At this stage the rating of a **Vital Structure** is not used and is only populated following the assessment of other relevant considerations as shown below.

Rule	**Suggested Hierarchy**
Sole Access to community	Vital Structure
Both major traffic disruption **and** lengthy diversion route	Vital Structure
Either major traffic disruption **or** lengthy diversion route	Important Structure
Susceptible to rapid failure	Important Structure
Significant social or economic impact	Important Structure
Structure of local significance	Important Structure

Retaining Walls

The method can be applied to retaining walls. It is however acknowledged that many authorities do not hold a full inventory of their retaining walls and as such this cannot be fully applied until the inventory is captured.

CSSW's Risk-Based Method: Structures Hierarchy
- **is based initially on the relevant carriageway or footway hierarchy**   - **can be adjusted to identify vital structure the restriction of which has been assessed as having the potential to cause major disruption**

Street Lighting

The function of street lighting can be broadly split into two categories:

- Highway Safety Lighting
- Community Lighting

The risks associated with the existence and operation of street lighting are related to the purpose of the lighting. There are however overarching risks that are largely independent of the category and location of the lighting. Safety risks relate predominantly to critical defects, for example where there is potential for electrocution. In theory the risk like the risk of a carriageway defect is a function of the number of people potentially exposed to the hazard. For lighting however, this is not as directly related to flow as it is for carriageways and footways. A light by the side of a heavily trafficked road with no footway is exposed to a large number of vehicles but the risk of them coming into contact with a unit that has become live is small. The unit may even be behind a safety fence, consequently the response to these is not driven by considerations of use. The risk is considered to be at such a level that as immediate a response as possible is considered appropriate regardless of where the asset is on the network. Safety risks apply equally to each category of lighting.

It is noted that a column that has collapsed would be treated as a carriageway and/or footway hazard and thus the inspection and repair regime for carriageways and footways would apply and set the appropriate response.

The risks associated with an individual light that has failed/gone out is considerably less than a safety defect. If an individual unit fails it is invariably part of a collection of lights in a road and will not create absolute darkness as light from adjacent units will provide some lighting albeit at a reduced level.

At this stage the CSSW method does not promote the use of a street lighting hierarchy as the basis for setting inspection and repair regimes. This may be reviewed when risk data is analysed as part of the required annual risk review.

Hierarchy as the Basis for Part-Night Lighting and Dimming

Where an authority has chosen to adopt a regime of part-night lighting and/or dimming they should have done so after the completion of a risk assessment. This method is consistent with the tenets of the new code of practice and the CSSWs risk-based method. It is recommended that this risk assessment is appropriately referenced in that authority's response to the code and the various sections of the lighting asset, subject to the adopted regime, being identified as the street lighting hierarchy for that purpose.

CSSW's Risk-Based Method: Streetlighting Hierarchy
- **is limited to differentiating between assets under different management regimes i.e. part night lighting and/or dimming** - **will be reviewed as risk data is analysed.**

Traffic Signals

All traffic management assets are to be assigned an initial category based on the hierarchy of the road where it is located based on the table below. For junctions that serve more than one road hierarchy the highest hierarchy should be used:

Carriageway Hierarchy	Traffic Management Hierarchy (As per highest Carriageway hierarchy)
CHSR	Primary Junction
CH1	
CH2	Secondary Junction
CH3	Local Junction
CH4	

All other traffic management assets (including pedestrian crossings) will initially be assigned the hierarchy of the adjacent road or footway hierarchy (the highest of the two). Further refinement of the hierarchy should be based upon local factors such as the importance of the junction to traffic management of the town/city it is located in.

Other Highway Assets not covered above e.g. Drainage, Street Furniture

Drainage and street furniture assets have not had separate hierarchies applied to them. They are mainly items that are inspected during routine inspections and as such the appropriate carriageway or footway hierarchy dictates the frequency of inspection and influence the categorisation and response to defects.

3. Risk Data Review

The method is built around a regular reviews of risk data (a minimum of every 2 years is recommended). It is recognised that there is potential for improvement in the data that can be analysed to improve understanding of risk. It is also accepted that risks change over time as the condition and use of the asset changes. The review is therefore the key step of the method from which proposed refinement of hierarchies, inspection frequencies and the repair regime can be made.

The risk review records data that relates to risk categorised as:

- Safety; the risk of user injury
- Maintenance; the risk of escalating maintenance needs (and cost)
- Financial Loss; the risk of incurring avoidable financial loss (e.g. 3rd party claim payout)

Risk Data Summary

Enter Relevant Data									**Consider what it may mean**	**Record Observation on risks**
		Enter data items, many of which come from the performance reporting regime						*What is trend of the period?*		*Consider if the data reflects a changing risk profile and thus need to refview the inspection regime*
Asset		**Data**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Trend**	**Interpretation**	**Observations**
Carriageways	Safety	Number of Cat 1 Defects							Increasing number of potential dangerous defects = increasing risk to road users	
		% of A Roads in poor condition (red, scanner)							Roads in poor condition have greater potential for dangerous defects	
		% of B Roads in poor condition (red, scanner)							^"	
		% of C Roads in poor condition (red, scanner)							^"	
		% of U Roads in poor condition (red, scanner) and or visual							^"	Unknown ? !!
		KSI (where road condition was a contributory factor)								
	Maintenance	Number of Cat 2 defects recorded							Escalating levels of minor defects can indicate increasing maintenance needs (now and in the future)	
		Number of Cat 2 defects not repaired (repair backlog)							If increasing numbers of repairs are not being repaired it	
		(% of roads to be considered for maintenance A roads (red and amber)							increasing amount of road requiring maintenance .... Will need to be addressed sometime	
		(% of roads to be considered for maintenance A roads (red and amber)								
		(% of roads to be considered for maintenance A roads (red and amber)								
		(% of roads to be considered for maintenance A roads (red and amber)								
	Financial	Value of payout of 3rd party claims								
		Number of claims received								
		Number of claims lost due to not adhering to inspection regime								
		Number of claims lost for other reasons								

The data collected is based around data that authorities already collect (for example for performance monitoring and reporting) and data that is readily collectable during normal operational activities (during inspections and repairs).

The method requires that the results are reviewed for significant changes and trends in the risk they represent. The data is also an input into risk assessment used to establish inspection and repair regimes.

4. Establishing an Inspection Regime

Risk based establishment of hierarchies is being undertaken predominantly based upon use. This reflects the fact that if a hazard or hazardous feature exists on an asset then the risk is a direct function of the number of users exposed to it. This principle is also applied to the establishment of inspection regimes. To provide a rational basis for establishing an inspection regime the concept of risk exposure has been adopted. Risk exposure is a measure of the exposure of users to a hazard. For carriageways the risk exposure has been calculated based upon the following:

- An individual defect. The exposure is measured based upon the number of people/vehicles exposed to an individual defect. It could have been developed based upon actual historical numbers of defects on different parts of the asset but the data on defects is not reliable enough at present to make this appropriate. Fluctuating numbers of defects would have created a constantly changing exposure making it impossible to derive a regime that could be adopted in practice
- Risk exposure is based upon an assumed response time to a safety defect of 24 hours.
- The inspection frequency for strategic routes (CHSR) have been adopted as the baseline level against which other hierarchy's inspection frequencies are developed from.
- The inspection interval for strategic routes (CHSR) recommended by the previous Code is a monthly regime (hence 30 days). This has been widely accepted as reasonable by Courts as suitable for the highest categories of local authority roads.
- A maximum exposure has been calculated using the maximum time a defect could be present before being repaired and the maximum number of vehicles being exposed to it (the top traffic volume in the band).

Baseline Inspection Frequency

As a baseline from which inspection frequencies for other levels of hierarchy can be derived the strategic route level has been chosen. It has been assumed that these roads carry traffic volumes in excess of 30,000 per day and exist in most authorities. A review of current inspection frequencies revealed that most authorities currently inspect these roads on a monthly basis.

The appropriateness of this has been considered by considering the categories of risk in turn as follows:

Safety Risk; is there evidence that current inspection regimes are providing inadequate protection against safety risk for users?

There is little detailed data available to enable detailed analysis of this question. Some broad analysis is possible which has been used as a reference to the choices of existing levels of inspection as a baseline position.

Data is available on safety outcome in the form of records of KSI (killed and seriously injured). These statistics are published annually by the police and used by councils as an input into their road safety programmes. They can be used to provide an overarching reference for the level of safety provided.

In 2016 there were 4,921 injury accidents recorded in Wales by the police(1). Of these contributory factors were recorded 2,257 times. The contributory factors record the attending police officer's opinion of the factors that contributed to the accident. They include driver error, impairment or distraction etc as well as Road Environment. Road environment includes condition as well as other factors such as alignment etc. It is therefore an over estimate of the effect of condition to include all of these for the calculation that has been made. Road environment was quoted as contributory factor 208 times. A prorate calculation therefore estimates 454 accidents where road environment was a potential contributory factor.

Accident Statistics	Source	Police recorded road accidents in Wales, 2016
Total	4921	29
Contributory Factors (total)	2257	June
Road Environment a CF (very likely or likely)	208	201
With Road Environment as a CF	**454**	**approx. injury per year with road environment as a contributory factor**
Traffic Volume Statistics	Source	Road Traffic in Wales, 2016
Vehicle Km travelled.	18.2	bn vehicle km
	1,000,000,000	bn
	18,200,000,000	vehicle kms
1 injury accident in every	40,131,579	km travelled
1 injury accident in every	40	million vehicle km travelled

Traffic volume statistics(2) show that an estimated 18.2bn vehicle km were travelled on local roads (excluding trunk roads). This means that there was on average 1 injury accident recorded by the police for which road environment was a contributory factor, for every 40 million vehicle km travelled. This indicates that on the whole local roads are reasonably safe. The accident statistics (1) also show there were 95 incidents that resulted in fatalities (representing 1 incident per 2,079million km travelled) and that there were 975 incidents that resulted in killed or serious injury (representing 1 per 203 million km travelled).

These statistics illustrate that overall local roads in Wales have a reasonably good safety record. Furthermore, this evidence does not indicate a large contribution of road condition to the statistics that do exist. As these outcomes are in part a result of the inspection and repair regimes currently employed it is reasonable to assume that current regimes are not fundamentally flawed.

For the purpose of developing a rational differential between different road hierarchies a baseline inspection frequency of monthly inspection on strategic routes (CHSR) has been adopted. This is a frequency which was recommended by the previous Code, is used currently by most authorities for their busier roads and has been generally accepted by Courts as reasonable.

Using the method outlined above the risk exposure has been calculated as shown below. This results in the figure of 930,000 per annum as the Risk Exposure Index (REI). This is the maximum number of vehicles exposed to a safety defect before it would be repaired. Considering the overarching statistics above this has been adopted as a starting point until better data is available.

Hierarchy	AADT	Response Time (days)	Initial Inspection Interval (days)	Initial Exposure Time (days)	**Initial REI (k pa)**
CHSR	30,000	1	30	31	930.0

The inspection intervals for the other levels of hierarchy are calculated by working out what inspection interval delivers the same level of risk exposure across all levels of the hierarchy. As illustrated below this means that minimum inspection frequencies could be as little as once every 12 years theoretically for minor roads. It is recognised that the condition information required to inform proper asset management of the network will be required much more frequently than this, and for the lower hierarchy roads it is considered that condition inspection requirements should drive the inspection regime. While there is little condition data available for the lower hierarchy roads at present, it is considered reasonable that for roads known to be in good condition a two-year inspection interval would be suitable to provide condition information.

Typical Current Inspection Regime						**Routine Inspection Frequency for Safety to provide the same level of risk exposure across all hierarchies**					
Asset Information	**Use Data**	**Time Data**			**REI (k pa)**	**REI (k pa)**	**Time Data**				
Hierarchy	AADT	Response Time (days)	Initial Inspection Interval (days)	Initial Exposure Time (days)	**Initial REI (k pa)**	**Standard REI (K pa)**	Exposure Time (Days)	Inspection Interval (days)	Theoretical Interval to normalise risk exposure (inspections per year)	Safety Inspection Interval for Same Exposure	Comment
CHSR	30,000	1	30	31	930.0	930.0	31	30	12	Monthly	**Baseline interval**
CH1	20,000	1	30	31	620.0	930.0	46.5	46	8	Every 6 weeks	
CH2	10,000	1	60	61	610.0	930.0	93	92	4	Every 3 months	
CH3	5,000	1	180	181	905.0	930.0	186	185	2	Every 6 months	
CH4	1,000	1	365	366	366.0	930.0	930	929	0.4	Every 2 years	
CH5	200	1	365	366	73.2	930.0	4650	4649	0.08	Every 13 years	

The method is recommending a default minimum inspection regime on roads of CH4 and above of two years where condition data is available to show the assets are in good condition and annually if condition data is not available or the asset is known to be in a poor condition. This means the recommended minimum inspection intervals are as shown below:

Routine Inspections		
Hierarchy	**Theoretical Routine Inspections (CSSW Minm)**	**Recommended Minimum**
CHSR	Monthly	Monthly
CH1	Every 6 weeks	Monthly
CH2	Every 3 months	Every 3 months
CH3	Every 6 months	Every 6 months
CH4	Every 2 years	Every 2 years (good condition), annually poor condition or condition unknown
CH5	Every 13 years	Reactive inspections.

The concept of use has been adopted as the basis for establishing a proposed inspection regime. The regime has focused on what is required to manage basic safety i.e. to discharge the authority's duty of care as the highway authority to maintain a safe highway. In the case of CH5 the theoretical minimum frequency of inspection to provide equivalent risk exposure is so infrequent that it is considered appropriate to only carry out reactive inspections on these roads. This is based on the assumption that this category of road is used predominantly by locals who will report required repair before a regime of inspection would identify them.

There is a logic used to determine an appropriate differential inspection regime based upon use such that an approximately similar level of risk exposure is delivered across the asset.

It is expected that over time in the coming years that data will be increasingly available that will inform refinement of the risk assessment and thus all aspects of this approach can be refined.

Ideally future data will include defect type, size and location and records of resulting adverse outcomes when such occur, for example the accident data references above and other records of adverse safety outcome such as 3rd party claims made for personal injury.

Data that is available indicates that a safety defects are more frequently identified from reactive inspection resulting from a notification by the public or other 3rd party. RCT report 2/3 of their cat 1 defects emanate from reactive inspections, Bridgend report 60% of their Cat 1 (safety) defects are identified from reactive inspection/3rd party notification.

Footways Inspection Regime

To determine an appropriate method of establishing an inspection regime for footways the same method as that above for carriageway has been adopted. For footways however, there is a research paper that provides some very useful references. TRL Report PPR171 "Development of a Risk Analysis Model for Footways and Cycleway, 2006 has been used as outlined below. Footways are rarely the scene of accidents recorded by the police hence the accident data used for carriageways is not relevant.

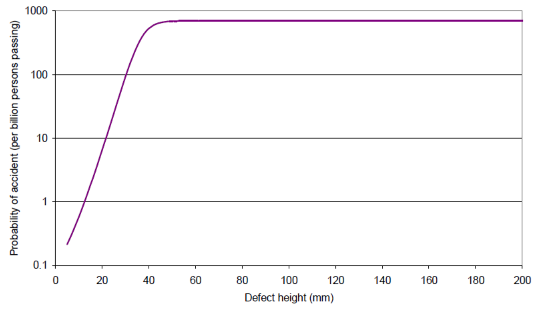


Figure 5 Probability of an accident

PPR171 (3) has however analysed the incidence of accidents based on claims data from a number of local authorities and derived the relationship illustrated below. This output is useful for both the establishment of inspection frequencies and to inform the setting of investigatory levels in the repair regime (see section below).

The graph illustrates that the probability of an accident for a 40mm defect is approximately 1000 per billion persons passing and for a 20mm defect it is approximately 10 per billion. Using these probabilities and the estimated footfall figures for different hierarchies as shown below it is possible to estimate the time between potential accidents on each level of the hierarchy for 20mm and 40mm defects.

Hierarchy	Footfall	Probability of an Accident at 20mm defect	Days between Accidents	Years Between Accidents	Accidents Per Year
FHVHU	15,000	0.00000001	6,667	18	0.055
FH1	10,000	0.00000001	10,000	27	0.037
FH2	5,000	0.00000001	20,000	55	0.018
FH3	1,000	0.00000001	100,000	274	0.004
FH4	500	0.00000001	200,000	548	0.002
FH5	100	0.00000001	1,000,000	2,740	0.000

For a 20mm defect potentially causing an accident the risk that is being managed is equivalent to the probability of 0.05 of accident per year in town centre areas.

Managing 20mm defects is therefore more of an exercise of preventing deterioration to a bigger defect than it is a direct safety management action.

Probability of an Accident Based upon PPR771: 40mm Defect					
Hierarchy	**Footfall**	**Probability of an Accident at 20mm defect**	**Days between Accidents**	**Years Between Accidents**	**Accidents Per Year**
FHVHU	15,000	0.000001	67	0	5
FH1	10,000	0.000001	100	0	4
FH2	5,000	0.000001	200	1	2
FH3	1,000	0.000001	1,000	3	0.4
FH4	500	0.000001	2,000	5	0.2
FH5	100	0.000001	10,000	27	0.0

40mm defects are predicted to potentially create 4 accidents per year on FH1 (town centre pedestrian areas) with footfall of 10,000 per day).

Most authorities currently adopt a regime of monthly inspection for these areas, a regime that is 3 times more frequent than the predicted incidence of accidents.

A baseline inspection frequency of monthly inspection on FHVHU (city centre) areas has been adopted based upon the analysis above. This data was considered to be the best available. Using the same method as for carriageways a baseline risk exposure score has been calculated for FHVHU (city centre) footways as shown below.

Asset Information	**Use Data**	**Time Data**			**REI (k pa)**
Hierarchy	Ave Footfall	Response Time (days)	Initial Inspection Interval (days)	Initial Exposure Time (days)	**Initial REI (k pa)**
FHV HU	15,000	1	30	31	465.0

The baseline REI figure has then been used to derive inspection frequencies that would deliver the same level of exposure across the other levels of the hierarchy as shown below:

CSSW Minimum Standard Routine Inspection for Safety											
Typical Current Inspection Regime						**Routine Inspection Frequency for Safety to provide the same level of risk exposure across all hierarchies**					
Asset Information	**Use Data**	**Time Data**			**REI (k pa)**	**REI (k pa)**	**Time Data**				
Hierarchy	Ave Footfall	Response Time (days)	Initial Inspection Interval (days)	Initial Exposure Time (days)	**Initial REI (k pa)**	**Standard REI (K pa)**	Proposed Exposure Time (Days)	Proposed Inspection Interval (days)	Theoretical Interval to normalise risk exposure (inspections per year)	Safety Inspection Interval for Same Exposure	Comment
FHV HU	15,000	1	30	31	465.0	465.0	31	30	12	Monthly	**Baseline interval**
FH1	10,000	1	30	31	310.0	465.0	46.5	46	8	6 weekly	
FH2	5,000	1	60	61	305.0	465.0	93	92	4	Every 3 Months	
FH3	1,000	1	180	181	181.0	465.0	465	464	1	Annually	
FH4	500	1	180	181	90.5	465.0	930	929	0.4	Every 2 Years	
FH5	100	1	365	366	36.6	465.0	4650	4649	0.08	Every 13 Years	

As with carriageways this calculation identifies a low level of inspection required on the more lightly used part of the network to manage safety. Following this calculation could mean inspections at intervals of 10 years on minor rural footways and 2 years on housing estate footways. This is considered too infrequent as inspection are required in order to manage maintenance and to plan any renewals required. A minimum inspection frequency is therefore recommended as:

Routine Inspections		
Hierarchy	**Theoretical Routine Inspections (CSSW Minm)**	**Recommended Minimum**
FHVHU	Monthly	Monthly
FH1	6 weekly	Monthly
FH2	Every 3 Months	Every 3 Months
FH3	Annually	Every 6 months
FH4	Every 2 Years	Every 2 years (good condition), annually poor condition or condition unknown
FH5	Every 13 Years	Reactive inspections only

Reactive Inspections

Many authorities rely as much on reactive inspections as they do on their regime of routine inspections. Standards relating to these inspections vary greatly as do the methods by which they are managed. There is insufficient data available to enable analysis of the contribution these inspections currently provide to the management of risk. The limited data that does exist indicates that approximately 2/3 of some authorities' footway safety defects are identified by reactive inspection/3rd party notification. It is proposed that authorities ensure that the same data is recorded for reactive inspections as for routine inspection in future such that the influence of reactive inspection can be analysed and suitable recommendation for applying a risk-based approach subsequently provided.

FH5 footways are very lightly used. So much so that the equivalent inspection regime to meet the risk exposure accepted on other levels of the hierarchy would only require inspection every 13 years. FH5 footways are predominantly used by local residents who will report defects long before a regime of this scale of interval would be able to identify defects. As the risk on these footways is so low it is considered appropriate to specify reactive inspections only as the minimum regime.

5. Establishing a Risk-Based Repair Regime

In order to assess the repair regime attempts were made to review repair data held by authorities. This data was found to lack the detail required to rationally assess the effect of the intervention criteria that are currently being applied.

Authorities typically record the data required in order to demonstrate that defects have been identified, categorised and then subsequently repaired. An inspector will usually record an assessment of a defect as a type (cat 1, cat 2 etc) rather than recording the dimensions of the defect.

The risk-based method is recommending that in future dimension data is recorded for all defects. This will in many instances need to be visually estimated. The subsequent analysis and use of this data will need to recognise this but will allow there to be an assessment of the number, type, location and size of defects against the adverse incidents that occurred as a result of or partially because of the defect.

This is not a big change from current practice as inspections currently require inspectors to assess the size of a defect in order to categorise it.

Current Standards

CSSW's stated wish is to create a nationally consistent approach. To assess how plausible this is a review was undertaken of current standards (defect definitions and response times). The review revealed some variation between authorities but also a high degree of commonality. Many authorities apply the same or similar standards to each other.

The Effect of Current Standards

To assess how well current standards are delivering safety an attempt was made to examine the results of the application of current standards. This involved a very broad assessment of safety outcomes and claims (injury and property damage) as referenced above in inspection section.

Carriageway Safety Outcomes

Accidents that have road environment as contributory factor are statistically rare. 1 injury accident (Slight, serious or fatal) for every 40 million vehicle km travelled.

Footway Safety

The estimated probability of an accident resulting from a 40mm defect (many authorities safety defect investigatory level) is 1000 per billion persons passing (or 1 per million persons passing).

Accidents as a result of a highway defect are rare and this outcome is being achieved from the application of current standards. It has therefore been considered a reasonable place to start to reference current standards when addressing a risk-based approach.

As noted in several places above, once better data is available a more detailed rational assessment of risk can be undertaken, and the results used to refine the method. In the meantime, however, it is considered useful to define a national minimum standard.

National Minimum Standards

CSSW has made previous attempts to define national minimum standards for repair. This project has reinvigorated that work and includes a set of minimum standards. As noted above analysis of data from repairs is not currently detailed enough to support assessment of differing intervention criteria. i.e. it is not possible from this data to determine if defects of a certain size are currently resulting in a higher incidence of injury.

The reasoning behind the standards are as follows:

Safety Defects are those that warrant rapid repair/making safe. Dimensions are provided to guide their identification

For carriageways a depth of >50mm has been defined. A defect of 50mm has deteriorated into the layer below the wearing course. Wearing courses are often in the range of 40-45mm . When the wearing course alone is defective the defect will typically deteriorate comparatively slowly. Once the defect extends into the layer below the risk of it deteriorating more rapidly into a much greater depth and thus risk to users is greater. Inspectors can usually see when inspecting a defect if the hole has developed into the lower layer. In some instances, defects of less than 50mm will just be laminated wearing course layers missing . These are maintenance defects but, in most instances, do not pose an immediate safety risk to users.

The minimum standard is set at a level which all defects exceeding the level should be repaired. It assumes that all defects will be encountered by users regardless of their position in the highway. It does not preclude inspectors using their judgement to assign lesser defects to a higher category if they believe, for example that rapid deterioration is likely.

Footway Defects

The report referenced above in the inspection section provides a useful guide on the risk associated with differing levels of footway defects. PRR171 estimates the probability of an accident at a 20mm and 40mm defect to be 10 in a billion and 1 in a million respectively i.e. it is 100 times more likely that an accident will occur at a 40mm defect than at a 20mm one.

Furthermore, the risk of an accident, according to this report does not increase significantly above 40mm. Using 40mm as intervention still only relates to defects that have a very low probability of causing accidents especially on the lower levels of hierarchy.

The analysis indicates that the process of footway management is largely a preventative one. By identifying and repairing defects at an initial level of deterioration they are prevented from deteriorating into safety defects with a much higher risk to users (albeit still a low risk in absolute terms).

The development of this method has highlighted that the predominant activity is the repair of maintenance defects as opposed to safety defects. The accompanying training material that is being developed to train inspectors uses 3 levels of defect definition as follows:

- **A Critical Defect** is one that the inspector consider the risk to safety high enough to require immediate action. Defects that pose an immediate or imminent risk of injury to road users typically include items such as, a collapsed cellar, missing utility cover, fallen tree, unprotected opening etc. Critical defects should be made safe at the time of the inspection if practicable or attended by the inspector until such time as the defect can be made safe. Making safe may constitute displaying warning notices, coning off or fencing off to protect the public from the defect. CSSW's minimum standard for a critical defect is a response time of 2 hours (to attend and make safe as soon as possible thereafter)
- **A Safety Defect** is one that requires prompt attention because it presents an imminent hazard. Safety defects requiring a response as soon as possible to remove a potential risk of injury to users will typically include items such as particular sizes of potholes, trip hazards, dislodged kerbs etc. If practical safety defects should be made safe at the time of the inspection. This may constitute displaying warning notices, coning off or fencing off to protect the public from the defect. If it is not possible to correct or make safe the defect at the time of the inspection, repairs of a permanent or temporary nature should be carried out within the response time specified. CSSW's minimum standard provides dimension data that can be used as a guide to identifying safety defects for different network hierarchies.
- **A Maintenance Defect** is one that is not a safety defect but requires repair at an appropriate time to guard against further deterioration. They do not present an imminent hazard to users. Maintenance defects should be categorised as higher priority; defects that warrant treatment, in order to prevent them deteriorating into a safety defect prior to the next scheduled inspection and lower priority; other defects that warrant treatment, in order to prevent them deteriorating to such an extent that additional works or costs are incurred.

The carriageway repair regime is focused upon the response to defects <u>once they have been identified.</u> Identification is via the inspection regime. This may be from a routine inspection or from reactive inspection. It is acknowledged that many defects are notified to the council by a 3rd party, e.g. a request for repair from a member of the public.

The minimum standards for carriageway repair regime have been based upon the application of the risk-based principle used to establish the hierarchy and the inspection regime.

There was no research information available to indicate the outcomes that are associated with differing sizes of defect. Logic dictates that larger defects pose a great risk to user but there are not available reliable studies that quantify this. Current regimes appear to have been based upon accepted practices that have evolved over time. This is not to discredit these regimes. It is a fact that roads are comparatively safe with low and decreasing incidence of injury accidents. This is enabled by regimes of repair that aim to prevent defects becoming dangerous.

The repair regime acknowledges that from time to time, sometimes as a result of external factors, defects may appear that clearly have the potential to cause harm to users. These defects are of a high risk to users and have been categorised as “critical” defects in the regime. It is expected that the response to these defects will be to make it safe as soon as is practical. It is not appropriate to try to define dimensional criteria for such defects. Trained personnel should be able to identify critical defects based on their nature and location without reference to specific “intervention” criteria.

The remaining regime has been based upon the following assumptions:

- The probability of accident occurring at a carriageway defect increases with the size of the defect (as logic would suggest)
- Defects that only affect the wearing course will typically deteriorate slower than defects that extend into the basecourse/beyond the wearing course
- Prevention of further deterioration is a key consideration in determining the response to defects that are at a level that do not pose an immediate hazard of injury to users
- Where the carriageway is habitually used by pedestrians such as defined or likely crossing points footway standards should apply

Determining an Appropriate Threshold

The major determinant in categorising a carriageway defect that is not immediately dangerous is how rapidly it may deteriorate into that state. The regime is designed to provide preventative repair such that defects that are actually potentially dangerous are minimised in terms of injury to users. There is also a need to repair defects that may cause property damage.

Roads that have been designed will invariably have a discreet layer of wearing course typically of a depth of up to 45mm. It is common for repairs to initiate by a hole appearing in the wearing course. Where the layer below is intact the defect may remain relatively stable in the short term i.e. deterioration into a much larger defect less probable than for a defect that has already extended into the lower layers. For this reason, a threshold between “small defects” and “larger defects” of 50mm has been chosen. A defect that is 50mm in depth will typically be deteriorating at both the wearing course and the subsequent layer and as such is prone to more rapid deterioration. The regime is based upon differentiating between defects either side of this threshold.

<table>
<tr><th colspan="5">Carriageway Repair Regime: Response Times</th></tr>
<tr><th>Carriageway Hierarchy</th><th colspan="2">Safety Defect</th><th colspan="2">Maintenance Defect</th></tr>
<tr><td>CHSR</td><td>>50mm</td><td rowspan="3">By the end of the next working day</td><td>>40mm</td><td rowspan="3">1 month</td></tr>
<tr><td>CH1</td><td>>50mm</td><td>>40mm</td></tr>
<tr><td>CH2</td><td>>50mm</td><td>>40mm</td></tr>
<tr><td>CH3</td><td>>75mm</td><td rowspan="3">5 days</td><td>>50mm</td><td rowspan="3">3 months</td></tr>
<tr><td>CH4</td><td>>75mm</td><td>>50mm</td></tr>
<tr><td>CH5**</td><td>>75mm</td><td>>50mm</td></tr>
</table>

** defect triggers on CH5 roads are to be considered an investigatory level rather than an intervention level as on these very low use roads, the risk to road users may vary considerably depending on the nature and location of the route and the individual defect.

Defect Size

The defect sizes chosen for each type of defect and hierarchy reflect the fact that carriageway defects deteriorate more rapidly on more heavily trafficked roads as a result of the volume of vehicles running over it. A defect of 50mm depth on CH2 and above will be subjected to repeated trafficking. All these roads carry >5,000 per day and as such a pot hole could deteriorate rapidly into a much bigger and more hazardous hole if not repaired promptly. For this reason, a differential standard of safety defect size has been adopted for the minimum standard shown above.

Response Times

The proposed response times are also based upon taking into account the different levels of use. The table below shows how risk exposure has been calculated and used to show what response times are required to deliver a consistent level of risk exposure across all levels of the hierarchy.

Safety Defect					
Carriageway Hierarchy	**AADT**	**AADT level for use in calculation**	**Exposure (vehicles exposed to a defect before it is repaired)**	**Response time (days) required to normalise exposure**	**Proposed Minimum Standard**
CHSR	30,000	30,000	30,000	1	same day
CH1	10,000 - 20000	20,000	30,000	2	By end of Next Working
CH2	5,000 -10000	10,000	30,000	3	By end of Next Working
CH3	1,000 - 5000	5,000	30,000	6	5 working days
CH4	200 - 1000	1,000	30,000	30	5 working days
CH5	<200	200	30,000	150	5 working days

Adopting a same day repair response time for busiest roads means that a maximum of 30,000 vehicles would potentially be exposed to the defect before it was made safe or repaired. The response times required to deliver the same level of exposure on the other levels of hierarchy are shown. For example, on CH3 roads a repair response time of 6 days would deliver the same level of exposure to the defect as for 1 day in CHSR.

The same logic has been applied for maintenance defects. A response time of 1 month (28-days) has been adopted for CHSR. This is a standard in common use currently and in the absence of data to the contrary it has been adopted as a reasonable period to repair non-safety defects to prevent them deteriorating to the extent of becoming a safety defect.

Maintenance Defect					
Carriageway Hierarchy	**AADT**	**AADT level for use in calculation**	**Exposure (vehicles exposed to a defect before it is repaired)**	**Response time (month) required to normalise exposure**	**Proposed Minimum Standard**
CHSR	30,000	30,000	840,000	1	1 month
CH1	10,000 - 20000	20,000	840,000	2	1 month
CH2	5,000 -10000	10,000	840,000	3	1 month
CH3	1,000 - 5000	5,000	840,000	6	3 months
CH4	200 - 1000	1,000	840,000	30	3 months
CH5	<200	200	840,000	150	3 months

Footway Repair Regime

The repair regime is focused upon the response to defects once they have been identified. Identification is via the inspection regime. This may be from a routine inspection or from reactive inspection. It is acknowledged that many defects are notified to the council by a 3rd party, e.g. a request for repair from a member of the public.

The minimum standards for footway repair regime have been based upon the application of the risk-based principle used to establish the hierarchy and the inspection regime. Reference has been made to relevant research, specifically the graph below reproduced from "PPR 171 The Development of a Risk Analysis Model for Footways and Cycletracks". The graph illustrates:

- The probability of accident occurring at a footway defect increases with the size of the defect (as logic would suggest)
- The probability does not increase significantly once that defect is approximately 40mm in depth

- The probability of an accident happening per person passing the defect is less than 1 in a million for a 40mm defect

Unlike carriageway defects footway defects do not typically deteriorate as a function of use. A carriageway defect can deteriorate as a result of vehicles running over it. It would be rare for footfall to be a function of the rate of deterioration of a footway defect {it may be a consideration where the footway is habitually crossed by vehicles or subject to parked vehicles}.

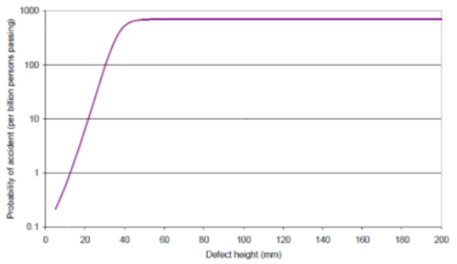


Figure 5 Probability of an accident

Based upon the graph the probability of an accident for a 40mm footway defect has been estimated at 800 per billion persons passing.

This equates to 1 per 1.25 million persons passing.

The table below uses this probability to estimate how the exposure of users to a defect could be normalised such that the number of people exposed to an individual defect before it is repaired is approximately the same across the network.

Footway Hierarchy	Daily Footfall	Footfall level of calculation	Annual Footfall (daily x 365)	Probability of an accident at a 40mm defect = 1 per :	Years between accidents	Accidents per year	Response time (hours) required to normalise exposure		Normalised Response time (days)	Proposed Minimum Standard
FHVHU	>10,000	15,000	5,475,000	1,250,000	0.2	4	24	15,000	1	same day
FH1	5,000 - 10,000	10,000	3,650,000	1,250,000	0.3	3	36	15,000	1.5	By end of Next Working Day
FH2	1,000 - 5,000	5,000	1,825,000	1,250,000	0.7	1	72	15,000	3	By end of Next Working Day
FH3	500 - 1,000	1,000	365,000	1,250,000	3.4	0	360	15,000	15	15 days
FH4	100 -500	500	182,500	1,250,000	6.8	0	720	15,000	30	15 days
FH5	<100	100	36,500	1,250,000	34.2	0	3600	15,000	150	15 days

Using the maximum footfall levels used in the hierarchy bands it is possible to calculate the predicted time between accidents by dividing the probability value (1.25m) by the annual footfall. This illustrates the predicted frequency of accidents. For FH1 footways this equates to approximately 3 accidents per year.

The FHVHU (city centre footway) hierarchy level has been chosen as the baseline. City centre footways are the highest use footways on national footway asset. This is an appropriate level to establish a national minimum standard regime against. A "same day response" has been adopted as appropriate for these footways with the next busiest level adopting a "by the end of the next working day" standard.

Taking the response time for FHVHU as being a day it is possible to normalise the level of exposure by calculating the repair response times for each level of hierarchy that would result in the same level of exposure i.e. to limit the number of people exposed to a defect to the same level as for FHVU i.e. 15,000. This results in response times as shown below.

Safety Defects			
Footway Hierarchy	**Footfall daily**	**Normalised Response time (days)**	**Proposed Minimum Standard**
FHVHU	>10,000	1	By the end of the next working day
FH1	5,000 - 10,000	1.5	
FH2	1,000 - 5,000	3	
FH3	500 -1,000	15	15 days
FH4 #	100 -500	30	
FH5 #	< 100	150	

It is impractical to use 6 different levels of response. The above regime is based upon averages and estimated volumes and as such it is not considered appropriate to introduce too many different responses.

To create a practical repair regime two minimum standard response times have been adopted next working day and 15 days. The next working day response on town centre footways reflect their higher levels of use. The 15-day response reflects the significantly lower level of use on other categories of footway. In applying a minimum standard like this a workable regime is possible that is at a level of response that is higher (significantly higher for some categories of footway) than is theoretically necessary to manage risk across the footway network equally.

To complete the regime, it is appropriate to consider the risk associated with smaller defects. A value of 25mm has been adopted as the basis for this analysis. PPR 171 illustrates that smaller defects present a much-reduced risk of an accident as logic would dictate.

Using the same graph from PRR171 a probability of accident for a 25mm defect has been estimated as shown below.

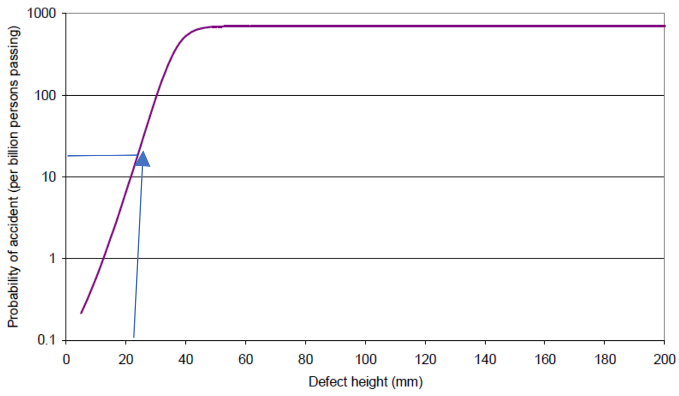


Figure 5 Probability of an accident

Based upon the graph the probability of an accident for a 25mm footway defect has been estimated at 30 per billion persons passing.

This equates to 1 per 33 million persons passing.

To establish a baseline response time for a defect with a lower probability of an accident occurring the probabilities have been contrasted as shown below:

	Probability of an accident 1 per	Response time (days)
40mm defect	1,25 million	1
25mm defect	33.33 million	27

The equivalent response time for a 25mm defect to provide the same predicted probability of an accident to a 1-day response time for a 40mm defect is calculated at 27 days. This is very close to the 28 days used by many authorities already.

It however makes sense to relate the repair regime to the inspection regime and it is therefore recommended that a minimum standard response time for a 25mm defect on a town centre footway is 1 month.

Using the same logic as used for the 40mm defects different response times for different categories of footway can then be derived as shown below.

Footway Hierarchy	Daily Footfall	Footfall level of calculation	Annual Footfall (daily x 365)	Probability of an accident at a 25mm defect = 1 per :	Years between accidents	Accidents per year	Response time (hours) required to normalise exposure	Exposure	Normalised Response time (months)	Proposed Minimum Standard
FHVHU	>15,000	15,000	5,475,000	33,333,333	6	0.164	24	420,000	0.9	1 month
FH1	5,000 - 10,000	10,000	3,650,000	33,333,333	9	0.110	36	420,000	1.3	
FH2	1,000 - 5,000	5,000	1,825,000	33,333,333	18	0.055	72	420,000	2.6	
FH3	500 - 1,000	1,000	365,000	33,333,333	91	0.011	360	420,000	12.9	
FH4	100 -500	500	182,500	33,333,333	183	0.005	720	420,000	25.7	
FH5	<100	100	36,500	33,333,333	913	0.001	3600	420,000	128.6	

As with the 40mm defect a simplified minimum standard is recommended at intervals that far exceed what is theoretically required to normalise risk. Based upon the analysis above the following minimum repair regime standard is proposed.

The analysis above shows that for a 25mm maintenance defect on FH3 footway the predicted frequency of an accident would be one every 91 years and an even less frequency for FH4 and FH5. For this reason it is not considered appropriate to set a minimum response time for defects of this size on those levels of footway hierarchy. This does not preclude an authority deciding to treat them as programmed repair if they so choose.

Footway Repair Regime: Response Times		
Footway Hierarchy	**Safety Defect >40mm**	**Maintenance Defect >25mm**
FHVHU	By end of next working day	1 month
FH1		
FH2		
FH3	15 days	
FH4		
FH5 #		

6. Competencies

The Code of Practice requires authorities to demonstrate the competency of both those involved in developing and those implementing the risk-based approach.

CSSW Accreditation Role

CSSW has recognised that the people most able to manage the competencies of those engaged in managing Welsh local highway assets are the authorities themselves. No one else external to this activity could or should have better knowledge of what is required than the authorities themselves. What is needed in order to meet the requirements of the Code is a systematic way of enabling authorities to evaluate their own level of capability and to address any areas that require strengthening via appropriate training.

CSSW represents all 22 Welsh highway authorities and has already adopted an accreditation role for training for visual condition assessment for carriageways, footways and structures. The training and method of managing accreditation was developed under the HAMP project.

CSSW has decided to use the national HAMP project again and the basics of the method used for visual condition assessment to assist with the following activities:

- Developing a documented definition of the competencies required to apply the risk-based method
- Creating training materials for inspector training
- Creating online training material for ongoing inspector refresher training
- Providing training for highway managers via the CSSW HAMP project

References

1. Police recorded road accidents in Wales, 2016, 29th June 2017, Welsh Government, Statistical First Release, Statistics for Wales
2. Road Traffic in Wales, 2016, 8th November 2017, Welsh Government, Statistical Bulletin, Statistic for Wales
3. Development of a Risk Analysis Model for Footways and Cycle Tracks, Bird, Sowerby and Atkinson, TRL, Report Number PPR171