



## ***Pedestrian Safety Guidance***

  
**CALL**  
0121 214 7107

  
**EMAIL**  
[info@lrssb.co.uk](mailto:info@lrssb.co.uk)

  
**WEB**  
[www.lrssb.org](http://www.lrssb.org)

  
**TWITTER**  
[@LightRailSSB](https://twitter.com/LightRailSSB)

  
**LINKEDIN**  
[@lightrailssb](https://www.linkedin.com/company/lightrailssb)

	<b>PEDESTRIAN SAFETY GUIDANCE</b>		<b>LRSSB - LRG - 24.0</b>	
			Issue	1
			Revision	1
			Date	14/12/2023
			Page	1 of 21

TITLE:		PEDESTRIAN SAFETY GUIDANCE				
REF:		LRG 24.0		STATUS:	FINAL	
ISSUE:		01	REVISION:	01	DATE:	14/12/2023
DEPT:		LRSSB Safety Assurance			REVIEW DUE:	14/12/2028
DOCUMENT OWNER:				DISTRIBUTION:		
LRSSB				ALL UK TRAMWAYS		
DESCRIPTION:						
THIS DOCUMENT PROVIDES GUIDANCE ON PEDESTRIAN SAFETY						
EXPLANATORY NOTE:						
The Light Rail Safety Standards Board is not a regulatory body and compliance with Guidance Notes or Approved Codes of Practice is not mandatory; they reflect good practice and are advisory only. Users are recommended to evaluate the guidance against their own arrangements in a structured and systematic way, noting that parts of the guidance may not be appropriate to their operations. It is recommended that this process of evaluation and any subsequent decision to adopt (or not adopt) elements of the guidance should be documented. Compliance with any or all the contents herein, is entirely at an organisation’s own discretion.						
SOURCE / RELATED DOCUMENTS:						
LRG 1.0 Tramway Principles and Guidance (TPG) (LRSSB) LRG 2.0 Guidance on Tramway Crossings for Non-Motorised Users (LRSSB) LRG 5.0 Tramway Audible Warning Acoustic Test Guidance (LRSSB) LRG 6.0 Fatigue Management (LRSSB) LRG 8.0 Guidance in the Management of Vulnerable Persons (LRSSB) LRG 9.0 Driver Selection and Recruitment Guidance (LRSSB) LRG 11.0 Medical Fitness Guidance (LRSSB) LRG 17.0 Driver Inattention Systems Guidance (LRSSB) LRG 28.0 Guidance on the Provision of Accessibility (LRSSB) LRG 33.0 Guidance on the Management of Drugs and Alcohol (LRSSB) LRG 37.0 Weather and Climate Resilience Guidance (LRSSB) LRG 41.0 Road Safety Audit (RSA) Guidance (LRSSB) Safety and Operation of Tramways in Interaction with Public Space, 2016, Fontaine, M., and Novales M. Transportation Research Procedia Vehicle and Pedestrian Safety at Light Rail Stops in Mixed Traffic, Transportation Research Record Journal of the Transportation Research Board The Highway Code Various Rail Accident and Investigation Branch (RAIB) Reports - refer to the RAIB website ( <a href="https://www.gov.uk/government/organisations/rail-accident-investigation-branch">https://www.gov.uk/government/organisations/rail-accident-investigation-branch</a> )						
RELATED TRAINING COURSES:			RELATED LEGISLATION:			
N/A			Health and Safety at Work Act 1974 Railways and Other Guided Transport Systems (Safety) Regulations (ROGS) 2006 (as amended)			

	<b>PEDESTRIAN SAFETY GUIDANCE</b>		<b>LRSSB - LRG - 24.0</b>	
			Issue	1
			Revision	1
			Date	14/12/2023
			Page	2 of 21

CHANGE NOTES:				
Date of Issue	Issue No.	Revision No.	Reviewer	Details of Revision
14/12/2023	01	01	LRSSB	Amendments to text / format
UNCONTROLLED WHEN PRINTED				

	<b>PEDESTRIAN SAFETY GUIDANCE</b>		<b>LRSSB - LRG - 24.0</b>	
			Issue	1
			Revision	1
			Date	14/12/2023
			Page	3 of 21

LRSSB

DOCUMENT CODE: LRG 24.0

PEDESTRIAN SAFETY GUIDANCE

CONTENTS

1.

Introduction
2.

Scope
3.

Pedestrian Hazardous Events
4.

Overview of Risk Controls and Mitigation
5.

Design of the Tramway System
6.

Enabling Driver Situational Awareness and Action

- Tables

Table A Terms

Table B Abbreviations

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	4 of 21

### Revisions from Previous Issue

Changes to Page 1 including the removal of the named preparer, reviewer and authorising person and insertion of an explanatory note in relation to the status of this guidance document.

Insertion of references to other relevant LRG documents published by LRSSB since the previous issue.

Alterations to Table A (from existing text).

Removal of Appendix 1, replaced by reference to the RAIB website.

Text amended to aid clarification where required / appropriate.

Minor presentational and typographical changes.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	5 of 21

## TERMS AND ABBREVIATIONS

**Table A – Terms**

Term	Definition
<b>Desire Line</b>	The path a pedestrian would naturally take between two points if there were no tram system.
<b>Hazard</b>	Something (for example, a condition, object or activity) with intrinsic properties to cause harm.
<b>Hazardous Event</b>	An event that has the potential to lead directly to death or injury.
<b>Pedestrian</b>	A person who is considered to have rights to the shared use of tramway infrastructure.
<b>Risk</b>	A combination of likelihood and severity of a hazardous event.
<b>Tramway Path</b>	The tramway path is the area reserved for a moving tram in its environment. It is derived from the swept envelope by adding the minimum appropriate clearance.
<b>Vulnerable Person</b>	A person aged 18 years or over who is, or may be, in need of community care services by reason of mental or other disability, age or illness, and who is or may be unable to take care of him or herself, or unable to protect him or herself against significant harm or exploitation. (Department of Health)
<b>Wheeled Users</b>	Pedestrian assisted or accompanied by a wheeled vehicle (for example, bicycle, scooter, pram, mobility scooter, etc.).
<b>Zoned Out</b>	A person who is distracted and not generally aware of their surroundings, for example, being focussed on their hand-held device.

**Table B – Abbreviations**

Term	Definition
<b>CEN</b>	CENELEC (European Committee for Electrotechnical Standardisation)
<b>LRSSB</b>	Light Rail Safety and Standards Board
<b>OCC</b>	Operational Control Centre
<b>RAIB</b>	Rail Accident Investigation Branch
<b>ROGS</b>	The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended)
<b>TPG</b>	Tramway Principles and Guidance
<b>UK</b>	United Kingdom

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	6 of 21

## 1. Introduction

- 1.1. This guidance supports the high level principles set out in LRG 1.0 Tramway Principles and Guidance (TPG) published by the Light Rail Safety and Standards Board (LRSSB).
- 1.2. This document provides guidance to tramways (Light Rail systems) in regard to managing pedestrian safety for those delegated this responsibility in relation to UK tramways based on 'line-of-sight' operations only. As with all guidance, this document is not prescriptive and is intended to give advice not to set a mandatory industry standard, and it is based upon goal setting principles as good practice.
- 1.3. Much of this guidance is based on the experience and good practice gained from existing UK tramways and from published documents. It does not prescribe particular arrangements adopted by any existing UK tramway and is intended to give guidance and advice.
- 1.4. This guidance is not intended to be applied retrospectively to existing tramways. However, owners and operators should consider and assess any implementation of this guidance and / or any subsequent revision, to ensure continual improvement in reducing risks, so far as is reasonably practicable.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	7 of 21

## 2. Scope

- 2.1. The Highway Authority have the overall responsibility for pedestrian safety. Therefore, liaison is required between the Highway Authority and the tramway owner, designers and operator in the provision of safety measures that complement the tramway. The Highway Authority are responsible for undertaking road safety audits that will encompass pedestrian safety at the inception of any new schemes and then on-going risk assessment (refer to LRG 41 for guidance on road safety audits).
- 2.2. Pedestrian safety around tramways is affected by the coming together of a wide-range of risk factors and risk controls. This guidance document is therefore split into two broad areas:
  - Outlining how pedestrians can be exposed to risk (refer to Section 0 of this guidance); and
  - Outlining the key risk controls and mitigation measures to assist the safety of pedestrians (refer to Sections 0 to 5.27 of this guidance).
- 2.3. Understanding potential tram risks from the pedestrian's perspective is a key part of ensuring safe outcomes for those in the vicinity of a tramway. This document provides an overview to assist understanding the different types of pedestrian, their priorities, skills, attitudes and behaviours.
- 2.4. This guidance is relevant for those involved with the following:
  - Tramway route concept design including early scheme development, appraisal, and selection;
  - Design of tramway layout, tram vehicle specification and tram operations;
  - Driver selection, training, and management; and
  - Ongoing management of tramway operations.
- 2.5. The scope for this guidance relates to the safety of pedestrians that may be impacted by the planned movement of trams within the confines of a publicly accessible tramway. In addition, it also considers potential hazardous events for pedestrians resulting from the tramway itself, for example, being caught in point work, slips, trips and falls on tram infrastructure property is also considered.
- 2.6. This guidance does not take into account hazardous events caused by failure of a sub-system on a tramway network, such as fallen overhead live equipment etc., or due to maintenance such as loose paving stones, cleaning etc., nor does it consider potential hazardous events for pedestrians caused by third parties unless tram movements contributed to the incident.
- 2.7. Pedestrians are those that are considered to have rights to the shared use of tramway infrastructure including wheeled users such as those with bicycles, scooters and prams (etc.); further guidance is provided in LRG 19 Cycle Tramway Interface Guidance and LRG 28 Guidance on the Provision of Accessibility in tramways. Specific issues around cycles, scooters and prams (etc.) are covered as appropriate within this guidance.



	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	8 of 21

- 2.8. Pedestrians are different to passengers. Passengers are those who are seeking to travel on a tramway and are not the subject of this guidance with regard to the platform tram interface, boarding and alighting etc. and are not considered within this document. For further guidance refer to LRG 1.0 TPG.
- 2.9. Although arrangements that seek to keep pedestrians away from prohibited areas are considered within this guidance, issues relating to unauthorised persons are not included.
- 2.10. Measures aimed at reducing risk specifically as a result of criminal acts or suicidal behaviour are not considered within this guidance. Further information relating to suicide risks are contained within LRG 8.0 Guidance in the Management of Vulnerable Persons.
- 2.11. Although reports published by the Rail Accident Investigation Branch (RAIB) involving pedestrians and tramways have been referenced for this guidance document, users of the guidance document are strongly recommended to refer to RAIB's website for full access to the reports.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	9 of 21

### 3. Pedestrian Hazardous Events

- 3.1. This section provides examples, though hazard identification activities may also be supported by risks assessments or the processes utilised by LRSSB, for example, the Safety Risk Model and Bowtie risk assessments.
- 3.2. Understanding how pedestrians are exposed to risk by trams or a tramway is an important part of managing risk to pedestrians. Relevant RAIB investigation reports, LRSSB LRG guidance documents and individual operator's own risk assessments have identified the following examples of hazardous events involving pedestrians (not exhaustively):
- Pedestrian moves or falls into path of approaching tram and is struck;
  - Pedestrian does not move away from approaching tram and is struck;
  - Tram is unable to stop before colliding with a pedestrian; and
  - Pedestrian is caught, slips, trips or falls on tramway infrastructure.
- 3.3. The following paragraphs outline some examples of the immediate causes for each of the above situations.
- 3.4. Hazardous event: pedestrian moves or falls into path of approaching tram and is struck. Potential causes include the following (not exhaustively) and also refer to Section 5.4.:
- Pedestrian does not realise tram is approaching (for example, they are 'zoned out');
  - Pedestrian does not realise a second tram is approaching (including from the other direction);
  - Pedestrian trips on tramway infrastructure (sign, step, rail etc.) and falls into path of approaching tram;
  - Pedestrian loses consciousness and falls into path of approaching tram;
  - Pedestrian crowding results in insufficient space, leading to pushing and falls;
  - Pedestrian misjudges the time and space available to cross; and
  - Bicycle, scooter or pram (etc.) slips on, or is caught in, the tram / highway infrastructure
- 3.5. Hazardous event: pedestrian does not move away from approaching tram and is struck. Potential causes include the following (not exhaustively):
- Pedestrian does not realise tram is approaching (for example, they are 'zoned out');
  - Pedestrian notices tram, but assumes it does not pose a danger, for example, they misjudge the tram speed, assume the tram will stop or take a different route, or believe they are standing outside of the tramway path;
  - Pedestrian is aware of danger posed by tram movement, but takes no action (excluding suicide); and
  - Pedestrian cannot move with their equipment, for example, cycle, scooter, pram, luggage (etc.).

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	10 of 21

3.6. Hazardous event: tram is unable to stop before colliding with a pedestrian. Potential causes include the following (not exhaustively):

- Tram driver does not see the pedestrian in time to take effective evasive action;
- Tram driver fails to take effective evasive action after seeing the pedestrian when there is sufficient time to act;
- Tram driver is unable to take effective evasive action as there is not enough time; and
- Tram is unable to slow despite timely driver action due to degraded vehicle or system conditions.

3.7. Hazardous event: pedestrian is caught, slips, trips or falls on tramway infrastructure. Potential causes include the following (not exhaustively):

- Tramway points change and the pedestrian, bicycle, scooter or pram (etc.) caught in point work;
- Pedestrian is caught in track work;
- The pedestrian is a vulnerable person<sup>1</sup>;
- Pedestrian loses footing / stability (including wheeled users);
- Pedestrian ill health;
- Pedestrian intoxication and narcotics impacting their decision making;
- Pedestrians rushing, for example, to cross ahead of tram, or towards a tramstop;
- Pedestrian's personal attire or belongings are caught or dropped (etc.) and they stop to retrieve items; and
- Pedestrian does not notice uneven surfaces, warning signs or other potential obstruction.

### Hazards

3.8. Sitting underneath immediate causes such as those listed above are a wide range of hazards related to the pedestrian, tram driver, infrastructure, and vehicle. These include the following (not exhaustively), refer also to Section 5:

- Pedestrian priorities and goals overriding other their ability to heed warnings;
- Pedestrian is 'zoned out';
- Tram system unable to effectively deal with pedestrian's focus being somewhere other than the system;
- Social and group characteristics, for example, assumptions that someone else has checked for approaching trams, compliance with an instruction to cross, fear of separation for parents and children etc.;
- Warning sounds are not heeded or are insufficiently audible;
- Signage is obstructed, insufficient or ignored by the pedestrian;
- Obstacles preventing sighting of the tram and / or pedestrian, including lineside items such as poles, vegetation, and taxi environments;

<sup>1</sup> Safeguarding adults, Patient <https://patient.info/doctor/safeguarding-adults-pro>

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	11 of 21

- Events that cause crowding in the vicinity of the tramway;
- Aspects relating to tram driver's technical and non-technical skills;
- Lack of proven obstacle detection and collision avoidance technology that can be used reliably in live operations;
- Adverse weather conditions impacting ground conditions and / or sighting;
- Ground conditions such as vegetation (for example, leaves), mud, or litter creating a hazardous walking surface for pedestrians;
- The wider environment, for example, segregated and poorly illuminated routes that are used as short cuts;
- Non-uniform or poorly contrasting stair risers;
- Areas where there is limited clearance to tramway path; and
- Surface gradients affecting pedestrians with reduced mobility.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	12 of 21

## 4. Overview of Risk Controls and Mitigation

- 4.1. There are many controls and / or mitigation measures that can help reduce risks to pedestrians that serve to ensure the following preventative actions are undertaken and / or in place (not exhaustively):
- Ensure pedestrians stay out of the path of an approaching tram;
  - Stop the tram to prevent a collision with a pedestrian;
  - Prevent pedestrian slips, trips and falls;
  - Setting line speeds according to risk;
  - Adopting defensive driving techniques; and
  - Marking of the tram path.
- 4.2. The above controls assist in preventing or minimising risks to pedestrians, and with additional identified measures help ensure the control can be delivered. For example, ensuring adequate pedestrian to tram intervisibility can help deliver the first two controls above, but on its own it cannot prevent an incident unless other measures are taken by the driver, tram and / or pedestrian.
- 4.3. The following additional controls can help reduce or mitigate the severity of consequence to pedestrians (not exhaustively):
- Reducing the speed of the tram;
  - Design tram and infrastructure to minimise severity of injury (for example, underrun protection, fewer trackside obstacles); and
  - Ensure a timely emergency response
- 4.4. Risk mitigation measures that help ensure the above controls are covered in the following sections.
- 4.5. Consideration of risk controls and mitigations should not be limited to normal operating conditions, with consideration also needing to be incorporated into operational processes such as degraded working, drivers in training, adverse weather, event planning and works.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>		<b>LRSSB - LRG - 24.0</b>	
			Issue	1
			Revision	1
			Date	14/12/2023
			Page	13 of 21

## 5. Design of the Tramway System

5.1. An adequate and sufficient design of the tramway systems is a critical element in preventing and mitigating risks to pedestrians. This section covers:

- Design of a route and layout of a tramway;
- Pedestrian crossing design;
- Tram vehicle design; and
- Operational design.

5.2. As part of its engagement with a tram project, tram operators should endeavour to ensure that hazards have been identified and are managed in the early stages of the development of a scheme, and throughout the subsequent design activities, operation and maintenance of the tramway.

### Design of the Route and Layout For a Tramway

5.3. Many hazards arise due to design constraints. However, they are managed through design as far as reasonably practicable during the very early stages of the development of a tramway scheme, for example, clear marking of the tramway. This includes decisions around the route and locations served, position of tramstops, presence of shared spaces and many other factors that may introduce or influence risks to pedestrians. Refer also to LRG 1.0 TPG and associated LRG guidance for further information.

### *Tramway Scheme Design Review – Pedestrian Design Safety Checklist*

5.4. Early design decisions should be reviewed and any concerns highlighted in a timely manner. Below are a number of items that could be included in a checklist for the design of tramway routes, including access points:

5.4.1. Has an RSA Stage 1 been undertaken? Refer to LRG 41.0 for further guidance.

5.4.2. Have pedestrian footfall levels been determined for the length of the proposed route, and how has the design taken findings into account? Minimising pedestrian-tram interactions is a core risk control, and it requires establishing data for pedestrian volumes along a route. Establishing this is important as it should inform fundamental decisions around urban spaces, crossings, shared spaces, pavements, event and crowd management etc. Existing data and pedestrian flow and crowd modelling can be considered and inform the design.

5.4.3. Have realistic pedestrian desire lines been defined along the proposed route? A desire line in this context is the path a pedestrian would naturally take between two points if there were no tramway. Pedestrian movement is shaped by an individual's priorities and goals. Therefore having an understanding of them is important as they can assist designers to ensure these can be accommodated as far as reasonably practicable. Aspects such as junctions, crossings and the wider urban design should be informed by an understanding of foreseeable desire lines.

5.4.4. Have foreseeable pedestrian tasks and distractions that impact behaviour been identified at stops and along the route? This includes aspects such as visually

	<b>PEDESTRIAN SAFETY GUIDANCE</b>		<b>LRSSB - LRG - 24.0</b>	
			Issue	1
			Revision	1
			Date	14/12/2023
			Page	14 of 21

checking other vehicle movements, wayfinding (signage), crossing roads, presence of display screens, temporary distractions such as events, parties etc. There are many potential distractions which will be competing for a pedestrian's attention and the combined impact of these can be overwhelming and may lead to pedestrians failing to detect trams. Any areas that have many distractions should be identified.

- 5.4.5. Have the types of pedestrian been profiled by location and time of day or year? Pedestrians vary in many ways, for example, their familiarity with an area (tourists verses commuters, etc.), whether they are travelling as a group (schools and night-life groups verses lone pedestrians, etc.), the reason for being there (hospital appointment verses shopping, etc.), their age, experience, attire and belongings (luggage etc.) and their mobility etc. Profiling pedestrians will help define the specific risks that need to be considered.
- 5.4.6. How familiar is the tram system to the pedestrians, and are there local interventions that need to be implemented to help ensure a consistent experience for pedestrians? Pedestrian behaviour may be influenced by their exposure to / interface with existing tram systems. However, if citizens are unfamiliar with sharing spaces with trams, and such sharing forms part of a design proposal, the design decision may represent a risk to pedestrians that needs to be properly assessed<sup>2</sup>.
- 5.4.7. Have significant large-scale events with high numbers of pedestrians been considered? Such events can easily overwhelm a street scene and tramway. Crowd management in the vicinity of a tramway should be a consideration in the design process.
- 5.4.8. Has a preliminary assessment of track layout and geometry taken account of pedestrian and tram driver sightlines, underrun protection, pedestrian desire lines and size of clearances around the path of a tram? The number and layout of junctions, track bends and reducing curve sharpness and cant helps reduce collision and underrun risk.
- 5.4.9. Has a preliminary assessment of existing and new visual obstructions around the tramway that may impact sightlines, examples include foliage where future growth and impact of vegetation management shortfalls need to be considered, junctions, vehicle parking, bus stops, overhead equipment, fencing, lampposts, tunnels, signalling and telecoms equipment and street furniture.
- 5.4.10. Has a preliminary assessment of tramway infrastructure surfaces and gradients been undertaken? For example gradients should not increase the likelihood of wheeled users rolling into the path of an approaching tram. Surfaces should also be planned to have adequate slip resistance values.
- 5.4.11. Have preliminary driver task analyses and workload assessments been performed to identify issues that negatively impact a drivers ability to manage pedestrian risk? Complex junctions, tramstops and areas of high footfall amongst other issues will impact how a driver performs critical tasks necessary to support pedestrian safety.

---

<sup>2</sup> COST (European Cooperation in Science and Technology) has published 'Operation and Safety of Tramways in Interaction With Public Space' (ref. TU1103)

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	15 of 21

5.4.12. Has the design of crossings considered a full range of potential risk control measures? Has the approach of pedestrians to crossings considered their exposure to associated signage and signals? Have lighting and visual indications such as the 'red / green man' used on pedestrian crossings been reviewed? Have visual and audible annunciations been considered?

5.4.13. If there are shared spaces between trams and road vehicles in the scheme design, are dedicated measures in place to alert pedestrians to the presence of trams? For example, marking of the tramway path on the road / tramway surface, co-ordinated signal design considering all etc.

5.4.14. Have access routes including stairs, ramps, lifts etc been assessed? The scheme may want to encourage wheeled users and pedestrians with reduced mobility to use specific routes.

5.4.15. Have proposed risk controls been assessed to demonstrate their effectiveness? A pedestrian's overriding priority and focus (for example, a hospital appointment etc.) may mean that passive information (such as notices, signage, ground markings etc.) can be easily and unintentionally ignored or overlooked. It is good practice for the design process to assume the most robust risk controls as a starting point as far as practicable, before using risk analysis and operational impact modelling to demonstrate the most appropriate and effective measures to balance risks and benefits.

#### Pedestrian Crossing Design

5.5. LRG 2.0 Guidance on Tramway Crossings for Non-Motorised Users provides guidance relating to effective crossing design to help ensure that pedestrians are not struck by trams. Guidance provided within LRG 2.0 includes the following for reducing pedestrian risk:

- Eliminate crossings where possible;
- Crossings shall be subject to quantified risk assessment to ensure that risks are suitably controlled. In some cases, this may well lead to the elimination of the crossing or grade separation;
- Crossings shall be safe, accessible and practical to use by all users;
- Designs should consider the general standards and principles adopted for highway design;
- Crossings should have treatments appropriate to the level of risk; and
- Crossing layouts should maximise awareness and encourage non-motorised users to stop and wait when necessary.

#### Tram Vehicle Design

5.6. Brake and adhesion system design is critical to pedestrian and tram safety. Appendix E of LRG 1.0 TPG provides guidance relating to pedestrian safety. Specific aspects of tram vehicle design that affect pedestrian safety are covered below.



	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	16 of 21

- 5.7. Tram design should support the sighting of pedestrians and enable effective action to be taken. Tram driver sightlines of pedestrians should not be obstructed by the vehicle itself. Glazing joins, the vehicle's front-end structure, sun visors, and technologies such as head-up displays should not result in blind-spots or distractions that obscure pedestrians. This includes sighting of pedestrians to the side of the driver and back along the length of the tram prior to it moving off.
- 5.8. Supplementary tram-fitted obstacle detection systems may be effective in identifying likely collision hazardous events. This technology is available on some modern tram systems. However, such technology is not without its issues and needs to be fully demonstrated in an operational setting. Key decisions need to be taken in terms of whether the technology is sufficiently accurate at detecting pedestrians to enable application of the tram's braking system, automatic sounding of the tram's horn, or whether an alert is provided to the driver to act.
- 5.9. Any application of technology such as that in Section 5.8 above should be suitably and sufficiently assessed to ensure that it does not import additional hazards. Testing should demonstrate the effectiveness of such systems compared to driver performance. Testing should also demonstrate that the alerts provide support to the driver and do not distract them from taking effective action, and minimise false warnings. New indications added to the cab should be subject to suitable user testing to ensure alerts are learnable and cannot be confused with other indications.
- 5.10. Assessing the risk of where coupled trams are run, or proposed, through pedestrian areas where there is a credible risk of pedestrians walking between coupled cars in normal and degraded operations.
- 5.11. The tram system should provide suitable visual and audible indications to alert pedestrians that a tram is approaching in order to provide the following:
- To help pedestrians locate and track a moving tram, the vehicle front end should provide a clear visual contrast to the surrounding background.
  - Forward tram vehicle lighting should not create avoidable glare or dazzle for pedestrians, and external tram direction indicators should be available for use and should also be consistent with that required for road vehicles. Details relating to external vehicle lighting requirements are provided in LRG 1.0 TPG.
  - Operational experience and human factors analysis should inform tram design. In response to the risk of a collision between a pedestrian and a tram, the driver will have to apply the brake and sound a warning in parallel. Suitable testing should be performed to demonstrate that this can be achieved in parallel and in a timely manner. In addition, positioning of lighting controls for the main and dipped beams used by the drivers should also be considered.
  - Audible warnings should be available to alert pedestrians of an approaching tram. LRG 5.0 Tramway Audible Warning Acoustic Test Guidance provides guidance in relation to sound pressure levels and other parameters for tram bells and horns, and a test method to determine audibility.
- 5.12. Lifeguard and vehicle end design are important considerations in reducing injury to pedestrians. Current guidance relating to passive safety measures are set out in LRG 2.0.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	17 of 21

This guidance provides recommendations on the following as well as suitable testing that should be applied to ensure the vehicle's design meets the requirements:

- Minimise the effect of impact;
- Deflect pedestrians away from the tram to prevent them from being drawn underneath;
- Ensure underframe design does not worsen injuries; and
- To prevent the tram's leading wheels from running over a pedestrian.

5.13. If a pedestrian is caught underneath a tram, the tram should be designed to support it being lifted from street level to provide safe access to treat and recover any injured persons. Emergency services should be able to easily determine where lifting equipment should be used to safely access and free injured persons, so engagement with local emergency services is therefore recommended.

5.14. To ensure a reliable and timely emergency response, the driver should have direct communication access to the tramway's operational control centre (OCC) about a pedestrian incident.

#### Tramstop and Crossing Announcements

5.15. Consideration needs to be given as to whether there should be spoken announcements made to alert pedestrians that a non-stopping service, or a second tram, is approaching. Unexpected tram movements are a key risk to pedestrians, forewarning them can help overcome this. Further guidance on tramstops can be found in LRG 1.0 TPG and other relevant LRG guidance documents.

#### Operational Design

5.16. Maximum permitted tram speeds should reflect potential risk with lower speeds adopted for higher risk areas such as shared spaces and crossings. Setting of line speeds should consider the likelihood of pedestrian incursions. This will be impacted by passive safety measures such as lighting, fencing, planting etc. Speeds should also take into account the sighting, reaction and braking times drivers will need to successfully avoid a collision when driving on line-of-sight principles.

#### *Warning Pedestrians*

5.17. Operators should ensure that there are sufficient and appropriate protocols and / or instructions in place for drivers to ensure that appropriate external lights are on, and to use turn external signal indicators to inform pedestrians about changes in tram direction.

5.18. Tramways should ensure that there are sufficient and appropriate protocols and / or instructions in place around the use of audible warnings to alert pedestrians about tram movements. Tramways should be aware that the sounding of audible warnings to safeguard pedestrians has several limitations, for example, warnings may be heard too late, ignored / disregarded, not made, or not heard at all etc.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	18 of 21

5.19. Protocols should be consistent with requirements set out in the Highway Code<sup>3</sup> and the guidance provided in LRG 5.0 Tramway Audible Warning Acoustic Test Guidance. These protocols should provide clarity and consistency around use of the horn or bell, such that drivers can sound the appropriate warning without hesitation.

5.20. A review of operational practices identified that the horn is typically used in the following situations:

- When the driver's line of site is obstructed, potentially concealing pedestrians;
- When passing non-stop through a tramstop. In these scenarios, some tramways require continuous sounding of the audible warning when passing to assist in alerting that a second is tram coming and to alert pedestrians the tram is not stopping;
- Before moving off from a tramstop where there is already a stationary tram, a crossing or a walkway (for depot / siding);
- In an emergency situation, sometimes through the use of short blasts of the horn; and
- When signage requires it.

5.21. The tram audible warning, for example a bell or a horn is often used in the following situations:

- On approach to a crowded area or area of intense pedestrian movement;
- When entering or leaving an enclosed area, such as a tunnel;
- When passing another tram;
- When moving off from a stand;
- When passing through a sharp bend; and
- When signage requires it.

5.22. Not all situations requiring use of the horn or bell can be defined, so driver training should emphasise that drivers need to use their own judgement. Drivers should be encouraged to use the horn if there is any doubt about the situation. Whilst not identified as a causal factor, one RAIB report identified that the driver sounded the bell just prior to a pedestrian collision and a horn was identified to have been more appropriate<sup>4</sup>.

5.23. Driver training should also consider the limitations around the tram's bell and horn in alerting pedestrians. The late sounding of an audible warning may distract a pedestrian, causing them to hesitate, or turn-back, which might delay their movement out of the tram's path. In some cases, letting the pedestrian complete their movement may be preferred.

5.24. Operational protocols and training should ensure that the tasks of applying the brake and sounding a warning do not come into conflict. Driver decisions and actions taken in response to a late passing pedestrian will likely be performed automatically and without conscious thought. Simulator training and testing of hazard perception of such scenarios

<sup>3</sup> <https://www.gov.uk/guidance/the-highway-code>

<sup>4</sup> Report 09/2019: Fatal collision between a tram and a pedestrian, near Saughton tram stop, Edinburgh, 11 September 2018: <https://www.gov.uk/government/news/report-092019-fatal-collision-between-a-tram-and-a-pedestrian-near-saughton-tram-stop-edinburgh>

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	19 of 21

has a valuable role to play in rehearsing the correct response and priming it for delivery whilst driving.

5.25. Refer to RAIB for other examples of tram related investigations.

#### *Non-Stopping Services*

5.26. Non-stopping services may surprise pedestrians who might expect the tram to call at the tramstop. The following protocols are recommended in this scenario:

- Make non-stopping movements at slow speed;
- Require a tram to stop if the opposite platform is already occupied;
- Be prepared to stop ahead of any pedestrian (or obstruction);
- Drivers should sound an audible warning as per Section 0 above; and
- Training for drivers on the arrangements for making a non-stop movement.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	20 of 21

## 6. Enabling Driver Situational Awareness and Action

6.1. Tram driver situational awareness is key to detecting and responding to pedestrian risk, as well as many other safety risks. Existing tramway policies and procedures and industry guidance serve to enable all-round effective driver performance. Specific guidance for relevant topics include the following (not exhaustively):

- Driver selection, training and development, and arrangements covering non-technical skills (refer to LRG 9.0 Driver Selection and Recruitment Guidance and the guidance provided below);
- Fatigue management (refer to LRG 6.0 Fatigue Management Guidance);
- Medical fitness (refer to LRG 11.0 - Medical Fitness Guidance); and
- Drivers maintaining attention (refer to LRG 17.0 Driver Inattention Systems Guidance).

6.2. Driver-focussed protocols around pedestrian safety are covered in Section 0 above. Specific management arrangements relating to driver performance and pedestrian safety are as set out in the following sections.

6.3. In developing driver knowledge of route risks, consideration should be given to identifying and learning areas of higher pedestrian risk, for example this may include (not exhaustively):

- Areas of high footfall;
- Locations where there are known visibility issues;
- Tramstops where there are non-stopping services;
- Areas where there are infrequent services;
- Areas that are difficult for pedestrians to cross;
- Locations prone to high-risk pedestrian behaviour;
- Locations prone to variations; and
- Susceptible areas from particular weather events (refer to LRG 37.0 Weather and Climate Resilience Guidance for further information).

6.4. Drivers should be notified in a timely manner about specific events that will affect expected pedestrian numbers and behaviour. This would include sporting events, concerts, public displays, memorials, fairs and other similar occasions. Details should include dates, times and the types of pedestrians expected (families, young persons, elderly, tourists, groups or individuals) and anticipated risks posed.

6.5. Similarly, drivers should report of any of the following events (not exhaustibly) to the OCC with agreed response protocols which may prepare following drivers:

- Suspected vulnerable persons (refer also to LRG 8.0 Guidance in the Management of Vulnerable Persons);
- Unplanned high concentrations of people; and
- Groups engaging in horseplay near the tramway.

	<b>PEDESTRIAN SAFETY GUIDANCE</b>	<b>LRSSB - LRG - 24.0</b>	
		Issue	1
		Revision	1
		Date	14/12/2023
		Page	21 of 21

- 6.6. Drivers should practice their response to hazardous pedestrian behaviours in a safe setting. Drivers should be trained to identify and respond to hazardous pedestrian behaviours in a realistic manner, typically this would involve simulation, possibly of previous incidents, so that drivers can prime their reactions. Experienced drivers should be encouraged to listen to their 'sixth sense' around pedestrians that might pose a risk, for example, drivers may have learnt to spot behavioural precursors which serve as an early warning system to the driver about a potential collision.
- 6.7. Driver training around providing the correct emergency response should cover scenarios where pedestrians are injured. The emergency response that follows a pedestrian injury should be consistent with other emergency response scenarios. Key considerations include the following (not exhaustively):
- Initiating the emergency response;
  - Preventing further injury (for example, tram movements);
  - Attracting attention of emergency services whilst on site;
  - Supporting the emergency response (as and when appropriate);
  - Responding to further instructions from the tramway's OCC;
  - Management of passengers; and
  - Clarification of roles and responsibilities in an emergency.
- 6.8. Drivers should be offered suitable post incident support that covers physical and emotional well-being. Witnessing pedestrian injury can be harrowing and drivers should make use of support offered by the tramway. Post incident counselling should be offered and a formal process for returning to work after a serious incident should be in place. In addition, organisations such as the Samaritans have produced resources to support trauma management and resilience amongst staff who may be involved in traumatic incidents<sup>5</sup> for further information refer to LRG 8.0 Guidance in the Management of Vulnerable Persons.

---

<sup>5</sup> Samaritans, Support for people affected by traumatic rail incidents: <https://www.samaritans.org/how-we-can-help/workplace/rail-industry-suicide-prevention-programme/support-people-affected-traumatic-rail-incidents/>