PEDESTRIAN SAFETY

Tramway Technical Guidance Note 2

OFFICE OF RAIL REGULATION

Contents

Introduction

This guidance is issued by the Office of Rail Regulation. Following the guidance is not compulsory and you are free to take other action. If you do follow the guidance you will normally be doing enough to comply with the law. Railway inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

Author:

Gary Crawshaw

At the request of HM Railway Inspectorate and with the assistance of the members of -

- The Pedestrian Safety Working Group
- The Light Rail Engineer's Group The ORR Tramway Standards Group
- HM Railway Inspectorate.

Pedestrian safety

It should be possible to demonstrate that the following issues, where relevant, have been considered in the design or modification of a tramway. It should also be possible to justify what is or is not considered to be relevant from the following issues.

1. Design conceptually as a complete system: Railway Safety Publication 2 (RSP2) requirements

The design of a tramway should be managed, according to best practice in Safety Management, coherently as a system from the initial concept throughout the project lifecycle. Tramway design and related urban redevelopment should be integrated with respect to managing pedestrian safety.

a. Responsibility starts at the planning stage of a new or revised tramway

Managing safety should start at the beginning of the design process for revising an existing tramway or planning a new one.

It should be fully understood that in the normal process of developing proposals for a new tramway there are many issues that are determined (created or mitigated) well before a construction contract is let. System safety issues should be considered at a very early stage in the project. There should be no outstanding safety issues relating to an outline design that remain unconsidered when an application is made for a Transport and Works Act or when a contract is let. Resolution of outstanding safety issues may not be satisfactorily achievable within the legal framework of the Transport and Works Order. The safety management process should begin at the start of the design process and transfer via documentation such as the hazard log throughout all the stages of the project.

It is essential that any contractual relationships within the project facilitate clear ownership and management of a continuous safety management process.

The safety management and associated records of design information and assumptions should be capable of being transferred to the relevant Responsible Persons as the contractual process develops. A Responsible Person must be appointed at each stage of the project lifecycle.

b. **Contributory factors in safety**

Guidance about factors that may affect safety is given in the following sections. Some of these issues may not be applicable in all situations. These sections are not necessarily exclusive and specific project factors need to be taken into consideration. However, evidence of all considerations should be included in the records within the Safety Management System (SMS). Normally these records would be included or referred to in the Hazard Log generated within the SMS, and should include any residual hazards identified as part of the design process in accordance with CDM.

c. **Safety management system (SMS)**

A Safety Management System should be implemented which identifies, controls (prevent or mitigate) and records potential hazards. It is essential that safety is managed adequately across the interfaces of different organizations and at all stages in a project.

A successful SMS needs to offer:

- Traceability
- Transparency
- Be capable of internal and independent audit
- Have a formal or legal basis which provides:
  - Sanctions for non-compliance
  - Protection for employees reporting risks and hazards.

d. Recognise all stages in a design process

In progressing a design there needs to be recognition of the actions required to proceed to the next level of closing out an identified hazard. It should not be assumed that a hazard can be closed without an understanding of what is required and what can realistically be achieved. Alternative means should always be considered and recorded in the interests of minimising the risk in failing to close out a hazard.

e. **Passing hazards down the supply chain**

When passing the mitigation of hazards down the supply chain care shall be taken to ensure that all parties involved in the issues are fully aware of the hazard identifications and other mitigating actions given to other parties. Solutions should not be passed down to single parties without a clear mutual understanding of the singularity and ownership of such particular issues. When passing down hazard mitigation to several parties a management process is required in order to optimise the combined hazard mitigation. It is recommended that a "Project Safety Certification Committee" is established to oversee hazard closeout in accordance with SMS best practice.

f. **Recognise all system interrelationships**

Many of the system design factors such as those outlined below are interrelated. This must be recognised and managed in an integrated manner during all stages of the design or modification of a tramway.

Interfaces shall be identified and managed from an early stage in the project using defined procedures within the project management system.

2. Design of alignment to accommodate tram in a pedestrian friendly manner: Sections 2&3 of RSP2

The alignment of the track should be considered carefully with potential pedestrian access to minimise the risk of serious injury. This is particularly relevant on vertical curves or where there are tight clearances for example in case a large overhang at the vehicle ends could lead to injuries. The radius of all horizontal and vertical curves should be reviewed in conjunction with the tram characteristics.

a. Recognising limitations of available vehicles is an essential interface identification requirement in relation to the local topography

At the project planning stage, the parameters and limitations of available vehicles being considered must be taken into account in order to satisfy the requirements given in 2.

b. Track geometry impact on pedestrian safety

- Effects of alignment on tram spatial positions relative to the road:
  - Hogs, sags, curves horizontal (reference pedestrian desire lines) and vertical;
  - Pedestrian protection from underrun;
  - Gap between tram and road, position of wheels ref. tram body;
  - Clearances to pedestrians etc., assessment of risks in presenting false security to pedestrians.
- Positioning of the alignment to maximise available space for pedestrian use, taking account of parking, loading, footfall etc.
- Consideration of consequences of derailment and how this interacts with the pedestrian environment.

c. Desire lines

Consideration must be given at an early stage of the infrastructure design to pedestrian movements around and across the tramway system. Desire lines may need to be modified to reduce risks to pedestrians. Desire lines may be affected by some of the sighting hazards listed in 2d.

d. Sighting hazards

The tramway should be designed to minimise the number of visual obstructions so that tram drivers and pedestrians can easily see each other.

Examples:

- Road junctions
- Vehicle inter-visibility
- Vehicle parking
- Bus stops
- Landscaping/trees
- OHLE and lighting poles
- Light to dark transitions
- Lighting levels
- Street furniture
- Tunnels/underpasses

e. Major buildings, schools and other institutions or facilities

The design of a tramway should take account of associated pedestrian movements and of pedestrians not giving the presence of trams their full attention.

f. Pedestrian management

Active and passive guidance measures should be considered in the design as necessary depending upon location and may need to take into account event management. Within the tramway there may be areas requiring pedestrian access, areas where pedestrians should be discouraged from walking (resulting from any risk assessment such as within a tramstop, for example) and areas where pedestrians are prohibited (such as next to a railway line). Methods of pedestrian control must be coherent throughout the system and include:

- Provision and delineation of pedestrian crossings;
- Signage;
- Active deterrents such as barriers, paving, planting etc. Where deterrents are provided to separate pedestrians and trams the deterrents should not also introduce potential trapping hazards with the tram body (side or front) or underside. Passive deterrents such as marking the tramway path should be considered.
- Defined walkways on bridges, viaducts and other restricted areas.

g. Junction design

Adequate provision must be given to pedestrian crossing phases at signalled junctions.

Wider area impacts on road traffic and pedestrian flows should be considered at an early stage of design development and subsequently during detailed junction design.

Non-signalled junctions should conform to necessary visibility requirements for both pedestrians and vehicle drivers. These should be in conformance with the Department for Transport requirements given in the publication “Manual for Streets” 2007.

h. Pedestrian crossings

Refer also to RSP2 sections 59, 63, 67, 68, 69, 93 and 169.

Where the demand dependent nature of tramway signalling could impact upon the available time allocated for pedestrians to cross, and the intensity of tramway traffic is well below the criteria normally applied to justify signal controlled crossings, it is found that pedestrians generally ignore signalled crossings. To reduce risk in these circumstances un-signalled crossings should be used except where the *mutual visibility of all road users* is inadequate. Exceptions to this guidance are as follows:

- where the crossings are common to other traffic sharing the lane or on adjacent lanes with no separation or
- where the crossings form part of a fully signalled junction and separation of the tramway crossing is not practicable or
- exceptionally, where tram and pedestrian flows are very high.

Section 63 of *RSP2* sets out the criteria for when signals for pedestrians should be used across the tramway. This is should be interpreted to mean that at places where pedestrians cross the tramway, uncontrolled pedestrian crossings with normal passive signing should be the default option even where other signalling is present unless such signing proves inadequate. However, consideration should be given to users that might need to take advantage of signalling them across the tramway, especially if it is provided for other roads at the junction. The note in section 69 refers to the criteria of visibility and flow which might then influence the need to signal.

Further clarification is given under the heading of ***"****Crossing Layouts****"*** in *Sections 67-69* of *RSP2.*

NOTE: In the absence of a tramway, practice varies between local authorities in terms of signalling provision at road junctions and pedestrian crossings and whilst some prefer not to signal, others opt for more signalling. In both cases, the reasoning seems to focus on practical experience of accident rates which perhaps vary regionally for each type of junction. Some tramways extend beyond a single local authority boundary causing additional complication.

Every effort should be made to achieve consistency along tramways and as far as possible, between tramway systems to avoid confusion to both tram drivers and pedestrians alike. Such things as crossing layout, tactile colouring and texture, signage and guard rail configurations (when considered as best practice should be) cascaded forward from one system to the next. In some places undue pressure to provide signals at every crossing point of the tramway as a matter of principle has had to be vigorously challenged to avoid an unwelcome precedent.

Such pressures usually stem from assumed levels of risk presented by the imposition of trams on existing highway or new alignments which are not consistent with experience in operation elsewhere. Frequently such perceptions are associated with the need to provide for those with impairments particularly in vision. There is fortunately now much practical experience of tramway operation in many city and suburban situations, with a wide range of pedestrians spanning the age and disability spectra. This includes developed experience in appropriate use of the tram's bell or chime to alert pedestrians to the tram's approach. New tramway systems should therefore remain consistent with RSP2 guidance as being best practice.

3. Operational issues

a. Sighting

Sighting studies should be carried out at an early stage and should continue throughout the development of the design. When carrying out sighting studies, potential maintenance issues e.g. soft landscaping design, should be considered.

The positioning of driver information signage and potential for driver distractions should be considered at an early stage.

Operators' SMSs should provide for dealing with temporary works external to the tramway e.g. road works, scaffolding etc.

Issues raised as part of sighting studies should be incorporated into the hazard log, in order to maintain the validity of the safety acceptance process.

b. Speed

Aspiration for run-time should be realistic taking account of all practical operating limitations.

Both geometric and operational speed limits need to be considered in parallel.

Operating speeds in pedestrian areas should consider random or unplanned movement of pedestrians.

c. Warning sounds

Refer to RSP2 sections 276 and 277.

4. Track: section 4 of RSP2

a. Point locations

Due regard should be given to the potential damage or danger of trapping small feet, and heels and wheels used by people in the street by avoiding the placement of points at such likely places, as far as possible. Refer to RSP2 section 126.

b. Points operating timing

Refer to RSP2 section 223.

5. Tramstops: section 5 of RSP2

a. Crossing the track

Defined crossing points are to be provided at tram stops.

It is a requirement that the walking or ground surface is finished flush with the rail head within a tramstop area and at least within 1m of a crossing point. Passengers should be encouraged to use defined crossing points and if there is bidirectional operation, deterred from crossing immediately behind a tram. Particular care should be taken at tramstops where trams may possibly only be required to stop when requested.

Warning signs shall be placed such that pedestrians are clearly warned of the dangers and footpaths designed to direct passengers to designated crossing points.

b. Desire lines at tramstops

The design of the tramstop and pedestrian access should, as far as possible, minimise the desire to cross the track at places other than the designated crossing points. Particular care should be taken at tramstops where trams may possibly only be required to stop when requested.

c. Visibility at tramstops

The design of the tramstop and pedestrian access is clearly described in RSP2 sections 148-150.

6. Design of tram to be pedestrian friendly: section 8 of RSP2

a. Tram underrun clause 278

On defined pedestrian areas where the walking surface is flush with the track, consideration should be given to ensure that, wherever possible, pedestrians are deflected away from the front of a tram rather than being drawn into the gap between the body and the track.

There must be a means of preventing pedestrians not requiring adult supervision from either being crushed between the road and the vehicle underfloor or from going under the vehicle wheels at all areas identified in the risk assessment. For the purpose of the following paragraph this will be referred to as “underrun protection”. Fast moving protection systems such as “drop down guards” should not be used.

The gap between the road surface and the underrun protection is dependent upon the vehicle layout and geometry in relation the alignment. This should be studied as a part of the project design, see also 2b. The presence of vertical curves may result in an unavoidable large gap between the body and the track at the front of the vehicle. In situations where this occurs, pedestrians shall be discouraged from being in the area of greatest risk. In these circumstances the hazard shall be mitigated by other considerations such as, for example, reduced vehicle speed.

b. Surfing

In order to prevent “surfing” the design of the tram should avoid the possibility of providing sufficient external hand or foot-holds.

c. Deflection on impact

The outside of the trams should be designed to deflect pedestrians away from the path of the tram wherever possible.

d. Protruding parts of vehicle

The outside of the tram should minimize protrusions that could become entangled with pedestrian’s clothing or cause injury.

e. Wheel protection

Protection against pedestrians form being overrun by wheels is covered by 6.1 above, refer also to RSP2 section 278 (c).

Appendix: Heritage tramcars, under run protection devices

Pedestrian Safety Standard:

This appendix should be read as an extension of the 'draft' Pedestrian Safety Standard and Appendix C; 'Guidance on Tramways' RSP 2.

Heritage tramcars may operate either on dedicated heritage systems or on systems that are normally operated by modern tramcars.

Heritage tramcars are traditionally fitted with a variety of under run protection devices and in the case of some early or very slow speed tramcars no frontal under run protection is provided.

Under run protection devices on electric tramcars may include drop down 'gate and tray' systems, sprung tray systems, 'providence' lifeguards or a solid blade system, this is an indicative list as there were also experimental systems in use on 1st generation tramways. In addition bogie tramcars may be equipped with side protection between the bogies.

Steam tram engines are fitted with skirting to not exceed a gap of 100mm (4 inches) from the road surface but from 1890 'life protectors' were an additional requirement.

Cable tramcars and horse drawn tramcars, which operate at very slow speed, not exceeding 12 kph (7mph) are not necessarily fitted with under run protection but some may be fitted with small 'plough' blades or brushes to remove debris from in front of the wheels. Certain works cars or tramway maintenance vehicles are not fitted with under run protection by the very nature of their usage, e.g. snowploughs.

Tramcars that are equipped with a heritage pedestrian under run protection system should not exceed 40 kph (25 mph).