Design Manual
NR/GN/CIV/300/03

Fire Safety at Stations

King's Cross concourse
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Document verification

Verification

Anthony Dewar
Professional Head, Buildings & Architecture, Technical Authority

Frank Anatole
Principal Architect, Buildings & Architecture, Technical Authority

Boaz Yariv
Standard Change Lead, Buildings & Architecture, Technical Authority

John Boyce
Head of Profession, Fire Safety, Technical Authority

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How to use the guidance suite

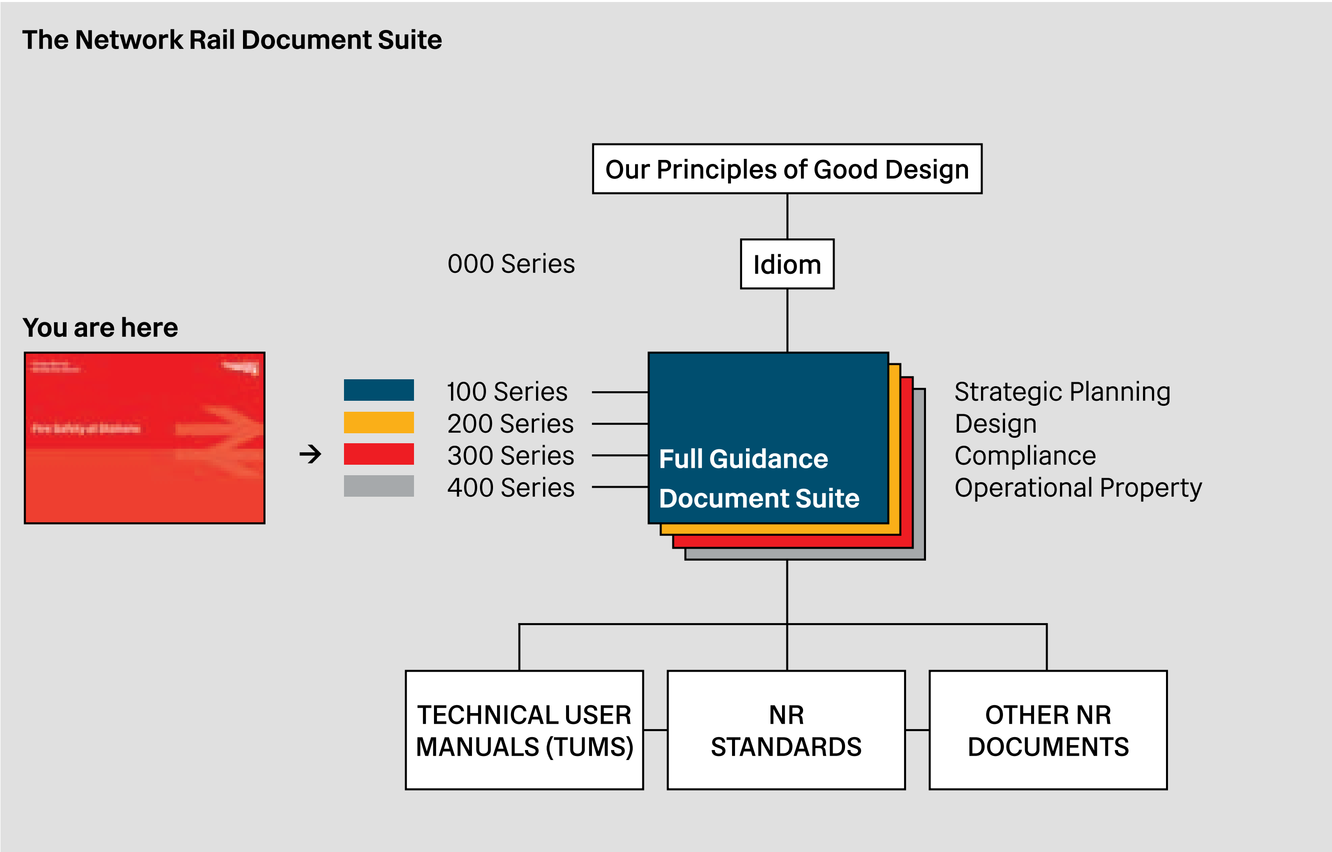

Figure 0.1 Network Rail Document Suite Summary

References to other documents

- Legislation / Regulations
- National Standard
- Network Rail document
- Published Document

Example

National Standard

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure, 2020, British Standards Institute

A full list of relevant documents, and other guidance suite documents is contained in Appendix E.

About this document

Section 1
The Fire Safety Design & Approvals Process

This section provides information on Network Rail's fire safety goals and objectives, the regulatory framework for the design of stations, and Network Rails project approvals process.

Section 2
Understanding the Rail Environment

This section provides contextual information relating to the specific design considerations for the fire safety design of stations, including a discussion on statical data and risk for station fires.

Section 3
Fire Safety Design Methodology

This section outlines a risk-based methodology for categorising stations according to their level of fire safety risk, the Rail Station Fire Risk Profile (RSFRP). The design approach for sub-surface stations is also summarised.

Section 4
Means of Escape and Evacuation Management

This section provides detailed guidance on the design approach for means of escape for stations, based on their RSFRP. Guidance on the beneficial use of lifts for evacuation is also provided.

Section 5
Internal Fire Spread

This section provides guidance on the design of fire rated construction such as elements of structure, compartmentation, and internal linings.

Section 6
External Fire Spread

This section provides guidance on the design of external walls and roofs, including façade systems.

Section 7
Access & Facilities for the Fire Service

This section provides guidance on the provision of Fire & Rescue Service access to stations, and specific facilities to assist fire fighting operations within buildings and platforms.

Section 8
Active Fire Safety Systems

This section provides guidance on the design and specification of active fire safety systems such as fire alarm systems, fire suppression, emergency lighting and other key systems.

Section 9
Construction Fire Safety Management

This section outlines the key requirements and considerations for managing fire safety during the construction process, including goals & objectives.

Section 10
Fire Safety Management & Risk Assessment

This section describes the key principles of fire safety management, the minimum levels of fire safety management, fire risk assessments and the management of special fire hazards.

About this document

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Appendix A
Simplified Platform Design Tool

This appendix describes a tool which provides a simple, tabulated method for developing an appropriate design for small station platforms, including platform length, width and escape route width.

B

Appendix B
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This appendix illustrates a series of simple examples of small station design options, based on the methodologies provided in this Design Manual.

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This appendix sets out the key principles and objectives for a Fire Strategy document, and the recommended content and structure of a Fire Strategy for a Network Rail station at each project stage.

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Appendix E
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Appendix F
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This section provides image credits and confirms the authors, contributors and steering group members for this Design Manual.

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How to Use This Document

Purpose

This document provides guidance on the fire safety design of Network Rail stations to assist designers, sponsors, project managers and other stakeholders. It is intended to clarify and complement existing design guidance (in particular BS 9992), and provides a framework for the fire safety design of new-build, extended or refurbished stations.

This Design Manual also provides contextual information on the regulatory background to fire safety design in the rail environment, and the Network Rail approval and assurance process.

It then sets out a risk profile methodology to fire safety design, which is proportionate and evidence-based, and utilises and builds on the principles found in BS 9999 when applied to the rail environment.

Additional technical guidance is also provided on specific topics, to complement existing guidance and standards.

Where appropriate, reference is made to relevant guidance and other documents to assist designers in understanding the key principles, considerations and requirements when designing or upgrading stations.

This Design Manual is intended to provide a uniform and consistent approach to fire safety design, which is cognisant of a station's environment and risk profile.

Scope

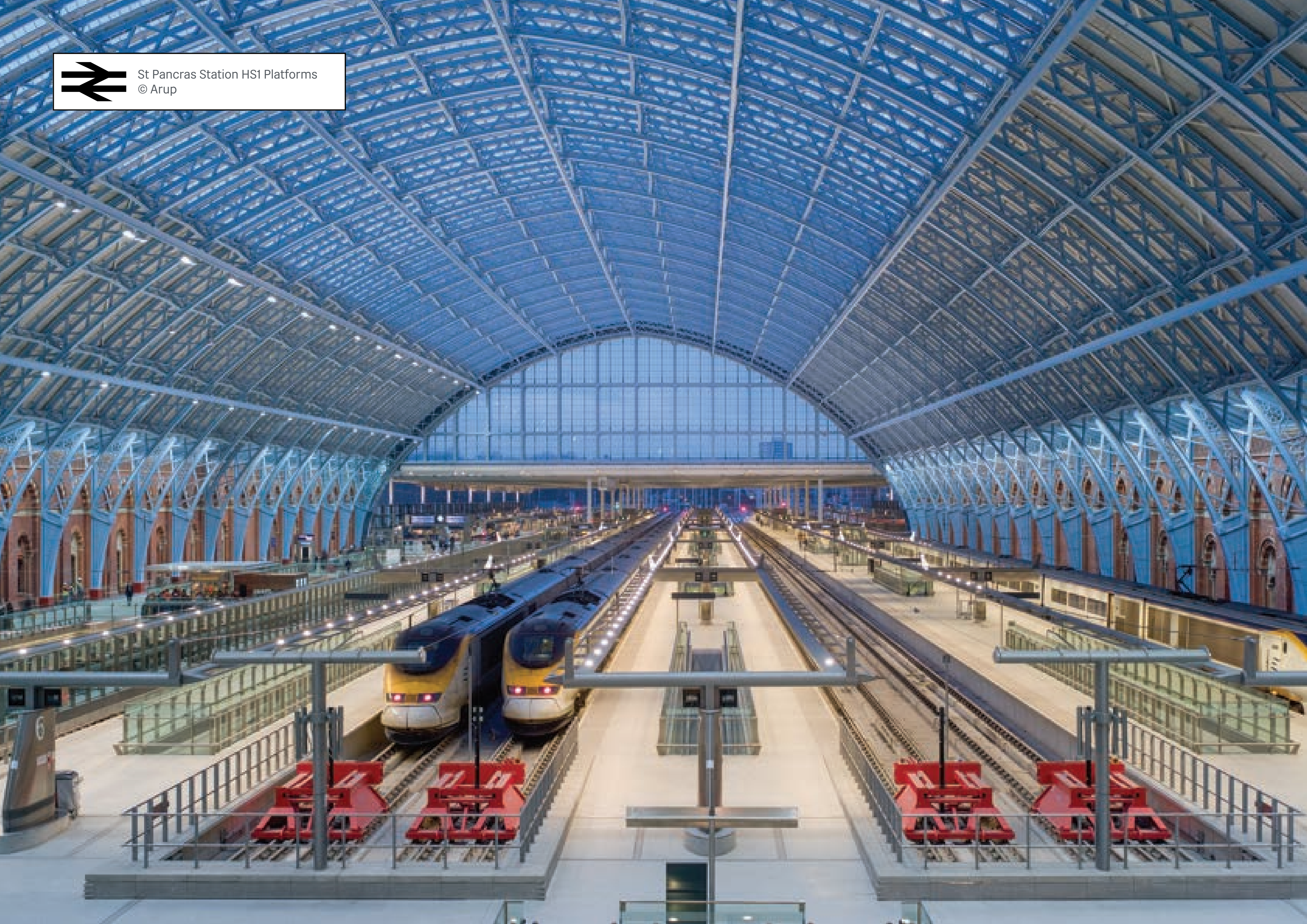
This Design Manual is aimed at project sponsors, developers, designers, project managers and contractors involved in projects for new or refurbished stations.

The guidance can be used for all station types including stations managed by Network Rail or by Train Operating Companies and can be applied to station areas such as public and staff areas, concourses, platforms, ancillary retail areas and external public realm areas/car parks immediately adjacent to stations.

The manual intends to promote an integrated approach between infrastructure and management solutions for new stations, or stations undergoing modernisation and refurbishment, including Access for All Schemes and platform extensions.

Additionally, whilst not intended to be applied retrospectively to existing stations not undergoing refurbishment, this guidance provides useful information for station managers and anyone with fire safety responsibilities in existing stations. For example, the guidance may provide useful context for those undertaking fire risk assessments for such premises.

Whilst this Design Manual clarifies and confirms the regulations and guidance applicable to sub-surface stations, it is not intended to be used as a design guide for this purpose. Please refer to the relevant existing regulations and design guidance for detailed information on the design of sub-surface stations.



St Pancras Station HS1 Platforms
© Arup

Fire Safety at Stations

The Fire Safety Design & Approvals Process

1

1.1 Network Rail Fire Safety Vision & Objectives

Network Rail's vision for fire safety aligns with both our safety vision of "*Everyone Home Safe Every Day*" and our operating vision of "*Putting the Passenger First*".

This is achieved by:

- **Fire prevention** - Eliminating fire risks and where this is not possible, ensuring such risks are managed to a level of ALARP (As Low as Reasonably Practicable).
- **Fire protection** - Ensuring suitable measures are in place to control the spread and growth of fire to meet NR fire safety objectives and these systems and building features are maintained and tested.
- **Fire intervention** - Ensuring suitable and sufficient emergency plans are in place and are tested on a regular basis with roles and responsibilities clearly defined and all persons have received adequate training.

This vision can be translated into several core fire safety objectives which are shown in Figure 1. These objectives extend beyond minimum statutory compliance of life safety only, and capture Network Rail's wider responsibilities as the custodian of the Great Britain's rail network.

Figure 1 Network Rail Fire Safety Objectives

1.2 Project Fire Safety Objectives

Prior to undertaking any fire safety design, it is important that designers have a clear understanding of the Fire Strategy objectives to be achieved. For example, what is the purpose of the Fire Strategy, what does it aim to achieve, and how?

The main objective for a Fire Strategy is the protection of life, including people in and around the building, and Fire & Rescue Service attending a fire incident.

Additional objectives may also be required on a project-by-project basis, including

- **Protection of business/operational continuity – **i.e. minimising disruption or interruption to operational processes, such as train operations.
- **Protection of environment/property –** i.e. minimising damage to property or assets that could result in expensive repairs, reducing impact on the environment in the event of fire.

The fire safety requirements to address each of the above may be different however they are often inextricably linked. For example, measures to protect life may inherently bring a degree of protection to property and operational continuity, and the environment. The design team should have a clear understanding of the purpose of the fire protection measures required for any project. The fire safety objectives should be clearly described in a Fire Strategy report prepared for the project (see Section 1.3).

Network Rail is required to comply with national fire safety legislation and regulations. These regulations are primarily aimed at achieving a minimum level of life safety.

Network Rail has additional standards/guidance that are aimed at achieving an enhanced level of protection to railway infrastructure to control risks arising from fire for the safety of Network Rail workforce, contractors, customers, assets, and business activity.

Refer to Section 1.4 and 1.5 for detailed information on legislation, regulations and Network Rail standards.

Image 1.1 Hexham Station © Northern

1.2 Project Fire Safety Objectives

1.2.1 Stakeholder Consultation Workshop (SCW)

A Stakeholder Consultation Workshop (SCW) should be held as early as practicable for projects that impact on the fire safety design of stations.

The purpose of the SCW is to establish and agree the key aims, objectives, standards and scope of works for the fire safety design, with all key stakeholders. Any aspect of the design which requires further development, or where a fire engineered approach is required (as described in Section 1.7), should be discussed and actions agreed and documented.

Detailed guidance on the SCW is provided in Section 4.5 of BS 9992.

Note that the SCW is not the same as a Qualitative Design Review (QDR). Where a SCW seeks to agree the terms for the overall fire strategy design for a project, a QDR is required for aspects of the design which involve a quantitative fire engineered approach. Further guidance on the QDR is provided in Appendix D.

Image 1.2 Glasgow Central Station © Network Rail

1.3 Fire Strategy

1.3.1 Purpose

A Fire Strategy defines the fire safety objectives and performance requirements for a station, and the design elements used to achieve these objectives.

The Fire Strategy should be a live document that evolves alongside the project (in line with Network Rail assurance procedures defined in NR/L2/CIV/003), providing a commensurate level of detail and clarity to enable the design to progress effectively through to construction and handover.

It should be updated at the end of a project to reflect the as-constructed arrangement, and provide a valuable resource for the station operator to understand and implement appropriate fire safety management procedures throughout the life of the station.

Following completion and handover of the project to the station operator, the Fire Strategy should form a key part of the Fire Performance Plan (a concept currently under development by Network Rail Technical Authority) for the station. This approach supports the "Golden Thread" of building information to support ongoing fire safety management.

Fire strategies must only be authored and assured by competent persons. Competency is multifaceted in context of academic and professional qualifications, in conjunction with professional experience and behaviours.

Fire strategies for Network Rail projects which include elements of performance-based design, risk analysis and/or computer modelling, should be authored by technically competent persons, and assured by a Chartered Fire Engineer registered with the Engineering Council through the Institution of Fire Engineers.

Appendix C provides detailed guidance on the recommended structure and content of a Fire Strategy for Network Rail station projects.

Where required by the planning authority a Fire Statement should also be provided.

Image 1.3 Eridge Station © Network Rail

Network Rail Document

NR/L2/CIV/003
Engineering and Architectural Assurance of Building and Civil Engineering Works

1.3 Fire Strategy

1.3.2 Fire Safety Impact Assessment for existing stations

Where a project involves minor or limited works to an existing station, and where the station has limited existing Fire Strategy information, it may not be necessary or proportionate to produce a Fire Strategy document to support the project.

In this instance, it would instead be appropriate to undertake a Fire Safety Impact Assessment (FSIA), whereby the impact of the proposed works is assessed against the baseline fire safety provisions for the station. This assessment should clearly document how the works affect these existing provisions, and what measures are being implemented to mitigate any additional risks being introduced.

Further guidance on the key considerations for undertaking a FSIA for minor works to existing stations is provided in Section 1.8.

Examples of works that may warrant a Fire Safety Impact Assessment, rather than a design Fire Strategy include:

→ **An Access for All (AfA) scheme for an existing small station** - where the project involves upgrading or replacing a footbridge to introduce access for persons of reduced mobility (PRM) to platforms. In this example, the FSIA should consider how the broadening of PRM access to platforms impacts on the means of escape strategy for the station, and in particular what provisions are proposed to facilitate the evacuation of PRMs (who now have access to areas of the station previously not available). Any further fire safety provisions which are impacted by the works should also be considered. Refer to Section 4.6 for further guidance on AfA schemes.

→ **A platform extension or widening project to an existing small station** – Here, the FSIA should consider how the extension will impact on platform occupancy numbers (e.g. to accommodate longer trains or increased passenger numbers), and what measures are required to assure sufficient escape capacity is provided. Any further fire safety provisions which are impacted by the works should also be considered.

Designers should seek guidance from the Network Rail Fire Safety Engineer with respect to whether a Fire Strategy or Fire Safety Impact Assessment is required for their project.

Development of a Fire Strategy or FSIA

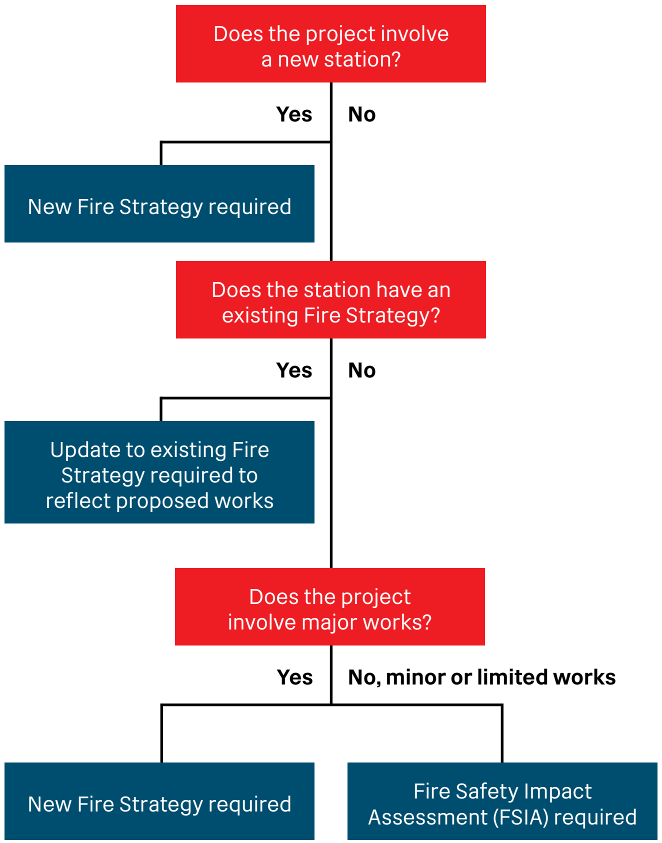


Figure 2 Flowchart illustrating the process for developing a Fire Strategy or FSIA

1.4 Fire Safety Legislation & Regulations

All Network Rail projects are required by law to comply with applicable national fire safety legislation and regulations. UK legislation and regulations are split into two key areas:

Primary Legislation.
This is the general term used to describe the main laws enacted by Governments within the UK. For example, an Act of Parliament such as:

- **The Building Acts** (e.g. the *Building Act 1984* or the *Building (Scotland) Act 2003*) – These enable National governments to make Building Regulations.
- **Equality Acts** (e.g. the *2010 Equality Act*) – This Act protects people from discrimination in the workplace and in wider society.
- **Fire Safety Acts** (e.g. the *Regulatory Reform Act 2001* in England & Wales & *The Fire (Scotland) Act 2005*) – These acts enable the national governments to make regulations relating to, amongst other things, the fire safety of operational premises.
- **Health & Safety Acts** (e.g. *The Health & Safety at Work Act 1974*) – This Act puts a duty on employers to ensure the safety health and welfare at work of their employees, and to ensure their activities do not endanger others.

Secondary Legislation.
This is the term used typically for the regulations produced by National Governments via power given to them by Primary Legislation. Examples include:

- **Building Regulations** (specific to each country in the UK) - These regulations require provisions to achieve a reasonable standard of health and safety for people in and about a building and include fire safety matters.*
- **The Regulatory Reform (Fire Safety) Order 2005** (applicable to England & Wales) & *The Fire Safety (Scotland) Regulations 2006* (applicable to Scotland) – These legislation/regulations place a legal duty on anyone in control of a premises to undertake a fire risk assessment and put in place and maintain general fire precautions.
- **The Construction (Design and Management) Regulations 2015** (UK-wide) – CDM regulations cover the legal duties relating to the management of health, safety and welfare when carrying out construction works. These duties apply to clients, designers, contractors,and workers.
- **Sub-Surface Rail Regulations** (specific to each country in the UK) - These Regulations set out the specific requirements for fire precautions at sub-surface railway stations.

*In England & Wales, Network Rail is licensed as a “statutory undertaker”, whereby rail infrastructure and station projects are not required to submit for formal Building Regulations approval, subject instead to Network Rail’s own internal approval process. Refer to Section 1.9.2 for further details.

Network Rail are also required to follow specific codes of practice under their licensing and other legal obligations, which may impact on the fire safety design of stations. For example, compliance with the “*Design Standards for Accessible Railway Stations, A Joint Code of Practice by the Department for Transport and Transport Scotland*” is a requirement of its license with the Office of Rail Regulation (ORR). If in doubt, designers should consult with the Network Rail Technical Authority for further information with respect to the application and hierarchy of specific codes of practice and other standards.

In addition to national fire safety legislation, regulations and codes of practice, Network Rail also requires compliance with its own standards, as described in Section 1.5 below.

1.4 Fire Safety Legislation & Regulations

Note: In addition to the legislation described above, the Building Safety Act 2022 (BSA) has been introduced in England & Wales, which includes a new legislative framework relating to the oversight of building safety, with particular emphasis on "higher-risk buildings" (HRBs). The impact of this legislation on Network Rail projects (in particular its applicability to Network Rail as a statutory undertaker), is under review. Designers and stakeholders should consult with the Network Rail Fire Safety Engineer for further information with respect to the application of the BSA.

Legislation / Regulations

Primary Legislation
Building Act 1984, Building (Scotland) Act 2003
2010 Equality Act
Regulatory Reform Act 2001
The Fire (Scotland) Act 2005
The Health & Safety at Work Act 1974
Building Safety Act 2022

Secondary Legislation
The Building Regulations 2010
The Building (Scotland) Regulations 2004
The Regulatory Reform (Fire Safety) Order 2005
The Fire Safety (Scotland) Regulations 2006 (applicable to Scotland)
The Construction (Design and Management) Regulations 2015
Fire Precautions (Sub-surface Railway Stations) Regulations 1989
The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009

Statutory Codes of Practice
Design Standards for Accessible Railway Stations, A joint Code of Practice by the Department for Transport and Transport Scotland, Version 4, March 2015

Image 1.4 Edinburgh Waverley Station Concourse © Network Rail

1.5 Mandatory Network Rail Standards

Network Rail has a series of mandatory standards that are required to be complied with for all Network Rail-managed property. In terms of fire safety these relate primarily to the fire safety management of operational buildings to achieve compliance with operational fire safety legislation, and achieve an acceptable level of operational continuity and property protection on the rail network.

Network Rail standards are mandatory for the stations which it manages. Network Rail standards are not mandatory for those stations which are owned by Network Rail but operated/managed by a train operating company (TOC), although they may provide a useful reference guide. For these stations, the TOC is responsible for ensuring appropriate fire safety management procedures are in place to comply with relevant fire safety legislation.

Network Rail's mandatory fire safety policy is set out in Fire Safety Policy (NR/L1/FIR/100). The specific requirements are contained in Table 1.

Please note that these standards are under review, and will be updated as part of the National Fire Standard Programme.

Network Rail's Fire Safety Policy assigns the role of a *"Person Responsible for Fire Safety"* (PRFS) for every Network Rail premises. This is an identified person who is responsible for the day-to-day management of fire safety in line with the standards outlined in Table 1.

This includes responsibilities such as:

→ Maintaining an up-to-date Fire Risk Assessment for the premises.

→ Assuring all fire safety systems are maintained and tested in accordance with manufacturer's instructions and relevant standards.

→ Assuring all staff receive instruction and training in fire safety according to their role and responsibility.

→ Liaising with statutory bodies such as the Fire Authorities and, where applicable, Building Control (in conjunction with the Network Rail Fire Safety Engineer).

→ Reporting any fires on rail premises/infrastructure as per Network Rail requirements.

It is important that the PRFS for the station (or an appropriately competent person on behalf of the PRFS) is consulted throughout the design and construction process to assure they fully understand any future fire safety management implications.

For TOC managed/operated stations, the responsible person/fire safety duty holder should similarly be consulted.

Standard Number	**Type**
NR/L1/FIR/100	Fire Safety Policy
NR/ L2/CTM/229	Level 2 Competence & Training for Emergency Evacuation Wardens and Persons Responsibly for Fire Safety
NR/L1/FIR/101	Fire Safety – Managed Stations
NR/L1/FIR/102	Fire Safety – Operational Estate
NR/L1/FIR/103	Fire Safety – Offices and Competency and Training Delivery Centre
NR/L1/FIR/105	Fire Safety – Property, Business Space, Freight and Miscellaneous Portfolios
NR/L1/FIR/106	Fire Safety – Maintenance
NR/L1/FIR/107	Fire Safety – Risk Assessment
NR/L1/FIR/108	Fire Safety – Fire Extinguishers
NR/L1/FIR/109	Fire Safety – Fire Log Book

Table 1 List of Network Rail Fire Safety Management Standards

1.6 Fire Safety Guidance

Fire safety guidance is often drafted to assist those responsible for the design, construction and operation of premises in meeting the requirements of the relevant primary and secondary legislation. It should be understood that the guidance itself does not form part of the legislation, but merely acts as a way of assisting a person to demonstrate that the legislation is met. Whilst following the guidance is not mandatory there should always be a means of demonstrating how the legislation is being complied with.

A number of fire safety guidance documents exist to assist designers and stakeholders to comply with legislative requirements for stations. This includes:

- This document, the *Fire Safety of Stations Design Manual* (NR/GN/CIV/300/03).
- The rest of the Network Rail Design Manual suite (100, 200, 300 & 400 series) which provides context and information around other aspects of the station design which require consideration alongside fire safety.
- **BS 9999: 2017 Code of practice for fire safety in the design, management and use of buildings** – This provides prescriptive guidance on the provision of measures to control or mitigate the effects of fire within the built environment. It utilises some fire engineering techniques through a risk-based approach to develop more flexible solutions than other prescriptive guidance. The primary objective is to assure that an adequate standard of life safety can be achieved in the event of fire in the building. Meeting the guidance of this standard can also have the effect of assisting the Fire & Rescue Service and/or of providing some property and environmental protection.
- **BS 9992: 2020 Fire safety in the design, management and use of rail infrastructure - Code of practice** – This British Standard complements BS 9999 and provides specific guidance relating to railway buildings and other relevant rail infrastructure. Where recommendations are not explicitly included in BS 9992, then the default is that BS 9999 be referred to for relevant guidance.
- **Approved Document B** *(England & Wales)* and the **Non-Domestic Technical Handbook** (Scotland) – Provide prescriptive guidance with respect to specific fire safety measures to achieve compliance with National Building Regulations. These guidance documents are not rail specific, and provide generic fire safety guidance on the more common building arrangements.

In addition, *Fire Safety Policy* (NR/L1/FIR/100) should also be referred to as a relevant document relating to Network Rail's fire safety vision and objectives.

The guidance adopted as part of the fire safety design process for a station should be agreed with all stakeholders and clearly documented. For existing stations, design guidance may also be useful in assessing/auditing and establishing any required fire safety provisions.

1.7 Fire Engineering Approach

Where it is considered necessary to deviate from the fire safety guidance on any project, alternative approaches may be used to demonstrate compliance with the legislation (such as Building Regulations). This is commonly achieved by means of a fire engineered approach.

A fire engineering approach considers the specific fire safety risks associated with a building or station, and applies fire safety science and engineering methods to demonstrate that an appropriate level of fire safety is achieved. When applied correctly, a fire engineering approach can often result in a more fundamental and efficient solution than simply applying prescriptive guidance or standards. Indeed in the case of some large and complex buildings, it might be the only viable means of achieving a satisfactory standard of fire safety.

Other benefits of applying a fire engineering approach include:

- → Provides a comparative, disciplined approach to fire safety design.
- → Takes into account the specific risks and mitigations on a particular project (rather than applying simplistic guidance that addresses common design situations only).
- → Provides opportunities for innovative design.
- → Enables a deeper level of understanding regarding the residual fire safety risks for the building, to inform management and operational decisions.

However, this approach should only be undertaken by a suitably competent and qualified Fire Engineer (in consultation with the Network Rail Fire Safety Engineer). and is likely to result in a greater degree of assurance and approval on a project.

Where such an approach is adopted, it is expected that reference should be made to documents such as:

- → *BS 7974: 2019 Application of fire safety engineering principles to the design of buildings. Code of practice.*
- → *CIBSE Guide E – Fire Safety Engineering.*

Appendix D of this design manual provides specific guidance on key design parameters and assumptions recommended by Network Rail to be considered as part of any fire engineered assessment and/or analysis.

National Standard

BS 9999: 2017
Fire safety in the design, management and use of buildings

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure

BS 7974: 2019
Application of fire safety engineering principles to the design of buildings

Approved Document B (England & Wales)

Non-domestic Technical Handbook (Scotland)

Published Document

CIBSE Guide E – Fire Safety Engineering, Chartered Institute of Building Services Engineers, 2019

Network Rail Document

NR/L1/FIR/100
Fire safety Policy

1.7 Fire Engineering Approach

National Legislative Framework & Guidance for construction work

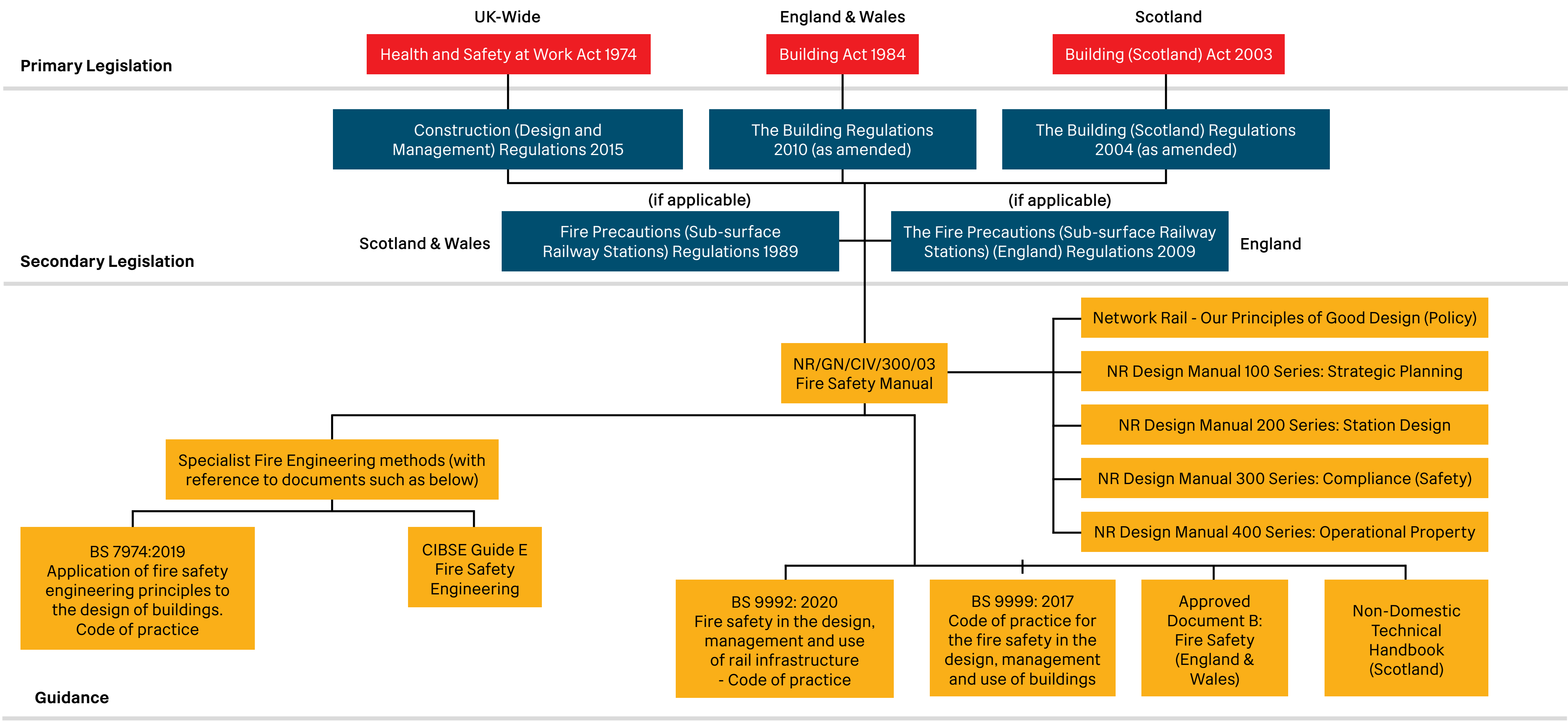


Figure 3 Flowchart illustrating the hierarchy of legislation and guidance for construction work

1.7 Fire Engineering Approach

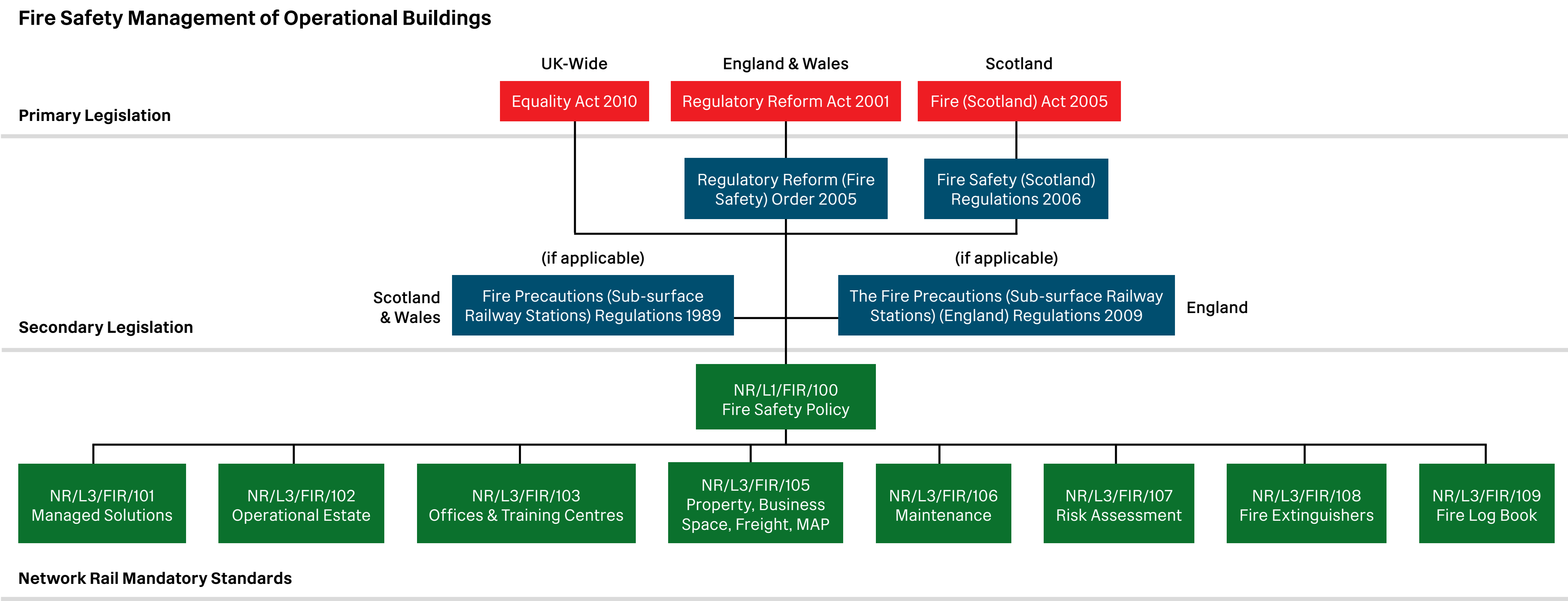


Figure 4 Flowchart illustrating the hierarchy of legislation and guidance for construction work

1.8 Minor Works to Existing Buildings

Within this guide minor works refers to a project, or a part of a project, where the extent of works do not qualify under the Building Regulations. This could involve works that do not qualify as building work under the Regulations, or are specifically exempt from the Regulations (although approval by Network Rail may still be required). Examples of minor works could include non-structural refurbishment of station areas, or aesthetic improvements such as decoration or minor replacement of existing building elements.

Where minor works are to be undertaken to a station with an existing Fire Strategy, this should be reviewed and updated as appropriate to reflect the new arrangements.

As described in Section 1.3.1, where minor works are undertaken to an existing station with no Fire Strategy, a Fire Safety Impact Assessment (FSIA) should be undertaken. The FSIA should consider the following:

- → Undertake an initial survey to understand the current fire safety provisions and arrangements at the station, including evacuation capacities.
- → Assess the proposed works to confirm the potential impact on the existing fire safety provisions. As a minimum, all minor works should be undertaken in such a way as to assure that existing benchmark fire safety arrangements are not reduced or degraded as a result of the proposed alterations and modifications to the station.
- → Where potential fire risks are identified, measures to reduce these risks should be adopted. Improvement works should assure that the level of fire safety risk is "as low as reasonably practicable" (ALARP), refer to Section 2.5, and where possible any identified risks should be demonstrated as presenting equivalence with current fire safety guidance/standards.
- → A quantitative assessment of the proposed works on evacuation capacities from platform and station areas may be required to support the proposed design approach
- → It should also be confirmed whether CDM Regulations and/or Sub-Surface Regulations apply.

Where required, guidance and assurance should be sought from the Network Rail Fire Safety Engineer.

Image 1.5 Workington Station © Network Rail

1.8 Minor Works to Existing Buildings

1.8.1 Heritage buildings and fire safety

Heritage buildings require a particular balance between preservation of fabric and features and achieving an appropriate level of fire safety.

For example, Network Rail owns more than 380 listed station buildings which may require listed building consent before any relevant work or alteration can be undertaken. In many cases, this may impact on the scope of fire safety improvement works that can be undertaken.

Image 1.6 Penrith Station © Arup

Where work is proposed to an existing heritage asset, it is important to consult with the relevant heritage authorities at an early stage to understand their requirements and agree an appropriate level of intervention to achieve the project's fire safety goals.

As above, this process should be clearly documented as part of the fire safety objectives for the project.

Further guidance is available in BS 9999, the *Heritage Care and Development design manual* (NR/GN/CIV/100/05) and other relevant heritage body guidance documents, such as:

- → *Fire Safety Management in Traditional Buildings, Guide for Practitioners 7*, Feb 2010, Historic Environment Scotland.
- → *Fire Safety Guidance Note: Heritage and Buildings of Special Interest*, GN80, Rev 5, May 2022, London Fire Brigade .

Published Document

Guide for Practitioners 7
Fire Safety Management in Traditional Buildings, Guide for Practitioners 7, Feb 2010, Historic Environment Scotland

GN80
Fire Safety Guidance Note: Heritage and Buildings of Special Interest, Rev 5, May 2022, London Fire Brigade

1.9 Assurance Process & Statutory Approvals

1.9.1 Network Rail Assurance Process

Network Rail operates a mandatory assurance business process for building and civil engineering works.

This business process is set out in detail in the Network Rail standard *NR/L2/CIV/003*, and applies to all structures, buildings and building services owned by Network Rail, and where proposed or actual works are to be undertaken such as:

- Enhancements,
- Replacements,
- Renewals,
- Repair works,
- Emergency works,
- Temporary works.

The assurance business process requires the submission of specific Forms at different stages of a project. The project stages are aligned with Network Rail's "*Project Acceleration in a Controlled Environment*" (PACE) approach.

The Forms most relevant to fire safety design include:

- *Form A – Certificate of Approval in Principle (AiP)* – Once the project has developed to a stage that a Single Option has been determined. This form is required to be signed by a Network Rail Fire Safety Engineer.
- *Form B – Certificate of Design and Check* – Once the design has progressed to a level of detail to allow it to be issued for construction.
- *Form C – Certificate of Design and Check for Temporary Works* – Relevant where fire safety is affected in the temporary construction condition. For example hoarding lines or segregated working areas, or where changes to fire systems, means of escape and other fire safety measures may need to be made.
- *Form D – Architectural and Layout Acceptance* – Required at appropriate stages such as prior to completion of option selection, single option development to AiP (i.e. before Form A), and completion of detailed design (i.e. after Form B).

Additionally, the process assigns a "Design Check Category" (0, i, ii, or iii) depending on the extent and complexity of the proposed design. In general, the more complex or unusual the design, the higher the Design Check Category, and thus the greater degree of checking which will be undertaken by Network Rail.

The project team should seek input from the Network Rail Designated Project Engineer (DPE) and Project Engineer (PE) to agree the assurance route for the proposed design. The Network Rail Fire Safety Engineer should also be consulted by the DPE/PE.

Please refer to *NR/L2/CIV/003* for more detailed information.

Network Rail Document

Form A
Certificate of Approval in Principle (AiP)

Form B
Certificate of Design and Check

Form D
Architectural and Layout Acceptance

NR/L2/CIV/003
Engineering and Architectural Assurance of Building and Civil Engineering Works

Network Rail Document

Building Act 1984 (England & Wales)

Building Regulations (specific to each country)

1.9 Assurance Process & Statutory Approvals

1.9.2 Statutory Approvals

England & Wales

In England & Wales, Network Rail is a licensed Statutory Undertaker under the *Building Act 1984*. As such, works to buildings forming part of a railway station are technically exempt from the requirement to obtain Building Regulations approval by a local authority or Approved Inspector.

However, Statutory Undertakers still have a legal responsibility with respect to ensuring the design, alteration or change of use of their assets provides a safe environment for all. Network Rail therefore requires the Building Regulations to be applied to all its buildings (where applicable), and compliance is required to be demonstrated as per the Assurance Process described in Section 1.9.1.

This exemption does not apply to Network Rail assets not connected to the railway (for example high street retail and other premises independent of the rail environment). For works to such premises, Building Regulations approval may be required.

Notwithstanding the applicability of Building Regulations approval to Network Rail projects, consultation with the relevant Fire & Rescue Service may still be appropriate, particularly with respect to fire service access and facilities. This should typically be undertaken by the design team, in coordination/agreement with the Network Rail Fire Safety Engineer.

Scotland

In Scotland, railway stations are not exempt from Building Regulations requirements, and building works will typically require a Building Warrant from the relevant Local Authority.

This statutory Building Warrant approval will be in addition to the Network Rail Assurance Process described in Section 1.9.1 above.

The Building Warrant approval process may require formal consultation with the Scottish Fire & Rescue Service.

Image 1.6 Glenfinnan Viaduct, Scotland © Malcolm Blenkey. There are key differences to the statutory approval process for Scotland.

Concourse at Liverpool
Street Station

Fire Safety at Stations

Understanding the Rail Environment

2

2.1 Categories of Stations

This section sets out some of the key principles relevant to the Network Rail environment and its operational needs, which require consideration to assure that the fire safety design of stations is appropriate and workable.

The *Station Design* Guidance Manual (NR/GN/CIV/100/02) presents the 6no. station categories (A-F) originally developed by the Department for Transport. The categories are based on the station size, the journeys made, and revenue generated. The station categories are further described in Table 2 below.

Station Category	No. across network	Type	Journeys made/ revenue generated, per annum
A	28	National Hub	Over 2m trips: over £20m
B	67	Regional Interchange	Over 2m trips: over £20m
C	248	Important Feeder	0.5–2m trips: £2–20m
D	298	Medium Staffed	0.25–0.5m trips: £1–2m
E	695	Small Staffed	Under 0.25m trips: Under £1m
F	1200	Small Unstaffed	Under 0.25m trips: Under £1m

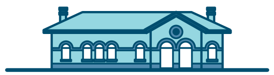
Table 2 Network Rail station categories

A - National Hub

Major station providing a gateway to the rail network from a large area, and acts as a significant interchange hub

B - Regional Interchange

Large station providing a gateway to the rail network from a large area. Often served by more than one Train Operating Company with a mix of service types. May be a terminus for some services

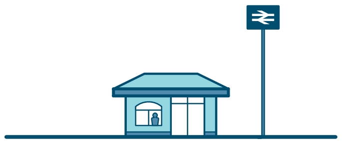


C - Important Feeder

Significant 'feeder' station, on a busy trunk route or as a subsidiary hub station. Often with services from more than one TOC and a regular long-distance service

D - Medium Staffed

Medium-sized, staffed station, with a core inter-urban business or high-volume inner suburban business



E - Small Staffed

Small, staffed station often with just one member of staff at any one time, or for only part of the day

F - Small Unstaffed

Small, unstaffed station

Network Rail Document

NR/GN/CIV/100/02
Station Design Manual

2.2 Station Design Considerations

The category of the station will influence the fire safety design approach for station projects. For example, the fire design process for a new-build Category A/B station will differ considerably compared to that of a Category E/F station.

Station design characteristics which can impact on fire safety design include:

Station size and type

Through-stations and terminus stations present different challenges, particularly with respect to means of escape and evacuating occupants from platforms.

Sub-surface stations or large interchange stations often involve a large number of platforms or occupants, on different levels with a combination of terminus and through-platforms. Interfaces with sub-surface stations or platforms are also common.

Larger stations can often have complex layouts which may present particular design challenges to means of escape, evacuation management and Fire & Rescue Service access. This will often make the application of traditional design guidance difficult and instead require the application of performance-based fire engineering methods.

Presence of train shed/platform canopies

It's common for larger, historic stations to include vaulted train sheds which can be open at one or both ends. Small to medium sized stations e.g. Category D/E often provide platform canopies to shelter waiting passengers from the elements.

The arrangement of roof cover can affect the smoke behaviour of a potential fire and therefore can significantly influence the fire safety design of the station.

Interfaces with other buildings/stations

Stations, particularly Category A/B stations, often interface with adjacent buildings such as shopping centres and hotels. These adjacent buildings may not be under the direct control or management of Network Rail, which presents potential challenges with regards fire safety management.

The fire safety design of such stations should take account of any interfaces, and how a fire in an adjacent area would affect the station (or vice versa).

Station passenger levels

A large interchange station e.g. Category A/B station could serve thousands of passengers a day, with further additional occupancy from ancillary retail facilities. Small stations e.g. Category E/F stations may only serve small trains with low passenger numbers, and therefore the Fire Strategy should reflect this.

The higher the passenger levels and train services, the greater risk of passenger congestion due to delays and abnormal emergency situations.

Passenger facilities and other uses

The larger the station, the greater the number and type of facilities are required to cater for passengers and rail staff. This introduces additional ancillary facilities such as retail, food, lounges, toilets, staff accommodation and plant space, all of which can affect the level of fire safety risk.

The fire safety design should take into account every occupied area of a station.

It's important that the fire safety design of every station reflects its individual characteristics and is proportionate to the level of risk.

Where a designer is unclear on the impact any of these characteristics on a station, advice should be sought from a suitably competent Fire Engineer, in consultation with the Network Rail Fire Safety Engineer.

2.3 Operating Principles

2.3.1 Train Operating Companies (TOCs)

The majority of small to medium sized stations (e.g. Category D/E/F) across the UK, whilst owned by Network Rail, are operated by train operating companies (TOCs).

Many large interchange stations are owned and operated by Network Rail but are used by multiple TOCs. This can result in a number of stakeholders with different fire safety duties. The fire safety design of every station should take account of the roles and responsibilities of all stakeholders to assure it can be managed appropriately.

2.3.2 Responsible person

Where a TOC is responsible for the operation of a station, they also assume the role of the "responsible person" or fire safety duty holder, under the relevant fire safety legislation.

The role of the responsible person/fire safety duty holder applies to all stations regardless of whether they are permanently staffed or not and requires them to provide and maintain adequate fire precautions.

At Network Rail managed stations, the role of "*person responsible for fire safety*" (PRFS) is assigned, as described in Section 1.5.

The responsible person has a duty to carry out a fire risk assessment which focuses on the safety in case of fire of all 'relevant persons'. The risk assessment should pay particular attention to those at special risk, such as persons of reduced mobility (PRM) and those with special needs, and should include consideration of any dangerous substances likely to be on the premises.

2.3.3 Fire safety management

When designing stations, or undertaking work on existing stations, it is necessary to consider what provisions can be included to minimise the reliance on fire safety management. Designs should not place unreasonably onerous requirements on a scheme as these could cause result in considerable cost and fire safety management implications.

Throughout the design process, the design team should consult with the responsible person/ fire safety duty holder to assure that sufficient measures are provided for the station to be effectively managed in the event of a fire. Any specific fire safety management measures on which the Fire Strategy is relied upon should be clearly documented as part of the Fire Strategy.

Section 10 of this Design Manual also provides guidance on fire safety management.

Image 2.1 Passenger Assistance at Paddington Station © Network Rail

2.4 Understanding the Risk

2.4.1 Overview

The railway station environment presents very specific fire safety risks that can vary widely depending on the particular characteristics of each station. The fire protection measures and fire safety design proposed for a station should be proportionate to the level of risk presented.

Existing station design guidance tends to consider two key fire scenarios: that of a fire on a train (whilst at the station) and a fire within the station facilities (or on the platform) itself. These require evacuation of the train(s) and station occupants to a place of safety.

The following sections discuss the historical prevalence of fires within station environments, and the leading causes relevant to Network Rail.

2.4.2 Station Fire Scenario

In 2022, Network Rail commissioned a study to evaluate available data on historic fire events on the UK rail network (and internationally), to understand the prevalence of fire incidents, and identify key trends.

According to the *RSSB Safety Management Intelligence System (SMIS) database*, 209 fire incidents were recorded in the 20no. Network Rail managed train stations between 2002 and 2021. The most common causes of fire ignition and fire alarm activations are highlighted in Table 3.

Approximately two thirds of all fire events occurred in four location types, see Table 4.

Common Ignition Sources / Causes of Fire Alarm Activations
Human Action (arson or accidental fire)
Electrical faults (electrical cabinets, socks, junction boxes, arcing etc)
Cooking equipment (dryers, grills, ovens, stoves, etc)
Track equipment (sleepers, insulation pots, rail supports etc)

Table 3 Common fire ignition causes in Network Rail stations between 2002 and 2021

Most common fire locations in Network Rail stations
Station platform
Station retail unit
Rail tracks
Station concourse

Table 4 Common fire locations within the rail environment for Network Rail station fires between 2002 and 2021

Published Document

RSSB Safety Management Intelligence System (SMIS) database, Rail Safety and Standards Board

RSSB, “Presentation: Fire Forum Train Analysis” 2019

2.4 Understanding the Risk

Fire prevalence decreases with the size of station. For example, Category A stations had a fire incident rate of 2.8 fires per station per year, whilst this reduced gradually to 0.4 fires per station per year for Category F stations.

Therefore, on average, the lower the station category, the lower the likelihood of a fire.

In total, 28,750 fire incidents from 10,054 locations (e.g. stations, tunnels, bridges, track areas etc) were reported between 2006 and 2022 across the Great Britain rail network. Key findings from all of these fire incidents include the following:

- → The leading fire incident causes were line side fires (28%) and arson (8%).
- → 19% of cases resulted in no property damage and 56% of cases reported property damage of less than £1,000.
- → 0.58% (167 incidents) were identified as being “business critical”.

Image 2.2 Troon Station Fire © Network Rail

2.4.3 Train Fire Scenario

898 reportable train fires (fire involving locomotives and rolling stock) were recorded by the RSSB between 2006 and 2019. (RSSB, "*Presentation: Fire Forum Train Analysis 2019*", 2019). This showed a generally downward trend each year (potentially as a result of more modern rolling stock being introduced). Table 5 shows the most common causes of train fires in 2019.

Common causes of train fires
Technical faults
Arson/Vandalism
Other human action

Table 5 Common causes of train fires

According to RSSB Safety Risk Model Table B1, 1 in every 20 passenger train fires and 1 in every 110 non passenger train fires result in an injury or fatality. Furthermore, unless a station has been designed with sufficient fire safety measures in place, a train fire within a station environment has the potential to compromise escape routes serving a station.

Fire engineering analysis for train fire design scenarios is typically based on data collated from rolling stock fire tests. Most of the full-scale rolling stock fire tests performed have been undertaken using older rolling stock which often contain interior finishes that do not conform to the current material fire performance requirements required on modern rolling stock.

Whilst the rolling stock operating across the UK varies considerably, new rolling stock is being gradually introduced across the network that should result in improved levels of fire safety.

Whilst identifying detailed statistics and trends is limited by the data available, it's clear from the studies and data presented above that fire events on stations and trains are relatively rare and generally of low consequence in terms of life safety and property protection/business criticality.

The prevalence of fires within station areas is shown to be proportionate to station size. Additionally, the probability and severity of train fires due to technical faults is decreasing as more modern rolling stock is being introduced.

Despite the above data it is still common to consider both a station and train fire scenario for a station in the UK, regardless of the specific station design characteristics. Consequently, there is no consideration given in current guidance to the reduced risks that may be present with smaller (i.e. lower category) stations.

Image 2.3 Train Fire at West Worthing Station in 2020

2.4.4 A risk-based approach

Risk is a product of the probability and consequence of a particular hazard. Within the context for fire safety design, this means the probability of a fire event occurring, and the consequence of it on occupants, property and business operation.

As discussed in the previous sections, the probability of a station fire (originating within the station itself, or on a train) typically reduces with the size of station. However, no design, regardless of approach, can be 100% "risk free", and even fires at smaller stations could impact on the life safety of occupants and on the operation of the railway.

Indeed, even prescriptive guidance is often not transparent or based on real-world fire experience or engineering science, and inherently assumes a level of tolerable risk deemed to be "acceptable" to society.

The challenge for designers is to work with all stakeholders so that they understand the level of risk posed by a particular design and agree that the risk is appropriate.

For some station designs, a risk-based approach may provide a more appropriate and proportionate solution than prescriptive compliance with existing design guidance.

To apply a risk-based approach to station design requires all stakeholders e.g. Network Rail, TOCs, design team to be involved. The risk analysis should consider all stakeholder objectives and applicable sensitivity studies to support the chosen design fire scenarios.

When considering a design fire scenario, the risk should be representative of a station's actual hazard i.e. related to the station design characteristics.

The following sections provide guidance on achieving an appropriate and proportionate level of fire safety for station design utilising a risk-based approach.

Image 2.4 Abbey Wood Station with exposed timber roof © Network Rail

2.5 The Concept of ALARP

The term ALARP (As Low As Reasonably Practicable) is often used in risk analysis, and as a method of determining an acceptance criteria, in recognising that there is a point at which the cost of further control measures become grossly disproportionate to any further reduction in risk.

Whilst there is no legal definition of the term "grossly," the level of severity or consequence of the event will influence the threshold in achieving ALARP, the higher the severity the higher the threshold.

The concept of ALARP is referenced in *PD 7974 Part 7 Probabilistic Risk Assessment: Application of fire safety engineering principles to the design of buildings 2019* (Section 5.2.4.1). Accordingly, any risk analysis in justifying a level of safety is ALARP would fall under the remit of a fire engineering approach, as it requires an evaluation of risk from first principles. Demonstration of ALARP should therefore be undertaken by a competent Fire Engineer with the necessary technical skills and experience to apply the concept appropriately.

Whilst ALARP balances cost against risk reduction, it is not purely a simple cost benefit analysis. This is because in achieving the threshold of ALARP, it is necessary to demonstrate that the cost is grossly disproportionate and not just disproportionate to any further reduction in risk. Risk analysis will require a level of numerical computation which should be considered as an extremely useful tool in supporting effective decision making.

Image 2.5 Fire & Rescue Service Command Support Officer at a railway station incident © FirePhoto Alamy Stock Photo

ALARP is commonly used in the environment as an appropriate means of balancing benefit and risk, in line with key rail safety legislation such as the *Common Safety Method for Risk Evaluation and Assessment* (CSM-REA), as established under the *Railways and Other Guided Transport Systems (Safety) Regulations 2006*. As such, reference to ALARP is made at various points within this Design Manual.

Published Document

Common Safety Method for Risk Evaluation and Assessment (CSM-REA)

Legislation / Regulations

Railways and Other Guided Transport Systems (Safety) Regulations 2006

National Standard

PD 7974 Part 7: 2019 (Section 5.2.4.1)
Probabilistic Risk Assessment: Application of fire safety engineering principles to the design of buildings

Aftermath of a train fire near
Bristol in October 2004
© PA Images Alamy Stock Photo

3

Fire Safety at Stations

Fire Safety Design Methodology

3.1 Overview

This section presents a risk-based methodology for categorising stations based on the level of fire safety risk they represent. This provides a framework for designers to develop an appropriate and proportionate fire safety design for stations. This approach is intended to complement and clarify the application of existing design guidance and provide a basis for the additional guidance provided in this Design Manual.

A summary of the existing design process for sub-surface stations is also provided, to provide clarity and consistency of approach for designers.

Image 3.1 St Pancras Station © Arup

3.2 Rail Station Fire Risk Profile (RSFRP)

3.2.1 Rail Station Fire Risk Profile

Network Rail stations vary considerably in terms of size, complexity, ancillary usage and therefore fire safety risk. For example, a large, national hub station such as King's Cross presents a very different level of fire safety risk to a small, rural station. As a result, fire safety guidance should be applied knowingly and specifically, based on the specific risk-profile of a station, to avoid arriving at an overly onerous or inappropriate design solution.

The Rail Station Fire Risk Profile (RSFRP) is based on the principles of the Risk Profile approach described in BS 9999 but applied more specifically to Network Rail stations. It provides designers with a simple means of establishing an appropriate risk profile for a station based on its size and characteristics. This enables appropriate and proportionate application of design guidance for the station.

The RSFRP should be established and applied by means of the following 3-step process:

Step 1
Assign the RSRFP

↓

Step 2
Verify the RSFRP aligns with the fire potential and consequence factors

↓

Step 3
Confirm station risk category

Image 3.2 Passenger Train on the Dartmoor Line © Network Rail

3.2.2 Step 1 – Assign RSFRP

Table 6 provides a simple “look-up” table that assigns a Rail Station Fire Risk Profile (e.g. A1, B2, C3 etc), as a function of the station category and station enclosure characteristics.

Where stations include multiple different enclosure characteristics (for example areas of enclosed platforms and canopied platforms), the most onerous RSFRP for the station should generally be selected. For some stations however, it may be appropriate to apply a different RSFRP to areas which are sufficiently independent from other areas. For example, means of escape and/or fire separation which enables different areas to effectively be treated independently.

The designer should confirm the RSFRP for the station, in consultation with the Network Rail Fire Safety Engineer.

Station Enclosure Characteristics	A - National hub	B - Regional interchange	C - Important feeder	D - Medium staffed	E - Small staffed	F - Small unstaffed
Sub-Surface Station (as defined by the Sub-Surface Rail Regulations)	n/a - Design requirements for sub-surface stations are covered in the relevant Sub-Surface Rail Regulations. Additional guidance is provided in BS 9992. Refer to Section 3.3 of this manual for further information.					**Not applicable**
Covered platforms, rail lines and concourse/station areas, with ceiling/roof less than 10m height. Concourse/station areas with ancillary uses (retail etc) and/or interaction with other buildings/stations.	D5	C5				
Covered platforms, rail lines and concourse/station areas, with ceiling/roof greater than 10m height (e.g. train sheds or similar). Concourse/station areas may have ancillary uses (retail etc) and/or interaction with other buildings/stations.	D4	C4	C4			
Full width and/or significant length platform canopies (rail line open to atmosphere). Covered concourse/station areas (any height). May have ancillary uses (retail etc).	D3	C3	C3	B3		
Full width and/or significant length platform canopies only (rail line open to atmosphere). No other enclosed station areas (except small waiting rooms/shelters).			C3	B3	B3	A3
Small (up to approx. 20m), individual platform canopies only. Rail line open to atmosphere. No enclosed station areas (except small waiting rooms/shelters/kiosks).				B2	B2	A2
Fully open-air platforms and rail line. No enclosed station areas (except small waiting rooms/shelters/kiosks).				B1	B1	A1

Table 6 Rail Station Fire Risk Profile (RSFRP)

3.2.3 Step 2 – Verify the RSFRP aligns with fire potential and consequence factors

The RSFRP is developed to provide a simple framework for the most common station types and risks only, and is intended to be used as a guide and/or design tool by designers.

There is significant variance in the design, operation, and specific fire risks to new and existing Network Rail-owned stations. Whilst Table 6 (Rail Station Fire Risk Profile (RSFRP)) seeks to provide as specific description of key characteristics as possible, there will always be a degree of subjectivity, and therefore interpretation required, in applying the RSFRP to a specific station.

Table 7 and Table 8 provide further detail on the key fire safety considerations relevant to each risk profile (e.g. A1 has a fire potential factor A and a fire consequence factor 1).

If the fire risks presented by a particular station do not align with the categories/characteristics in Table 6, an appropriate RSFRP should be assigned based on the information in Table 7 and Table 8 by a suitably competent person (e.g. Fire Engineer), with agreement from the Network Rail Fire Safety Engineer.

Fire Potential Factor	Description
D	High volume of large, intercity trains entering and leaving the station every hour via multiple platforms, regularly high platform occupancies with baggage, refuse bins and concessions/ food, beverage and retail outlets. Concourses/station served by larger retail outlets, passenger lounges and other ancillary uses with multiple tenants.
C	Multiple regional/intercity trains entering and leaving the station every hour via multiple platforms, high platform occupancies at specific times with baggage, refuse bins and small concessions (vending machines etc). Concourses/station served by small food and beverage and retail outlets (retail/coffee kiosk typically less than 25m²), smaller passenger lounges and ticket office.
B	Multiple regional trains entering and leaving the station every hour via 2 or 3 platforms, moderate platform occupancies at specific times with baggage, refuse bins and small concessions (vending machines and/or small ticket/retail/ coffee kiosks less than 25m2 with no internal seating). Ticket office and/or ticket machines.
A	Small number of regional trains entering and leaving the station every hour via 2 platforms ("up" and "down" platforms). Generally low platform occupancies with refuse bins and "bus shelter" passenger shelters, although some existing stations may have canopies. Typically no retail outlets.

Table 7 Fire potential factor

Fire Consequence Factor	Description
5	Potential for significant fire radiation and smoke logging of any concourse and/or platform areas, from train and/or station fires. Low ceiling heights and/or interconnected tunnels mean there is potential for high smoke densities and temperatures. Sub-surface station as defined by Sub-Surface Rail Regulations, or enclosed station as defined by BS 9992.
4	Potential for fire radiation and smoke logging of areas of concourse and platform areas, from train and/or station fires. Large volume enclosures may reduce smoke density and temperature in some areas. Enclosed station as defined by BS 9992.
3	Potential for fire radiation and smoke logging in station/concourse areas. Fire radiation and smoke build-up along platforms beneath roof/canopy with high levels of ventilation to assist in heat/smoke dissipation. Surface station as defined by BS 9992.
2	Localised areas of fire radiation and smoke build-up beneath areas of roof/canopy. Majority of station and platforms are open to atmosphere. Surface station as defined by BS 9992.
1	Fully open-air station (with the exception of small shelters/ticket office etc). Risk of localised area of radiation around a platform/ train fire but no smoke build-up. Surface station as defined by BS 9992.

Table 8 Fire consequence factor

3.2.4 Step 3 – Confirm station risk category

Once the RSFRP has been confirmed for the station, a station risk category can be assigned as per Table 9.

The design guidance in this manual is then structured to address these station risk categories, such that the design approach is risk-informed.

Station Fire Risk Category	Rail Station Risk Profile (RSFRP)
Sub-Surface	Refer to **Section 3.3**
Higher Risk	D5, C5
Medium Risk	D4, C4
Low Risk	D3, C3, B3, A3
Very Low Risk	B2, B1, A2, A1

Table 9 Station risk categories

Image 3.3 Gleneagles Station © Network Rail

3.3 Sub-Surface Stations - Design Approach

Sub-surface stations are those that contain platforms considered to be enclosed underground. The definition of a sub-surface station is given by the Sub-Surface Rail Regulations, however typically this includes platforms that are:

- Fully or mainly in a tunnel or under a building.
- If the roof or ceiling above the platform and track are at or below the ground level of any fire exit.

Sub-surface stations are considered to be the highest risk station type, due to the potential severe consequences of a fire in an enclosed, underground environment. As such, the fire safety design of sub-surface stations is required to comply with the legislative requirements of the Sub-Surface Rail Regulations. This includes specific requirements for measures such as:

- Doors to be kept locked.
- Means for fighting fire.
- Means for detecting fire and giving warning in case of fire.
- Combustible matter and materials used in internal construction of premises.
- Instruction and training of persons working in premises.

BS 9992 is the main design standard for sub-surface stations, and provides further guidance on more specific design measures, including means of escape, for sub-surface stations.

Variations from the guidance of BS 9992 for sub-surface stations should only be sought on an exceptional basis and should be demonstrated, by the competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992 and comply with the Sub-Surface Rail Regulations.

Legislation / Regulations

Fire Precautions (Sub-surface Railway Stations) Regulations 1989 (applicable in Scotland)

The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009 (applicable in England & Wales)

National Standard

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure

Image 3.4 London Liverpool Street sub-surface station © Network Rail

Fire at Nottingham Station in 2018
© Martyn Williams Alamy
Stock Photo

4

Fire Safety at Stations

Means of Escape and Evacuation Management

4.1 Means of Escape Principles

All stations should be provided with adequate means of escape. Ideally this should enable all station occupants to escape unassisted from any areas of the station in the event of a fire, although in some circumstances it may be necessary to provide assisted escape for some station occupants. The overall objective is to assure that all occupants can ultimately reach a place of safety at which they are no longer at risk from the effects of the fire.

Means of escape is a major factor in the design of any station and influences key elements such as the positioning and sizing of escape routes and exits, and the length and width of platforms. It is therefore important to consider means of escape as early as possible in the design process.

The means of escape design should be considered in conjunction with other key people-movement factors that influence station capacity and design, such as perturbation, special events and any other potential abnormal conditions. Guidance on these is available by reference to the *Station Capacity Planning* Design Manual (NR/GN/CIV/100/03).

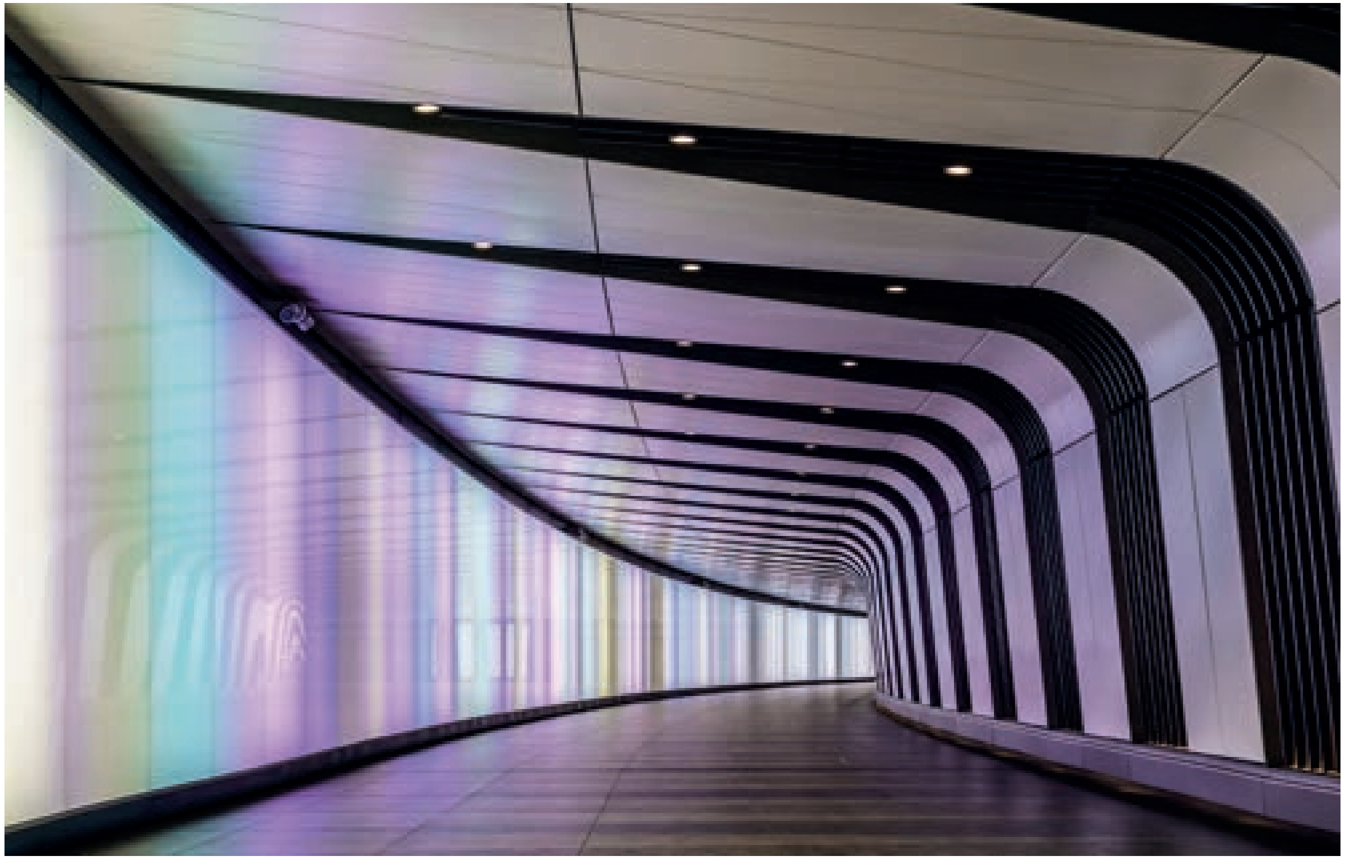


Image 4.1 Kings Cross Underground Station subway
© Colin, Wikimedia Commons

Network Rail Document

NR/GN/CIV/100/03
Station Capacity Planning

4.2 Means of Escape Design Methods

4.2.1 Overview

Every station presents unique challenges and constraints with respect to designing for means of escape. Designers therefore need to understand, evaluate and apply the tools and methods available to them, in order to develop an appropriate and proportionate design for their station for meeting the prescribed evacuation time criteria.

This section describes the design methods that can be applied for station means of escape, including:

- → Prescriptive compliance with BS 9992.
- → The Simplified Platform Escape Design Method.
- → The Network Rail Platform Emergency Egress Tool (PEET).
- → The Platform Passenger Refuge Approach.
- → A Fire Engineered approach.

Section 4.3 then provides specific guidance on the circumstances where it is appropriate to apply these methods, as a function of a station's fire risk category, and other key characteristics.

Appendix B provides case study examples of the design approaches described in this section, and how they may be applied to some common station layouts.

4.2.2 Prescriptive Compliance with BS 9992

BS 9992 provides prescriptive guidance on the design of rail infrastructure, including stations. Section 4 of BS 9992 addresses the design of means of escape as applied to "sub-surface", "surface" and "enclosed" stations.

Where areas of a station are akin to a more traditional building layout (for example staff and public areas away from platforms and other rail infrastructure), reference is primarily made to BS 9999 for more detailed design guidance. This includes reference to the BS 9999 risk profile method (not to be confused with the RSFRP method described in Section 3.2 of this Design Manual).

Image 4.2 BS 9992 © BSI

BS 9992 then provides more specific guidance with respect to the following:

- → Means of escape from platform areas, for example:
  - – Enclosed and sub-surface platforms should be provided with at least two exits, and one-way travel distances should be no more than 20m. Exits should also not be more than 100m apart (Clause 14.4.1).
  - – Surface station platforms should also be provided with at least two exits, and one-way travel distances should be no more than 20m (Clause 14.4.2).
  - – Platforms should be sized to accommodate a full train occupancy plus those on the platform awaiting that train, with an allowance of not less than 0.5m^2 per person (Clause 14.8).
- → Provision of escape routes with respect to sub-surface stations and the use of escalators and evacuation trains (Clause 14.5).
- → The design and calculation of escape capacity for platforms and stations, including consideration of the two design fire scenarios (Clause 14.6):
  - – Train on fire in the station.
  - – Fire within the station structure.

→ Means of escape for persons with restricted mobility (PRM), for example:
  - Accessible means of escape;
  - Provision of refuges; and
  - Use of lifts for evacuation of PRMs.

Following the guidance of BS 9992 (and where appropriate BS 9999) provides the most prescriptive design method for stations, but may not provide the most appropriate and proportionate design solution in all cases.

For example, the recommendation for at least two platform exits and one-way travel distances no greater than 20m applies to all stations, regardless of size or level of fire safety risk. This may prove to be a disproportionately onerous design criteria for smaller stations, such as those with a RSFRP of Low Risk or Very Low Risk (as described in Section 3.2).

As a result, Network Rail has developed a series of additional design method options for smaller stations, to provide a more proportionate, risk-based approach when compared to prescriptive compliance with BS 9992. These are described in Sections 4.2.3 to 4.2.5.

4.2.3 Simplified Platform Escape Design Method

For surface stations, Appendix A provides a tabulated method for calculating the maximum single-direction (i.e. dead-end) travel distance on a platform, as a function of the available platform width and escape route width.

This design method has been based on a conservative radiation and means of escape analysis for simple station layouts, and offers an alternative, risk-based approach to the prescriptive guidance of BS 9992.

This method is suitable for platforms with no roofs or canopies, or platforms with canopies that are limited in nature as follows:

→ Any individual canopy less than 20m length, and not enclosing the only exit(s) from the platform.

→ Individual canopies up to 40m that conform to the following:
  - At least 4.0m height (when measured to the lowest extent of the canopy roof.
  - Is open on both main sides and at least 10m from any adjacent canopies.
  - No buildings, walls or other obstructions are present within 1.5m of the canopy roof.
  - Does not enclose or connect to any escape routes or enclosed footbridges.
  - Canopies with a wall or building at the rear, where escape is possible behind the wall/building.
  - The total length of canopies should not extend for more than 50% of the platform length.

Refer to Appendix A for further details.

This method provides a simple, but inherently conservative means of designing key platform design parameters for simple platform layouts.

For design cases where this method is not applicable, or where the outputs do not produce design parameters that are practicable (as described in Section 4.4) for a particular station, the Network Rail Platform Egress Emergency Tool (PEET) may be considered, as described below.

4.2.4 Network Rail Platform Emergency Egress Tool (PEET)

The Network Rail Platform Emergency Egress Tool (PEET) has been developed by Network Rail as a decision aid to assist users to develop a platform design configuration with an acceptable level of fire safety risk.

It has been developed to replace the previous Network Rail Platform Egress Risk Model (PERM), and can be applied to platforms with no roofs/canopies, or roofs/canopies that are limited in nature, as described in Section 4.2.3.

PEET assumes that the worst-case, yet credible scenario is a growing train fire which progressively compromises the platform and exits over time. It then considers key factors such as:

- → The risk to platform occupants, with respect to the probability of a train fire event occurring and the potential consequence (i.e. occupants being unable to reach a platform exit).
- → Whether the risk level is acceptable or not.
- → Potential design options to reduce the risk to an acceptable level, and the costs/benefits of each option.
- → Identify which design options have a proportionate cost.

The tool is suitable for surface stations only (not sub-surface), and can be used to assess the risk for the following:

- → New platforms.
- → Platform extensions and modifications (addition/relocation of escape routes etc).
- → Changes in platform and train occupancies, and train characteristics (service frequency/length/loading).
- → Changes between managed and unmanaged platforms.

Whilst PEET has been developed to be as user-friendly as possible, it is recommended that application of the tool is undertaken, or supervised, by a suitably competent person. This could include a qualified Fire Engineer, or a non-fire safety design specialist with assistance from the Network Rail Fire Safety Engineer.

Note: PEET is currently under development and is not yet published. Further detailed information on PEET will be published by Network Rail in due course.

4.2.5 Platform Passenger Refuge Approach

Where it is not possible or practicable (see Section 4.4) for the means of escape design for an existing low or very low risk station to comply with either BS 9992, the *Simplified Platform Escape Design Method*, or *Platform Emergency Egress Tool*, it may be possible to adopt an alternative design approach based on the provision of platform refuges supported by specific fire safety management procedures.

This approach assumes that the platform escape route design (including number, location and sizing of exits, platform width and/or dead-end platform travel distance) is insufficient to demonstrate that all occupants are able to escape the platform safely in the event of a fire scenario. As such, there is potential for station or train occupants to gather at remote ends of a platform unable to reach an escape route, for example due to a growing train fire.

In this scenario, the *Platform Passenger Refuge Approach* requires the responsible person/fire safety duty holder, typically the Train Operating Company (TOC), to provide appropriate refuge facilities at platform ends, supported by robust procedures to address this dynamic situation. This should involve the use of trained station staff (where available) and train crew to undertake the following:

- Safely evacuate the train and, where access to a platform escape route is not possible, direct occupants to a relatively safe position on the platform (i.e. a temporary platform refuge), as remote from the fire hazard as possible.
- Communicate with the signaller (by the train driver) to immediately close all lines into the station and raise the alarm with the emergency services.
- Communicate directly with trained control room staff who have real-time awareness of the situation (e.g. via CCTV and Public Address), to agree a safe means of evacuating all passengers from the platform refuge via the most suitable method. This includes any PRMs, and any other occupants requiring assistance.
- Communicate directly with passengers remaining at the platform refuge to update them on the incident, and how/when they will be able to escape safely from the station.

The number of occupants that could be located at a platform refuge should be as low as possible, and in any case should not exceed the number of occupants that can be safely and securely supported by the management arrangements available.

Measures should also be in place to assure that occupants are not left at a platform refuge indefinitely, and a means of escape can ultimately be provided (even if initially delayed).

Note: It is the legal responsibility of the responsible person/fire safety duty holder to put arrangements in place to safely evacuate all occupants from a station / train without reliance on the emergency services. Network Rail do not support any physical reliance on non site-based staff (e.g. mobile staff or staff based at another location) to attend to an incident to support the safe evacuation of station occupants.

Evacuation methods should be pre-defined in the Station Emergency Plan, with clear criteria and decision-making processes, including where dynamic decisions based on risk require to be made. All staff who may have a role in these evacuation methods should receive regular training.

Physical provisions, where required, should be included within the station design to facilitate this approach, for example:

- Emergency voice communication (EVC) system at platform refuge locations to allow trained station/train staff and passengers (if required) to communicate with the control room staff (refer to Section 8.5 for details).
- Real-time CCTV and Public Address system inked back to the same signaller/trained control room staff to enable effective management of all passengers located at platform refuges.

Platform refuges should only be considered as a last resort for existing Low Risk and Very Low Risk risk stations, where it has been demonstrated that it is not possible or practicable to comply with either BS 9992 or the *Simplified Platform Escape Design Method*, or *Platform Emergency Egress Tool* (see Sections 4.2.3 and 4.2.4 respectively).

It is generally not acceptable to rely on platform refuges for new stations, unless in exceptional circumstances and where agreed with the Network Rail Fire Safety Engineer.

It is necessary that the station operator, as the responsible person/fire safety duty holder, is directly involved with the development of any station design that involves the *Platform Passenger Refuge Approach*, so that they are fully aware of what is required and are confident that the relevant operational procedures can be implemented.

Where the *Platform Passenger Refuge Approach* is proposed by the project design team, this should be agreed as part of the stakeholder consultation workshop (SWC), which should include fire safety representation from Network Rail.

The reasoning for adopting this approach should be formally documented, including consideration of the practicability of all options (with reference to the factors described in Section 4.4) and the decision-making process for the proposed preferred option.

Image 4.3 Existing stations like Sherbourne Station may have limited improvement options © Network Rail

4.2.6 Fire Engineered Approach

Fire engineering analysis and assessment methods may be employed by the designer as an alternative to the design methods described in Sections 4.2.2 to 4.2.5.

In some cases, this may be the only realistic means of achieving an appropriate and proportionate station design when considering the specific goals and constraints of a project.

The goal of a fire engineering approach should be to demonstrate that the design complies, as a minimum, with the legislative and Network Rail mandatory requirements described in detail in Section 1.4 to 1.6 of this document. Section 1.8 also provides guidance on the design approach for works to existing buildings.

When employing a fire engineered approach for some or all of a station design project, this should only be undertaken by an appropriately competent and qualified Fire Engineer, in consultation with the Network Rail Fire Safety Engineer.

Detailed guidance on undertaking Fire Engineered analyses and assessments for Network Rail-owned stations is provided in Appendix D of this manual

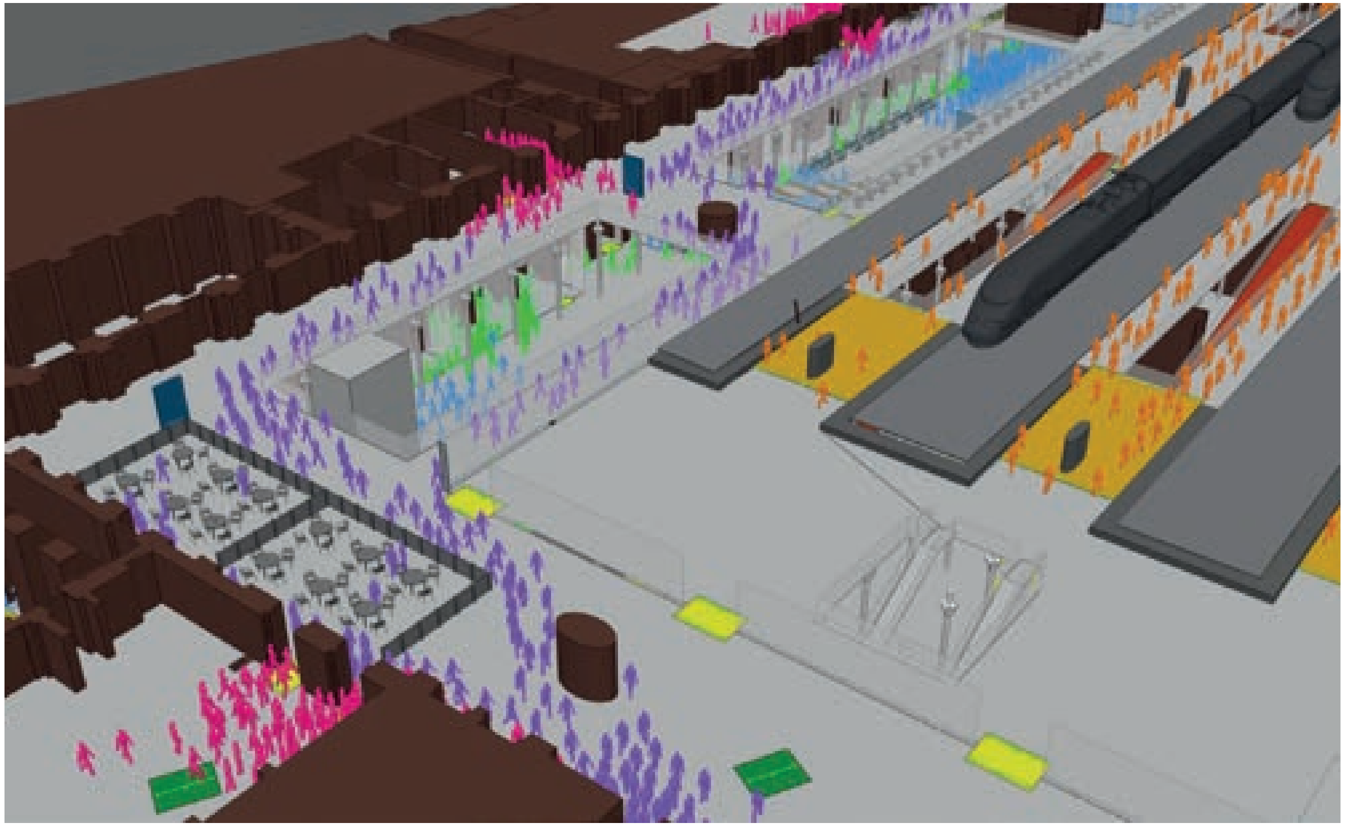


Image 4.4 Fire Engineering evacuation analysis © Arup

National Standard

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure

4.3 Means of Escape Design Approach

4.3.1 Overview

The escape route design for a station should be proportionate to its fire safety risk profile. For example, a Category A National Hub station is likely to require significantly more onerous escape provisions than a small Category E/F station due to the number of potential fire risks present and the greater volume of passengers potentially affected.

The guidance in this section provides advice on the most appropriate means of escape design approach (as described in Section 4.2) for different station risk categories.

It also assumes the minimum level of fire safety management described in Section 10 is provided at all times.

4.3.2 Sub-Surface Stations

Specific guidance on the design of Sub-Surface Stations, including means of escape design, is provided in Section 3.3.

4.3.3 Higher Risk Stations

As described in Section 3, Higher Risk stations are defined as those with a RSFRP of D5 or C5.

Higher Risk stations typically include large, busy stations with areas of low ceilings/roofs to platforms and concourses. In these stations, a high volume of train movements, plus factors such as ancillary uses such as extensive areas of retail, food and beverage outlets and interfaces with other buildings, introduce an increased potential for fire events occurring. In addition, low ceilings within the station could promote the rapid spread of fire and smoke that could affect a high number of people and escape routes.

Network Rail expect that any project involving a new Higher Risk station, or any works to an existing Higher Risk station that may affect its fire safety means of escape provisions, employs a competent Fire Engineer to develop a Fire Strategy for the project (as described in Section 1.3).

The means of escape design for a higher risk station project should be based on the guidance of BS 9992 (as summarised in Section 4.2.2). Variations from the guidance of BS 9992 may be sought provided they are demonstrated, by the competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992, and compliance with the Building Regulations where applicable, or where not applicable a risk that is *"as low as reasonably practicable"* (ALARP), as described in Section 2.5.

Higher Risk Stations (New and Existing)

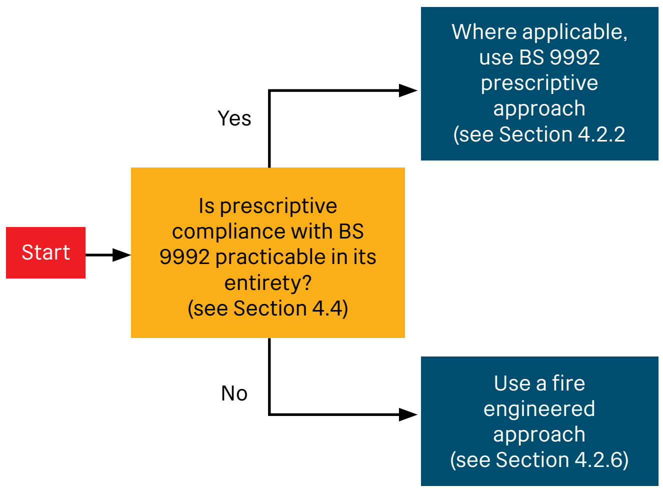


Figure 5 Flowchart summary of means of escape design approach for higher risk stations

4.3.4 Medium Risk Stations

As described in Section 3, Medium Risk stations are defined as those with the RSFRP of D4 or C4.

Medium Risk stations typically include large, busy stations with high ceilings/roofs to platforms and concourses. These could include train sheds with two or more enclosed sides and other high volume concourses/station areas. Similar to Higher Risk stations, they are likely to have a large number of trains entering and leaving, with ancillary retail, food and beverage outlets and other uses that introduce the potential for fire events. However, the larger volume spaces in the station are likely to reduce the immediate effects of fire and smoke spread on occupants and provide them with more time to escape safely.

It is expected by Network Rail that any project involving a new Medium Risk station, or any works to an existing Medium Risk station that may affect its fire safety means of escape provisions, employs a competent Fire Safety Engineer to develop a Fire Strategy for the project (as described in Section 1.3).

The means of escape design for a Medium Risk station project should generally be based on the guidance of BS 9992 (as summarised in Section 4.2.2). Variations from the guidance of BS 9992 may be sought provided they are demonstrated, by the competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992, and compliance with the Building Regulations where applicable, or where not applicable a risk that is *"as low as reasonably practicable"* (ALARP), as described in Section 2.5.

In addition, the *Simplified Platform Escape Design Method* and/or the Network Rail *Platform Emergency Escape Tool* (PEET) may be applied to stations or stations with roofs or canopies that are limited in nature (as described in Section 4.2.3).

4.3 Means of Escape Design Approach

Medium Risk Stations (New and Existing)

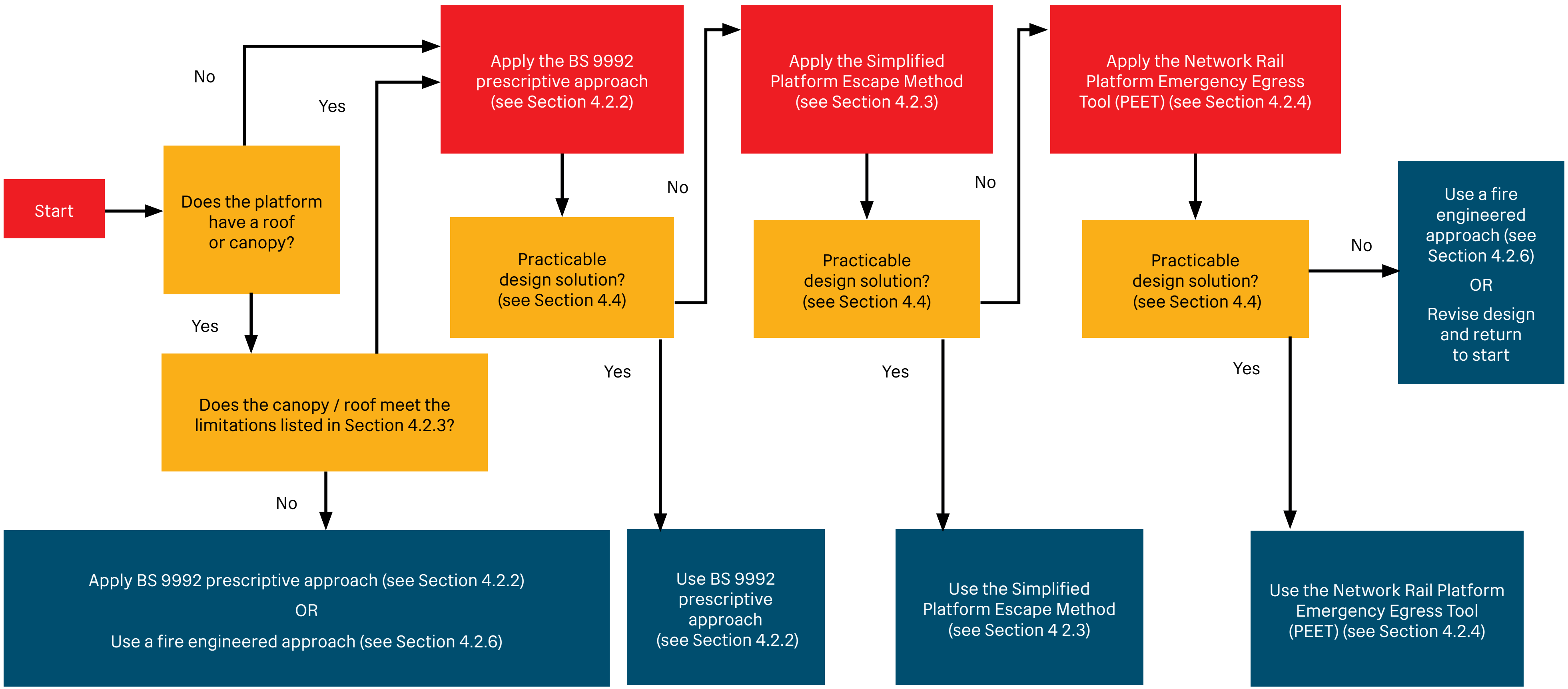


Figure 6 Flowchart summary of means of escape design approach for medium risk stations

4.3.5 Low Risk Stations

As described in Section 3, Low Risk stations are defined as those with a RSFRP of D3, C3 or B3.

Low Risk stations typically include medium-sized regional stations and smaller city stations, and consist primarily of open rail lines and large canopies covering the full width and/or length of the platforms. Station concourse areas with some limited ancillary retail/concession/kiosk uses may be enclosed by a roof, however the frequency of trains and extent of potential fire risk within the station is considerably less than a Medium Risk or Higher Risk station.

Some stations that may typically be defined as Low Risk but contain specific hazards that could increase their potential fire risk, may be deemed to be Medium Risk stations. This could include stations with non-standard arrangements of station canopies or enclosed areas, or the presence of combustible materials or other ignition/fire spread sources, that could increase the likelihood or consequence of a fire event. Where there is uncertainty regarding whether a station should be deemed to be Low Risk or Medium Risk, designers should consult with the Network Rail Fire Safety Engineer.

New Low Risk Stations

Network Rail expect any project involving a new Low Risk station, or any works to an existing Low Risk station that may affect its fire safety means of escape provisions, employs a competent Fire Engineer to develop a Fire Strategy for the project (as described in Section 1.3).

The Fire Strategy for a new Low Risk station project should be based on the following:

- **Entirely open platforms or platforms with canopies limited in nature (as defined in Section 4.2.3), where smoke and heat from a train fire is unlikely to spread beneath the canopy and adversely affect occupants escaping from the platform –** The means of escape design should be based on (in order of preference):
  - BS 9992 (as summarised in Section 4.2.2).
  - The *Simplified Platform Escape Design Method* described in Section 4.2.3.
  - The Network Rail Platform *Emergency Egress Tool* (PEET) described in Section 4.2.4.
  - When considering the most appropriate option from the above, the practicability of each option should be considered, as described in Section 4.4.
- **Platforms with a canopy that does not qualify as being limited in nature (as defined in Section 4.2.3) or a platform/station area enclosed by a roof -** Means of escape design should be based on guidance of BS 9992 (as summarised in Section 4.2.2).

Variations from the methods above may be sought via an alternative fire engineered approach provided they are demonstrated, by the competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992, and compliance with the Building Regulations where applicable, or where not applicable a risk that is "as low as reasonably practicable" (ALARP), as described in Section 2.5.

Existing Low Risk Stations

The Fire Strategy for works to an existing Low Risk station should follow the design approach described above for new stations where possible/practicable. As described above, guidance on the consideration of practicability is provided in Section 4.4.

However, it may not be possible or practicable for an existing Low Risk station to comply with the options set out above in Section 4.3.5, due to existing site constraints and/or project scope limitations. In these circumstances, an application may be made to the Network Rail Fire Safety Engineer to adopt the alternative *Platform Passenger Refuge Approach* defined in Section 4.2.5.

4.3.6 Very Low Risk Stations

As described in Section 3, Very Low Risk stations are defined as those with a RSFRP of B2, B1, A2 or A1.

Very Low Risk stations typically include small, open-air rural/sub-urban stations with only a couple of platforms and a relatively low frequency of passing trains. Fire risks are generally limited to small, isolated objects such as refuse bins, concession stands or vending machines. Small canopies or waiting rooms/shelters may be provided, however these are unlikely to affect occupants means of escape from platform areas.

New Very Low Risk stations that follow a simple design approach may not require specific Fire Safety Engineering design input unless there are non-standard aspects of the design which could present an increased fire safety risk. However, a Fire Strategy should be developed for the project by the designers (as described in Section 1.3), and this may require input from a competent Fire Engineer.

The means of escape design for Very Low Risk stations should follow the guidance for Low Risk stations described in Section 4.3.5.

Appendix B provides a series of case studies showing the application of the means of escape design principles in this section on common Very Low Risk station layouts and project types.

4.3 Means of Escape Design Approach

Very Low / Low Risk Stations (New and Existing)

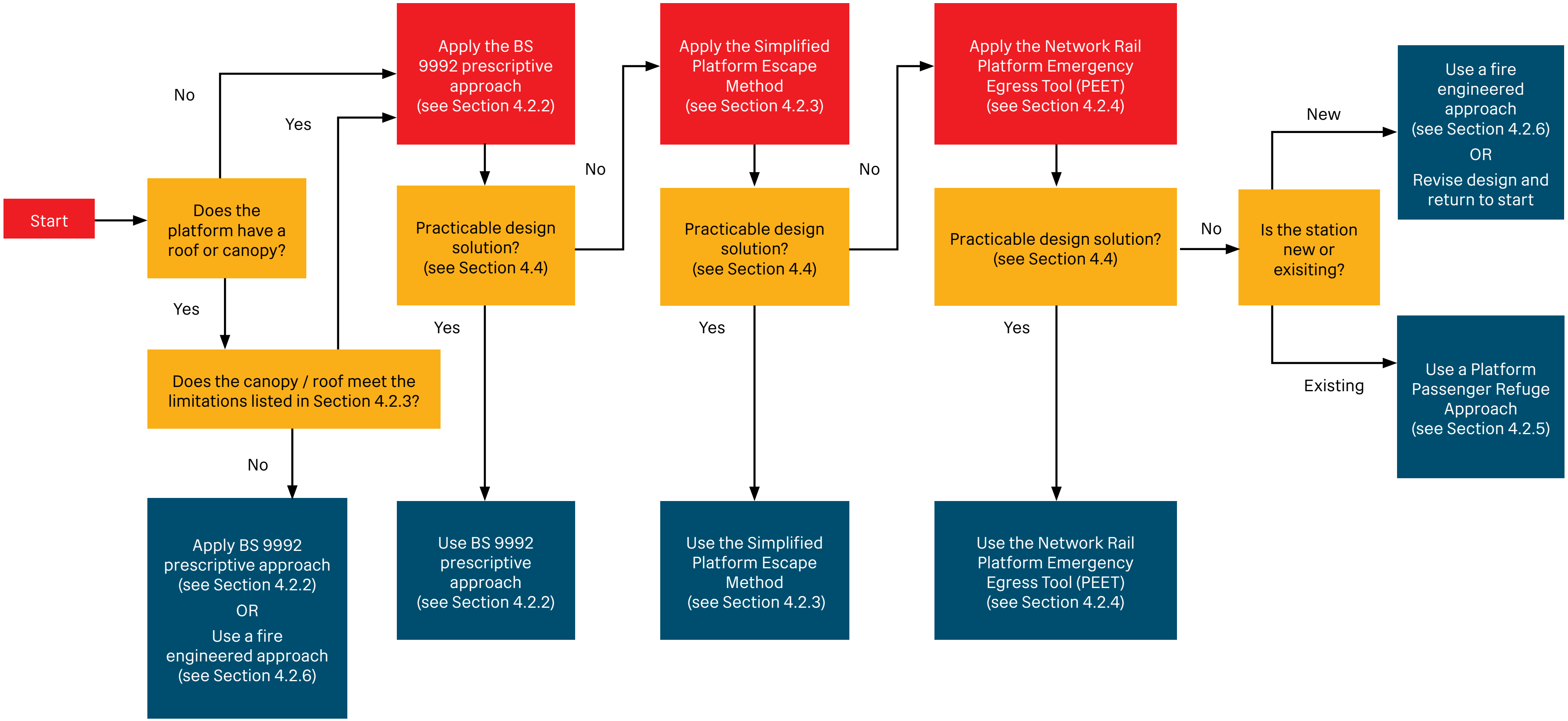


Figure 7 Flowchart summary of means of escape design approach for low and very low risk stations

4.4 Consideration of Practicability

As described in the previous sections, providing an appropriate and proportionate means of escape design for a station requires the designer to consider the practicability of all potential design options.

Consideration of practicability, with respect to Network Rail stations, should include the following factors:

- The cost/benefit of each design option with respect to life safety, capital cost and whole-life (i.e. construction, inspection, maintenance, decommissioning and deconstruction) cost.
- The benefits and limitations of each option with respect to station usability, including providing equal and dignified means of escape for persons with restricted mobility (PRM).
- Consideration of sustainability, in particular avoiding unnecessary life-cycle impacts on emissions, materials or the environment.

Therefore, whilst cost is an important consideration of practicability, it should not be seen as the only determining factor.

The Network Rail Fire Safety Engineer should be consulted and involved with the process of determining an acceptably practicable means of escape design.

Where an application to the Network Rail Fire Safety Engineer is required, the practicability of each option considered should be quantified where possible, and clearly documented. This should include options which are compliant with prescriptive guidance (e.g. BS 9992) but are deemed to be "impracticable", so that the degree of impracticability can be demonstrated and assessed.

Examples of design arrangements that may be considered to be "impracticable" and "practicable" in most circumstances are provided in Table 10 and Table 11.

Note these are described in simple terms for guidance and information only. Responsibility for assessing and demonstrating the practicability of specific design options for a project rests with the design team.

Appendix B provides case study examples of the design approaches described in this section, and how the consideration of practicability could be applied to some typical station layouts.

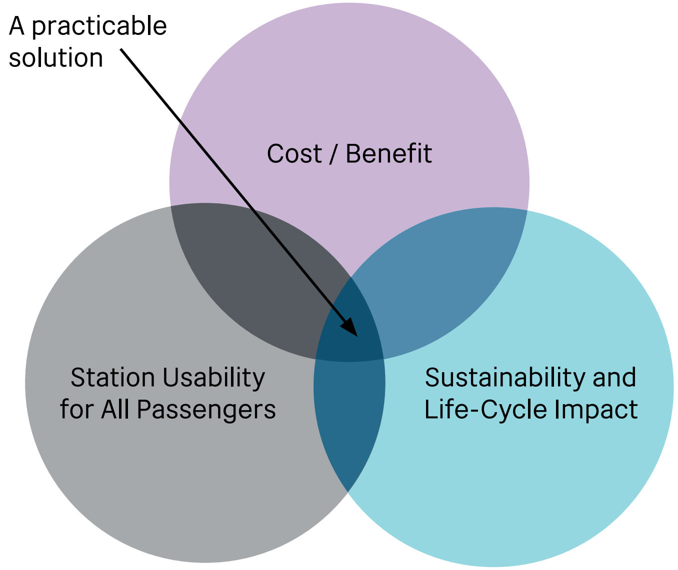


Figure 8 Consideration of practicability for means of escape

4.4 Consideration of Practicability

Examples of "impracticable" means of escape design
Platform means of escape requiring excessive ramp gradient/lengths. It is typically impracticable to provide a ramped means of escape from a platform that requires a significant level change (i.e. level change, gradients or lengths in excess of relevant accessibility standards such as *Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland*, 2015). This includes any means of escape from a platform either directly to a place of safety (e.g. platform exit ramps to an adjacent public area), or as part of an escape route to a place of safety (e.g. footbridges or footbridges).
Additional footbridge/subway required only for evacuation purposes. It is typically impracticable to provide an additional footbridge or subway to a platform, which is required only for the purposes of emergency evacuation (i.e. not required to satisfy other station design considerations such as general access/circulation).
A widened platform with excessive widths required only for means of escape. It is typically impracticable to provide an excessively widened platform solely for the purposes of evacuation, where the widening significantly impacts on factors such as platform design, topography, capital/whole-life costs and life-cycle impact. Side platform widths in excess of 6m usable width may typically be considered to be impracticable in most circumstances, however this may vary on a project-specific basis depending on the factors above.

Table 10 Examples of "impracticable" means of escape design

Examples of "practicable" means of escape design
A simple platform exit to an adjacent public area. Where a platform exit (e.g. secondary means of escape) may be provided to an adjacent public space, such as a road, car park or public path. A ramp may be a practicable solution to resolve minor changes in level, where compliant with relevant accessibility standards (e.g. *Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland*, 2015). Appropriate measures may be provided to secure the platform exit for security/revenue protection purposes, provided the exit remains available for escape at all times. It may also be practicable to provide additional paths (within the station boundary) to reach an adjacent public area, subject to an appropriate project-specific assessment of additional requirements/considerations such as lighting, security, accessibility and costs etc.
A widened platform that can be constructed within the station boundary. Where a widened platform can be provided within the station boundary, or without significant additional land-take. Side platform widths of between 4-6m usable width may be considered as reasonable in most circumstances, however this may vary on a project-specific basis depending on factors such as platform design, topography, capital/whole-life costs and life-cycle impact.
Ramped means of escape where compliant with relevant accessibility standards. Ramps forming part of any escape route, where compliant with relevant accessibility standards (e.g. *Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland*, 2015), may provide a practicable design solution subject to a project specific assessment of factors such as station usability, weather-protection and costs.

Table 11 Examples of "practicable" means of escape design

Network Rail Document

NR/GN/CIV/300/04
Inclusive Design Manual

National Standard

BS 9999: 2017
Fire safety in the design, management and use of buildings

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure

4.5 Persons with Restricted Mobility (PRM)

4.5.1 PRM evacuation design principles

Persons with restricted mobility, or PRMs, can be affected by a wide spectrum of physical and cognitive impairments that could impact their ability to safely escape from a station. Additionally, other passenger groups may require assistance to escape, including elderly people and those with buggies/prams and other mobility devices.

Designers should therefore consider the ability for all PRMs (and occupants requiring assistance) to escape safely and not just, for example, wheelchair users.

By law, employers, businesses, public bodies and transport services are required to make reasonable adjustments for PRMs to assure safe access and egress. In practice, this means that they should not be exposed to a significantly greater risk from fire compared with other occupants.

Furthermore, the means of escape design should not discriminate against PRMs. For example, providing a refuge with no primary mode of (assisted or unassisted) escape would not be acceptable.

Network Rail's approach and objectives regarding inclusive design are described in the *Inclusive Design* Manual (NR/GN/CIV/300/04). This includes ensuring that PRM escape is an integral part of the architectural design concept.

Where possible, measures to facilitate self-evacuation should be prioritised over those that require assistance or staff intervention. This includes (in order of preference) approaches such as:

- → Level escape routes from stations and platforms to an area of ultimate safety.
- → Ramped escape routes (with a gradient, width, provision of landings etc compliant with relevant National requirements) from stations and platforms to an area of ultimate safety.
- → Evacuation lifts (or beneficial use of passenger lifts for evacuation) from stations and platforms to a place of ultimate safety. Please refer to Section 4.5.2.
- → Level, ramped or lift-assisted escape routes from platforms to a place of relative safety within a station (i.e. refuge), where assisted onward egress to a place of ultimate safety is possible.

Reliance on staff assistance to facilitate the manual evacuation of PRMs from station areas and refuges should be avoided wherever possible (and not relied upon at all at unstaffed stations). Where unavoidable, physical measures should be provided such as emergency voice communication systems and evacuation devices (refer to Section 8.5 for details).

BS 9992 and BS 9999 provide specific guidance on the means of escape design for PRMs.

It is not acceptable to rely on the Fire & Rescue Service to evacuate PRMs from a station. This is the responsibility (under Regulations) of the responsible person/fire safety duty holder.

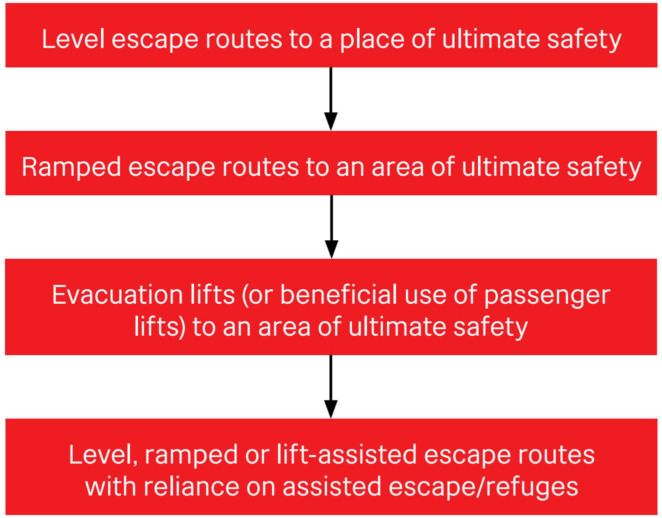


Figure 9 Hierarchy of PRM evacuation design principles

4.5.2 Lifts for Evacuation

Where designed and used appropriately, lifts can provide an efficient and dignified means of evacuating PRMs, whilst avoiding onerous management measures such as manual lifting and lowering.

Evacuation lifts should be considered as the preferred means of vertical escape for PRMs from all accessible areas of Network Rail stations, where level or ramped egress is not possible/practicable. Evacuation lifts should comply with the guidance set out in BS 9992, BS 9999 and other referenced standards.

Beneficial use of passenger lifts for evacuation

Whilst the preferred method, it is recognised that evacuation lifts (which are compliant with BS 9999 etc as described above) can provide challenges to station operators, on the basis that they rely on operation by trained staff. This commonly makes them unsuitable for smaller stations with limited or no permanent staffing.

Therefore, in some circumstances, it may be appropriate to utilise lifts that are not specifically designed as evacuation lifts (as defined by BS 9999), and can be used directly by occupants/passengers without physical staff intervention.

This applies only to specific station/lift arrangements where the risk to occupants evacuating via the lift is sufficiently low, such as lifts within Low Risk or Very Low Risk stations that serve footbridges and other escape routes, where all levels of the lift are visible and open to atmosphere.

This approach, whilst deviating from BS 9992 and BS 9999 guidance for the specification of evacuation lifts, provides a more proportionate means of evacuating PRMs from smaller stations and platforms. The approach seeks to balance the costs and management implications of providing fully compliant evacuation lifts, whilst still enabling a safe and dignified means of evacuation for PRMs.

For example, a platform on a small rural train station may be provided with a footbridge, with passenger lifts on each side. Where no other level escape route from the platform is available, utilising the passenger lifts may be the most efficient and dignified means of escape for PRMs. In this circumstance, if the lift is located in the open-air and all levels are visible, occupants should be able to visually identify whether the lift is safe to use in an emergency situation. An example of this is provided in Case Study 4 in Appendix B.

4.5 Persons with Restricted Mobility (PRM)

A passenger lift (i.e. a lift used for the movement of passengers, and not specifically designed as an evacuation lift) may be proposed as a vertical means of escape for PRMs, subject to the following:

- The passenger lift is located in the open-air (including lifts in weather-protected enclosures), in a Low Risk or Very Low Risk station, and all lift levels are visible.
- The passenger lift is constructed in accordance with BS EN 81-20, including a remote alarm system in compliance with BS EN 81-28.
- The lift complies with the recommendations of BS 9992 Clause 16.4.1 *(fire protection of lifts and refuges – open areas)*. Where lift wells are located on an open platform, it is not normally expected that fire resisting enclosure or protected lobbies will be required, unless a specific need is identified that requires additional fire protection to the lift well (e.g. a fire hazard adjacent to the lift).
- The lift shaft (and any associated lift plant room) is provided with a self-contained, mains-powered automatic fire detection system compliant with BS 5839-1, which will disable the lift in the event of a fire activation within the lift shaft or any associated plant spaces (in accordance with BS EN 81-73). The intent of this is to assure occupants do not become trapped in the lift in the event of a fire. Alternatively.
- Where the station is unstaffed and not provided with a standalone fire alarm system, and where only a small number of smoke detectors are required to serve the lift shaft (and plant room, if provided), detection according to BS 5839-6 may be installed, where this is monitored at all times by the lift management system and the lift is disabled upon activation.
- Where the lift serves a covered/enclosed footbridge, the automatic fire detection system described above is extended to the enclosed footbridge area outside the lift door.
- Any air intake vents are positioned and designed to reduce the possibility of smoke migration into the lift shaft and lift motor rooms.
- The lift is provided with a primary and secondary power supply in accordance with BS 9999 Annex G.2.2, or a single power supply on a separate circuit to all other station circuits and either.
  - Routed such that it will not be affected by a station or train fire (e.g. located below ground and/or away from any fire hazards).
  - Formed of Category 2 fire resistant cables in compliance with BS 8519.
- Signage is provided advising occupants that the lift is available for use in an emergency if safe to do so. Alternative or additional methods could also be proposed such as automated voice messaging.
- The lift and the surrounding area is covered by real-time CCTV and Public Address, linked back to a fire control centre that can remotely disable the lift in the event of a potential hazard being identified, and provide guidance to PRMs as required.
- An emergency voice communication (EVC) system should be provided adjacent to the lift, to allow passengers or staff to communicate directly with trained control centre staff with access to real-time CCTV. Refer to Section 8.5 for further guidance.
- In the event of the lift being out-of-use (for maintenance etc), the responsible person/fire safety duty holder is responsible for developing an appropriate temporary fire risk assessment and management plan for the evacuation of PRMs from the station.

The design and any fire safety management procedures for its use in an emergency should be clearly documented within the station Fire Strategy (or Fire Safety Impact Assessment) and agreed in writing with the Network Rail Fire Safety Engineer.

4.5 Persons with Restricted Mobility (PRM)

Note: A formal specification for the beneficial use of passenger lifts for evacuation is currently under development by Network Rail at the date of publication of this Design Manual, therefore the guidance provided in this section may be subject to change. Designers seeking to adopt this approach should consult with the Network Rail Fire Safety Engineer.

Image 4.5 Reston Station ribbon footbridge with lifts © Network Rail

National Standard

BS 9999: 2017
Fire safety in the design, management and use of buildings

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure

BS EN 81-20: 2020
Safety rules for the construction and installation of lifts - lifts for the transport of persons and goods. Passenger and goods passenger lifts (Incorporating corrigendum April 2021)

BS EN 81-28: 2018
Safety rules for the construction and installation of lifts - lifts for the transport of persons and goods. Remote alarm on passenger and goods passenger lifts (Incorporating corrigendum January 2019)

BS 5839-1: 2017
Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises

BS EN 81-73: 2020
Safety rules for the construction and installation of lifts - particular applications for passenger and goods passenger lifts.

BS 5839-6: 2019
Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises (+A1:2020)

4.6 Access for All Schemes (AfA)

Network Rail is undertaking a programme of works to improve access to rail stations for persons of restricted mobility (PRM), named the Access for All Scheme (AfA). The scheme involves undertaking work to existing stations to improve step-free access to station and platform areas.

Commonly, AfA schemes for existing stations involve the introduction of short ramps, lifts and other measures to provide an inclusive means of accessing (and egressing from) stations for occupants with cognitive and/or mobility impairments. By definition, AfA schemes therefore result in the introduction of wider access to station and platform areas for PRMs where limited access was previously available. With respect to fire safety, this therefore requires consideration of providing a means for these occupants to escape in an equitable and safe way.

One of the key challenges for AfA schemes is providing improved escape arrangements for PRMs to stations, where existing site constraints may limit the ability to provide simple step-free access/egress routes from platforms.

Image 4.6 AfA Scheme at Tring Station © Network Rail

Whilst the Building Regulations apply to all new building works, there is no requirement to upgrade a station to meet current standards. Instead it is necessary to ascertain whether any works associated with an AfA scheme have an adverse effect on any existing fire safety arrangements (i.e. making the existing situation worse), and if so, provide appropriate measures to negate this effect such that the risk is “as low as reasonably practicable” (ALARP), as described in Section 2.5.

This should be documented as part of a Fire Safety Impact Assessment (FSIA), as described in Section 1.3.1.

With respect to improvements to means of escape for PRMs, AfA schemes should include the provision of:

- → Suitable and sufficient measures to facilitate safe and dignified escape for all passengers.
- → Measures which are not discriminatory in context of providing an equivalent level of safety in comparison to fully mobile evacuees. Therefore, PRMs should not be exposed to a significantly greater risk than fully mobile occupants.

The guidance provided within this section of the Design Manual provides a framework to developing an appropriate means of escape design for all occupants from existing stations, and can be applied to AfA schemes.

In particular, the beneficial use of passenger lifts for evacuation, and other design methods aimed at ensuring all occupants are able to escape from platform areas, should provide a useful means of developing a successful AfA scheme design.

For the avoidance of doubt, the following design measures are **not** appropriate for use as part of an AfA scheme (or any other type of works to new and existing stations):

- → Measures that result in PRMs being afforded a less equal opportunity to escape, when compared to fully mobile occupants. For example, providing a refuge intended exclusively for use by PRMs to avoid providing step-free egress from platform ends.
- → Providing a refuge or other area in a station where PRMs are expected to wait indefinitely, or for an extended duration of time when compared to fully mobile occupants, for assistance to escape.
- → Placing any form of reliance on physical assistance from any of the following, to assist PRMs from escaping from a station safely;
  - Members of the public,
  - Untrained staff,
  - Off-site staff,
  - Fire Service personnel.

2004 train fire caused by starter motor fault
© PA Images / Alamy Stock Photo

5

Fire Safety at Stations

Internal Fire Spread

5.1 Internal Fire Spread Principles

The optimum solution for fire safety is prevention of a fire occurring in the first place. However, it should be assumed at the design stage that a fire may occur in the station. Consequently, sufficient protection should be in place to prevent a small fire becoming large.

The principle of fire safety design is to prevent a fire spreading to such proportions that it will detrimentally impact on station occupants escaping and fire fighters attending the fire. This also brings benefits beyond just life safety, by limiting fire damage and the impact of this on operational continuity and other key objectives. This is usually addressed by providing fire resisting enclosures (compartmentation) or fire suppression (sprinklers etc) or a combination of both.

The potential risk associated with combustible materials for both occupants and firefighter safety needs to be considered. The provision of controlling fire spread is inextricably linked to the means of escape provisions. For example, a large amount of combustible material on a platform that has two remote means of escape routes may present a significantly lower risk than the same amount of combustible material on a platform that only has a single direction means of escape.

BS 9992 is the primary guidance document for the design of internal linings, elements of structure and compartmentation.

BS 9992 bases guidance on the level of enclosure of stations. For example, “sub-surface”, “enclosed” and “surface” stations are all defined. The level of enclosure for the station should be determined before applying the recommendations of BS 9992.

BS 9992 recommends for all materials used in station premises to have minimal contribution to fire growth. This reduces the potential of large uncontrollable fires within stations and providing sufficient time for occupants to escape before the fire could impact on them. Added levels of protection are considered in BS 9992 to protect business critical assets and business continuity.

Stations are becoming more sustainable in their function and in their build-up. This may include the introduction of combustible materials like timber. The use of timber or any combustible material within station design should be discussed and agreed with all relevant stakeholders as soon as possible, including the Network Rail Fire Safety Engineer.

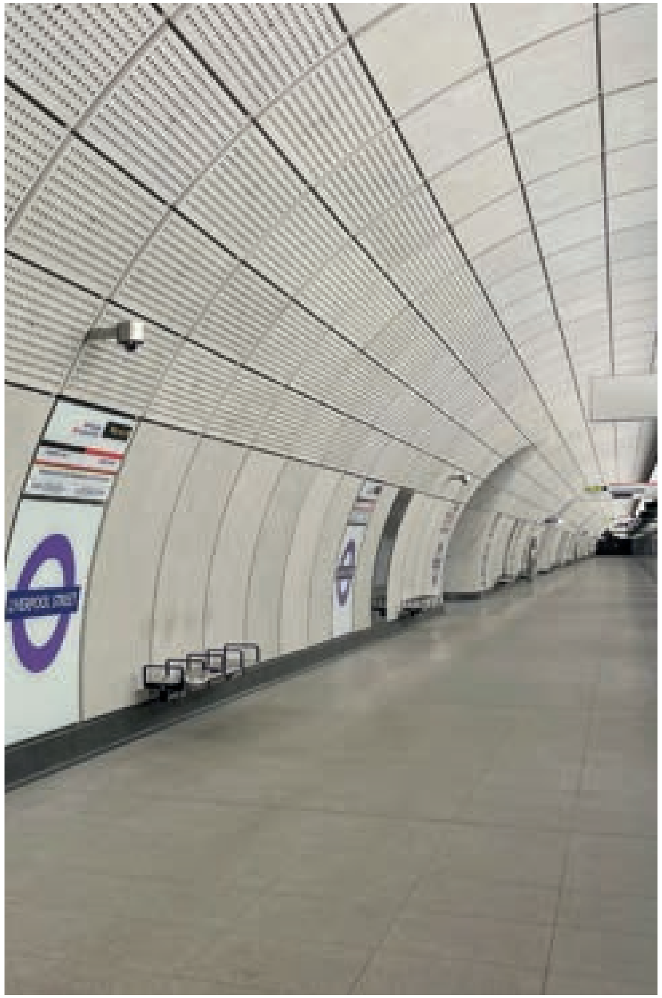


Image 5.1 Liverpool Street Concrete Panel Lining © Network Rail

5.2 Internal Linings

The choice of materials used in a station should not directly contribute to the intensity of a fire. However, the reaction to fire of these materials will impact how the fire develops and spreads. The key elements to consider are the rate at which flames propagate over the surfaces, the smoke production and the tendency to produce burning droplets or particles. These factors should be reviewed before determining the choice of materials and finishes.

All stations should follow the guidance of BS 9992 for materials and finishes.

Variations from the guidance of BS 9992 may be sought provided they are demonstrated, by a competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992 and, where applicable, comply with the Building Regulations. This could include the proposed use of internal lining materials such as exposed timber, or other materials which do not comply with the guidance of BS 9992, and should consider the impact of these materials on the life safety of occupants and operational continuity of the station.

Please refer to Section 6.1.2 for further discussion and guidance regarding the use of timber as an external/internal lining or construction material.

Image 5.2 London Bridge Station concourse with timber ceiling linings © Network Rail

5.3 Elements of structure

5.3.1 General

The purpose of providing fire protection to loadbearing elements of structure is so that they can withstand the effects of fire to an appropriate degree, without losing their capability to:

- → Protect escape routes inside and outside of the station, allowing sufficient time for escape.
- → Restrict fire spread between fire resisting enclosures so that these enclosures remain standing for the duration they are required to.
- → Reduce the risk to Fire & Rescue Service personnel who may require access to the structure for fire-fighting operations.

All stations should follow the guidance of BS 9992 and BS 9999 for the fire safety design of loadbearing elements of structure.

BS 9992 recommends the following minimum levels of structural (loadbearing) fire resistance, as defined in BS EN 13501-2. These should be achieved by all elements of structure, regardless of the provision of sprinklers:

- → 60 minutes for surface stations.
- → 90 minutes for enclosed stations.
- → 120 minutes for sub-surface stations.

However, the level of enclosure should not be the only factor which is used to determine the required period of fire resistance of elements of structure for a station. Other characteristics which should be considered include the following:

- → The height of the station.
- → The depth of the basement (if a basement forms part of the station design).
- → The evacuation strategy i.e. a simultaneous evacuation strategy or phased evacuation.

BS 9999 provides specific guidance on the consideration of these factors when determining the fire safety performance of elements of structure. This may result in a higher fire performance being required than the minimum values above.

Common methods for providing structural fire protection include fire resistant boarding systems, intumescent paints, cementitious sprays or reliance on the inherent fire performance of materials forming the element of structure (typically for steel and timber).

The proposed means for providing the appropriate level of structural fire resistance should be clearly identified to the Network Rail Fire Safety Engineer, and included within the station's Fire Strategy.

Variations from the guidance of BS 9992 may be sought provided they are demonstrated, by the competent Fire Engineer, to provide an equivalent level of fire safety to BS 9992 and, where applicable, comply with the Building Regulations.

Image 5.3 Complex loadbearing and non-loadbearing structures at King's Cross Station © Arup

5.3 Elements of structure

5.3.2 Use of timber and other combustible materials

Where elements of structure are constructed of materials which are combustible (i.e. materials not classed as A1 in accordance with BS EN 13501-1), for example glass reinforced polymer (GRP), fibre reinforced polymer (FRP) or timber structures, their fire resistance performance should achieve at least 20 minutes structural (loadbearing) fire resistance, and/or comply with the recommendations in Section 5.3.1, whichever is more onerous.

The fire resistance of timber structures should be verified using fire test data. For timber structural members, the fire resistance is often achieved by relying on the charring of the outer layer of the timber. The timber is allowed to char and form a sacrificial layer which provides the protection to the remaining timber structure. The rate of charring will depend on the species of timber. Refer to BS EN 1995-1-2 for further guidance.

5.3.3 Canopies and roofs

Station and platform canopies/roofs typically do not require a structural fire resistance performance if they are free-standing and/or self-supporting, unless required to do so to meet fire safety objectives beyond those of life safety and compliance with the Building Regulations.

However, canopies that are supported by (or form part of) loadbearing elements of structure, and/or are considered to be business critical, should achieve the relevant fire resistance performance recommended by BS 9992 and BS 9999.

For example, a canopy which forms part of a structure that supports a floor or compartment wall may require structural fire protection.

Where combustible materials are proposed for canopies (e.g. timber), these should be carefully considered so that they achieve the recommendations outlined in Section 6, with respect to surface spread of flame.

Image 5.4 Platform canopy at Stamford Station © Network Rail

National Standard

BS EN 1995-1-2: 2004
Eurocode 5: Design of timber structures. General - Structural fire design (incorporating corrigenda June 2006 and March 2009)

5.3 Elements of structure

5.3.4 Footbridges

Footbridges provide a key circulation route to and from station platforms. Additionally, they provide a potential route of escape in the event an evacuation, if available.

In the event of a fire directly affecting the footbridge (e.g. a train fire beneath the bridge), it should be assumed that the footbridge is not relied upon for escape. It is therefore generally appropriate and proportionate for footbridges, which are constructed of non-combustible materials (e.g. steel, concrete etc) and located in surface (and some enclosed) stations, not to be provided with structural fire protection

However, the following types of footbridges should be provided with at least 30 minutes structural (loadbearing) fire resistance:

1. Footbridges within sub-surface stations;

2. Footbridges within enclosed stations, where there is potential for a build-up of heat from a fire to impact the structure; and either

A. Occupants are not provided with an alternative escape route.

B. Occupants using the footbridge may not be aware of a fire hazard whilst using it (for example enclosed footbridges, or footbridges which do not directly communicate with the station/ platform area below).

Consideration should be given to ongoing maintenance requirements of fire protection to footbridges, as well as the protection of any services for life safety systems which may be supported by, or pass under, a footbridge.

Image 5.5 Footbridge at Market Harborough Station © Network Rail

The fire protection strategy for footbridges should be documented within the station's Fire Strategy. Where footbridges within enclosed stations are proposed to be unprotected, this should be discussed and agreed with the Network Rail Fire Safety Engineer.

All footbridges constructed of materials which are combustible, for example glass reinforced polymer (GRP) or timber structures, should achieve at least 20 minutes structural (loadbearing) fire resistance.

5.4 Compartmentation & Fire Separation

5.4.1 General

Compartmentation refers to the provision of fire resisting enclosures to prevent a fire spreading beyond the room of fire origin. This is a key element of the Fire Strategy design for a station, not only with respect to the life safety of occupants, but also to minimise damage and disruption to the operational railway.

Compartmentation can often utilise physical features of a building's design such as solid walls and floors to create physical barriers to resist the spread of fire and smoke.

All stations should follow the guidance of BS 9992 and BS 9999 for compartmentation. Variations from this guidance may be sought provided they are demonstrated, by a competent Fire Engineer, to provide an equivalent level of fire safety and, where applicable, comply with the Building Regulations.

Fire resistance requirements can, in some circumstances, be reduced where an automatic fire suppression system is provided, as described by BS 9999.

An up-to-date set of compartmentation drawings should be maintained for the station as part of its Fire Strategy information. Refer to Appendix C for further guidance on the content of a station Fire Strategy.

5.4.2 Openings in compartmentation

Openings are frequently required in fire resisting ceilings, walls or floors to allow the passage of services etc. This includes but is not limited to doors, pipes, risers, ducts and cables.

Fire rated seals (commonly referred to as fire-stopping) are required for openings in compartment walls/floors so that the fire resisting enclosure of compartments are maintained.

Openings in all compartmentation should meet the recommendations given in BS 9992, Clause 44.3.

Fire doors and shutters

Fire doors and fire shutters/curtains should achieve at least the same fire resistance as the wall in which they are installed, in accordance with BS 9992 Clause 44.3.2.

Fire curtains and fire shutters often provide only limited "insulation" fire resistance performance (typically a maximum of 30mins).

If a fire shutter/curtain is proposed that does not meet the relevant "insulation" fire resistance, a risk assessment should be undertaken by a competent Fire Engineer to confirm that it provides an appropriate level of performance. This may include consideration of the systems' "integrity" and "radiation" fire resistance (as described by BS 8524-1), and the potential impact on compartmentation and means of escape.

Where a lift shaft is enclosed in fire rated construction (for example as part of a firefighting shaft), the lift doors should achieve FD30 (without smoke seals) in accordance with BS 9999.

Consideration relating to security requirements for fire doors should also be given. Please refer to the *Security in Stations* Design Manual (NR/GN/CIV/300/02) for further guidance.

National Standard

BS 8524-1: 2013
Active fire curtain barrier assemblies. Specification

BS 9999: 2017
Fire safety in the design, management and use of buildings

Network Rail Document

NR/GN/CIV/300/02
Stations Design Manual

Published Document

ASFP Red Book, Association of Specialist Fire Protection

Fire-stopping and service penetration seals

Fire-stopping and service penetration seals should meet the recommendations given in BS 9992, Clause 44.3.3. Further guidance is available from industry best-practice guides such as the ASFP Red Book.

Fire-stopping should only be installed by third-party accredited contractors, and appropriate products should be selected that reduce the potential for unauthorised damage or interference. For example where openings are commonly used to run IT cables, a proprietary fire-stopping sleeve or other high-traffic cabling system should be considered.

Image 5.6 Set of FD60 fire doors between Glasgow Queen Street Station High & Low Level Stations © Arup

Fire dampers and ductwork systems

Where air handling services and ductwork penetrate fire resisting walls and floors, they should not compromise the fire performance of the element they pass through.

Measures to maintain the fire-resistant performance of walls and floors for ductwork penetrations are commonly achieved by means of one or more of the following methods:

→ Thermally actuated fire dampers.
→ Fire resisting enclosure.
→ Fire-resisting ductwork.
→ Automatically actuated fire smoke dampers.

BS 9999 Clause 32.5.2 provides guidance on the methods above, including the appropriate design circumstances for each.

The location and type of fire dampers should be clearly identified on the relevant system drawings for the station, and should be positioned to enable them to be accessed for regular inspection, testing and maintenance.

Image 5.7 Example of a cable penetration sealed with firestopping © Arup

5.4.3 Compartmentation of ancillary facilities

Ancillary spaces within stations, such as retail units, concession/catering outlets and storage spaces, provide important spaces to enhance the passenger experience, generate income and assist with day-to-day station management.

However, these spaces should typically be separated from other concourse and platform areas by fire resistant construction to minimise the potential for a fire event from affecting the operational railway, and the life safety of station occupants.

Retail/catering facilities and storage areas should therefore be enclosed by a minimum of EI 60 (in accordance with BS EN 13501-2) fire resistant construction.

Fire doors and fire shutters used as part of this enclosure should achieve a minimum of E 60.

Where the enclosure of retail/catering is not practicable (for example standalone concession stands or units within open concourses), consideration of alternative Fire Engineering design approaches may be appropriate. This may involve the use of smoke control and/or automatic fire suppression systems to contain the spread of fire and smoke. Further guidance on the use of Fire Engineering analysis is provided in Appendix D.

Image 5.8 Retail Units at Birmingham New Street Station © Network Rail

Where retail areas are connected to the station, but are intended to be operated independently (for example an adjacent shopping centre/precinct with different opening hours and/or a separate fire safety management regime), these should be separated from the station by a minimum of EI 60 construction. This includes any associated concourse/mall spaces serving the retail area.

National Standard

BS EN 13501-2: 2023
Fire classification of construction products and building elements. Classification using data from fire resistance and/or smoke control tests, excluding ventilation services

Leeds Station
© Paul Childs, Railway Heritage Trust

6

Fire Safety at Stations

External Fire Spread

6.1 External Façade

6.1.1 Overview

A key consideration for the fire safety design of buildings is the risk of fire spreading over the external surface (façade), and from one building to another.

The risk of external fire spread across the façade generally increases with building height and the combustibility of its component parts, whilst the risk of fire spread between buildings typically decreases with separation distance and the provision (or not) of fire suppression.

These factors are addressed in the following sections.

6.1.2 Fire spread across a building façade

The external walls of all buildings forming part of Network Rail-owned stations should comply, as a minimum, with the guidance of *BS 9999* (in England and Wales) or the *Non-Domestic Technical Handbook* (in Scotland).

In addition, Network Rail will generally not support the use of external wall materials or components with a reaction to fire classification worse than Class B (in accordance with BS EN 13501-1). This includes components such as external surfaces and insulation.

Furthermore, Network Rail expects that all parts of the external façade for sub-surface, Higher Risk and Medium Risk stations (in accordance with Section 3.2) achieve Class A1 or A2.

The use of timber for exposed external wall, ceiling or canopies is discussed further below.

Use of Timber and other Combustible Materials

Timber is becoming a common construction material for new stations, owing to its advantages in terms of embodied carbon and other sustainability metrics, and its use is to be supported where possible. However, timber is combustible, and the fire risk associated with the use of exposed timber requires to be considered and assessed as part of the station design.

Exposed timber surfaces on station buildings should either comply with *BS 9999* or the *Non-Domestic Technical Handbook*, or achieve Class B in accordance with BS EN 13501-1 (whichever is more onerous).

Timber used for the construction of canopies and other non-building station infrastructure should also generally achieve Class B.

With fire retardant treatment, timber can typically achieve a maximum of a Class B classification. However, there are practical limits to the types and sizes of timber elements that can be treated, and therefore fire-retardant treatments may not be feasible in all cases. In addition, fire retardant treatments often have limitations to their serviceable life and may need to be re-applied regularly, particularly when used in an external environment.

Where exposed timber (or any other material) is proposed that does not comply with the guidance above, a detailed risk assessment should be carried out by a competent Fire Engineer to demonstrate that the life safety of station occupants is not affected. This assessment should consider the specific combustible design arrangement and its impact on means of warning and escape, internal and external fire spread, and firefighting access. This risk assessment should be submitted to the Network Rail Fire Safety Engineer for review and included in the station's Fire Strategy.

6.1.3 Fire spread between buildings

BS 9999 Section 35 provides guidance on the design of external walls to reduce the risk of fire spread between buildings. This includes consideration of the distance between buildings, or to the relevant site boundary where there are no adjacent buildings (but may be in the future).

Where a building is less than 1m from the relevant boundary (or an adjacent building), there is an increased risk of flame spread between buildings. As such, BS 9999 recommends that external walls are formed of non-combustible material, achieve an appropriate level of fire resistance and openings and other extents of openings are limited.

Where a building is more than 1m from the relevant boundary (or an adjacent building), BS 9999 provides a design method for determining the appropriate degree of fire resistant performance for the external wall. This seeks to control or limit the areas of openings or areas of non-fire resisting external walls, depending on the distance to adjacent buildings or a relevant boundary.

The provision of fire suppression within the building can significantly reduce the requirements for fire performance.

Image 6.1 Birmingham New Street facade © Network Rail

Where a degree of fire resisting performance is required from the external walls, it is important to consider the fire performance of the entire façade assembly, and not just the individual components.

Building or platform canopies generally are not required to be considered with respect to the risk of fire spread between buildings, in view of the high degree of ventilation and heat dissipation achieved.

National Standard

Approved Document B, 2022, Department for Levelling Up, Housing and Communities, UK Government

BS 9999: 2017
Fire safety in the design, management and use of buildings

BS EN 13501-1: 2018
Fire classification of construction products and building elements.

Non-Domestic Technical Handbook, 2023, The Scottish Government

External Fire Spread

6.2 Roof

6.2.1 General

The risk of fire spread to a building from an adjacent building via burning embers landing on the roof should also be considered.

BS 9999 Section 35 provides guidance on the fire performance of the external surface of roofs, depending on its proximity to the relevant boundary.

6.2.2 Photovoltaic (PV) Panels

PV panels (commonly known as solar panels) are composed of cells which convert energy from the sun into electricity. They are commonly situated on building roofs as a clean energy source.

Whilst PV technology is still evolving, there are a number of documented examples of fires starting within PV panels, and PV panels contributing to the growth and spread of fires.

PV panel fires can be challenging to fight, due to their specialist semiconductor materials and electrical currents. Additionally, safe access to roof areas can be difficult and dangerous.

Where PV panels are proposed as part of any Network Rail station project, the following measures are recommended:

- → PV panels should be designed and installed in accordance with the relevant standard, for example BS EN IEC 61730-1.
- → The local Fire & Rescue Service (and building control body, if applicable) should be consulted at the earliest opportunity.
- → PV panel surfaces should meet the reaction to fire classifications given by BS 9999 Section 35 for roof surfaces.
- → Roof areas around and supporting PV panels should be formed of non-combustible surface materials.
- → A safe means of Fire & Rescue Service access should be provided. This should be coordinated and agreed with the local Fire & Rescue Service.
- → An isolation switch should be provided, in a location readily available to the Fire & Rescue Service, to isolate the PV system and assure the safety of firefighting personnel. The isolation system should provide a safe means of electrical discharge and an indication of status.

Image 6.2 PV panels on Blackfriars Station roof © Network Rail

6.2.3 Green Roofs

Green roofs on Network Rail station buildings should be designed in line with the UK Government's best practice guidance document *Fire Performance of Green Roofs and Walls* and documents referenced within, particularly The Green Roof Organisation (GRO)'s *The GRO Green Roof Code of Best Practice 2021.*

The following key recommendations should be met to support the roof design:

- A management strategy should be in place so that the roof remains healthy and regularly maintained throughout its design life, as the health of the living roof is vital to its fire safety.
- Fire breaks (non-vegetated strips, made of ballast with a nominal diameter of 20-50mm) with a width of 500mm should be installed around all openings in the roof and vertical elements (such as lift overruns etc).
- The substrate should be at least 30mm deep.
- The substrate organic content should be less than 20%.

Additionally, irrigation to the plants may be advisable (after discussions with suppliers) to maintain vegetation in a healthy, moist and living state through long dry, hot spells – meaning the vegetation is less likely to ignite and become involved in a fire.

Image 6.3 London Cannon Street Station © Outdoor Venues London

National Standard

BS EN IEC 61730-1
Photovoltaic (PV) arrays - design requirements

Published Document

The GRO Green Roof Code of Best Practice 2021

Manchester Victoria

7

Fire Safety at Stations

Access & Facilities for the Fire Service

7.1 Fire Service Consultation

Rail stations can present a significant challenge for Fire & Rescue Services attending a fire incident.

For example, large stations may include areas above and below ground level, with extensive retail facilities and other ancillary uses. Smaller stations may be located in remote areas with limited facilities such as vehicle access and water supplies.

Stations also commonly have a large footprint (e.g. long platforms and access to areas via footbridges etc), with areas that are remote from the nearest fire vehicle access point. Special hazards are also commonly present including live overhead wires, "third rails", and passing trains that require coordination with signallers and other key safety personnel who may not be present at the station.

When designing new stations, or undertaking work to existing stations, the relevant Fire & Rescue Service should be consulted as early as possible in the design process. This consultation should consider the specific capabilities, resources and response procedures likely to be used by the Fire & Rescue Service to attend a fire incident at the station, and the facilities required to assist this.

For some stations with non-standard designs or particular hazards to firefighters, the Fire & Rescue Service may request additional facilities beyond those recommended by fire safety guidance (as described in this section and its relevant references).

Image 7.1 Nottingham Station © Network Rail

Inversely, small remote stations may require limited or no specific facilities if the Fire & Rescue Service are satisfied that sufficient vehicle access and water supply is available nearby.

In addition to consulting with the Fire & Rescue Service, Network Rail Design Manual NR/GN/CIV/100/09 *Implementation Strategy for Small and Medium Stations* recommends that police and ambulance services should also be consulted when designing new stations and undertaking work to existing stations.

Network Rail Document

NR/GN/CIV/100/09
Implementation Strategy for Small and Medium Stations

7.2 Firefighting Shafts

Particular station characteristics increase the risk for firefighting and rescue operations, these include:

→ Depth of occupied areas (e.g. basements and sub-surface stations).

→ Height of buildings (in particular storeys greater than 7.5m).

Buildings within a surface or enclosed station with a storey greater than 7.5m, and all sub-surface stations, should be provided with firefighting shafts in accordance with Section 18 of BS 9992.

Firefighting shafts consist of a protected stair, with specific measures built in to provide a relatively safe space for the Fire & Rescue Service to access all floors of the building for search, rescue and firefighting operations. Additional measures including lobbies on every level, dry fire mains, smoke ventilation and firefighting lifts are also provided, dependent on the building height and layout.

Image 7.2 Firefighters climbing stairs in full kit © Gazette Series

7.3 Fire Vehicle Access

Fire vehicle access to all station buildings should be provided in accordance with Section 19 of BS 9992, and Section 21 of BS 9999.

Calculation of the floor area of the building should include any enclosed concourses or train sheds with a ceiling height less than 11m. Platform canopies (if open to the permanent way) and small freestanding waiting rooms/shelters formed of non-combustible material may be excluded from the calculation of floor area.

Where small stations do not contain any buildings (other than small freestanding waiting rooms/shelters), fire vehicle access should be provided to all main entrances/exits to the station, and within 18m of all fire main inlets (refer to Section 7.4).

Image 7.3 Emergency Vehicle Parking at Stirling © Arup

7.4 Firefighting Water Supplies

7.4.1 Hydrants and other external water sources

Fire vehicles attending an incident at a station will carry a limited supply of water, sufficient only for a short period. It is therefore necessary that a suitable external water supply is available within, or adjacent to, every station to provide the Fire & Rescue Service with sufficient water for the duration of a fire incident.

External water supplies can be provided by one or more of the following, in line with BS 9999 Section 22:

→ Fire hydrants provided by a water supply company on the street mains.

→ Private hydrants on Network Rail-owned property (e.g. station car parks, access roads and/or within the station itself), in accordance with BS 9990 and ideally forming part of a ring main system.

→ A static emergency water tank (in accordance with BS 9992 Section 20.2).

→ A natural water supply such as a nearby river or lake (where sufficient vehicle access and hard-standing is available).

External water supplies should be capable of delivering a sufficient water flow and pressure to enable effective firefighting to be undertaken, as agreed with the relevant Fire & Rescue Service. Refer to BS 9999 Section 22 for further details.

The external water supply should be located within 90m of the main entrance to the station, and any dry fire main inlets, on a route suitable for laying hose.

Note: Firefighting water supply guidance may differ in Scotland, and station designs should comply with the guidance of the Non-Domestic Technical Handbook in consultation with the Scottish Fire & Rescue Service.

Image 7.4 Training at Birmingham New Street © Network Rail

7.4.2 Fire Mains

Fire mains should be provided to firefighting shafts within station buildings and sub-surface stations, and to station areas with long hose laying distances, as recommended by Section 18 of BS 9992.

Fire mains systems should be designed in accordance with Section 20.1 of BS 9992, and BS 9990.

Where platforms are remote from fire vehicle access/ hardstanding areas, dry fire mains should be provided to serve these platforms, as per Figure 10.
In particular, this should apply to:

→ Platforms/concourses that can only be accessed via platform buildings, footbridges or underpasses (i.e. no direct access from fire vehicle parking area).

→ Platforms where every part of the platform is greater than 60m from the nearest fire vehicle parking area, as measured along a route suitable for laying hose.

In accordance with Section 20.1.3 of BS 9992, double outlets should be provided to all dry fire mains serving platforms, tunnels, station concourses with hose distances greater than 60m, and any other area where a second outlet within a firefighting lobby or cross-passage is not available within 60m.

Key
RVP - Fire Service Rendezvous Point
1. Fire Main Inlet
2. Fire Main Outlet (side platform)
3. Fire Main Outlet (island platform)

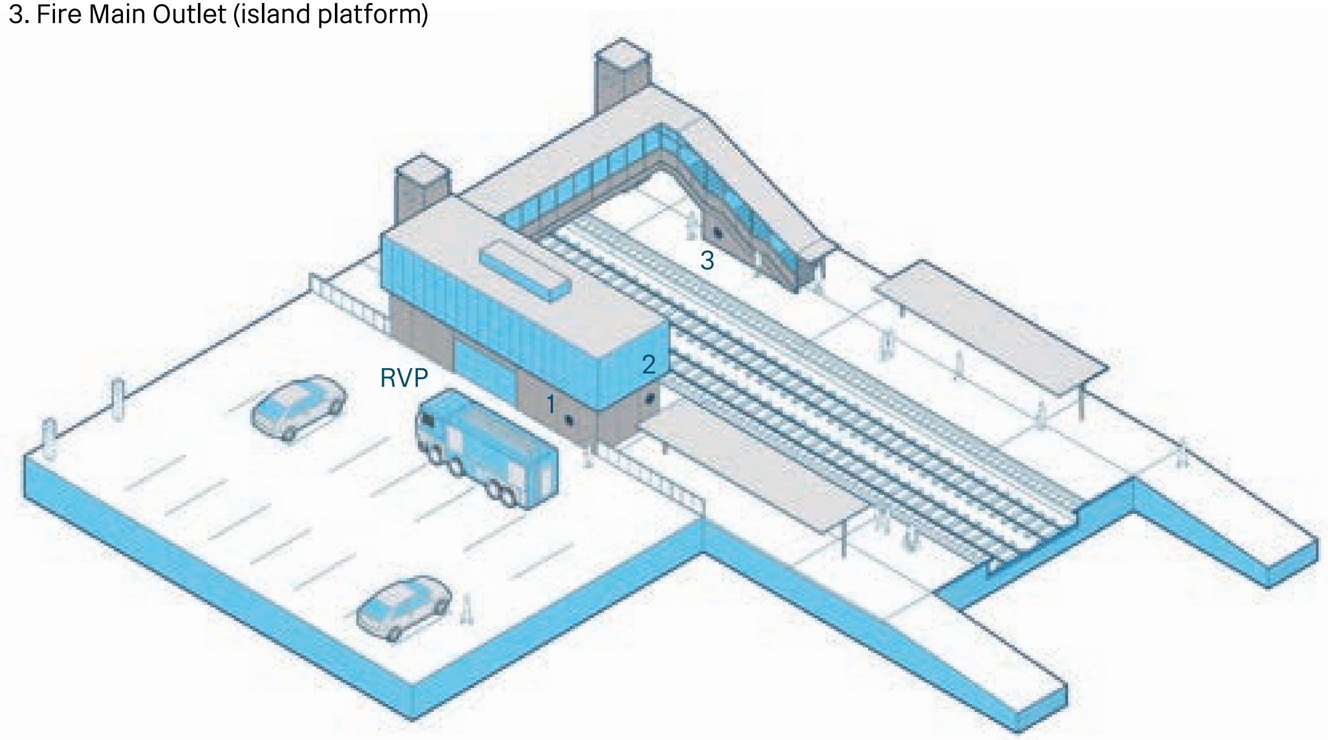


Figure 10 Dry fire main arrangement for simple stations.

7.4.3 Pre-Charged Fire Mains

Dry fire mains requiring long horizontal pipework runs should be avoided where possible, however where necessary, "pre-charged" fire mains should be provided in accordance with Section 20.1.2 of BS 9992. These systems are designed as dry fire mains, but are permanently filled with non-pressurised water, via a header tank (typically 1m^3 volume).

The need for pre-charged fire mains should be discussed with the relevant Fire & Rescue Service, with consideration of the following:

→ Potential for extended fill time of the dry fire main system due to the length of pipework.

→ Volume of water required to fill the pipework, when compared to the water carrying capacity of the initial attending fire vehicles, before being connected to an external water supply.

For example, it may be appropriate to provide a pre-charged fire main system to a station with a remote platform, if the length of pipework is such that:

→ Fill time of the dry fire main system could inhibit firefighting operations.

→ There is a risk of exhausting the initial fire vehicle water capacity before the Fire & Rescue Service can connect to an external water supply.

7.5 Fire Service Communication Systems

7.5.1 General

In line with BS 9992, it is necessary that Fire & Rescue Service personnel are able to communicate with each other throughout the duration of an incident, without interruption or interference.

The relevant Fire & Rescue Service should be consulted as early as possible within the design process to confirm if they require any communication equipment to be provided within the station to assist their operational systems and procedures.

This may be particularly relevant to stations where their own communication equipment may be impaired, such as sub-surface stations, tunnels, large or complex enclosed stations, tunnels or other stations with large footprints.

Where required, Fire & Rescue Service communication systems should be designed in accordance with Section 21 of BS 9992.

7.5.2 Fire Control Centres

A fire control centre should be provided in all sub-surface stations, and other large and complex stations (typically stations with a Higher Risk or Medium Risk RFSRP, as per Section 3), in accordance with Section 21.3 of BS 9992, and Section 24 of BS 9999.

Image 7.5 London Bridge station control room © Network Rail

The fire control centre could form part of a joint operational control room, that could also incorporate other key elements such as security, public address, train operations and systems controls etc.

7.6 Fire Service Premises Information Boxes

When attending a fire incident, it is necessary that the Fire & Rescue Service are able to quickly access key Fire Strategy information about the station, including its layout, fire safety systems, firefighting facilities and access points.

This is particularly relevant to sub-surface stations, or large surface stations (typically with a Higher Risk or Medium Risk RFSRP, as per Section 3), where the station layout and its Fire Strategy design may be complex.

The relevant Fire & Rescue Service should be consulted to confirm their requirements for a Premises Information Box. Where required, these should be provided in accordance with Section 22 of BS 9992.

Initial information should be simple, concise and easy to follow for attending Fire & Rescue Service personnel. Further information could also be provided, however it should be set out in a clear, logical and easily navigable format.

The contents of a Premises Information Box may be linked with the Station's Incident Response Plans (SIRP).

Image 7.6 Premises Information Box signage (National Fire Chiefs Council)

7.7 Heat and Smoke Ventilation

Smoke ventilation is required for enclosed spaces where the build-up of heat and smoke could present a particular hazard to firefighting personnel. This typically includes sub-surface stations, basement areas, covered car parks/ service yards/roadways and firefighting shafts.

Please refer to Section 8.6 for further information.

Section 23 of BS 9992 provides further guidance on the situations where heat and smoke control is required, and the design of such systems.

Image 7.7 Smoke ventilation testing as part of the KCRC East Rail Extension, Tsim Sha Tsui, Hong Kong © Arup

2016 Incident at
Paddington Station
© Ian Redding / Alamy Stock Photo

8

Fire Safety at Stations

Active Fire Safety Systems

8.1 Overview

Active fire safety systems form a key element of the overall package of fire safety measures for a station. They include systems to detect a fire, notify occupants, assist them to evacuate safely, initiate fire containment measures, and assist Fire & Rescue Service operations.

Active fire safety systems should be designed, installed and maintained in line with the relevant industry standards. Their basis of design (including any variations) and their cause and effect should be clearly documented within the station's Fire Strategy (as described in Section 1.3).

Image 8.1 Fire alarm panels at the entrance of a Network Rail station © Arup

8.2 Fire Detection and Alarm

8.2.1 General

Fire detection and alarms systems for all Network Rail stations should be designed in accordance with Section 45 of BS 9992.

In accordance with BS 9992, the need for a fire detection and alarm system should be determined according to the recommendations in BS 9999, based on its risk profile for non-public areas. The category of system should be L5/M as defined in BS 5839-1, with the coverage of automatic detection being defined by a risk assessment undertaken by the fire system designers.

Automatic smoke detection should not normally be installed in public areas of stations, unless required to activate other fire protection systems.

In accordance with Section 35 of BS 5839-1, manual call points may be omitted from public areas where there is a risk of malicious operation, subject to there being adequate surveillance of the building and the provision of manual call points at suitable staffed locations. Where manual call points are to be provided in public areas of a station, these should be sited and installed to minimise the potential for false alarms and/or malicious activation.

For sub-surface stations, manual call points should be provided to both public and non-public areas.

Small, unstaffed stations (i.e. typically Very Low Risk stations) with no buildings (other than small waiting shelter/rooms) should, as a minimum, be provided with a Public Address (PA) system and real-time CCTV which is monitored remotely at all times when the station is open to the public. These systems should provide a means for a fire incident to be monitored remotely once the alarm is raised, and appropriate instructions to be provided for occupants on actions to take.

Additionally, any lift plant rooms and lift shafts or lift enclosures should be provided with a fire detection system which, in the event of a fire, automatically returns the lift to access level, disables and notifies the remote control centre with control of the PA and CCTV systems.

Where the *Platform Passenger Refuge Approach* described in Section 4.2.5 is adopted, a means for two-way communication with staff on the platforms should also be provided as per Section 8.5.

8.2.2 Fire alarm system cause & effect

The cause and effect for the fire alarm system at a Network Rail station should be clearly documented as part of the Fire Strategy for the station. This should include a clear narrative on the intended operation of the fire alarm system and any other systems which depend on its operation. This includes:

- Confirmation of whether a "simultaneous" or "phased" evacuation approach is adopted, and any relevant details.
- Confirmation of whether an alert or staff investigation stage is provided, and information on the management procedures supporting this.
- Confirmation of the fire safety systems that are interlinked and are affected by the operation of the fire alarm system. This could include alarm sounders, Public Address/Voice Alarm (PAVA), smoke control, access control, ticket gates, gas supply isolation, plant shutdown and other systems.

A cause and effect matrix should be developed that describes the specific response of all systems interlinked with the fire alarm system, depending on the type and location of fire alarm activation. This matrix should be sufficiently detailed to allow detailed design of the relevant systems, and programming of the overall fire alarm system.

BS 9992 provides further guidance on the cause and effect for staffed and unstaffed stations, including investigation periods and key fire safety system responses.

8.2.3 Public Address / Voice Alarm (PAVA)

For larger stations, transportation interchanges, and stations which have complex evacuation strategies (for example sub-surface, Higher Risk, Medium Risk and some Low Risk stations, as defined in Section 3), PAVA systems should commonly be provided, and designed upon the principles detailed in BS 5839-8.

Where automated voice alarm messages are to be used to support evacuation, the specific messages used (and their cause and effect) should be agreed with the Network Rail Fire Safety Engineer.

For stations which do not require voice alarm or fire detection and alarms within public areas, it may be appropriate to use a Public Address system to support incident and evacuation management. In such cases a risk assessment should be undertaken to ascertain the appropriate requirements of the system for use during an incident. This may include:

- Dual power supplies,
- No single point failure,
- Diversity of cable routing,
- Monitoring of circuits,
- Provision to make automated and live announcements.

National Standard

BS 5839-1: 2017
Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises

BS 5839-8: 2023
Fire detection and fire alarm systems for buildings - Design, installation, commissioning and maintenance of voice alarm systems. Code of practice

8.3 Fire Suppression

The provision of fire suppression as part of a Network Rail station design project should be discussed and agreed with all stakeholders as early as possible, including the Network Rail Fire Safety Engineer.

Section 46 of BS 9992 provides guidance on the decision-making process for the inclusion of fire suppression for life safety and business continuity purposes.

The basis behind the decision for inclusion (or otherwise) should be clearly documented within the station's Fire Strategy (as described in Section 1.3), alongside the systems' basis of design and key features.

Where a sprinkler system is to be provided, this should be designed in accordance with BS EN 12845. Additional conformance with BS EN 12845 Annex F (additional measures to improve system reliability and availability) and/or LPC Rules for Automatic Sprinkler Installations should be agreed with all stakeholders on a project-by-project basis.

Where a water-mist system is to be provided, this should be designed in accordance with BS 8489.

Image 8.2 Aftermath of the fire at Troon Station © Network Rail

National Standard

BS EN 12845: 2015
Fixed firefighting systems - automatic sprinkler systems - design, installation and maintenance (+A1:2019)
BS 8489-1:2016
Fixed fire protection systems - industrial and commercial water-mist systems.

8.4 Emergency Lighting

Emergency lighting should be provided to Network Rail stations wherever normal lighting is installed, including external open areas (such as open-air platforms and public areas that could form part of an escape route), enclosed footbridges and subways.

Emergency lighting should be designed in accordance with Section 47 of BS 9992, following the general guidance of BS 5266-1 and the additional (rail-specific) guidance of RIS-7702-INS.

National Standard

BS 5266-1: 2016
Emergency lighting. Code of practice for the emergency lighting of premises

Published Document

RIS-7702-INS: 2013
Rail Industry Standard for Lighting at Stations

Image 8.3 Kings Cross Station © Paul Carstairs

8.5 Escape & Fire Safety Signage

Emergency escape signage and fire safety notices should be provided to all station areas accessible to the public and staff in accordance with BS 9992, following the general guidance of BS 5499-4 and BS 5499-10.

Reference should also be made to the fire safety signage requirements within Network Rail standard NR/L3/FIR/102 *Fire Safety: Operational Estate.*

Emergency Do Not Enter (EDNE) Signage

EDNE signage typically consists of an illuminated sign that can be switched on and off as required to advise occupants not to enter an area if there is an emergency or other hazard. EDNE signs may typically be installed at the entrances to specific compartments or areas of a station to prevent occupants entering an area where a fire event is in progress.

Where possible, the station Fire Strategy should be developed to minimise the reliance on EDNE signs, and should only be used as a support measure to other fire safety management procedures. EDNE signs should not be used as a replacement for staff management of a fire incident.

Where required though, EDNE signs should be interfaced with the station fire alarm system, and be programmed to illuminate in the fire scenarios specified by the station Fire Strategy and cause & effect. Particular attention should be paid during the commissioning/testing phase of the project to assure that the EDNE signs operate exactly as intended, as malfunction of these signs could create confusion and present a hazard to occupants in an emergency.

The layout and specification of EDNE signage should be discussed and agreed with the Network Rail Fire Safety Engineer. Reference may be made to London Underground standard *LUL S1087: Fire Prevention and Protection – Emergency Do Not Enter Signs* for guidance on the typical design, layout and operation of EDNE signs in the rail environment.

Image 8.4 Emergency exit doors and signage at Glasgow Queen Street © Arup

8.6 Emergency Voice Communication (EVC)

8.6.1 Station Buildings

Emergency Voice Communication (EVC) systems used as part of a PRM evacuation strategy in refuge areas within station buildings should be designed in accordance with BS 5839-9. This includes the provision of a two-way receiver/communication panel located at the main fire alarm panel, and any repeater panels located within the station.

Consideration of additional receiver panel locations should be made on a project-by-project basis to suit the operational procedures for the station. For example, station control room or control points used by station management and the Fire & Rescue Service.

8.6.2 Platforms

Where an EVC system is proposed on a platform area in a staffed station (where the station is managed by on-site staff at all times when the station is occupied by the public with an automatic fire detection and alarm system), it should be designed in accordance with BS 5839-9, with a receiver/communication panel located at the main fire alarm panel, and any other repeater panels located within the station.

Where an EVC system is proposed on a platform area in an unstaffed station, or a station with no automatic fire detection and alarm system, an appropriately robust 2-way platform telecommunication system (for example GSM-R or an equivalent hardwired system) should be provided. Where hardwired, the cable should be routed such that it is unlikely to be affected by a fire event on a train or within the station.

The EVC system should communicate directly to a control centre operated by staff trained in emergency evacuation procedures for the station, who have access to station CCTV and Public Address to enable remote and appropriate instructions to be provided for occupants on actions to take.

Platform “Help Points” are a common and familiar means of 2-way communication for station occupants and could be used as an EVC, subject to them being provided with an “Emergency” function which connects directly to a control centre as described above.

Image 8.5 Emergency Help Point © Arup

8.7 Station Smoke Control

Smoke control systems may bring life safety, asset protection and operational continuity benefits to a station design, for example, where there is potential for smoke from a fire to build-up and affect a station's means of escape provisions, and/or spread to other areas of the station.

Smoke control is commonly used as part of the Fire Strategy design for sub-surface stations, enclosed car parks and other areas where smoke could cause a hazard to occupants escaping a fire.

Smoke control systems could be provided in several forms, such as:

- → **Natural smoke ventilation via openable smoke vents** – commonly used to provide ventilation to medium sized concourses and other smaller spaces, where smoke is buoyant and rises to the top of the space quickly.
- → **Mechanical smoke extraction systems** – commonly used to extract smoke from larger volume spaces, where smoke may be cooler and less buoyant.
- → **Jet or impulse smoke fans** – commonly used to direct smoke along tunnels and other enclosed spaces towards an open end or exhaust point.
- → **Stair pressurisation** – used as a means of maintaining smoke-free conditions in escape and firefighting shafts to deep basements, or other aspects of a fire engineered approach.

The performance requirements for a smoke control system should be developed by a competent Fire Engineer as part of the overall Fire Strategy for the station.

The purpose/objective and required performance of a smoke control systems should be considered and documented as part of the overall Fire Strategy for the station, in consultation with all relevant stakeholders (including the PRFS, responsible person/fire safety duty holder, Network Rail Fire Safety Engineer, Network Rail project team and enforcing authorities).

BS 9992 provides guidance on the design of station smoke control systems, including fire scenarios, tenability criteria and design standards.

Image 8.6 Impulse smoke fans serving sub-surface rail lines at Birmingham New Street Station © Network Rail

Station and retail interface at London Paddington
© Network Rail

Fire Safety at Stations

Construction Fire Safety Management

9

9.1 Introduction

Construction work can include a variety of processes and actions. The definition of "construction work" for all Network Rail sites should be based on the definition provided in *The Construction (Design and Management) Regulations 2015* (CDM), as described in Section 1.4.

It's important to be aware that CDM applies to construction work, and not just construction projects, therefore it doesn't matter how short or small the work carried out is, the risks associated with the work should still be considered and mitigated.

As fire safety is intertwined within almost every part of a building, even minor construction work could have an impact on the building's fire safety measures if not considered and assessed properly. For example, works to paint walls in a corridor may reduce the width of the escape route, or block it entirely.

Larger railway infrastructure construction projects can take years to complete and can involve multiple construction phases. Where this construction work affects an existing station, it's common for existing fire provisions within the building to be temporarily or permanently impacted.

There is also often a need for rail services to continue operating throughout the refurbishment work, with limited capacity to reduce operational levels during the construction work. This can introduce a potential interface between operational station and construction areas, which can add considerable complexity to a project, and can significantly affect the programme and cost of the works.

Therefore, to reduce the risk of fires occurring and to assure the life safety of occupants if they do occur, the impacts of phasing work should be considered from the outset of the design and in the development of a construction phase plan as early as possible.

Image 9.1 Glasgow Queen Street platform extension works
© Network Rail

Legislation / Regulations

Construction (Design and Management) Regulations 2015

9.2 Construction Fire Safety Requirements

9.2.1 Legislation and Regulations

As described in Section 1.4, *The Health and Safety at Work Act 1974* is the primary legislation regarding health and safety in the UK, and imposes general duties on employers and others for the reduction of risk to persons due to workplace activities. Additional primary and secondary legislation also sit alongside and beneath this, as described further in Section 1.4, including:

1. *The Building Act 1984* in England & Wales or the *Building (Scotland) Act 2003* in Scotland.

2. *The Construction (Design and Management) Regulations 2015* (CDM).

3. *The Regulatory Reform (Fire Safety) Order 2005* (RRO) in England & Wales or the *Fire (Scotland) Act 2005* in Scotland.

If the station is classified as 'sub-surface' then the Sub-Surface Railways Regulations (SSRR), as described in Section 1.4, would also apply to any workplace activities.

9.2.2 Guidance

The principal fire safety guidance document for rail infrastructure projects is BS 9992, which provides guidance in relation to fire safety during construction in Section 10. In addition, the following guidance documents should also be referred to as appropriate:

- → *HSG 168 – Fire Safety in Construction Guidance 3rd Ed. 2022* – The principal fire safety guidance document provided for general construction work within the UK.
- → *Fire Prevention on Construction Sites – The Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation, 10th edition, 2022* – Provides further guidance from the Fire Protection Association (FPA), and supplements the HSG 168 recommendations.
- → In England & Wales, if the site is classified as 'sub-surface' then the *Regulatory Reform (Fire Safety) Order 2005 Guidance Note 3: Fire safety on sub-surface railway stations (DCLG March 2009) (GN 3)* would also apply to any construction activities.
- → *L153 – Managing Health & Safety in Construction: Guidance on Regulations* – A guidance document by the HSE on complying with the CDM Regulations.

Legislation / Regulations

The Building Act 1984 in England & Wales or the Building (Scotland) Act 2003

The Construction (Design and Management) Regulations 2015

The Regulatory Reform (Fire Safety)

The Fire (Scotland) Act 2005

Published Document

HSG 168
Fire Safety in Construction Guidance 3rd Ed. 2022

(GN 3)
Regulatory Reform (Fire Safety) Order 2005 Guidance Note 3: Fire safety on sub-surface railway stations (DCLG March 2009)

L153
Managing Health & Safety in Construction: Guidance on Regulations

Fire Prevention on Construction Sites -The Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation
10th edition, 2022

9.3 Construction Stage Goals & Objectives

All construction work undertaken on Network Rail sites is required, as a minimum, to comply with the legislation relating to construction fire safety outlined in Section 9.2.1 The guidance documents in Section 9.2.2 should also be followed, unless an alternative approach is formally agreed with the Network Rail Fire Safety Engineer on a project-by-project basis.

A construction stage Fire Risk Assessment (FRA) is required to be undertaken for all construction work, regardless of size and scope, to identify the hazards and demonstrate suitable and sufficient measures are in place to mitigate the risks. Further guidance on construction stage FRAs is provided in BS 9992.

The methodology of risk assessment should be appropriate to the specific hazards on site, and may include utilising a Hazard and Operability (HAZOP), Hazard Identification (HAZID) and Hazard Analysis (HAZAN) approach if required.

The existing operational FRA for the station will also require to be updated continually as a "live" document, to account for any changes to the fire safety measures within the operational station as a result of the construction works.

In addition to life safety, consideration of other key objectives should be given in relation to managing fire safety during construction on Network Rail premises. These should be discussed and agreed with the Network Rail Fire Safety Engineer on a project-by-project basis:

- **Property protection** – Network Rail's goals and objectives related to protection of property on their sites and buildings should be met and implemented at all times during construction. Network Rail operate critical infrastructure therefore the protection of the property and the asset when under-going construction work is important.
- **Protection of heritage assets** – Many of Network Rail's stations contain areas of significant heritage interest/significance. Works affecting listed heritage assets are often restricted, and temporary fire mitigation measures may be more limited. Fire prevention is therefore key in reducing loss.
- **Operational continuity** – The property protection objective described above can also be applied directly to operational continuity where the area affected by construction work is considered important in the continued operation of the railway.

More complex projects such as the refurbishment of existing rail station buildings will require much more in-depth evaluations of the potential impact of fire on their operations due to, for example, a false alarm activation. Fire events may cause a greater level of disruption over a longer period and also impact on reputational damage.

- **Communication, coordination and control** – Effective communication and co-ordination of the construction work and associated fire safety impacts between the multiple project stakeholders can be one of the most difficult and demanding parts of any construction project. Responsibilities should be clearly defined, and documentation and procedures need to be developed in a robust nature prior to work commencing.

9.3 Construction Stage Goals & Objectives

Example good-practice risk reduction and interim protection measures are described below in terms of items that could form part of a construction stage FRA and management strategy:

- → Liaison with the Fire & Rescue Service to assure that adequate access and facilities are provided at all times. Regular familiarization visits should also be facilitated.
- → Amendment of the construction sequencing to construct areas in a defined order to implement compartmentation in phases, and reduce the extent of potential fire and smoke damage.
- → Replacement of final design combustible materials with materials of an improved fire performance.
- → Off-site material storage and good on-site refuse control and removal.
- → Avoiding hot works where possible and implementing strict control measures where required. **Note: The use of acetylene should avoided on all Network Rail projects, unless in exceptional circumstances where supported by a detailed risk assessment and method statement.**
- → Removal or replacement of interim combustible materials with materials of an improved fire performance, e.g. metal pallets.
- → Installation of interim wireless fire alarm and detection system solely for the construction period to provide early warning of a fire (such systems could then be removed and reused at another location).
- → Implementation of a dedicated ‘fire safety team’ of enforcers and responders to enforce fire safety measures and respond to quickly to alarm activations.
- → Installation of suppression systems earlier in the construction phasing to provide protection to important areas.
- → Installation of temporary or final design fire-fighting access and provisions to enable earlier extinguishment of a fire scenario.

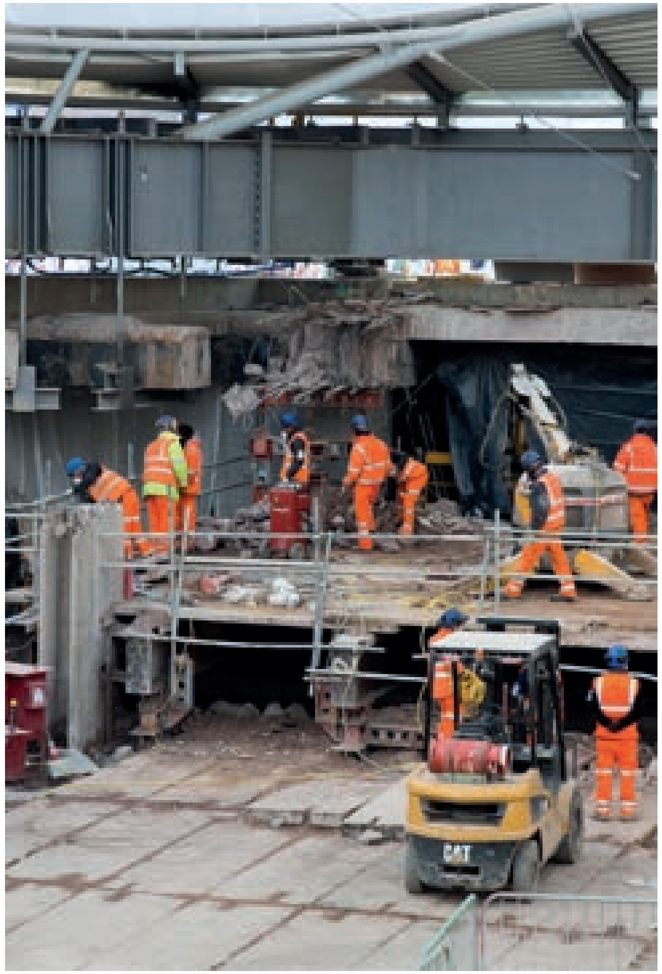


Image 9.2 Birmingham New Street atrium construction work

9.4 Determination of Project Complexity

HSG 168 outlines good practice methods in both fire prevention and risk assessment to be undertaken by responsible persons during "lower-risk and less complex projects".

The guidance recognises that "*a competent person (with the skills, knowledge and experience in fire risk assessments on construction sites), such as a fire engineer, should be engaged to provide specialist advice for complex and/or high-risk projects. Such projects are likely to need specialist advice beyond the scope of this guidance*".

HSG 168 provides the following examples of complex sites, which are common configurations in stations:

- → Interconnected buildings.
- → A large-scale or multi-storey refurbishment project.
- → Sites that are partially occupied or will be occupied as part of a phased release.
- → Multiple underground levels.
- → Complex fire arrangements in the final design.

Although the above descriptions encompass many station buildings, Network Rail own and operate a variety of sites, buildings and infrastructure across the UK, and not all stations necessarily fall under the complex or high-risk category. On the other hand, some small and relatively simple projects may have specific fire safety objectives in relation to property, operations and/or heritage which require specialist fire engineering advice.

Prior to undertaking construction work, the Principal Contractor should provide confirmation to Network Rail (and seek their agreement) on whether the site and/or construction work proposed constitute a complex or high-risk project which might require specialist advice from a Fire Engineer.

9.4 Determination of Project Complexity

Any Fire Engineer proposed to provide construction stage fire safety advice should be able to demonstrate sufficient knowledge, experience and competency in construction fire safety which is specific to the project, prior to their engagement. An example would be where construction work is proposed in a sub-surface station environment, the Fire Engineer would be expected to demonstrate experience and knowledge in this particular area of construction fire safety.

Image 9.3 Bristol Temple Meads main train shed scaffolding © Network Rail

Construction of the atrium at Birmingham New Street

Fire Safety at Stations

Fire Safety Management & Risk Assessment

10

10.1 Fire Safety Management Principles

10.1.1 General

As discussed in Section 1, fire safety legislation requires a person(s) in control of a premises to put in place general fire precautions and undertake a fire risk assessment.

For all Network Rail-managed premises, a *"Person Responsible for Fire Safety"* (PRFS) should be assigned, who is responsible for the day-to-day management of fire safety in line with Network Rail's fire safety management standards (as described in Section 1.5). This includes responsibilities such as:

- Maintaining an up-to-date Fire Risk Assessment and other relevant fire safety documentation for the premises (for example compartmentation/ Fire Strategy drawings).
- Ensuring all fire safety systems are maintained and tested in accordance with manufacturer's instructions and relevant standards.
- Ensuring all staff receive instruction and training in fire safety according to their role and responsibility.
- Liaising with statutory bodies such as the Fire Authorities and, where applicable, Building Control (in conjunction with the Network Rail Fire Safety Engineer).
- Reporting any fires on rail premises/ infrastructure as per Network Rail requirements.

Where a station is managed by a train operating company (TOC), the TOC should assign a responsible person/fire safety duty holder with overall responsibility for fire safety, in line with the relevant fire safety legislation.

Whilst not mandatory, the roles and responsibilities for the Network Rail PRFS may provide a useful reference guide for TOCs to develop/implement their own fire safety management procedures.

This section provides guidance on the minimum levels of fire safety management recommended by Network Rail for its station premises (including TOC-operated stations), with respect to its Rail Station Fire Risk Profile (RSFRP), as described in Section 3.

10.1.2 "Staffed" vs "Managed"

It's important to note the difference between a station being "staffed", and a station being "managed" with respect to fire safety. A station which is "staffed" is not automatically deemed to be adequately "managed". Equally however, a small unstaffed station may also be "managed" remotely.

The fire safety management of all Network Rail-owned station premises should be in line with the guidance in this section and its associated standards.

The degree and means of fire safety management appropriate to a particular station varies depending on its level of fire risk.

For example, fire safety management of a large, busy station may be undertaken by permanent, on-site staff performing the PRFS and/or responsible person role, such as the Station Manager.

Whereas a small station (which has limited or no permanent staffing of competent persons who can perform the PRFS/responsible person role) may require a degree of remote or periodic fire safety management via specific procedures and remote system monitoring.

It is the responsibility of the PRFS/responsible person for each station to develop an appropriate fire safety management plan for the station to assure it meets the legislative requirements, Network Rail minimum standards (where applicable), and the guidance in this section.

Image 10.1 Station operator staff © Network Rail

10.2 Minimum Levels of Fire Safety Management

10.2.1 Network Rail Managed Stations

In every station that is owned and operated by Network Rail, the PRFS is required to comply with the mandatory Network Rail standard *"Fire Safety – Managed Stations"* (NR/L3/FIR/101), and the other relevant NR standards described in Section 1.5, particularly:

- → *Fire Safety – Maintenance* (NR/L3/FIR/106).
- → *Fire Safety – Risk Assessment* (NR/L3/FIR/107).
- → *Fire Safety – Fire Extinguishers* (NR/L3/FIR/108).
- → *Fire Safety – Fire Log Book* (NR/L3/FIR/109).

Additional fire safety management guidance is provided within Sections 2 & 3 of BS 9992, and BS 9999.

10.2.2 Sub-Surface Stations

All sub-surface stations should be staffed at all times when public have access, and staff should have the duties and training required by the relevant Sub-Surface Rail Regulations.

Additionally, for Network Rail managed sub-surface stations, the PRFS is required to comply with "*Fire Safety – Managed Stations*" (NR/L3/FIR/101), and the other relevant mandatory Network Rail standards, as described in Section 10.2.1.

Where a sub-surface station is owned by Network Rail, but operated by a 3rd party (e.g. TOC), compliance with NR/L3/FIR/101 is not mandatory, but is recommended as a means of demonstrating that the responsible person/fire safety duty holder is implementing appropriate fire safety management procedures. Additional fire safety management guidance is provided within Sections 2 & 3 of BS 9992, and BS 9999.

10.2.3 Higher Risk & Medium Risk Stations

As described in Section 3, Higher Risk stations are defined as those with an RSFRP of D5 or C5. Medium Risk stations are defined as those with the RSFRP of D4 or C4.

Higher Risk and Medium Risk stations typically have high passenger levels, multiple operational stakeholders (e.g. TOCs, commercial tenants, adjacent buildings etc) and complex fire safety systems. This requires a high degree of day-to-day operational management and coordination.

As such, Higher Risk and Medium Risk stations that are owned by Network Rail, but operated by a 3rd party (i.e. TOC), are expected to be permanently staffed by the responsible person/fire safety duty holder (typically the Station Manager), and their delegated staff with specific duties, at all times when the station is occupied by the public.

All staff with specific fire safety duties should undergo regular training, including emergency exercises and drills. This training should be clearly documented and regularly updated as required.

The responsible person/fire safety duty holder is responsible for ensuring compliance with the relevant fire safety legislation, for example the *Regulatory Reform (Fire Safety) Order 2005* or the *Fire (Scotland) Act 2005.*

"*Fire Safety – Managed Stations*" (NR/L3/FIR/101), whilst not mandatory for 3rd-party-operated stations, is recommended to be followed for all Higher Risk and Medium Risk stations. Additional fire safety management guidance is provided within Sections 2 & 3 of BS 9992, and BS 9999.

Image 10.2 Busy platform at London Euston © Network Rail

10.2.4 Low Risk Stations

As described in Section 3, Low Risk stations are defined as those with a RSFRP of D3, C3 or B3.

Low Risk stations generally have a lower passenger occupancy, fewer operational stakeholders and more limited fire safety systems. However, these stations may have high passenger levels at peak times, or for special events, which require particular consideration and additional management.

As a minimum, Low Risk stations should be staffed by a dedicated responsible person/fire safety duty holder (typically the Station Manager), and any delegated staff with specific duties, during busy times (including special events).

During off-peak times, and when the responsible person/fire safety duty holder is not on site, specific fire safety management procedures should be documented and implemented to assure the following:

- → In the event of a fire within the station, or a train arriving into the station on fire, occupants can be alerted and are able to evacuate the station safely.
- → Any PRMs are supported to use the relevant escape provisions, and in particular any areas which require them to wait and/or seek staff assistance.
- → The Fire & Rescue Service can be contacted promptly and are able to access the site.

The procedures should be proportionate to the potential fire safety risk to station occupants and passengers and consider the specific layout and design of the station.

A combination of station staff, train crew and/or remote monitoring, control and communication systems may be used (e.g. remote fire safety system monitoring, real-time CCTV and Public Address, linked to a control centre staffed by trained personnel).

Where the *Platform Passenger Refuge Approach* applies to the station, or if it is established that there is a risk of passengers being unable to reach a station exit as a result of a station or train fire, the provisions described in Section 4.2.5 should also be complied with.

All staff with specific fire safety duties should undergo regular training, including emergency exercises and drills. This training should be clearly documented and regularly updated as required.

The responsible person/fire safety duty holder is responsible for ensuring compliance with the relevant fire safety legislation, for example the *Regulatory Reform (Fire Safety) Order 2005* or the *Fire (Scotland) Act 2005.*

"*Fire Safety – Managed Stations*" (NR/L/FIR/101), whilst not mandatory for 3rd-party-operated stations, is recommended to be followed for all Low Risk stations. Additional fire safety management guidance is provided within Sections 2 & 3 of BS 9992, and BS 9999.

10.2 Minimum Levels of Fire Safety Management

10.2.5 Very Low Risk Stations

As described in Section 3, Very Low Risk stations are defined as those with a RSFRP of B2, B1, A2 or A1.

Very Low Risk stations typically have a low passenger occupancy, fewer fire safety systems and limited operational stakeholders (typically a single TOC, although trains from other TOCs may call at the station too). There may be periods where higher passenger levels are present due to special events or other causes of perturbation.

It is unlikely that Very Low Risk stations will be regularly staffed by a dedicated responsible person/fire safety duty holder during peak or off-peak times (except during perturbation or special events). However, the responsible person/fire safety duty holder remains responsible for ensuring compliance with the relevant fire safety legislation.

Therefore, fire safety management procedures should be documented and implemented to assure the following:

- → In the event of a fire within the station, or a train arriving at the station on fire, occupants can be alerted and are able to evacuate the station safely.
- → Any PRMs are supported to use the relevant escape provisions, and in particular any areas which require them to wait and/or seek staff assistance.
- → The Fire & Rescue Service can be contacted and are able to access the site.

The procedures should be proportionate to the potential fire safety risk to station occupants and passengers, and consider the specific layout and design of the station.

A combination of train crew and/or remote monitoring, control and communication systems may be used (e.g. remote fire safety system monitoring, real-time CCTV and Public Address, linked to a control centre staffed by trained personnel).

Where the *Platform Passenger Refuge Approach* applies to the station, or if it is established that there is a risk of passengers being unable to reach a station exit as a result of a station or train fire, the provisions described in Section 4.2.5 should also be complied with.

Image 10.3 Quiet platforms at Reston Station © Network Rail

10.2 Minimum Levels of Fire Safety Management

Stations with limited operational fire safety management

It may be acceptable for some Very Low Risk stations to be provided with limited levels of operational fire safety management, on the basis that it is deemed by the responsible person/fire safety duty holder that the potential of a fire event is sufficiently low, and the station is designed to assure that the risk to occupants from a fire event is low.

This approach may be appropriate for small stations with low passenger levels and/or train stops per day, there are limited sources of fire ignition or fuel within the station, and where there is no reliance on remote staff intervention to facilitate evacuation for any passengers (including PRMs). For example, a small single/double platform open station that serves a rural community with level/ramped egress routes.

No stations (regardless of size) are exempt from the requirement for the responsible person/fire safety duty holder to comply with the relevant fire safety legislation. However, it may be deemed (by a Fire Risk Assessment) that limited regular management intervention is necessary if train crew are sufficiently trained to facilitate the evacuation of the train and station if required.

Network Rail does not support any form of “wait in place” evacuation procedures (such as platform refuges) to be implemented at stations with limited or no fire safety management. Passengers should be able to evacuate the station by the physical measures provided, and any assistance offered by the train crew present.

Network Rail Document

NR/L3/FIR/106
Fire Safety – Maintenance

NR/L3/FIR/107
Fire Safety – Risk Assessment

NR/L3/FIR/108
Fire Safety – Fire Extinguishers

NR/L3/FIR/109
Fire Safety – Fire Log Book

NR/L/FIR/101
Fire Safety – Managed Stations

National Standard

BS 9999: 2017
Fire safety in the design, management and use of buildings

BS 9992: 2020
Fire safety in the design, management and use of rail infrastructure,

Legislation / Regulations

Regulatory Reform (Fire Safety) Order 2005

The Fire (Scotland) Act 2005

10.3 Fire Risk Assessments

As described in Section 1, there is a legal requirement for the responsible person of any premises to undertake a Fire Risk Assessment (FRA).

Standard NR/L3/FIR/107 sets out Network Rail's requirements for carrying out a Fire Risk Assessment for their premises. Compliance with this standard is mandatory for all Network Rail-owned stations, including those managed by 3rd parties (e.g. TOCs etc).

For Network Rail managed stations, the Network Rail Fire Safety Engineer is responsible for carrying out the FRA, with the support of the *"Person Responsible for Fire Safety"* (PRFS). The FRA should be formally recorded on a centralised database designated by the Technical Authority. The PRFS is then responsible for maintenance of the FRA. An annual review of the FRA is also to be undertaken by the Network Rail Fire Safety Engineer.

For Network Rail-owned stations operated by a 3rd party TOC, the responsible person/fire safety duty holder is responsible for carrying out, maintaining and reviewing the FRA. The TOC's responsible person/fire safety duty holder may seek, or delegate support from an appropriately qualified Fire Risk Assessor to assist them with complying with NR/L3/FIR/107 and the relevant fire safety legislation applicable to the station.

Additional guidance on undertaking fire risk assessments in a transport environment is available from the following documents:

→ "*Fire Safety Risk Assessment – Transport Premises and Facilities*", HM Government, 2007.

→ "*Practical fire safety guidance for existing non-residential premises*", Scottish Government, 2022.

Image 10.4 A Busy Waterloo Station © Network Rail

Network Rail Document

NR/L3/FIR/107
Fire Safety – Risk Assessment

Published Document

Fire Safety Risk Assessment – Transport Premises and Facilities, HM Government, 2007

Practical fire safety guidance for existing non-residential premises, Scottish Government, 2022

10.4 Special Fire Hazards

10.4.1 General

As part of the ongoing fire safety management and fire risk assessment process for a station, consideration should be given to any special fire hazards that may present a particular risk of fire ignition and/or rapid or difficult to control fire spread.

BS 9999 provides a definition and specific guidance on design for places of special fire risk. This includes oil-filled transformer and switch gear rooms, boiler and generator rooms, and storage spaces for fuel and other highly flammable substances.

Where applicable, reference should also be made to specific regulations pertaining to special fire hazards, such as *The Control of Substances Hazardous to Health Regulations 2002* (COSHH), and the *Dangerous Substances and Explosive Atmospheres Regulations 2002* (DSEAR).

10.4.2 Lithium-Ion Batteries

Lithium-ion batteries (LIBs) are becoming extensively used across the transportation industry, in particular e-bikes and e-scooters. They offer significant benefits over traditional battery technology which include high specific energy, high power and long cycle life and are often seen as contributing to a sustainability agenda.

However, LIB fires pose hazards which are significantly different from conventional battery fires in terms of initiation, spread, duration, toxicity, and extinction. In particular, a major cause of fires to LIBs is the onset of thermal runaway, which once initiated is extremely difficult to reverse or impede.

There have been several high-profile fire incidents involving LIBs which have resulted in the total loss of a facility.

As a result, many train operating companies have introduced bans on e-scooters and e-bikes.

For stations where e-scooters and e-bikes are permitted, the station's Fire Risk Assessment should consider the risk posed. In particular, the Fire Risk Assessment should focus on prevention measures in conjunction with both protection and intervention measures in promoting an integrated and holistic approach to risk management.

There will be circumstances where it is not practicable to install fire suppression systems to existing facilities designed to deal with LIB fires, especially in the absence of necessary infrastructure such as water supplies, fire tanks and pumps etc.

Nevertheless, the provision of fire compartmentation or use of specialised storage cabinets will be in many cases be a viable alternative. Whilst this technology does present several fire risks, it is possible such risks can be managed by the effective implementation of appropriate mitigation measures.

Image 10.5 Aftermath of an e-bike fire caused by a lithium-ion battery ©London Fire Brigade

10.4.3 Electric Vehicle (EV) Charging

Network Rail has developed a specific Design Manual for electric vehicle charging systems, NR/GN/CIV/200/13, in addition to the design standard NR/L2/CIV/902 for electric vehicle charge points and associated infrastructure.

In addition, fire-specific guidance for electric vehicle parking and charging is provided by the document *T0194 – Covered car parks – fire safety guidance for electric vehicles*, developed by Arup on behalf of the UK Government Office for Zero Emission Vehicles (OZEV).

Image 10.6 EV charging points at Leeds Station © Network Rail

Published Document

T0194
Covered car parks – fire safety guidance for electric vehicles, UK Government, Office of Zero Emission Vehicles

Legislation / Regulations

COSHH
The Control of Substances Hazardous to Health Regulations 2002

DSEAR
Dangerous Substances and Explosive Atmospheres Regulations 2002

T0194
Covered car parks – fire safety guidance for electric vehicles, UK Government, Office of Zero Emission Vehicles

National Standard

BS 9999: 2017
Fire safety in the design, management and use of buildings

Network Rail Document

NR/GN/CIV/200/13
Design Manual for Electric Vehicle Charging Systems

NR/L2/CIV/902
Electric Vehicle Charging Points and Associated Infrastructure

St Pancras International Station
© Daniel Clements

Fire Safety at Stations

Appendix A: Simplified Platform Design Tool

A

A.1 Introduction

A.1 – Introduction

A.1.1 - Overview

The Simplified Platform Design Tool provides a simple, tabulated method for calculating an appropriate maximum single direction travel distance for a platform, as a function of platform width and platform exit width.

This design method has been derived from the Network Rail *Platform Emergency Egress Tool* (PEET) to provide a simplified set of tabulated results to assist designers of simple platform layouts in confirming appropriate design parameters.

The *Simplified Platform Design Tool* therefore incorporates a number of assumptions and limitations which are either embedded into the design tool or accounted for by applying an appropriate safety factor. The results are therefore inherently conservative but should provide a useful initial method for designers to establish appropriate parameters for simple platform layouts.

Where a design case does not conform to the limits of applicability and assumptions listed in Section A1.2 below, or if the *Simplified Platform Design Tool* does not yield results that are appropriate or practicable for a project, the full *Network Rail Platform Emergency Egress Tool* (PEET) could be applied. Alternatively, a Fire Engineered approach may be used (by a suitably competent Fire Engineer) to demonstrate compliance with the relevant Building Regulations and other requirements, as described in Section 1.4.

Appendix B provides case study examples for some typical station layouts, including worked examples of how the *Simplified Platform Design Tool* and PEET could be applied.

A.1 Introduction

A.1.2 – Applicability of Design Tool

The Simplified Platform Design Tool is applicable to inform the design of the following for surface stations:

- **New side or island platforms.**
- **Physical modifications to existing side or island platforms** - such as extensions or platform widening.
- **Alterations to platform escape routes** – including location, width and type (i.e. stepped, ramped or footbridge etc).
- **Changes to platform occupancies** - the tool inherently provides three platform occupancy characteristics to choose from, including crush loaded (as applied in most cases), fully loaded and lightly loaded platforms.

This method is suitable for platforms with no roofs or canopies, or platforms with canopies that are limited in nature as follows:

- Any individual canopy less than 20m length, and not enclosing the only exit(s) from the platform.
- Individual canopies up to 40m that conform to the following:
  - At least 4.0m height (when measured to the lowest extent of the canopy roof).
  - Is open on both main sides and at least 10m from any adjacent canopies.
  - No buildings, walls or other obstructions are present within 1.5m of the canopy roof.
  - Does not enclose or connect to any escape routes or enclosed footbridges.
  - Canopies with a wall or building at the rear, where escape is possible behind the wall/building.
- The total length of canopies should not extend for more than 50% of the platform length.
- The platform is served either by one or more direct exits (at the sides or ends), or by a single footbridge. The tool does not currently provide for a combination of direct exits and footbridges from a platform.

A.1.3 - Assumptions

For a full set of assumptions relating to the specific calculation of parameters from the *Simplified Platform Design Tool,* please refer to the relevant supporting literature for the *Network Rail Platform Emergency Egress Tool* (PEET) upon which it is based.

The calculation results from the PEET have been discretised in order to allow for them to be presented in tabular format.

A.2 – Methodology

The Simplified Platform Design Tool consists of a series of simple look-up tables for designers to refer to. In parallel, a step-by-step methodology is provided that describes which tables to use for a specific design case, and how to derive the maximum single direction travel distance. The step-by-step methodology is described in detail below. A summary flowchart is also provided in Figure 14.

__Step 1 – Confirm appropriate look-up table(s) to utilise__

A key consideration for the *Simplified Platform Design Tool* is the arrangement of escape routes from the platform.

In particular, the configuration of platform exits (and whether evacuation is directly from the platform via side or end exits, or by means of a footbridge) influences the available platform width and available time for passengers to escape off the platform.

For example, evacuating via stairs to a footbridge in the centre of a side or island platform would likely result in a slower evacuation than via an exit directly off the side or end of the platform. This is on the basis that the platform escape width is reduced when footbridge stairs are provided, and the footbridge stairs are closer to the fire itself.

For these arrangements use Table 13

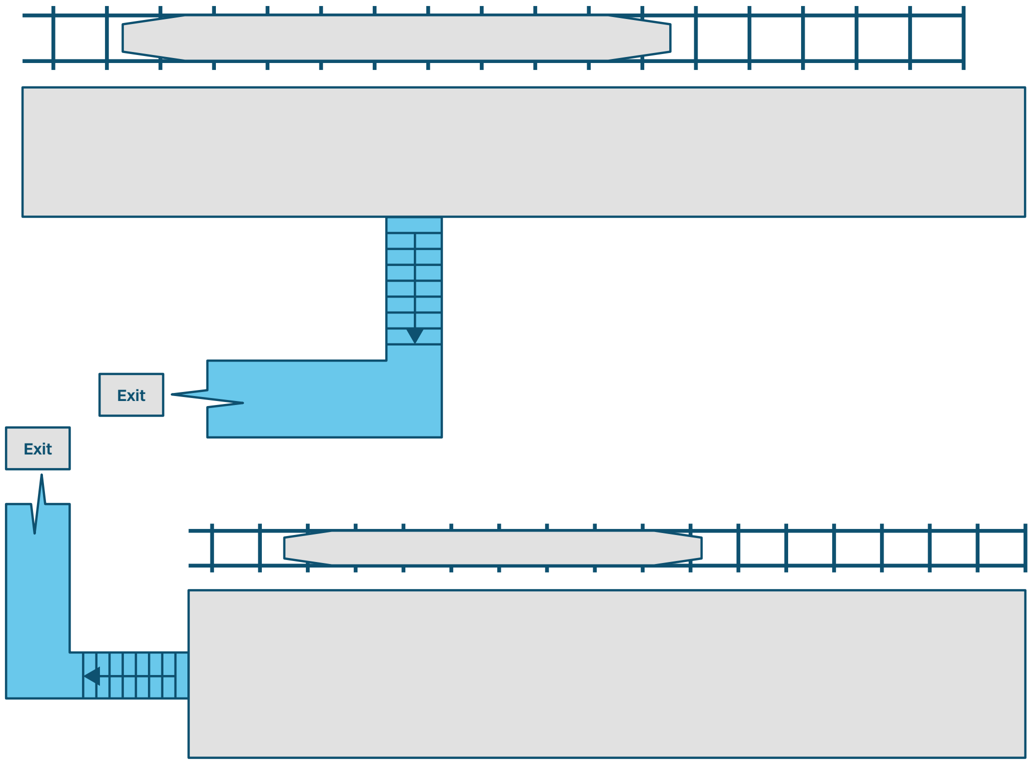


Figure 11a Table selection guidance sketch for simplified platform design tool where footbridges/underpasses are present

A.2 Methodology

To address this, the *Simplified Platform Design Tool* provides two sets of tables for the following design cases:

- → Escape from side/island platform is achieved directly from side or end (i.e. perimeter) exits, such as level exits or stairs accessed from the side or end of the platform – **Use Table 13.**
- → Escape from side/island platform is achieved via stairs to a footbridge/underpass – **Use Table 14 to Table 18**.

These platform configurations (and the relevant tables to use) are illustrated in Figure 11.

Step 1 requires the user to confirm the appropriate set of tables for their design case.

It should be noted that the *Simplified Platform Design Tool* does not currently allow for combinations of footbridge/underpass and direct platform side/end escape routes. However, in such instances Table 14 to Table 18 could be used to produce a conservative output.

For this arrangement use Tables 14 to 18

Indicative footbridge/underpass location shown (footbridge at far end of platform).

Tables 14 to 18 to be used when footbridge discharges on the central part of the platform (irrespective of its location along the platform length.

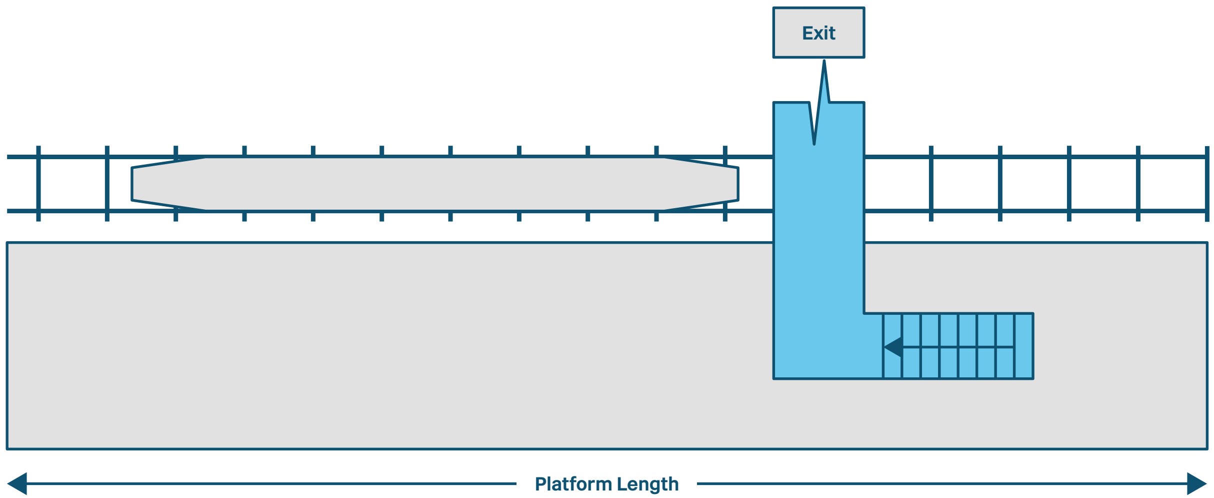


Figure 11b Table selection guidance sketch for simplified platform design tool where footbridges/underpasses are present

A.2 Methodology

Step 2 – Confirm available "total aggregate equivalent horizontal exit width" or "available clear stair width"

The rate at which passengers evacuate the platform is dependent on the available exit widths off the platform. Wider exits afford a larger exit flowrate, and therefore typically allow for longer platform dead ends. The aggregate exit width (sum of all available egress exits) is therefore a key parameter.

The clear width of each of the platform exits or footbridge stairs should be measured in accordance with BS 9999 Figure 14 and Clause 17.4.1. Stair widths should be measured between the innermost part of the handrails as per BS 9992 Table 1. Further:

→ When applying Table 13:

- BS 9992 recognises that the egress flowrate through vertical means of egress (i.e. stairs) are slower than through horizontal means of egress (i.e. level exits).
- Hence a correction factor of 0.7 should be applied to all vertical means of egress exit widths to appropriately represent the contribution of vertical exits to an equivalent horizontal width in terms of exit capacities (see equation below).

  Equivalent horizontal exit clear width = 0.7 x vertical exit clear width

- **The total aggregate of all equivalent horizontal platform exits widths should be calculated.**

→ When applying Table 14 to Table 18:

- As Table 14 to Table 18 apply to a single footbridge/underpass stair, no correction factor is applied. The table headings are presented in terms of available clear stair width.
- **The clear stair width of the footbridge /underpass stair should therefore be measured.**

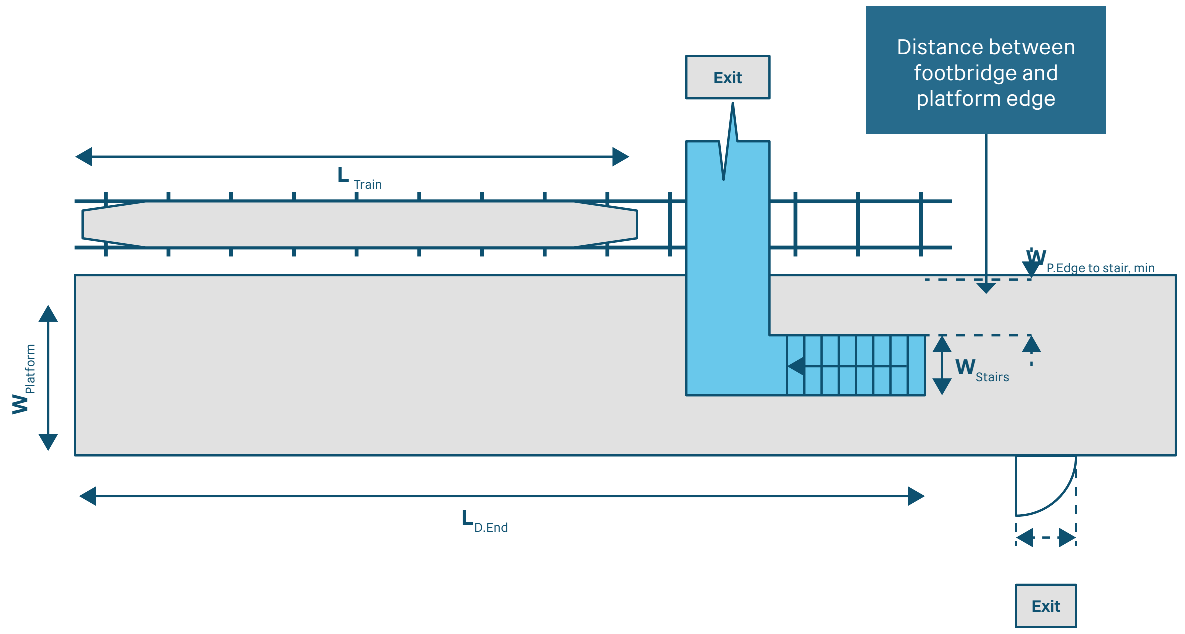
Step 3 – Confirm the distance between the footbridge and the platform edge (when applying Table 14 to Table 18 only)

The flow of passengers from the platform dead-end via a footbridge/underpass escape route, is dependent on the distance between the platform edge and the start of the footbridge stair.

The further the footbridge/underpass is from the platform edge, the more time for escape is typically available before the final exit (in this case the footbridge/underpass) is compromised by the fire.

The distance between the platform edge and the nearest point of the footbridge stair should therefore be measured, as per Figure 12.

A.2 Methodology



Note: Platform width should be larger than the sum of the stair width and distance to the platform edge.

$$W_{platform} > W_{stair} + W_{p.edge\ to\ stair,\ min}$$

Figure 12 Sketch showing distance between footbridge and platform edge

Table 14 to Table 18 summarise the allowable dead-end distances accounting for the separation distance between the footbridge and the incident platform edge in increments of 0.5m, between 2.0m to 4.0m.

Where required, the measured distance should be rounded down to the nearest 0.5m, and relevant Table 14 to Table 18 used accordingly. **The results should not be interpolated.**

A.2 Methodology

<u>Step 4 – Confirm minimum platform width</u>

The *Simplified Platform Design Tool* evaluates the maximum allowable dead-end distance by taking into account the rate at which passengers can walk past the growing train fire. Typically, a wider platform allows for a larger number of persons to walk past the growing fire, and for a longer period of time, subject to assumed platform furniture and obstruction. The platform width is therefore a key parameter.

The clear platform width of the platform should therefore be measured, as per Figure 13.

<u>Step 5 – Confirm dead-end travel distance from simplified table</u>

Using the inputs detailed in Steps 2, 3, and 4, the appropriate maximum dead-end travel distance can be identified from the table identified in Step 1 (i.e. Table 13 or Table 14 to Table 18, as relevant.

Tables 13 to 18 contain additional conditions for platforms which are regularly accessed by Diesel Multiple Unit (DMU) trains.

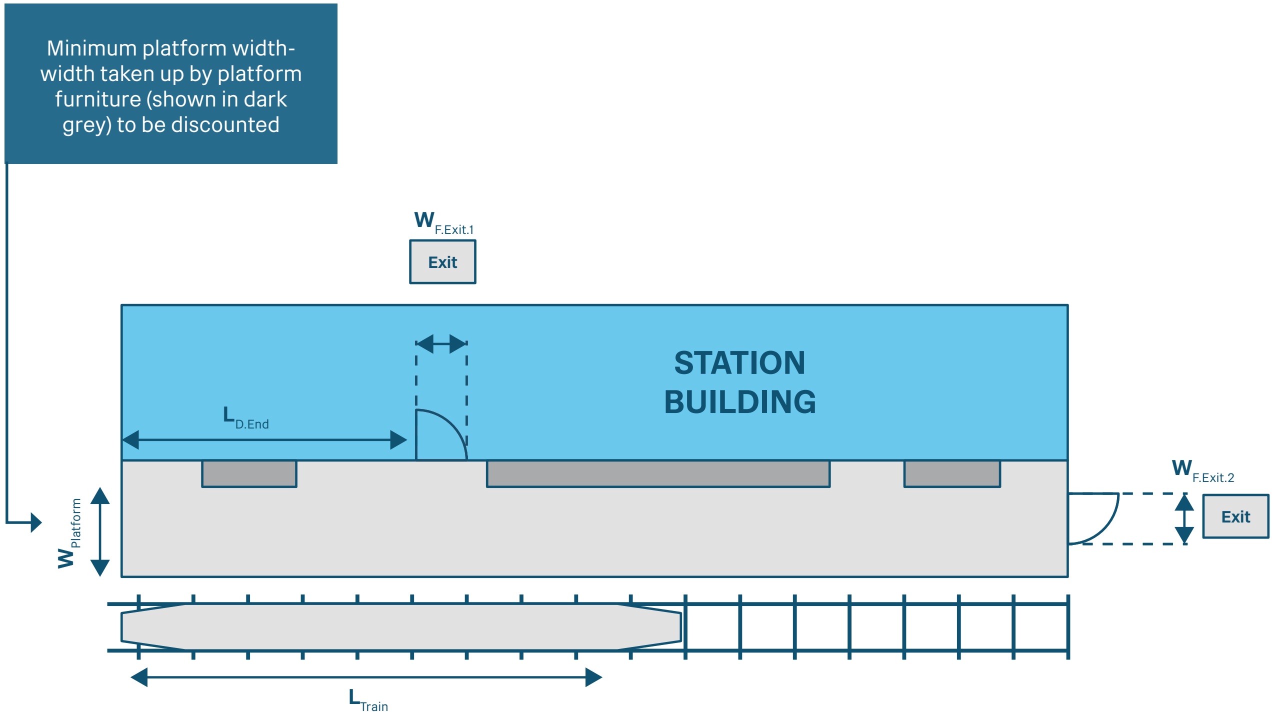


Figure 13 Sketch showing minimum platform width measurement

A.2 Methodology

Step 6 – Apply correction factor based on train occupancy and platform type

For conservatism, the *Simplified Platform Design Tool* always assumes a crush loaded train occupancy escaping via the platform. The crush loaded train occupancy is assumed to be 150 persons per 20m of carriage.

In addition, the tool initially assumes a high density occupancy located on the incident platform (to account for passengers waiting to board the train). The fully loaded occupancy is assumed to be 75 persons per 20m of carriage (i.e. 50% of fully-loaded train occupancy).

It may be appropriate in some cases to assume a lower platform occupancy density, for example stations serving small or rural areas where busy peak periods are not expected:

- → For a medium density platform, the boarders occupancy is taken as 20% of the fully loaded train occupancy.
- → For a low density platform, the boarders occupancy is taken as 10% of the fully-loaded train occupancy.

A fully loaded platform occupancy is recommended to be assumed for most design cases unless specific data can be provided to demonstrate otherwise.

However, in cases where platform occupancies are less onerous, and can be justified/supported by relevant station patronage figures or other suitable information, a reduced platform loading may be appropriate. For platforms serving lower occupancies, the allowable maximum dead-end distance can therefore be increased commensurately, when compared to the values given in Table 13 to Table 18.

The correction factors for side and island platforms to account for different platform loadings are presented in Table 12.

The correction factor should be applied to the dead-end travel distance established in Step 5, as per the following equation:

Maximum allowable dead end distance = (Indicative dead end distance × correction factor)

Note: the maximum allowable dead-end distance should not exceed 304m. This upper limit is set based on the 8 minute platform clearance time for surface stations specified by BS 9992, and a horizontal travel speed of 38m/min (BS 9992 Table 3). If applying the correction factor results in a travel distance exceeding 304m, this should be limited to 304m.

Platform Loading	Description	Correction Factor	
		Side Platform	Island Platform*
High density	The total platform occupancy for a high density platform assumes 225 persons per 20m of platform (including a fully loaded train occupancy)	1.0	0.75
Medium density	The total platform occupancy for a medium density platform assumes 180 persons per 20m of platform (including a fully loaded train occupancy)	1.25	0.88
Low density	The total platform occupancy for a low density platform assumes 165 persons per 20m of platform (including a fully loaded train occupancy).	1.36	0.94

* For island platforms, an additional platform occupancy (boarders) on the non-incident side of the platform has been considered. This is assumed to be 75 persons per 20m of platform.

Table 12 Correction factors for side and island platforms for different platform loadings

A.2 Methodology

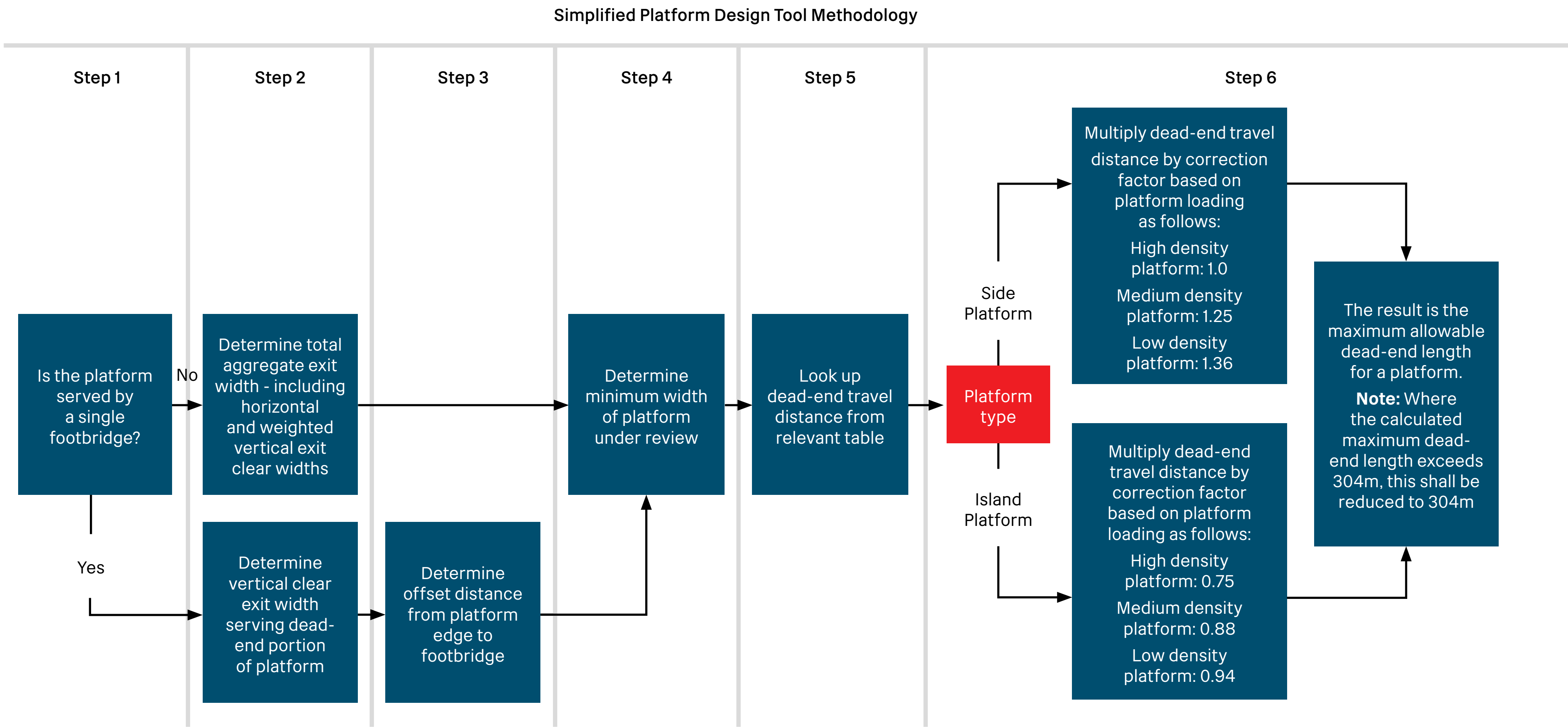


Figure 14 Simplified platform design tool methodology flowchart

Table 13

Table 13 - Allowable dead-end platform length (m) for platforms served by perimeter exits

Total aggregate equivalent horizontal exit width (m)																	
	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m	4.5m	4.8m	5.1m	5.4m	5.7m	Unrestricted exit width (m)
Platform width (m)																	
2.50	34	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
2.75	34	42	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
3.00	46	56	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
3.25	46	58	67	74	74	74	74	74	74	74	74	74	74	74	74	74	74
3.50	46	58	70	78	84	84	84	84	84	84	84	84	84	84	84	84	84
3.75	46	58	70	81	90	94	94	94	94	94	94	94	94	94	94	94	94
4.00	55	67	79	91	102	110	113	113	113	113	113	113	113	113	113	113	113
4.25	55	69	81	93	104	115	123	124	124	124	124	124	124	124	124	124	124
4.50	55	69	83	94	106	118	128	136	136	136	136	136	136	136	136	136	136
4.75	55	69	83	96	108	120	131	140	148	148	148	148	148	148	148	148	148
5.00	68	83	97	110	124	135	147	159	167	173	173	173	173	173	173	173	173
5.25	68	85	99	113	127	140	152	163	174	183	187	187	187	187	187	187	187
5.50	72	89	107	120	134	148	161	172	184	195	203	206	206	206	206	206	206
5.75	72	90	107	124	138	152	166	178	189	201	211	220	221	221	221	221	221
6.00	76	95	113	130	146	160	174	188	199	211	223	232	241	241	241	241	241
6.25	76	96	114	132	149	164	178	192	206	217	229	241	250	257	257	257	257
6.50	76	96	115	133	151	168	183	196	210	224	235	247	259	267	273	273	273

Table 13

Table 13 - Allowable dead-end platform length (m) for platforms served by perimeter exits

Total aggregate equivalent horizontal exit width (m)																	
	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m	4.5m	4.8m	5.1m	5.4m	5.7m	Unrestricted exit width (m)
6.75	76	96	115	134	152	169	187	201	215	229	241	253	265	276	285	289	289
7.00	81	100	119	139	157	176	193	210	224	238	252	264	276	288	298	304	304
7.25	81	101	120	139	159	177	195	213	229	243	257	271	283	295	304	304	304
7.50	93	115	135	154	173	193	211	229	246	262	276	290	304	304	304	304	304
7.75	93	117	138	158	177	196	215	234	252	269	284	298	304	304	304	304	304
8.00	110	135	159	179	199	218	237	257	275	292	304	304	304	304	304	304	304
8.25	110	138	162	185	206	225	244	264	283	301	304	304	304	304	304	304	304
8.50	110	138	166	189	212	232	252	271	290	304	304	304	304	304	304	304	304
8.75	110	138	166	193	216	238	259	278	297	304	304	304	304	304	304	304	304

NOTE: For side platforms regularly accessed by Diesel Multiple Units (DMUs) trains, platforms with a clear width narrower than 3.5m should have a one-way travel distance of not exceeding 20m, as per BS 9992. For wider platforms, the values in this table should apply.

Table 14

Table 14 Allowable dead-end platform length (m). Footbridge discharges onto platform Footbridge situated 2m away from platform edge

Final exit width (m) →	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m	4.5m	4.8m	5.1m
Platform width (m)														
Up to 5.00	32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5.25	32	41	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5.50	32	41	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5.75	32	41	55	56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.00	32	41	55	65	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.25	32	41	55	65	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.50	32	41	55	65	75	73	73	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.75	32	41	55	65	75	84	84	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7.00	32	41	55	65	75	93	93	76	N/A	N/A	N/A	N/A	N/A	N/A
7.25	32	41	55	65	75	93	93	88	75	N/A	N/A	N/A	N/A	N/A
7.50	32	41	55	65	75	93	93	99	88	76	N/A	N/A	N/A	N/A
7.75	32	41	55	65	75	93	93	110	100	90	N/A	N/A	N/A	N/A
8.00	32	41	55	65	75	93	93	120	112	104	88	N/A	N/A	N/A
8.25	32	41	55	65	75	93	93	120	123	116	103	86	N/A	N/A
8.50	32	41	55	65	75	93	93	120	132	127	117	101	86	N/A
8.75	32	41	55	65	75	93	93	120	133	138	129	116	102	83

NOTE: Cells marked as Not Applicable (N/A) are not feasible platform configurations; the platform width should be at least as large as the sum of the stair width and the distance to the incident platform edge.

NOTE: For island platforms regularly accessed by Diesel Multiple Units (DMUs) trains, where the distance between the footbridge and either platform edge is less than 2.0m, the one-way travel distance should not exceed 20m, as per BS 9992.

Table 15

Table 15 Allowable dead-end platform length (m). Footbridge discharges onto platform.
Footbridge situated 2.5m away from platform edge

Final exit width (m) →	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m	4.5m	4.8m
Platform width (m)													
Up to 5.50	38	29	35	36	36	36	36	36	36	36	36	36	36
5.50	38	48	35	36	36	36	36	36	36	36	36	36	36
5.75	38	48	58	36	36	36	36	36	36	36	36	36	36
6.00	38	48	58	64	36	36	36	36	36	36	36	36	36
6.25	38	48	58	67	79	36	36	36	36	36	36	36	36
6.50	38	48	58	67	84	36	36	36	36	36	36	36	36
6.75	38	48	58	67	88	36	36	36	36	36	36	36	36
7.00	38	48	58	67	88	94	36	36	36	36	36	36	36
7.25	38	48	58	67	88	98	101	36	36	36	36	36	36
7.50	38	48	58	67	88	103	106	110	36	36	36	36	36
7.75	38	48	58	67	88	103	111	117	115	36	36	36	36
8.00	38	48	58	67	88	103	115	122	123	113	36	36	36
8.25	38	48	58	67	88	103	115	127	130	128	36	36	36
8.50	38	48	58	67	88	103	115	131	135	136	129	36	36
8.75	38	48	58	67	88	103	115	131	140	143	144	127	36

NOTE: For island platforms regularly accessed by Diesel Multiple Units (DMUs) trains, where the distance between the footbridge and either platform edge is less than 2.0m, the one-way travel distance should not exceed 20m, as per BS 9992.

Table 16

Table 16 Allowable dead-end platform length (m).
Footbridge discharges onto platform Footbridge situated 3m away from platform edge

Final exit width (m) →	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m
Platform width (m)											
Up to 6.00	38	41	49	55	61	64	64	64	64	64	64
6.25	38	48	49	55	61	64	64	64	64	64	64
6.50	38	48	67	55	61	64	64	64	64	64	64
6.75	38	48	67	55	61	64	64	64	64	64	64
7.00	38	48	67	78	90	64	64	64	64	64	64
7.25	38	48	67	79	93	64	64	64	64	64	64
7.50	38	48	67	79	95	105	64	64	64	64	64
7.75	38	48	67	79	95	109	114	64	64	64	64
8.00	38	48	67	79	95	110	119	122	64	64	64
8.25	38	48	67	79	95	110	122	127	129	64	64
8.50	38	48	67	79	95	110	124	132	135	137	64
8.75	38	48	67	79	95	110	124	136	141	146	64

NOTE: For island platforms regularly accessed by Diesel Multiple Units (DMUs) trains, where the distance between the footbridge and either platform edge is less than 2.0m, the one-way travel distance should not exceed 20m, as per BS 9992.

Table 17

Table 17 Allowable dead-end platform length (m). Footbridge discharges onto platform.
Footbridge situated 3.5m away from platform edge

Final exit width (m) →	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m
Platform width (m)										
Up to 6.50	47	41	49	54	65	72	78	84	84	84
6.75	47	59	49	54	65	72	78	84	84	84
7.00	47	59	74	54	65	72	78	84	84	84
7.25	47	59	74	82	65	72	78	84	84	84
7.50	47	59	74	83	94	72	78	84	84	84
7.75	47	59	74	83	99	72	78	84	84	84
8.00	47	59	74	83	103	108	78	84	84	84
8.25	47	59	74	83	103	112	115	84	84	84
8.50	47	59	74	83	103	117	121	125	84	84
8.75	47	59	74	83	103	117	126	132	133	84

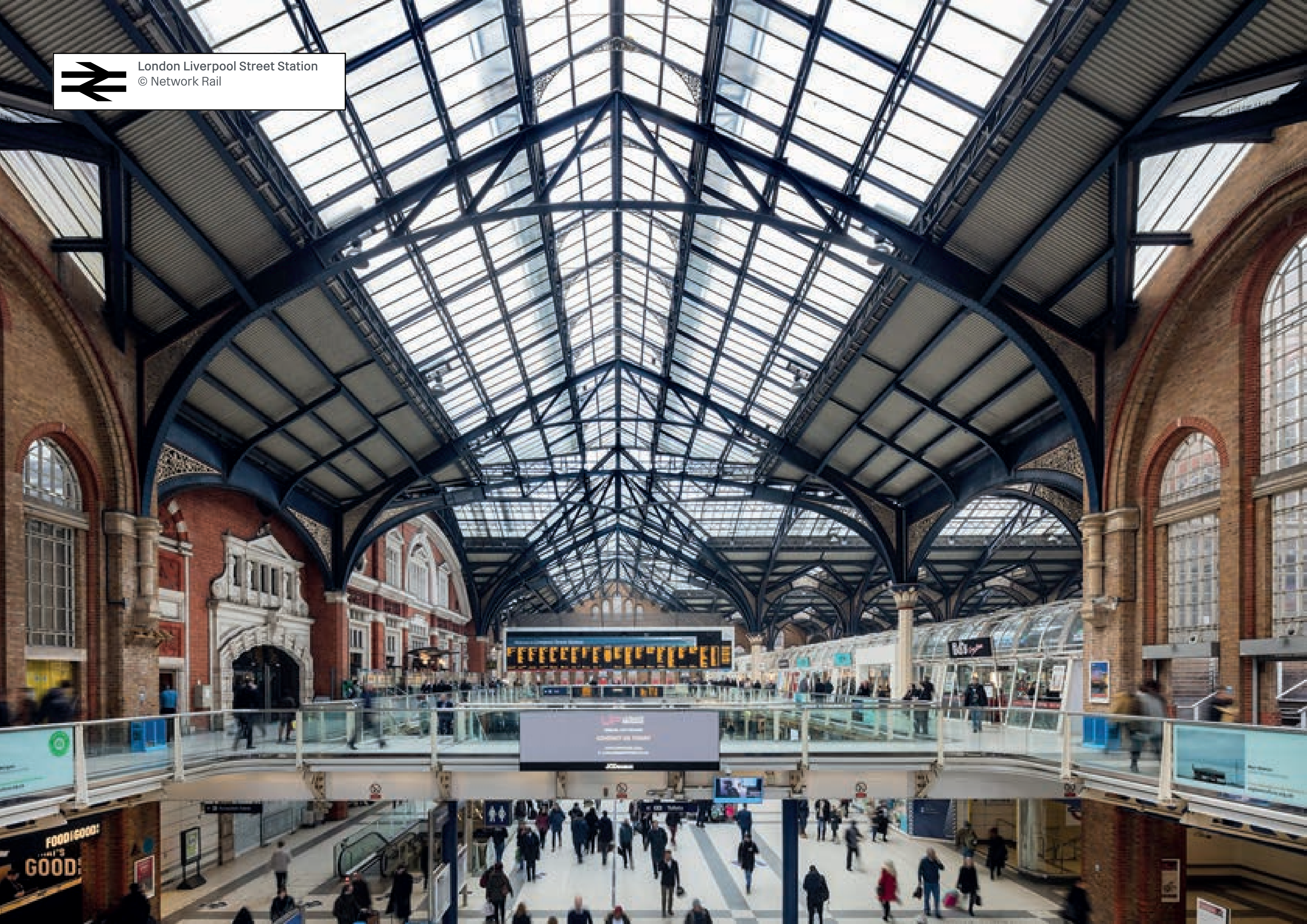
NOTE: For island platforms regularly accessed by Diesel Multiple Units (DMUs) trains, where the distance between the footbridge and either platform edge is less than 2.0m, the one-way travel distance should not exceed 20m, as per BS 9992.

Table 18

Table 18 - Allowable dead-end platform length (m). Footbridge discharges onto platform.
Footbridge situated 4m away from platform edge

Final exit width (m) →	1.2m	1.5m	1.8m	2.1m	2.4m	2.7m	3.0m	3.3m	3.6m	3.9m	4.2m
Platform width (m)											
Up to 7.0	50	48	58	66	74	83	91	99	105	111	113
7.25	50	63	58	66	74	83	91	99	105	111	113
7.50	50	63	79	66	74	83	91	99	105	111	113
7.75	50	63	79	89	74	83	91	99	105	111	113
8.00	50	63	79	92	74	83	91	99	105	111	113
8.25	50	63	79	92	102	83	91	99	105	111	113
8.50	50	63	79	92	106	115	91	99	105	111	113
8.75	50	63	79	92	106	119	124	99	105	111	113

NOTE: For island platforms regularly accessed by Diesel Multiple Units (DMUs) trains, where the distance between the footbridge and either platform edge is less than 2.0m, the one-way travel distance should not exceed 20m, as per BS 9992.



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Fire Safety at Stations

Appendix B: Station Design Case Studies

B

Introduction

Introduction

This appendix provides a number of case studies to illustrate the intended application of the means of escape design approach to Very Low Risk stations, outlined in Sections 4.2 and 4.3 of this Design Manual.

The case studies are illustrative and show the key considerations and design options for each approach provided by this methodology.

Case Study 1: New Station with Side Platforms
This case study is intended to illustrate the potential design approaches for a new, Very Low Risk station. The example comprises a two platform station positioned on an embankment.

This embankment arrangement has been selected to illustrate the challenges with providing secondary means of escape (in particular for PRMs) for stations with no level access/egress.

- → **Design Option 1: BS 9992-Compliant Design** – Illustrates the likely design approach needed to comply with the prescriptive guidance of BS 9992, including step-free secondary means of escape from platform ends.
- → **Design Option 2: Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)** – Illustrates the potential benefits and considerations of applying one of these tools, including developing a more efficient (and proportionate) design solution for a very low risk station. The beneficial use of platform lifts for PRM evacuation is also shown.
- → **Design Option 3: Application of Platform Passenger Refuge Approach** – This option is not considered for this example, on the basis that the *Platform Passenger Refuge Approach* is not applicable to new stations.

Case Study 2: New Station with Side Platforms
Similar to Case Study 1, this case study illustrates the potential design approach for a new, “very low risk” station, but comprising this time of a single island platform.

This arrangement is intended to show how the application of the new Design Manual approach could avoid the need to provide additional footbridges to an island platform.

- → **Design Option 1: BS 9992-Compliant Design** – Illustrates the likely design approach needed to comply with BS 9992, including the provision of accessible footbridges at either end of the island platform.
- → **Design Option 2: Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)** – Illustrates how the application of one of these tools, when combined with the wider island platform and use of lifts for PRM evacuation, could result in a beneficial design with a single footbridge.

Introduction

Case Study 3: Existing Station Platform Extension Scheme – This case study shows an existing "very low risk" station which is to undergo a platform extension scheme.

This case study is intended to show how the design approach could be applied to existing stations, including consideration of the *Platform Passenger Refuge Approach*. A side platform example is provided in this case study, however similar principles can also be applied to existing island platforms.

- **Existing Layout** – Shows the layout of the existing station, which is to undergo a platform extension and AfA scheme.
- **Design Option 1: BS 9992-Benchmarked Design** – Illustrates how the application of BS 9992 to a platform extension scheme may require the introduction of an additional footbridge.
- **Design Option 2: Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)** – Illustrates how the application of one of these tools may provide an acceptable solution, subject to an acceptable platform width being practicable.
- **Design Option 3: Application of Platform Passenger Refuge Approach** – Illustrates the potential design benefits of applying this alternative approach for an existing station, whilst noting the additional implications on fire safety management of the station.

Case Study 4: Existing Station Access for All (AfA) Scheme – This case study shows an existing "very low risk" station which is to undergo an Access for All (AfA) scheme.

This case study is intended to show how the beneficial use of passenger lifts for evacuation could provide a more appropriate and proportionate design for AfA schemes, when compared to applying prescriptive BS 9992 guidance.

- **Existing Layout** – Shows the layout of the existing station, which is to undergo an AfA scheme.
- **Design Option 1: BS 9992-Benchmarked Design** – Illustrates the likely design approach needed to comply with BS 9992, including the provision of a new ramped, accessible footbridge.
- **Design Option 2 – Beneficial use of passenger lifts for evacuation** – Illustrates how the beneficial use of passenger lifts for evacuation approach (described in Section 4.5.2) could be applied to an AfA scheme

Case Study 1

Case Study 1 – New Station with Side Platforms

Case study 1 shows a typical design arrangement for a new, small unstaffed station constructed in a rural location. The station is classed as Very Low Risk in accordance with Section 3.2.

The station comprises of two side platforms located on an embankment, served by a new car park and drop-off point on one side. Main access to the station is provided via stairs to Platform 1, and an accessible footbridge is also provided with lifts serving the car park and platforms.

Main access to Platform 2 is via the accessible footbridge. No canopies are provided within the station.

The station is located on a main line between major cities, and is served by both local trains (typically 2-3 carriage) and intercity trains (up to 8 carriages). However, due to its rural location no more than 50 people are expected to be alighting to/from a train at a time.

Both platforms are approximately 250m long and are initially proposed to be 3.5m wide. All stairs (including the footbridge and Platform 1 stairs to the car park) are proposed to be 3.25m wide each.

Design Option 1 – BS 9992-Compliant Design

If designed to comply fully with BS 9992 guidance, the following key design features for means of escape are required to be provided:

- There should be at least two exits from each platform, and one-way travel distances should not exceed 20m (BS 9992 Clause 14.4.2) – *In the context of this case study, escape routes would therefore be required within 20m of either end of both platforms.*
- For unstaffed stations, the means of escape route should allow PRMs to proceed to a place of safety unaided. They should not be exposed to a significant additional risk from fire, compared to those who can readily use stairs to reach a place of safety (BS 9992 (Clause 16.1) – *Platform-end escape routes would therefore require to be accessible. Where situated on an embankment, this would require ramps to be provided.*
- Lifts not designed as evacuation or firefighting lifts (that meet the relevant guidance of BS 9999) should not be used as a means of evacuation for PRMs (BS 9992 Clause 16.3) – *Footbridge lifts are not designed as evacuation or firefighting lifts, therefore should not be used for evacuation from the station.*

Prescriptive compliance with BS 9992, in this example, would therefore result in a station design which requires secondary means of escape from both ends of each of the two platforms. Due to the position of the station on an embankment, these means of escape would require to consist of ramps which would be unlikely to comply with best-practice accessibility guidance with respect to length, gradient and/or height. As described in Table 10, this would typically be deemed to be an "impracticable" design solution in most cases.

Additional considerations such as land-take (for platform exits and escape paths), capital costs (for ramp and path infrastructure, lighting and security measures), maintenance and security would also be relevant to any assessment of practicability (as described in Section 4.4).

For the purposes of this case study, it is therefore assumed that this design solution is deemed to be "impracticable" (as per Section 4.4). Therefore, in line with the design process described in Section 4.3.6 for new Very Low Risk stations, the *Simplified Platform Escape Design Method* and/or *Network Rail Platform Emergency Egress Tool (PEET)* could be applied to establish whether a more practicable design solution can be obtained.

Note: *The Platform Passenger Refuge Approach* is not typically accepted as a design method for new stations. Refer to Section 4.2.5 for details

Case Study 1

Design Option 1: BS 9992-Compliant Design*

A. Secondary means of escape required at both ends of the platforms to comply with BS 9992 Clause 14.4.2

B. Passenger lifts not for PRM evacuation, as per BS 9992 Clause 16.3

C. Ramps required to facilitate disabled evacuation to comply with BS 9992 Clause 16.1

*Note: The example station layout illustrated in this figure is developed to reflect technical compliance with BS 9992. For the avoidance of doubt, the ramps shown would not be compliant with best-practice accessibility guidance such as such as Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland, 2015, or BS 8300. Refer to Page 144 for further discussion.

Figure 15 Illustration of Case Study 1, Design Option 1 (BS 9992-Compliant Design)

Case Study 1

Design Option 2 - Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)

This option involves applying one of the two tools described to establish a more appropriate length of platform before a secondary means of escape is required, based on the platform width and available escape route capacity. These options consider specifically the risk posed to occupants escaping from the platform due to a train fire scenario.

The *Simplified Platform Escape Design Method* is a simplified (and therefore more conservative) version of the *Network Rail Platform Emergency Egress Tool (PEET).*

For both approaches however, the greater the platform and escape route widths, the longer the permitted platform length before a secondary means of escape is required.

When applied to this case study, a dead-end platform travel distance of no more than 150m is necessary before a secondary means of escape is required.

By applying the *Simplified Platform Escape Design Method*, a minimum side platform width of 5.00m would be required, if following the 6-step process described in Appendix A:

Step 1: Confirm appropriate look-up table

Table 13 is applicable, on the basis that escape from the platform is via side exits (Note: in this case study, the footbridge stairs do not encroach on the platform width).

Step 2: Confirm "total equivalent horizontal exit width"

Platform exit stairs for both platforms are 3.25m wide. When applying the 0.7 correction factor, the total equivalent horizontal exit width is calculated as approx. 2.3m.

Step 3: Confirm distance between footbridge and platform edge

Not applicable, on the basis that the footbridge stairs do not encroach on the platform width.

Step 4 & 5: Confirm minimum platform width

Steps 4 & 5 are adapted in this case study to calculate the allowable platform width (when the dead-end travel distance is known). When the dead-end travel distance is taken as at least 150m, and the total equivalent horizontal exit width is 2.3m, Table 13 confirms a minimum platform width of 7.5m (noting that the figures in Table 13 cannot be interpolated).

Step 6: Apply correction factor based on platform occupancy

The 7.5m minimum platform width may be reduced in this case, on the basis that a "low density" platform occupancy can be assumed (i.e. no more than 50 persons are assumed to be waiting on the platform at any one time). A correction factor of 1.36 (as per **Table 12**) can therefore be applied to the dead-end platform length (i.e. 150m / 1.36), resulting in a 'weighted' platform dead-end length for low density occupancy of 110m. Therefore minimum permitted platform width of **5.0m** can be determined from Table 13, for a 110m 'weighted dead-end length' provided with 2.3m of total equivalent horizontal exit width.

Alternatively, by applying the Network Rail *Platform Emergency Egress Tool* (PEET), a less conservative platform width of 4.9m could be ascertained, based on similar assumptions (including a platform occupancy allowance for a crush loaded train, plus 50 people located on the platform). This is a result of PEET applying less discretized (and therefore more precise) calculation values.

Case Study 1

Design Option 2 – Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)

A. Secondary means of escape from platform ends not proposed

B. Passenger lifts used as a beneficial means of escape for disabled occupants

C. Platform width increased to 5m or 4.9m, in line with Simplified Platform Design Tool or PEET outputs respectively

Figure 16 Illustration of Case Study 1, Design Option 2 *(Simplified Platform Escape Design Method* or *Network Rail Platform Emergency Egress Tool*

Design Option 3 - Application of Platform Passenger Refuge Approach

The *Platform Passenger Refuge Approach* should not be applied to new stations (as discussed in Section 4), and therefore is not considered or applied as part of Case Study 1.

Beneficial use of passenger lifts for evacuation

As described in Section 4.5.2, it may be appropriate for passenger lifts to form part of an escape route for PRMs in specific circumstances. In particular passenger lifts serving footbridges where all levels of the lift are visible and open to atmosphere, such as the passenger footbridge lifts included in this case study. Lifts proposed to be used as vertical means of escape for PRMs should meet the criteria described in Section 4.5.2.

If beneficial lifts for PRM evacuation were to be utilised as the primary means of PRM escape from the platforms in this case study, it could reduce or remove the need to provide level or ramped egress from the platforms to support PRM evacuation.

Evaluation of Design Options

Case Study 1 illustrates how applying alternative design methods could result in a more appropriate and proportionate solution for the design of a simple, Very Low Risk station consisting of side platforms.

A prescriptive, BS 9992-based design approach would, in this example, result in secondary means of escape being required at platform ends. This is unlikely to be a satisfactory or practicable design solution, given the stations/project's constraints and relative fire safety risks.

Instead, by applying either the *Simplified Platform Escape Design Method* or PEET, and subject to sufficient platform width and exit capacity being provided, there is potential to avoid the need to provide secondary means of escape from platform ends. This could bring benefits to the project with respect to land-take, capital and maintenance costs and reducing potential security implications resulting from multiple paths, stairs and gates etc.

Additionally, the provision of beneficial lifts for the evacuation of PRMs (as per Section 4.5.2) would enable PRMs to escape via the footbridge lifts, with no reliance on ramps. This would provide a more equitable and dignified means of evacuation for these station users, and also reduce design impact and capital/maintenance costs for the station.

Case Study 1

A. Beneficial use of passenger lift for PRM evacuation.

B. Emergency Voice Communication (EVC) system.

C. CCTV & Public Address coverage to platform areas, including refuge area.

Figure 17 Indicative image showing the provision of EVC, CCTV and Public Address to support beneficial use of passenger lifts for evacuation

Case Study 1 - New Station with Side Platforms

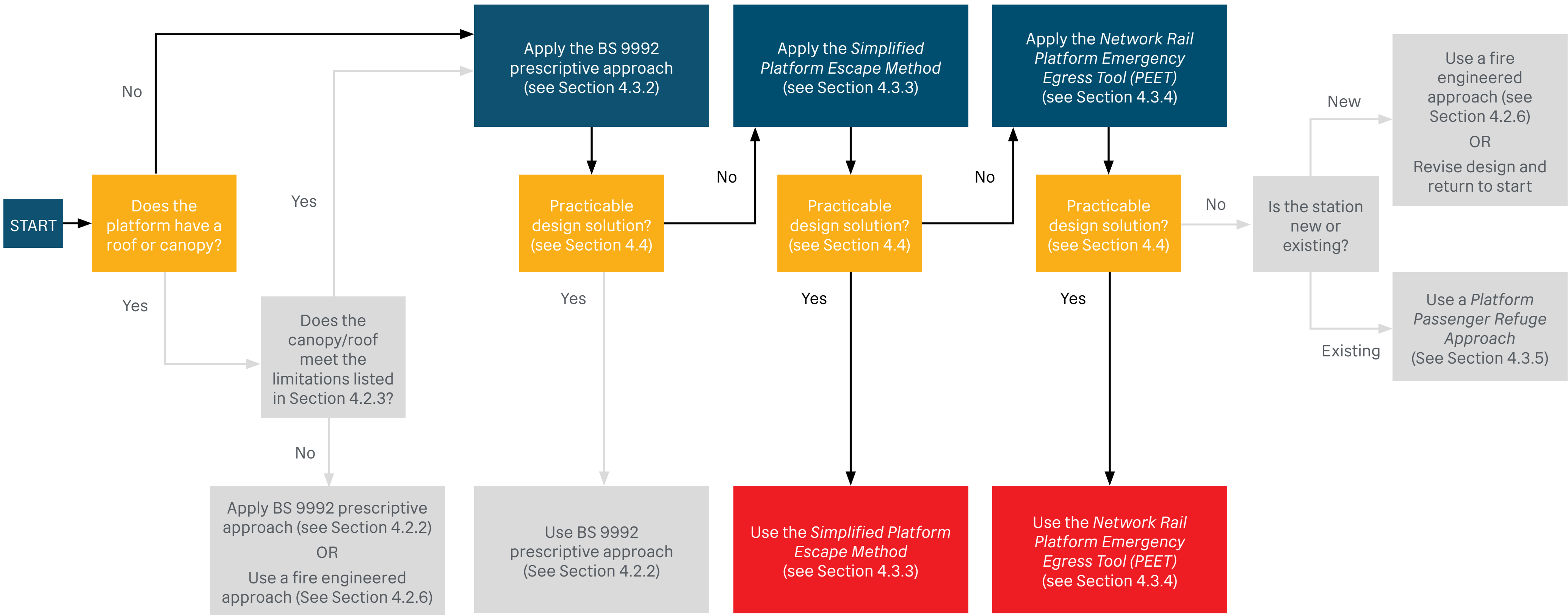


Figure 18 Flowchart showing the Simplified Platform Escape Design Method approach used for Case Study 1

Case Study 2 – New Station with Island Platform

Case Study 2 shows an island platform design arrangement for a small unstaffed station in a rural location. Similarly to Case Study 1, the station is classed as Very Low Risk in accordance with Section 3.2.

The station comprises a double-platform island, serving two "slow lines", with a new car park and drop-off point on the other side of two further "fast lines". Access is therefore required to the island station platforms via accessible footbridge over three different lines.

The station is located on a main line between major cities, but only serves local commuter trains (typically 4-6 carriages). Intercity trains pass via the "fast" lines and would not stop at the station. As the station serves a large commuter town area, there is potential for peak morning and evening services to be very busy.

The station is provided with an 50m long canopy which is open on all four sides, and extends close to the full width of the island platform.

The island platform is approximately 160m long and 8.5m wide.

Design Option 1 – BS 9992-Compliant Design

If designed to comply fully with BS 9992 guidance, the following key design features for means of escape are required to be provided:

- There should be at least two exits from each platform, and one-way travel distances should not exceed 20m (BS 9992 Clause 14.4.2) – *In the context of an island platform, this would typically require footbridges (or subways) at either end.*
- For unstaffed stations, the means of escape route should allow PRMs to proceed to a place of safety unaided. They should not be exposed to a significant additional risk from fire, compared to those who can readily use stairs to reach a place of safety (BS 9992 Clause 16.1) – *Platform-end footbridges would therefore require to be provided with ramps, to enable PRMs to escape the island platform unaided. Evacuation lifts rely on staff control, and therefore are typically unsuitable for unstaffed stations.*
- Lifts not designed as evacuation or firefighting lifts (that meet the relevant guidance of BS 9999) should not be used as a means of evacuation for PRMs (BS 9992 Clause 16.3) – *Footbridge lifts are not designed as evacuation or firefighting lifts, therefore should not be used for evacuation from the station.*

This approach therefore would likely involve the provision of two accessible footbridges, one at either end of the island platform, with ramped access. As described in Table 10, providing an additional footbridge for the primary purpose of means of escape is not typically supported as a practicable design solution.

In addition, whilst ramps serving a footbridge as shown in this case study may comply with BS 9992, they are unlikely to comply with best-practice accessibility guidance with respect to length, gradient and/or height, and as such would also be an "impracticable" design solution.

For the purposes of this case study, it is therefore assumed that this design solution is deemed to be "impracticable" (as per Section 4.4). Therefore, in line with the design process described in Section 4.3.6 for new Very Low Risk stations, the *Simplified Platform Escape Design Method* and/or *Network Rail Platform Emergency Egress Tool (PEET)* could be applied to establish whether a more practicable design solution can be obtained.

Case Study 2

Design Option 1 - BS 9992-Compliant Design*

A. Entry to footbridges to be within 20m of platform end

B. Passenger lifts not used for disabled occupant evacuation, as per BS 9992 Clause 16.3

C. Footbridges required at both ends of the platform to comply with BS 9992 Clause 14.4.2

D. Canopied island platform

E. Ramps required to facilitate PRM evacuation via footbridges to comply with BS 9992 Clause 16.1

*Note: The example station layout illustrated in this figure is developed to reflect technical compliance with BS 9992. For the avoidance of doubt, the ramps shown would not be compliant with best-practice accessibility guidance such as such as Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland, 2015, or BS 8300. Refer to Page 151 for further discussion.

Figure 19 Illustration of Case Study 2, Design Option 1 (BS 9992-Compliant Design)

Case Study 2

Design Option 2 - Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)

Similarly to Case Study 1, this option involves applying one of the two tools to establish an acceptable island platform length before a secondary means of escape (i.e. second footbridge) is required, based on the platform width and available escape route capacity. These options consider specifically the risk posed to occupants escaping from the platform due to a train fire scenario.

Whilst a canopy is provided on the island platform, the design tools can be applied on the basis that the canopy is open on all four sides, and therefore any smoke is likely to travel underneath the canopy and escape to atmosphere (i.e. not form a smoke layer that is likely to affect occupants escaping from the platform).

When applied to this case study, to avoid a secondary means of escape (i.e. second footbridge), a dead-end platform travel distance of at least 70m is required where the single footbridge is located in the centre of the island platform.

By applying the *Simplified Platform Escape Design Method*, the proposed 8.5m platform width would be sufficient to accommodate a dead-end travel distance of 70m, based the 6-step process described in Appendix A:

Step 1: Confirm appropriate look-up table

Table 14 to Table 18 are applicable, on the basis that egress from the island platform is via stairs to a footbridge.

Step 2: Confirm “total clear stair width”

The footbridge stairs have an available clear width of 2.7m.

Step 3: Confirm distance between footbridge and platform edge

The distance between the footbridge and the platform edge is measured as 2.9m, as per Figure 13. Table 15 (i.e. 2.5m distance) is therefore applicable in this case, on the basis that the more conservative table is selected.

Step 4: Confirm minimum platform width

The minimum platform width is measured as 8.5m, as per Figure 14.

Step 5: Confirm dead-end travel distance from simplified table

Reading off Table 15, with a platform width of 8.5m (from Step 4), and an available clear stair width of 2.7m (from Step 2), a dead-end travel distance 103m can be accommodated.

Step 6: Apply correction factor based on platform occupancy

On the basis that the station serves a large commuter town area, there is potential for platforms to be busy at peak times. As such, a “high density” platform loading is assumed, as per Table 12. The dead-end travel distance established in Step 5 should therefore be multiplied by a correction factor of 0.75, resulting in a maximum allowable dead-end travel distance of 77.2m. This exceeds the 70m minimum distance required to accommodate a single footbridge design.

Therefore, provided the platform width and stair width parameters can be accommodated as part of the footbridge design, there may be no further need to apply the *Network Rail Platform Emergency Egress Tool (PEET)* in order to establish a less conservative figure.

Therefore, by applying just the *Simplified Platform Escape Design Method*, it can be demonstrated that the proposed island platform design requires only a single, central footbridge.

Case Study 2

Design Option 2 - Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)

A. Canopied island platform

B. Single footbridge in more optimal location on platform (central)

C. Island platform has sufficient width to facilitate escape past a train fire

D. Passenger lifts used as a beneficial means of escape for PRM occupants (as per Section 4.5.1)

E. Ramps not required to serve footbridge, due to provision of beneficial passenger lifts

Figure 20 Illustration of Case Study 2, Design Option 2 (*Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool)*

Case Study 2

Design Option 3 -Application of Platform Passenger Refuge Approach

The *Platform Passenger Refuge Approach* should not be applied to new stations (as discussed in Section 4), and therefore is not considered or applied as part of Case Study 1.

Beneficial use of passenger lifts for evacuation

As described in Section 4.5.2, it may be appropriate for passenger lifts to form part of an escape route for PRMs in specific circumstances. In particular passenger lifts serving footbridges where all levels of the lift are visible and open to atmosphere, such as the passenger footbridge lifts included in this Case Study.

Lifts proposed to be used a vertical means of escape for PRMs should meet the criteria described in Section 4.5.2.

If beneficial lifts for PRM evacuation were to be utilised as the primary means of PRM escape from the platforms in this case study, it could reduce or remove the need to provide ramped egress from the island platform to support PRM evacuation.

Evaluation of Design Options

Case Study 2 illustrates how applying alternative design methods could result in a more appropriate and proportionate solution for the design of a simple, Very Low Risk station consisting of an island platform.

A prescriptive, BS 9992-based design approach would, in this example, result in the provision of two accessible footbridges, with ramped access. This would likely be an unsatisfactory and impracticable design solution on the basis that it does not comply with best-practice accessibility guidance, and results in significant additional footbridge infrastructure being required.

Instead, by applying the *Simplified Platform Escape Design Method*, and subject to sufficient platform width and exit capacity being provided, there is potential to avoid the need to provide a second footbridge to the island platform.

Additionally, the provision of beneficial lifts for the evacuation of PRMs (as per Section 4.5.2) would enable PRMs to escape via the footbridge lifts, with no reliance on ramps. This would provide a more equitable and dignified means of evacuation for these station users (when compared to lengthy and/or steep ramps), and also reduce design impact and capital/maintenance costs for the station.

Case Study 2

A. Beneficial use of passenger lift for PRM evacuation

B. Emergency Voice Communication (EVC) system

C. CCTV & Public Address coverage to platform areas, including refuge area

Figure 21 Indicative image showing the provision of EVC, CCTV and Public Address to support beneficial use of passenger lifts for evacuation

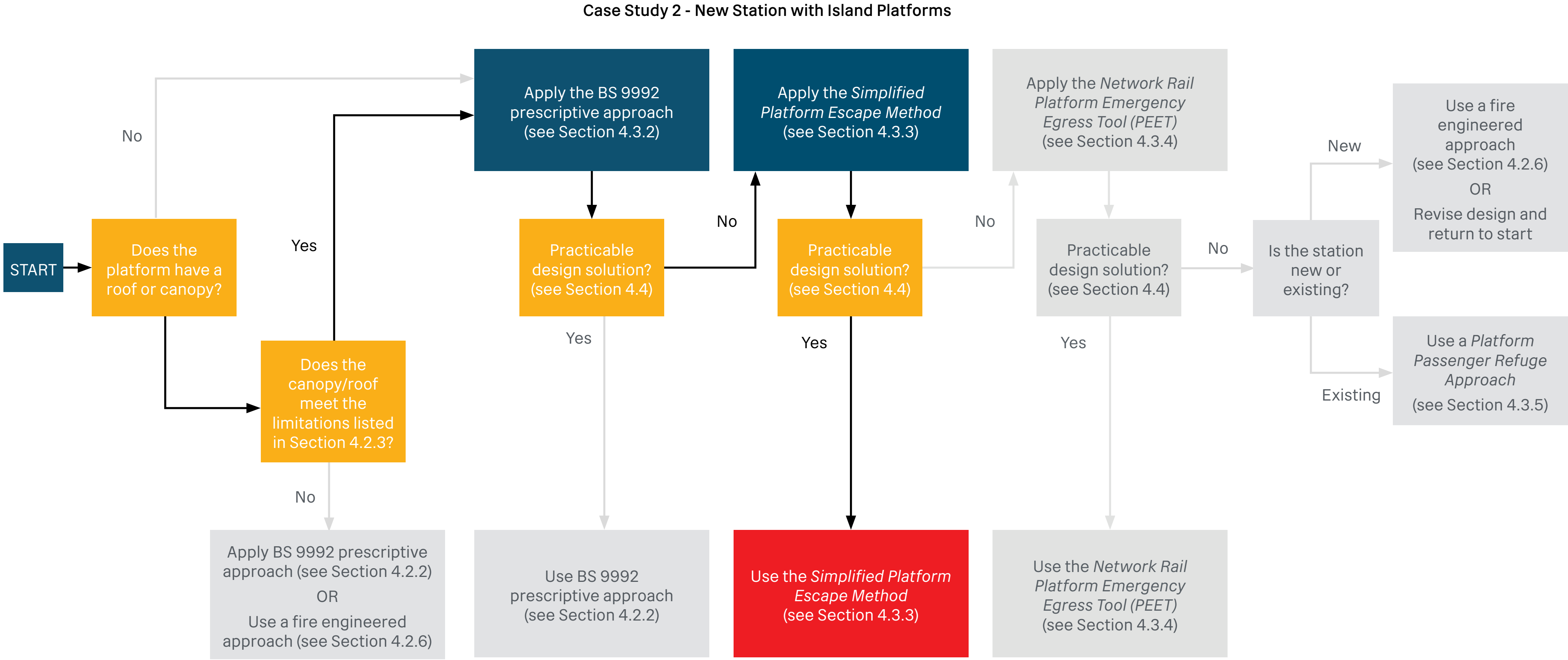


Figure 22 Flowchart showing the *Simplified Platform Escape Design Method* approach used for Case Study 2

Case Study 3 – Existing Station – Platform Extension Scheme

Case Study 3 shows an existing small unstaffed station in a suburban location. The station is classed as Very Low Risk in accordance with Section 3.2 and consists of two side platforms connected by a single footbridge.

Access to the station is provided to Platform 1 via a ramp (approx. 1.5m height) from the street. Access to Platform 2 is via an accessible footbridge only, which is served by 2no. lifts.

No new exits can be provided to either platform, due to existing site constraints within the suburban area.

The station is located on a suburban commuter line serving a major city and is proposed to be upgraded by means of platform extensions to both platforms (to accommodate larger trains of up to 6 carriages).

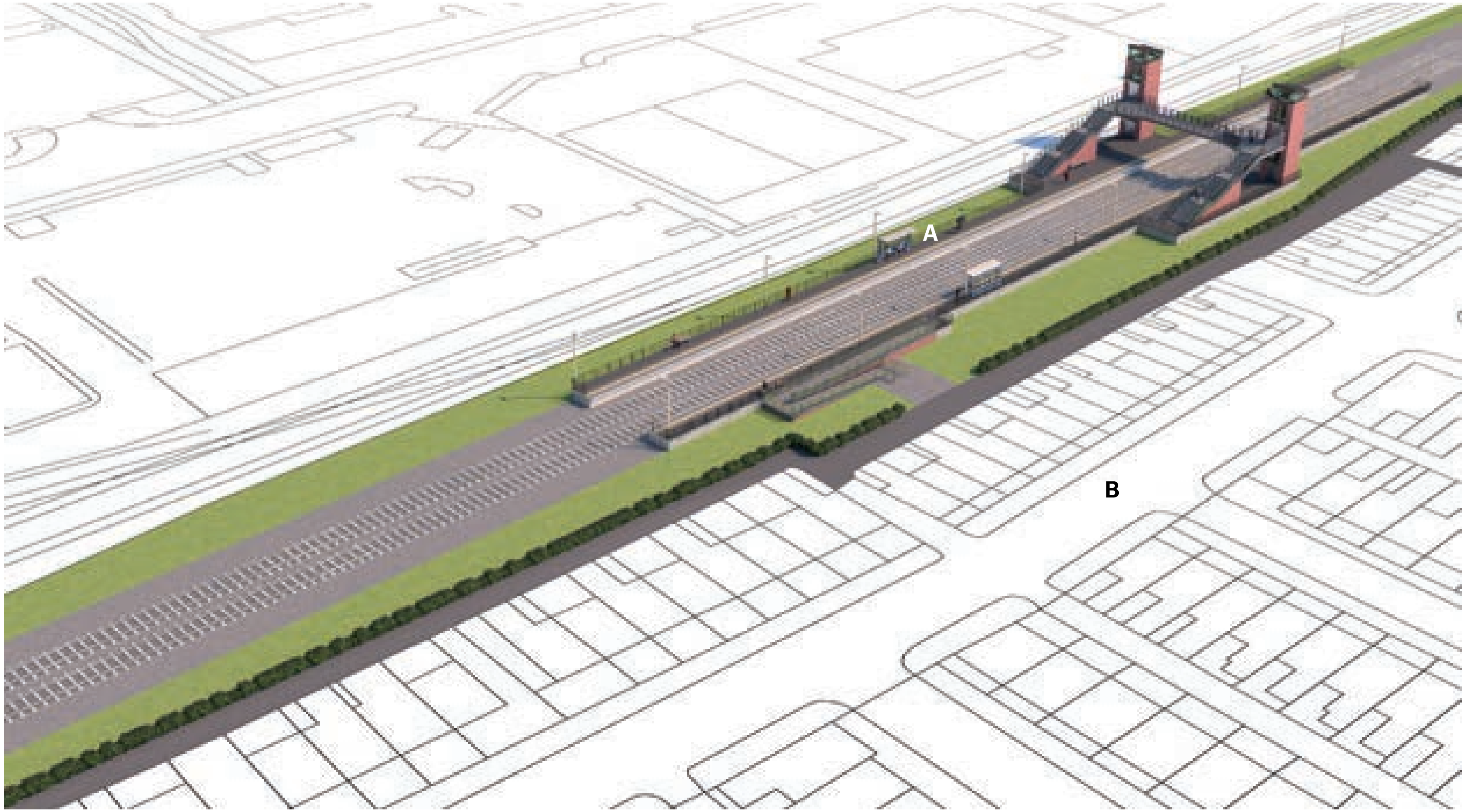
The existing station is not provided with any canopies, nor are any proposed as part of the upgrade works.

The existing platforms are approximately 100m long and 3.2m wide and are proposed to be extended to 160m length.

The platform extension works impact on the existing means of escape provisions, in particular with respect to increased travel distance along the platforms to reach an exit. The design should therefore be shown not to detrimentally impact the level of fire safety provided to station occupants and provide improvements where possible within the scope of the project.

Case Study 3

Existing Station Layout



A. Existing short platforms can only serve small trains

B. Suburban area with limited additional land available

Figure 23 Illustration of the existing station layout for Case Study 3

Case Study 3

Design Option 1 – BS 9992-Compliant Design

If the platform extension scheme is designed to comply fully with BS 9992 guidance, the following key design features for means of escape are required to be provided:

- There should be at least two exits from each platform, and one-way travel distances should not exceed 20m (BS 9992 Clause 14.4.2) – *In the context of this case study, the platform extension works will extend the existing travel distances along the platforms, and therefore worsen the existing situation with respect to escape from the platforms.*

  When prescriptively applying BS 9992, escape routes would therefore be required within 20m of the new, extended end of both platforms. This may require the provision of a new footbridge, if direct exits from the platforms are not available.

- For unstaffed stations, the means of escape route should allow PRMs to proceed to a place of safety unaided. They should not be exposed to a significant additional risk from fire, compared to those who can readily use stairs to reach a place of safety (BS 9992 Clause 16.1). Furthermore, lifts not designed as evacuation or firefighting lifts (that meet the relevant guidance of BS 9999) should not be used as a means of evacuation for PRMs (BS 9992 Clause 16.3) – *Footbridge lifts are not typically designed as evacuation or firefighting lifts, therefore should not be used for evacuation from the station. The new platform-end footbridges would therefore require to be provided with ramps, to enable PRMs to escape Platform 2 unaided.*

This approach therefore results in the potential addition of a second accessible (ramped) footbridge to the station, located at the far end of a 160m-long platform. The second footbridge is not required for any other purpose other than means of escape, and would also likely require ramps which are not compliant with best-practice accessibility guidance with respect to length, gradient and/or height. As such, this approach would be deemed to be an “impracticable” design solution as per Section 4.4.

Therefore, in line with the design process described in Section 4.3.6 for existing “Very Low Risk” stations, the *Simplified Platform Escape Design Method* and/or *Network Rail Platform Emergency Egress Tool (PEET)* could be applied to establish whether a more practicable design solution can be obtained.

Case Study 3

Design Option 1 – BS 9992-Benchmarked Design*

A. Platform extended to accommodate newer, longer trains

B. Second footbridge required at the of extended platforms to comply with BS 9992 Clause 14.4.2

C. Ramps required to facilitate disabled evacuation via footbridges, to comply with BS 9992 Clause 16.1

D. Passenger lifts not used for PRM evacuation, as per BS 9992 Clause 16.3

*Note: The example station layout illustrated in this figure is developed to reflect technical compliance with BS 9992. For the avoidance of doubt, the ramps shown would not be compliant with best-practice accessibility guidance such as such as Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland, 2015, or BS 8300. Refer to Page 160 for further discussion.

Figure 24 Illustration of Case Study 3, Design Option 1 (BS 9992-Benchmarked Design)

Case Study 3

Design Option 2 - Application of Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool (PEET)

In this Case Study, the two design tools can be applied to establish whether sufficient escape width and platform width is provided by the existing station to accommodate the extended platforms. If not, the likely platform/escape route width required can also be calculated so that this can be reviewed against the existing site constraints to confirm whether there is scope to accommodate this.

A dead-end travel distance of at least 140m would be required in order to maintain a single footbridge arrangement for the extended platforms, in the same location as the existing footbridge (note for simplicity, the exit ramp from Platform 1 is ignored as part of this example).

The Simplified Platform Escape Design Method can be applied as follows:

Step 1: Confirm appropriate look-up table

The stairs to the existing footbridge are located behind the back of the platform. The footbridge stairs therefore do not encroach on the platform width. Table 13 is therefore applicable.

Step 2: Confirm "total equivalent horizontal exit width"

The footbridge stairs have an available clear width of 2.7m. When applying the 0.7 correction factor, the total equivalent horizontal exit width is calculated as approx. 1.89m.

Step 3: Confirm distance between footbridge and platform edge

Not applicable, on the basis that the footbridge stairs do not encroach on the platform width.

Step 4: Confirm minimum platform width

In order to maintain the same platform width as existing, a minimum platform width of 3.2m is taken.

Step 5: Confirm dead-end travel distance from simplified table

Reading off Table 13, with a platform width of 3.2m (from Step 4), and an available clear stair width of 1.89m (from Step 2), a dead-end travel distance 65m can be accommodated.

Step 6: Apply correction factor based on platform occupancy

The station serves a suburban area and is being extended to accommodate longer trains. For this Case Study, it is therefore assumed that a "high density" platform loading is appropriate, as per Table 12. The correction factor for a high density side platform loading is 1, therefore the maximum allowable dead-end travel distance is 65m.

Case Study 3

65m is less than the 140m minimum travel distance required to accommodate a single footbridge arrangement as proposed. Therefore, the *Simplified Platform Escape Design Method* does not support a single footbridge design approach, when assuming that the existing platform width of 3.2m is maintained.

However, it is possible to re-apply Steps 4 to 6 to calculate the required platform width, based on a minimum travel distance of 140m, and a 2.7m footbridge stair width. In this case, as minimum platform width of **8.00m** can be ascertained from Table 13.

Alternatively, by applying the *Network Rail Platform Emergency Egress Tool (PEET)*, a less conservative maximum dead-end travel distance of 69.7m could be achieved, however this is still insufficient. To achieve the required 140m dead-end travel distance, a platform width of **7.5m** would be required.

Within the constraints of this existing station example, it is assumed that a platform widening from 3.2m to 7.5m is not possible and/or practicable. This could be supported, as per the examples provided in Table 10, whereby platforms in excess of 6m may typically be considered as “impracticable”. Additionally, site/land restrictions for an existing station may mean that platform widening is not possible.

In this case, it may therefore be appropriate to adopt the *Platform Passenger Refuge Approach* for the station.

Design Option 2 - Simplified Platform Escape Design Method or Network Rail Platform Emergency Egress Tool

A. Platform extended to accommodate newer, longer trains

B. Second footbridge from extended platform not proposed

C. Platform width increased to 8m or 7.5m, in line with Simplified Platform Design Tool or PEET outputs respectively

Figure 25 Illustration of Case Study 2, Design Option 2 (*Simplified Platform Escape Design Method* or *Network Rail Platform Emergency Egress Tool*)

Case Study 3

Design Option 3 – Application of the Platform Passenger Refuge Approach

For this option, the station extension scheme goes ahead on the basis that no additional footbridge or widened platforms are provided to serve the newly extended platforms.

However, the proposed design introduces the following potential risks:

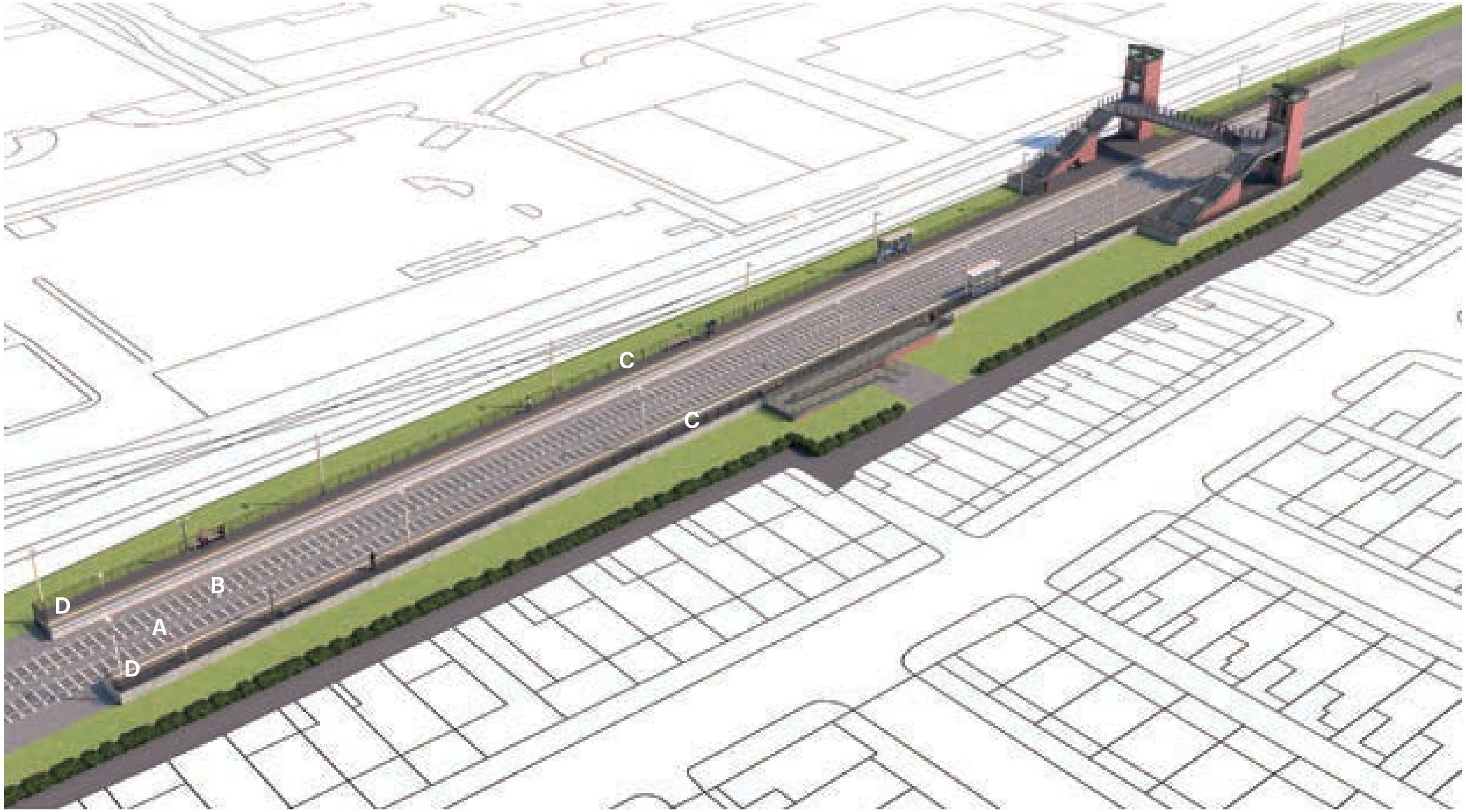
- There is potential for train/station occupants at the remote end of the extended platforms to be prevented from escaping past a growing train fire and reaching an exit. Whilst not in immediate danger from the fire, these occupants are stranded with no means of immediate escape.
- PRMs on Platform 2 have no means of escaping from the platform, if it is assumed that the new lifts provided as part of the replacement footbridge are not to be used for evacuation.

Instead, the *Platform Passenger Refuge Approach* is proposed, as described in Section 4.2.5, whereby relatively safe positions at platform ends (i.e. temporary platform refuges) are provided to accommodate any occupants who are unable to access a platform escape route. These refuges are supported by robust and documented procedures (by the responsible person/fire safety duty holder, in this case the TOC), and reasonable infrastructure measures, to safety evacuate all occupants from the platforms.

Examples of reasonable infrastructure measures to support the *Platform Passenger Refuge Approach* include an appropriate EVC system at each platform refuge location, supported by CCTV and a Public Address system. These measures should be designed to enable train crew/staff to communicate directly with trained control room staff, who can monitor the situation in real-time and update/advise occupants accordingly.

This approach therefore significantly reduces the station infrastructure requirements (and associated design, costs and maintenance implications), but instead may increase the potential for occupants to be prevented from reaching an escape route. Increased responsibility is therefore placed on the TOC to develop robust procedures (supported by reasonable infrastructure measures) to address these risks.

Design Option 3 - Application of the Platform Passenger Refuge Approach



A. Platform extended to accommodate newer, longer trains

B. Second footbridge from extended platform not proposed

C. Platform widths are in line with existing station platforms

D. Additional systems at platforms ends, including EVC system, CCTV and Public Address

Figure 26 Illustration of Case Study 2, Design Option 3 (*Platform Passenger Refuge Approach*)

Case Study 3

A. Platform passenger refuge area

B. Emergency Voice Communication (EVC) system

C. CCTV & Public Address coverage to platform areas, including refuge area

Figure 27 For the purposes of this case study, it is assumed that platform end exits cannot be provided due to site constraints.

Case Study 3

Evaluation of Design Options

Case Study 3 illustrates the full range of potential design options applicable to an existing Very Low Risk station.

A prescriptive, BS 9992-based design approach would, in this example, require the provision of a second accessible footbridge (or subway), with ramped access. This would likely be an unsatisfactory and impracticable design solution on the basis that it does not comply with best-practice accessibility guidance, and results in significant additional footbridge /subway infrastructure being required.

By applying either the *Simplified Platform Escape Design Method* or the *Network Rail Platform Emergency Egress Tool (PEET)*, it can be determined that a secondary means of escape could be avoided subject to a platform width of 7.5m being provided. However in this example, widened platforms may not be possible or practicable due to the constraints of the existing, suburban station site.

Instead, the *Platform Passenger Refuge Approach* could be applied which, whilst increasing the fire safety management responsibilities for the stations' operator, could result in a more practicable and proportionate design solution.

Case Study 3

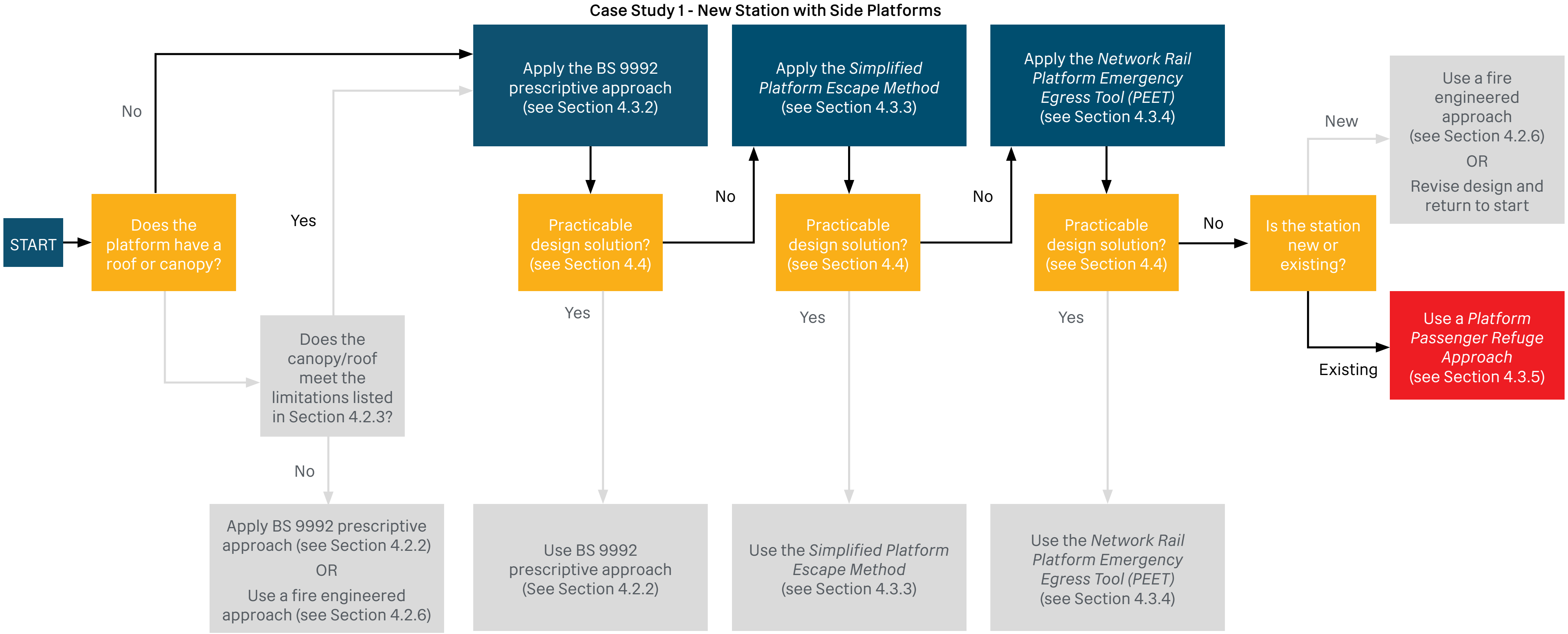


Figure 28 Flowchart showing the Simplified Platform Escape Design Method approach used for Case Study 3

Case Study 4

Case Study 4 – Existing Station – Access for All (AfA) Scheme

Case Study 4 shows an existing small unstaffed station in a suburban location, similar to the station shown in Case Study 3. The station is classed as Very Low Risk in accordance with Section 3.2 and consists of two side platforms connected by a single footbridge. Access to the station is provided to Platform 1 via a ramp (approx. 1.5m height) from the street.

For this case study, access to Platform 2 is via the footbridge only, which currently is not served by any lifts. There is therefore no accessible means of accessing Platform 2 without scheduled staff assistance.

The station is located on a suburban commuter line serving a major city, and is proposed to be upgraded by means of an Access for All (AfA) scheme to introduce step-free access to Platform 2 (by provision of a new, replacement accessible footbridge).

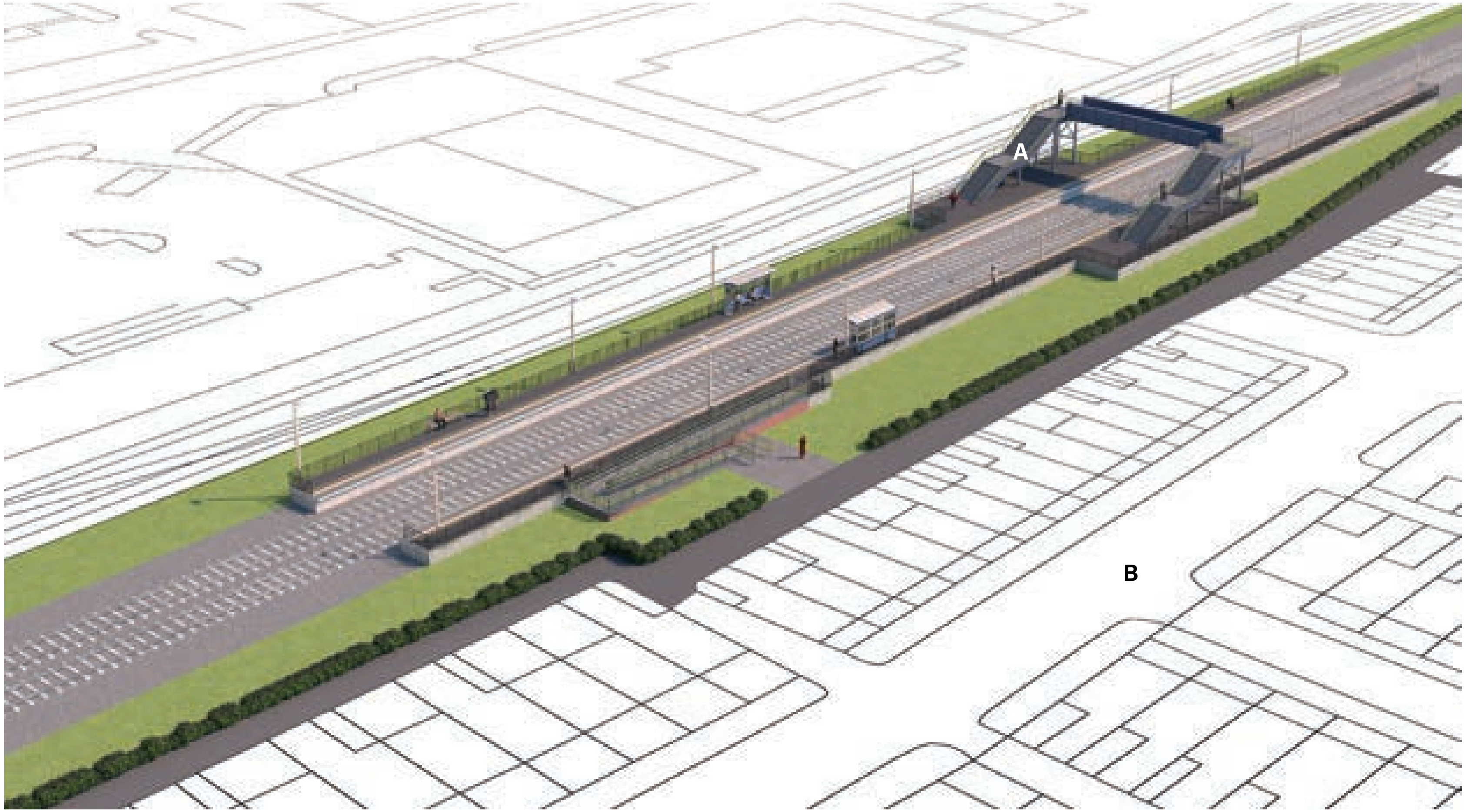
No other upgrades or works are proposed as part of the scheme, therefore the only impact of the AfA scheme on the existing means of escape provisions for the station is the introduction of PRM access to Platform 2 (where none was available previously). As described in Section 4.6, the scheme's design should therefore achieve the following objectives:

→ Suitable and sufficient measures to facilitate safe and dignified escape for all PRMs from Platform 2.

→ Measures should be provided which are not discriminatory in context of providing an equivalent level of safety in comparison to fully mobile evacuees. Therefore PRMs should not be exposed to a significantly greater risk than fully mobile occupants.

Case Study 4

Existing Station Layout



A. Existing footbridge with no step-free access

B. Suburban area with limited additional land available

Figure 29 Illustration of the existing station layout for Case Study 4

Design Option 1 – BS 9992-Benchmarked Design

If BS 9992 guidance is applied to the AfA scheme's design, the following key design features for means of escape would be equired to be provided:

- For unstaffed stations, the means of escape route should allow PRMs to proceed to a place of safety unaided. They should not be exposed to a significant additional risk from fire, compared to those who can readily use stairs to reach a place of safety (BS 9992 Clause 16.1) – *The replacement footbridge would therefore require to be provided with an accessible means of escape for PRMs, without reliance on staff assistance.*
- Lifts not designed as evacuation or firefighting lifts (that meet the relevant guidance of BS 9999) should not be used as a means of evacuation for PRMs (BS 9992 Clause 16.3) – *Evacuation lifts (as designed to BS 9999) rely on staff control and are therefore typically unsuitable for unstaffed stations. In addition, footbridge lifts are not typically designed as evacuation or firefighting lifts, and therefore should not be used for evacuation from the station.*
- Ramped egress via the replacement footbridge would therefore be the only means of providing accessible means of escape from Platform 2, to comply with BS 9992 – *However it is unlikely that ramps of the height, length and/or gradient required to serve a new platform footbridge would comply with best-practice accessibility guidance, such as the Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland, 2015.*

Prescriptively applying BS 9992 for this Case Study would therefore require the provision of a ramped footbridge, which would not comply with best-practice accessibility guidance. As such, this approach would be deemed to be an “impracticable” design solution as per Section 4.4.

In this instance, it may be appropriate to instead employ the *beneficial use of passenger lifts for evacuation*, as described in Section 4.5.2.

Note: For this case study example, and in line with the guidance in Section 4.6, BS 9992 is applied only with respect to the introduction of PRM accessibility to Platform 2, and is not applied retrospectively to the remainder of the station, which remains as-existing.

Case Study 4

Design Option 1 – BS 9992- Benchmarked Design*

A. New, replacement footbridge to provide PRM access to platform

B. Ramps required to facilitate PRM evacuation via footbridge, to comply with BS 9992 Clause 16.1

C. Passenger lifts not used for PRM evacuation, as per BS 9992 Clause 16.3

*Note: The example station layout illustrated in this figure is developed to reflect technical compliance with BS 9992. For the avoidance of doubt, the ramps shown would not be compliant with best-practice accessibility guidance such as such as Design Standards for Accessible Railway Stations, Joint Code of Practice by the DfT and Transport Scotland, 2015, or BS 8300. Refer to Page 172 for further discussion.

Figure 30 Illustration of Case Study 4, Design Option 1 (BS 9992-Benchmarked Design)

Design Option 2 – Beneficial use of passenger lifts for evacuation

As described in Section 4.5.2, it may be appropriate for passenger lifts to form part of an escape route for PRMs in specific circumstances. In particular, passenger lifts serving footbridges where all levels of the lift are visible and open to atmosphere, such as the passenger footbridge lifts commonly used as part of AfA schemes. Lifts proposed to be used a vertical means of escape for PRMs should meet the criteria described in Section 4.5.2.

If beneficial lifts for PRM evacuation were to be utilised as the primary means of PRM escape from Platform 2 in this Case Study, it could reduce or remove the need to provide ramped egress from the platform to support PRM evacuation. This may therefore enable the provision of a stepped-access footbridge, served by passenger lifts to support PRM access and means of escape.

Design Option 2 – Beneficial use of passenger lifts for evacuation

A. New, replacement footbridge to provide PRM access to platform

B. Beneficial use of passenger lifts for PRM evacuation, therefore ramps not required

Figure 31 Illustration of Case Study 2, Design Option 2 (Beneficial use of passenger lifts for evacuation)

Case Study 4

A. Beneficial use of passenger lift for PRM evacuation

B. Emergency Voice Communication (EVC) system

C. CCTV & Public Address coverage to platform areas, including refuge area

Figure 32 Indicative image showing the provision of EVC, CCTV and Public Address to support beneficial use of passenger lifts for evacuation

Case Study 4

Evaluation of Design Options

Case Study 4 illustrates how the beneficial use of passenger lifts for evacuation (as per Section 4.5.2) could be applied to AfA projects, to provide an efficient and practicable solution for PRM egress from platforms.

This would provide a more equitable and dignified means of access and evacuation for station users (when compared to lengthy and/or steep ramps), and also reduce design impact and capital/maintenance costs for the station.

Wemyss Bay Station
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C

Fire Safety at Stations

Appendix C: Structure & Content of a Fire Strategy

C.1 Fire Strategy Principles

C.1 Fire Strategy Principles

A Fire Strategy is a document which sets out the fire safety design principles and features for a building or station. It provides the reader with an understanding of the fire safety objectives of the design and the protection measures and fire safety management requirements.
It should be developed by a competent person with a level of knowledge and experience of fire safety design appropriate to the scale and complexity of the project.

The term Fire Strategy is often associated with a design document that is developed at each stage of design, informing the project team of the key fire safety design features and requirements.

However, the Fire Strategy should also be developed and updated throughout the construction stage, and at handover/completion, to confirm the final Fire Strategy arrangements for the building.

This is key to a successful handover of fire safety information from the contractor to the operator, and to assure the operator is fully aware of the fire safety features and ongoing management requirements for the building.

The objective and content of the Fire Strategy therefore varies depending on the stage of design and construction, as described in Table 19 below.

Project Acceleration in a Controlled Environment (PACE)		Fire Strategy Objective
PACE Phase	**PACE Stage**	
Strategic Development & Project Selection	ES1 Client requirement defined and baseline ES2 Constraints identified and project feasibility confirmed ES3 Single option identified and endorsed	The Fire Strategy should inform the design team and other project stakeholders of the key fire safety considerations for the project, to allow for adequate planning and programming. The Fire Strategy should set out the key objectives and basis for design for fire safety, including all fire safety regulations, legislation and mandatory standards to be complied with, and the design standards to be adopted. The document should confirm the acceptance criteria for each objective, in terms of what needs to be achieved and how this is measured. A high-level description of key design features should be provided, with commentary on potential design options (including risks and opportunities for each). This may require supporting quantitative and/or qualitative analysis to support the options-selection process. An overview of any areas requiring specific fire safety management (in addition to those normally required by legislation) should be clearly outlined. The Fire Strategy should clearly identify the key fire scenarios considered as part of the design process and the assumed actions of management and occupants of the station. Relevant stakeholders should be identified and early consultation initiated where required (for example PRFS/responsible person, Fire & Rescue Service, Network Rail Fire Safety Engineer etc). The Fire Strategy should clearly identify which areas of the fire safety design that need to be developed and/or resolved at the next design stage.

C.1 Fire Strategy Principles

Project Acceleration in a Controlled Environment (PACE)		Fire Strategy Objective
PACE Phase	**PACE Stage**	
Project Design	ES4 Design standards approved and Approval in Principle	The Fire Strategy should be developed to provide sufficient technical detail to allow all relevant disciplines to progress their design information as required. Design compliance with relevant fire safety regulations, legislation and other key objectives should be confirmed. Where deviations to design standards are proposed, these should be fully justified (via fire engineering analysis where required) and agreed with all relevant stakeholders. The Fire Strategy should confirm the specific design standards and performance requirements for all fire safety systems. All future fire safety management requirements relied upon as part of the design for the station should be fully documented and confirmed as being agreed with all relevant stakeholders. Formal consultation with all relevant stakeholders should be undertaken and documented within the Fire Strategy.
	ES5 Construction ready design approved	The Fire Strategy should be sufficiently developed to achieve formal design approval/assurance (typically Form B approval) from the Network Rail Technical Authority, and other approving authorities where relevant, and to inform contractor procurement and construction-level design information.
Project Delivery	ES6 Construction complete	Any design changes during the construction stage should be agreed in writing and formally documented within the Fire Strategy. The Fire Strategy should include detailed information on the cause and effect for any fire safety systems, to enable their correct design and programming. Ongoing discussions with stakeholders (including key site visits or inspections) should be recorded and included in the Fire Strategy.
Project Close	ES7 Project Demobilised and handed back to sponsor	The Fire Strategy should confirm the final fire safety elements installed as part of the station construction, including their key features, design standards and operational requirements. Design changes made during construction should also be documented and included. The Fire Strategy should confirm that the design has been developed and constructed to comply with the relevant regulations, legislation and standards. Key operational information relating to the fire safety systems should be included, and guidance on appropriate inspection and maintenance information. Any special hazards, critical equipment and other key information requiring the particular attention of the station operator and attending emergency services should be clearly set out. Fire safety management requirements should also be clearly defined and confirmed as being agreed with the relevant duty holders.
	ES8 Contractual accounts settled, warranties transferred to maintainer, formal close-out	

Table 19 Fire Strategy Objectives

C.2 Fire Strategy Structure

Whilst the level of detail and specific content of a Fire Strategy may vary depending on the project stage, the overall structure should remain largely consistent.

Table 20 provides guidance on the recommended structure and content to form a Fire Strategy for a Network Rail station. The structure described may be varied as required to suit the specific needs of a project, and the relevant design stage.

Fire Strategy Section	Recommended Content
Executive Summary	This section describes the major items within the Fire Strategy, giving an overview of the station, the relevant guidance used to inform the strategy and a summary of the major design proposals that do not comply with the recommendations of the guidance. This section should give a sufficient overview of the main text, allowing the reader to understand the key issues, without reading the full document. It should clearly outline any areas where departures from the guidance have been made, and the conclusions and recommendations relating to the fire strategy.
Introduction	The introduction should detail the background and key contextual information for the project. This should include information on the specific design stage, project team members and key stakeholders. The fire safety objectives for which the fire strategy is being developed to achieve should be clearly outlined. A statement should also be provided confirming the key limitations, exclusions and assumptions for the Fire Strategy as required.
Station Description	This section should provide a description of the station to a sufficient level of detail to enable the reader to understand its key characteristics relevant to the Fire Strategy, including site/station layout, occupancy type, ancillary uses. The Rail Fire Safety Risk Profile (RFSRP) should also be confirmed, alongside the station operator/PRFS, and any other operational stakeholders (e.g. retail tenants etc) should also be provided, where known. A clear site plan along with a diagram showing the station layout at each level and key features should be provided.
Basis of Design and Key Objectives	The relevant legislation and regulations applicable to the Fire Strategy design should be confirmed, alongside the key design standards used to form the basis of design. If required, the process proposed for varying from these design standards (whilst still complying with the projects' legal and mandatory Network Rail requirements) should be confirmed, for example via fire engineering analysis. Any other key objectives should also be set out, for example requirements regarding property protection, operational continuity etc. The acceptance criteria for these objectives should also be confirmed, including what needs to be achieved and this is to be measured.
Information relied upon	This section should outline the relevant information that has been used to develop the Fire Strategy. For example, the relevant architectural drawings, client brief etc.

C.2 Fire Strategy Structure

Fire Strategy Section	Recommended Content
Means of Escape	This section should describe the specific means of escape design adopted for the station, including consideration of factors such as: • Station Occupancy – including occupancy type (e.g. passengers, staff, ancillary retail use etc), and maximum design occupancy in normal, perturbation and emergency operation; • Horizontal Evacuation – confirming horizontal means of escape design, including the number, location and capacity of escape routes, and travel distances; • Vertical Evacuation – confirming, where applicable, the vertical means of escape design, including the number, location and capacity of stairs or ramps, and any merging flows or other potential bottlenecks; • Evacuation of PRMs – consideration and confirmation of the means of escape for PRMs, in particular any aspects that require additional design consideration or management. For example, use of lifts, refuges or staff carry-up/down procedures.
Internal Fire Spread	This section should describe the measures relating to compartmentation, internal linings resistance to fire and structural fire protection if/where applicable to the station. Simple, smaller stations may require limited detail on this, but others may require substantial consideration of internal fire spread measures.
External Fire Spread	This section should consider the potential risk of fire spread between station buildings themselves, and to the relevant boundary. Additionally, measures to prevent fire spreading via the external walls and roof should also be considered and included where relevant.
Fire Service Access & Facilities	This section should clearly document the access provisions and facilities provided to the Fire & Rescue Service, including vehicle access, water supplies, firefighting shafts and fire mains. Information on communication systems, information boxes and smoke ventilation systems should also be provided where relevant. Confirmation of consultation and agreements with the relevant Fire & Rescue Service should also be provided.
Fire Safety Systems	This section should confirm the active fire safety systems proposed/provided within the station including fire alarm system, fire suppressions systems, EVCs, emergency lighting and signage and lift systems where relevant.
Fire Safety Management	This section should clearly set out the elements of the station design which require, or rely on, staff or management intervention by the PRFS /responsible person. This should include the fire safety management objectives, strategy for implementation, and any ongoing training or maintenance tasks.
Appendices	Appendices should be provided with detailed drawings outlining compartmentation provisions and other key Fire Strategy provisions within the station, records of key consultations/ meetings/inspections, and any other specific appendix necessary to support the main report content.

Table 20 Fire Strategy structure and key content

Elizabeth Line at
Paddington Station
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Fire Safety at Stations

Appendix D: Fire Engineering Analysis

D

D.0 Introduction

D.0.1 Introduction

This appendix provides specific guidance on the application of Fire Engineering analysis for Network Rail station projects. This guidance recommends the overall methodology to be adopted, the design fire scenarios to be considered, and key input parameters and acceptance criteria relevant to the rail environment.

This appendix is intended to promote a consistent approach to the methodology and parameters used where fire engineering analysis is adopted. It provides a reference guide for use by competent Fire Engineers with the necessary technical skills/experience to correctly understand, interpret and apply the principles and parameters described.

It may be appropriate/necessary to vary the approach and/or parameters described in this section on a project-by-project basis, in consultation with the Network Rail Fire Safety Engineer.

It is the responsibility of the designer/Fire Engineer to assure all designs are compliant with the relevant legislation, regulations and other mandatory requirements, and any supporting analysis/justification is specific, applicable and appropriate to the project.

D.0.2 Fire Engineering Analysis Approach

Figure 33 describes the Fire Engineering analysis approach recommended by Network Rail for station design projects. The steps shown in Figure 33 are intended to align with the fire safety design and Qualitative Design Review (QDR) processes described by BS 7974-1.

General information on each sub-step is detailed in Section 4 of BS 7974-1. However, this appendix provides rail-specific guidance on each of these steps, including key considerations, fire scenarios, parameters and acceptance criteria.

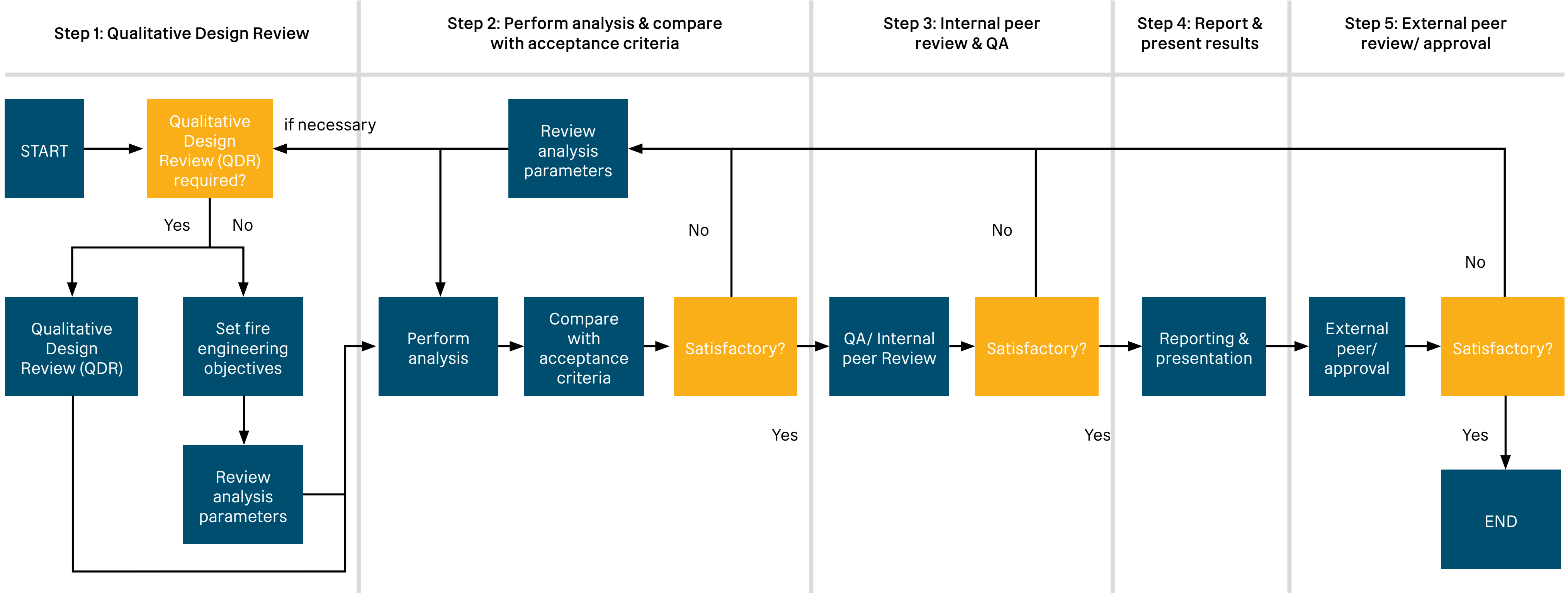

Figure 33 Fire engineering analysis process

D.1 Step 1: Qualitative Design Review

D.1.1 Introduction to the QDR

Before any type of fire engineering analysis is undertaken, it is important first to confirm the objectives, method, acceptance criteria and fire scenarios upon which the assessment will be based.

For Network Rail projects, these should be confirmed by means of a Qualitative Design Review (QDR) in the following circumstances:

- → Where a quantitative or qualitative fire engineering analysis is proposed based on first principles.
- → Where complex or computational fire engineering analysis is proposed.

Fire engineering design based on prescriptive compliance (e.g. BS 9992 etc) or semi-prescriptive assessment (e.g. *Simplified Platform Design Tool* or PEET) does not typically require a formal QDR to be undertaken with Network Rail. However, in these circumstances, the Fire Engineer should be able to demonstrate that appropriate internal quality assurance processes are in place.

Where a QDR is required, the stakeholders involved in the QDR process should be agreed with Network Rail before Step 1 is initiated. BS 7974-1 provides detailed guidance on the QDR process, as summarised in Figure 34.

Further guidance on the QDR, as applied to Network Rail projects, is then provided in Sections D1.2 to D1.6.

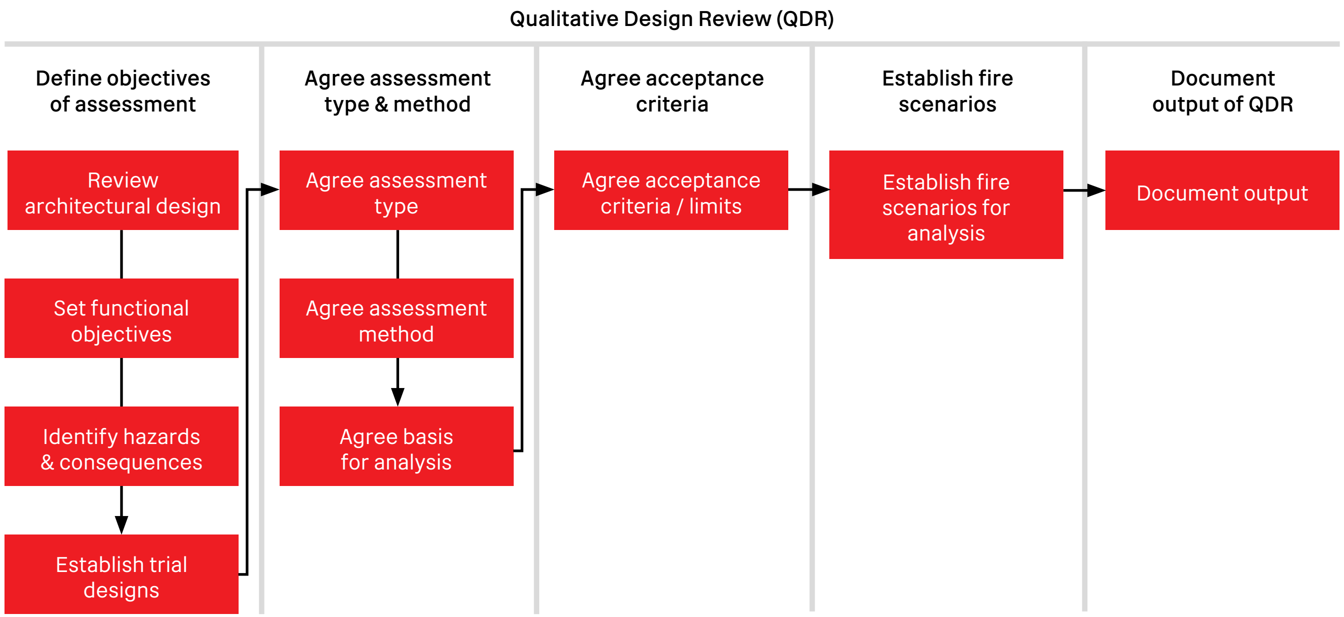

Figure 34 QDR process

D.1 Step 1: Qualitative Design Review

D.1.2 Define objectives of assessment

This step aims to clearly identify and define the objectives of the fire engineering assessment.

For example, if a fire engineering analysis is proposed to address a specific deviation from prescriptive guidance, such as BS 9992, this should be clearly explained and the relevant risks identified and addressed.

Where an analysis is proposed to address multiple objectives and/or deviations from guidance, each specific objective/deviation should be identified and an appropriate assessment developed.

Further, the intent of the prescriptive guidance, and the "perceived risk" of not complying with this, should be identified in order to accurately define the objectives of the fire engineering assessment.

"Perceived risk" should consider both the risk to the life safety occupants in and around the building and attending firefighting personnel. Additional perceived risks relating to property protection and operational continuity should also be considered on a case-by-case basis (in consultation with Network Rail).

An example of identifying and defining the assessment objectives is presented below.

- → Prescriptive basis of design: BS 9992
- → Proposed deviation from prescriptive guidance: BS 9992 Clauses 14.4.1-14.4.2 state that all stations (enclosed, sub-surface and surface) should have at least two exits from a platform.
- → Intent of prescriptive guidance: to provide an alternative escape route for passengers on a platform, where they can turn their back on a fire and escape the premises.
- → Proposed deviation from prescriptive guidance: it is proposed that a platform will be provided with just a single means of escape, via a central footbridge.
- → Perceived risk of non-compliance with prescriptive guidance: In the event of a fire on the platform or on a train with a fire-stopping at the platform, there is potential that platform occupants will be prevented from reaching an escape route due to levels of heat and smoke that could prevent their safe passage along the platform.
- → Functional objective of fire engineering assessment: demonstrate that the proposed platform exit arrangement does not inhibit occupants' ability to safely reach an exit, in the event of a fire on the platform or on a train.
- → Hazards and consequences relevant to the assessment:
  - – Hazards: radiation and the effects of smoke from a train fire on occupants escape along the platform.
  - – Consequences: occupants are either unable to escape past the fire to reach a platform exit, and are therefore stranded on the platform.

D.1.3 Agree assessment type and method

The most appropriate fire engineering assessment method should be identified based on the specific objectives and risks, as well as the complexity of the station design. Depending on these parameters, a fire engineering assessment method could be qualitative and/or quantitative.

Any specific measures, assumptions or requirements relied upon during the fire engineering assessment should be agreed and confirmed in writing with the Network Rail Fire Safety Engineer.

Qualitative assessment – A qualitative assessment justifies the deviation based on logical reasoning, statistics, proven solutions, simple calculations etc. Therefore, a qualitative assessment should only be used for straightforward or minor deviations from fire safety guidance that present a low perceived risk to occupants and the Fire & Rescue Service.

D.1 Step 1: Qualitative Design Review

All justifications that are qualitative should be discussed and agreed in principle with the Network Rail Technical Fire Safety Engineer. Any specific measures, assumptions or requirements relied upon should be agreed and confirmed in writing.

Quantitative assessment – A quantitative assessment relies on test data, calculations and other analyses to predict the likely events of a specific design fire scenario. Therefore, a quantitative assessment is appropriate for most deviations and should be used where the deviation presents a greater risk to occupants and the Fire & Rescue Service.

A common quantitative method used in fire safety is the Available Safe Egress Time (ASET) vs. Required Safe Egress Time (RSET) approach.

The Available Safe Egress Time (ASET) is the time calculated between the time of ignition of a fire and the estimated time at which conditions become untenable. The characteristics of a fire which typically govern tenability include smoke and radiation. Common tools used to quantify the ASET include the following:

- **Smoke spread analysis** – An assessment of potential smoke movement and behaviour to predict factors such as smoke temperature, visibility and toxicity. Common methods include:
  - Smoke flow calculations as detailed in Chapter 6 of *CIBSE Guide E* (these should be used as a basis to check first principles).
  - "Zone model" analysis, which approximates smoke interaction and is useful for rapid assessment of simple cubic geometries.
  - Computational Fluid Dynamics (CFD) is based on solving equations to represent smoke's local momentum and temperature in finite details. CFD is useful for capturing more realistic smoke movement and behaviour in more complex geometries.
- **Radiation analysis** – An assessment of the radiative effect of fire to predict the risk of ignition of nearby objects/materials and/or the hazard to occupants escape in vicinity to the fire. Guidance on radiation analysis can be found in;
  - *BR187: 2014 – External fire spread.*
  - *SFPE Handbook of Fire Protection Engineering.*
  - *CIBSE Guide E.*
- **Structural fire response analysis** – An assessment of the potential response of structural elements or systems to fire, in terms of their load carrying capacity and ability to withstand the effects of fire. Common methods include:
  - Calculations using the Eurocodes (BS EN 1992-1-2 (Eurocode 2)) - These describe the different methods designers can use to determine the fire resistance of a structural member.
  - Computational finite element modelling and/or heat transfer analysis may be used to provide a more detailed structural fire analysis.

Further guidance is provided below regarding these analysis types, when applied to the rail environment.

Application to the rail environment

<u>Smoke spread analysis</u>

Computational smoke modelling may be appropriate for stations with roofs, canopies and other design features that could result in complex smoke behaviour (i.e. smoke behaviour that cannot be calculated by simple smoke flow or zone model calculations). Table 22 lists the typical input parameters for smoke spread analysis with regards to a train and station fire.

D.1 Step 1: Qualitative Design Review

Radiation analysis

Specific assumptions to take into consideration when undertaking radiation analysis in the rail environment are listed below:

- When assessing the effects of radiation from a train fire, radiating panels consisting of the window and door openings on the side of a train carriage facing the platform should be used.
- The train carriage should be located at the most onerous realistic location along the platform, with respect to the assessment's objectives.
- All doors on the platform side are assumed to be open, whereas doors on rail side remain closed (however all glazing elements are still allowed to break if conducting CFD analysis).
- The centreline temperature of the flame should be used as the temperature of the radiating panel.

Table 22 lists the typical input parameters for radiation analysis with regards to a train and station fire.

D.1.4 Agree acceptance criteria

Each assessment objective outlined should be supported with an acceptance criteria, as this allows for the objectives to be clearly measured. Acceptance criteria can be numerical or non-numerical depending on the type of assessment method selected.

Acceptance criteria pertaining to business continuity may include setting a maximum tolerance period of disruption (MTPD) or setting a maximum acceptable outage (MAO).

Common numerical acceptance criteria for human tenability are outlined in Table 21. Tenability is deemed to be reached when at least one of these values have been exceeded.

Acceptance criteria	Value	Reference
Visibility to reflective signage	10m	PD 7974 – 6: 2019
Exposure to radiant heat	2.5 kW/m²	PD 7974 – 6: 2019
Convected heat/smoke temperature	60°C	PD 7974 – 6: 2019
Minimum clear layer height	2.5m above the floor	PD 7974 – 6: 2019

Table 21 Tenability acceptance criteria

D.1.5 Establish fire scenarios

Once the objectives of the fire engineering assessment are confirmed, it is then necessary to define the reasonable worst-case design fire scenarios relating to the perceived risks and fire scenarios identified in Step 1.

The worst-case design fire scenario should account for the following items:

- Rail Station Fire Risk Profile (RSFRP).
- Complexity of the station design.
- Location of fire.
- Impact of any active/passive fire safety measures.

Historically, fire safety design for the rail environment requires consideration of two key fire scenarios; a train fire and station fire. Guidance on each of these is provided below.

Train fire scenario: A train arrives at the station with one train carriage on fire, as per Clause 14.7.1 of BS 9992.

The train is typically assumed to be crush-loaded as a worst-case, although lower occupancies may be justified on a case-by-case basis. For example, a station on a rural line where large train occupancies do not occur.

According to the *RSSB GERT8000-M1 Rulebook (Dealing with a train accident or train evacuation)*, in the event of a train fire, the driver should stop the train immediately (i.e. on the open line) should it not be possible to put the fire out within a few seconds.

D.1 Step 1: Qualitative Design Review

If the fire starts close to the station, the train may still continue to the station during the initial stages of fire growth and detection, if safe to do so. It is reasonable to assume that this could occur if the train is within approximately 1.0km of the station. This 1.0km distance, approx. 2 minutes away from the station, allows for ignition and discovery of the fire, the driver's decision-making and potentially continuing the final approach into the station.

However, where possible, the train should not enter into, or be stopped in, an unsuitable place (for example a tunnel, viaduct or other location where evacuating the train would present an unacceptable hazard). Therefore, the presence of potential hazards on the track on the approach to the station should be identified, and the potential impact they may have on driver decision-making should be considered.

Therefore, the credible train fire scenarios which should be considered are:

- **Train approaching station** - Single carriage fire starting within 1.0 km (approx. 2 minutes away) of the station with a growing fire on board as the train reaches the platform.
- **Train at the Station** - Single carriage fire starting at the platform and growing.

Recommended fire characteristics (for example growth rates and peak fire sizes) are described in Table 22.

This train fire scenario should be considered for Higher Risk, Medium Risk, Low Risk and Very Low Risk, as described in Section 3.2.

<u>**Station fire scenario:**</u> These involve a fire starting in either a room/compartment etc within a station building/structure or an item on the platform (luggage/goods/refuse etc)

- **Fire in an ancillary area or part of a station building (retail/kiosk/staff room/plant room etc)** - The fire characteristics are highly dependent on the type of area the fire originates in. The specific parameters of fire scenarios within a station building or ancillary area should follow recommendations outlined in PD 7974-1, PD 7974-2 and PD 7974-3. Table 22 outlines the recommended parameters for a typical, sprinkler retail unit fire.

  Consideration of fire scenarios involving combustible construction materials such as timber and other combustible façade components should also be given, as appropriate.

- **Luggage fire on platform** – Fires starting within luggage is a known phenomenon, which has increased in recent years with the growth of battery-powered electrical devices. In particular, the presence of lithium-ion batteries in proximity to combustible material within luggage can provide a means for fire ignition and growth.

  Whilst it is typically uncommon for large volumes of luggage build-up on platforms and within station areas, there may be some circumstances where larger accumulations of luggage may occur.

  A luggage fire starting on the platform or concourse should therefore be considered for stations with high passenger numbers (i.e. Higher Risk and Medium Risk stations, as described in Section 3.2), and smaller stations (Low Risk stations) where passengers may be expected to travel with large amounts of luggage (e.g. stations serving airports and other transport hubs).

- **Refuse fire on platform** – It has become relatively uncommon for large refuse bins to be located on platforms, largely for security reasons. However, there may be potential for smaller refuse bins and/or larger bins in specific cases. The potential for a refuse fire scenario should be considered and included/discounted as appropriate.

  In many cases, the fire characteristics and parameters for a luggage fire and a small refuse bin fire may be similar, and therefore could be assessed together.

D.1.6 Document output of QDR

The process and outcomes of the QDR should be appropriately documented, as described in Clause 5.9 of BS 7974-1.

D.2 Step 2: Analysis & Acceptance Criteria

Review analysis parameters

Once the QDR process has been completed, and all objectives, methods, acceptance criteria and fire scenarios for the fire engineering assessment have been confirmed and agreed, the assessment can be undertaken and the results verified to confirm that the objectives are met (as referenced in Step 1).

Guidance is provided below on common assessment parameters and acceptance criteria, where relevant to the rail environment. This guidance is structured as per the Available Safe Egress Time (ASET) vs. Required Safe Egress Time (RSET) approach commonly adopted for quantitative fire engineering analysis.

Further general guidance on parameters, acceptance criteria and best-practice fire engineering analysis are provided by the documents listed below:

- *BS 7974: 2019 Application of fire safety engineering principles to the design of buildings. Code of practice.*
- *CIBSE Guide E – Fire Safety Engineering.*

Available Safe Egress Time (ASET)

Fire characteristics

When determining the ASET, first the fire characteristics should be determined. Table 22 lists the typical input parameters for a train fire and station retail unit (sprinklered) fire.

D.2 Step 2: Analysis & Acceptance Criteria

Input parameters	Train fire		Additional train fire scenario for Diesel Multiple Unit (DMU) trains		Station fire (retail, sprinkler protected)	
	Value	Reference/Comment	Value	Reference/Comment	Value	Reference/Comment
Smoke spread analysis						
Total convective peak heat release rate (MW)	8* Convective HRR: 5.6	The fire is contained within a single carriage during the period of evacuation and does not spread to other carriages.	4	Fire located in train undercarriage at track level beneath a single carriage.	2.5 (Total HRR: 3.85MW)	Based on fast-response sprinklers BR 368, Table 3.3
Growing or steady-state	Growing	Credible train fire scenarios include a train carriage on fire approaching the platform or a train carriage on fire starting at the platform – both scenarios are likely to be in the growing stage of the fire.	Growing	Diesel pool fire scenario, with un ultra-fast initial growth phase up to peak heat release rate	Steady state	BR 368, Table 3.3
Fire growth rate (t^2 fire curve – slow, medium, fast, ultra fast)	Medium	Stacks of combustibles are not likely in train carriages therefore; medium growth is considered acceptable.	Ultra-Fast		n/a	Steady-state fire assumed, as per BR 368, Section 3.3
Materials	80% plastic and 20% cellulosic	Acceptable based on rolling stock of trains.	Diesel	Diesel pool fire at track level assumed	95% plastic 5% cellulosic	This may change dependant on the type of fire load within the retail unit (e.g. textiles, café, giftshop)
Radiation analysis						
Temperature which windows break	**400°C**	**V. Babrauskas, Glass breakage in fires, Fire Science and Technology, Inc, (2011)**				
Emitter emissivity	**1**	**Considered blackbody emitter for conservatism**				
Radiating panel	**All windows and doors on platform side of train carriage.** **Centreline temperature of the flame should be used as the temperature of the radiating panel**					

Table 22 Input parameters for rail specific design fire scenarios

D.2 Step 2: Analysis & Acceptance Criteria

*-8MW has commonly been used as the peak heat release rate for a train fire. However, this figure is based on historic test data on rolling stock and may not be appropriate for more modern rolling stock (where more stringent fire standards commonly apply). It is recommended that 8MW is conservatively used for a train fire scenario, unless more specific test data on applicable rolling stock is available.

Effect of sprinklers

As per Clause 6.6.4 of *CIBSE Guide E*, a fire may grow until the heat in the plume sets off the first sprinkler heads.

If a suppression system is installed within the station, then the peak heat release rate depends on the sprinkler head parameters i.e. response time, RTI value, temperature activation.

If project specific sprinkler head parameters are available then the activation time as calculated by equations detailed in *SFPE Handbook of Fire Protection Engineering 5th edition*, Chapter 40 by Robert P. Schifiliti et al. should be used to quantify the peak heat release rate of any fire in stations that are sprinkler protected.

However, if insufficient information is available on the type of sprinklers installed, then the conservative values in Table 22 should be used.

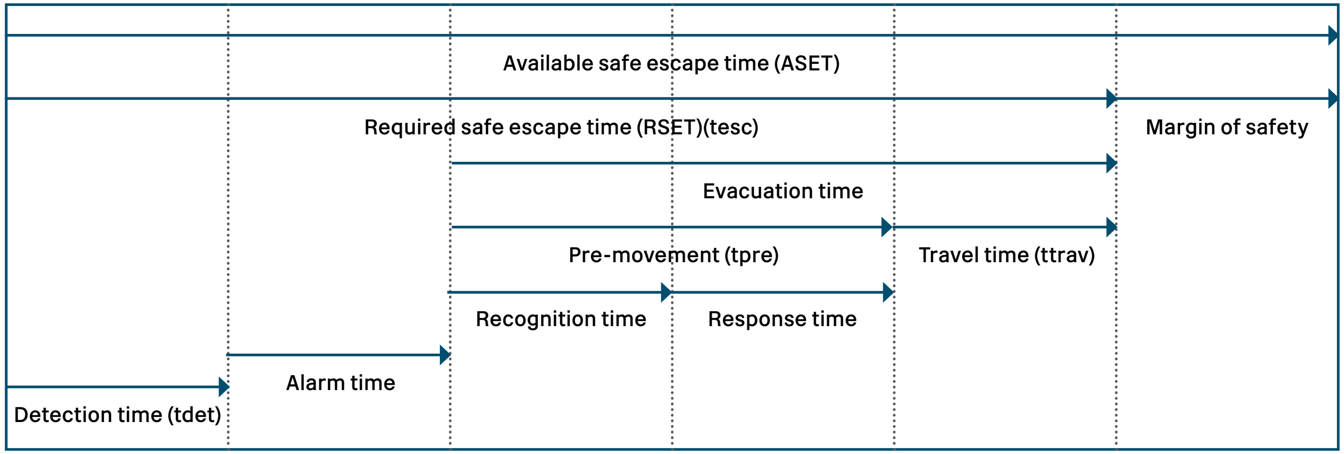

Figure 35 Break down of evacuation time as per PD 7974-6

Required Safe Egress Time (RSET)

The Required Safe Egress Time (RSET) measures the evacuation time for occupants from a building. The RSET is typically made up of the detection time, alarm time, pre-travel time (this includes the recognition time and the response time) and the travel time. In the first instance, calculations as defined in PD 7974-6:2019 should be used. The times which the RSET is made up of (see Figure 35) are based on the behavioural profile classified for the station. Guidance on classifying a behavioural profile for each risk type station is detailed in this section.

D.2 Step 2: Analysis & Acceptance Criteria

Behavioural profile for stations

In the rail environment the RSET can vary substantially depending on the type of station. For example, as Higher Risk stations tend to be larger and more complex (but with a greater level of fire safety management), the travel time (i.e. combined walking and queuing time) (i.e. combined walking and queuing time) is likely to be significantly larger than the detection, alarm and pre-movement time.

This may contrast with a Low Risk or Very Low Risk station where longer detection, alarm and pre-movement times may be expected due to the reduced provision of automatic fire detection/alarm systems and on-site fire safety management, when compared to the travel time.

In particular, the calculation of pre-movement time can vary considerably depending on the type of station. Typical parameters to quantify pre-movement times different station types are outlined in Table 23 below, as per the criteria described in PD 7974-6, and as applied to the station RSFRP defined in Section 3.2

Station RSFRP*	Alarm system**	Building complexity**	Fire safety management characteristics **
Higher risk Medium risk	Level A2 (two stage) Alarm time is taken as time out delay (usually two or five minutes). Investigation times should be included if allowed for in the system.	Level B3	Level M1 (normally requires voice alarm)
Low risk	Level A2 (two stage), as above; or Level A3. Depending on the specific fire alarm design approach.	Level B1 or B2 Depending on specific building layout/design.	Level M3***
Very low risk	Level A3 Typically limited/no fire alarm system provided, therefore reliance is generally placed on occupants/staff raising the alarm verbally, or occupants visually identifying a fire. Alarm time can be at least two minutes if the first respondent is well trained.	Level B1	Level M3

Table 23 Typical building characteristics of each risk type station as per PD 7974-6

*-see Section 3.2, Table 9 for definition of the different risk type stations

**-these are typical parameters which can be applied to certain risk type stations, additional consideration should be taken for the project specific station before applying these characteristics as these parameters may not be suitable.

***-A level M3 management is taken as the most conservative for a Low Risk station. The level of management can vary depending on the staff to occupant ratio. If the level of staff is high for most of the time the station is operating then this should be factored in when calculating the pre-movement time for occupants. The specific pre-movement time should be agreed with the Network Rail Fire Safety Engineer.

D.2 Step 2: Analysis & Acceptance Criteria

Occupancy density for stations

The occupancy of stations should be considered as per Clause 14.2 of BS 9992. This relies on peak-period demand based on passenger data for the station. Stations which serve stadia and other high occupancy venues should also consider events loads.

When the platform and train occupancies are not specified, the total occupancy should be established through a passenger footfall study that aligns with the project specific station characteristics. The occupancy loads used in the analysis should be agreed with the Network Rail Fire Safety Engineer.

In the first instance the peak occupancy of the station can be assumed to be directly proportional to the largest train capacity served by the platform, or largest dead-end, whichever is smallest:

- A crush loaded density is assumed to consist of 150persons/20m of train (i.e., 7.5 persons per m of train). This value has been determined based on typical crush loaded capacities of commuter trains.
- The platform loading is conservatively taken at 50% of the crush loaded train capacity.

Additional staff occupancy of platforms should be factored in and consideration should be taken towards unstaffed and staffed stations. This factor should be 0% for unstaffed stations and up to 2% for staffed stations (depending on the size of the station). The factor allowed for staff in stations should be discussed and agreed with the Network Rail Fire Safety Engineer.

Lower train/platform occupancies may be justified on a case-by-case basis, in consultation with the Network Rail Fire Safety Engineer, where a station's location and use is such that a crush-loaded train is not a realistic or foreseeable scenario. For example, a station on a rural line, where large train occupancies do not occur.

Where reduced train/platform occupancies are proposed, these should be supported by relevant passenger data (both existing and future forecasts).

RSET for rail environment

Provides rail-specific parameters to inform the RSET for a station. These are primarily based on data from BS 9992 and PD 7974-6.

D.2 Step 2: Analysis & Acceptance Criteria

Input parameter	Value		Reference
Detection time			
Time to detection depends upon the system in use and the design fire conditions. Automatic detection is considered necessary for performance-based design			PD 7974-6 Annex A
Alarm time			
Time to general warning depends on the system in place. Investigation times should be included if allowed for in the system. See **Section 3.2** for guidance on each risk type station.			PD 7974-6 Annex A
Pre-travel time Total pre-travel times (i.e. from alarm to movement of 99% of occupants) should not exceed 1.5 minutes			
Higher Risk station (M1, B3, A2) Medium Risk station (M1, B3, A2)	1st percentile: 1.5 minutes	99th percentile: 5.5 minutes	PD 7974-6 Table E.2
Low Risk station (M3, B1-B2, A2-A3)	1st percentile: >15 minutes (specific pre-movement time to be agreed with Network Rail)	99th percentile: >30 minutes (specific pre-movement time to be agreed with Network Rail)	
Very Low Risk station (M3, B1, A3)	1st percentile: >15 minutes (specific pre-movement time to be agreed with Network Rail)	99th percentile: >30 minutes (specific pre-movement time to be agreed with Network Rail)	
Travel time* Travel times are specific to the station and should be calculated for each station as per the escape capacities and speeds identified in BS 9992			
Horizontal passageway, stopped moving walks and ramps <1:20	Flow capacity - 80 people per minute per metre width		Table 1 BS 9992
Stairs (measured between the innermost part of the handrails), and ramps ≥1:20	Flow capacity - 56 people per minute per metre width		
Automatic ticket gates in the open position (standard width gates)	Flow capacity - 50 people per minute per metre width		
Automatic ticket gates in the open position (wide aisle gates of a minimum width 900mm)	Flow capacity - 80 people per minute per metre width		

Table 24 Rail specific input parameters for the Require Safe Egress Time (RSET)

D.2 Step 2: Analysis & Acceptance Criteria

Input parameter	Value	Reference
Escalator escape capacity (travel speed <30 m/min)	Flow capacity - 56 people per minute per metre width	Table 2 BS 9992
Escalator escape capacity (travel speed ≥30 and ≤45m/min)	Flow capacity - 75 people per minute per metre width	
Escalator escape capacity (travel speed >45 m/min)	Flow capacity - 120 people per minute per metre width	
Horizontal circulation	Travel speed - 38 m/minute	Table 3 BS 9992
Vertical circulation	Travel speed - 12 m/minute	

Table 24 Rail specific input parameters for the Require Safe Egress Time (RSET) (continued)

*-If lifts are to be utilised in the event of a fire, lift cycles should be included as part of the travel time. Lift cycle times depend on the type of lift installed into the station.

D.3 Step 3: Internal Peer Review & QA

To support the robustness of the fire engineering analysis, sensitivity studies should be undertaken. Sensitivity studies should identify variables that have the potential to significantly affect the level of safety to occupants and the Fire & Rescue Service. Variables used as part of an ASET vs RSET assessment that may be considered as part of a sensitivity study could include location of fire, heat release rate, smoke control/extraction system parameters, occupant distribution and occupant walking speed.

Establish a safety factor

After an appropriate ASET and RSET value has been determined, the results should be compared at appropriate time steps. An appropriate safety factor should be accounted for when comparing both values. The safety factor should be based on the level of conservatism that has been factored into the calculation and the assumptions made. This will vary depending on the station design, therefore the safety factor applied should be agreed with the Network Rail Fire Safety Engineer.

D.4 Step 4: Report and Present Results

Once the fire engineering assessment has been completed, and the results verified as achieving its objectives, it is necessary to present the findings clearly in an appropriate report format.

A fire engineering assessment report should be produced that describes the fire engineering analysis process, and clearly shows how the results meet the objectives set out and agreed as part of the QDR process in Step 1.

The report should also include commentary on any assumptions and limitations, information relied upon, and further recommendations/next steps.

All technical parameters and inputs should be fully referenced, and appropriate explanatory figures provided to assist the readers' understanding.

D.5 Step 5: External Peer Review

D.5 Step 5: External Peer Review

Once complete, the fire engineering assessment report should be presented to the Network Rail Fire Safety Engineer for formal review and comment, as part of the Network Rail assurance process (refer to Section 1.9.1 for details).

The Network Rail Technical Fire Safety Engineer will review to confirm that the fire engineering assessment has been undertaken as agreed at QDR stage, and that all assumptions, limitations and results are appropriate.

The Network Rail Fire Safety Engineer may request further detail, information or clarification from the design team, and reserves the right to seek further internal or external peer review if appropriate.

Fire Safety at Stations

Appendix E: Reference Documents

E

Appendix E

Reference Documents

The following legislation, regulations, industry standards and Network Rail standards have been referenced by this Design Manual.

Legislation

- Building Act 1984,
- Building (Scotland) Act 2003
- Equality Act 2010
- Regulatory Reform Act 2001 (England & Wales)
- The Fire (Scotland) Act 2005
- The Health & Safety at Work Act 1974
- Building Safety Act 2022

Regulations

- The Regulatory Reform (Fire Safety) Order 2005
- The Fire Safety (Scotland) Regulations 2006
- The Construction (Design and Management) Regulations 2015
- The Building Regulations 2010 (as amended)
- The Building (Scotland) Regulations 2004 (as amended)
- Fire Precautions (Sub-surface Railway Stations) Regulations 1989
- The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009
- Railways and Other Guided Transport Systems (Safety) Regulations 2006

Statutory Codes of Practice

- Design Standards for Accessible Railway Stations,A joint Code of Practice by the Department for Transport and Transport Scotland, Version 4, March 2015

National Standards

- BS 9999: 2017 - Fire safety in the design, management and use of buildings
- BS 9992: 2020 - Fire safety in the design, management and use of rail infrastructure
- BS 7974: 2019 - Application of fire safety engineering principles to the design of buildings
- Approved Document B, 2022, Department for Levelling Up, Housing and Communities, UK Government
- Non-Domestic Technical Handbook, 2023, The Scottish Government
- PD 7974 Part 7: 2019 - Probabilistic Risk Assessment: Application of fire safety engineering principles to the design of buildings
- BS EN 81-20: 2020 - Safety rules for the construction and installation of lifts - lifts for the transport of persons and goods. Passenger and goods passenger lifts (Incorporating corrigendum April 2021)

- BS EN 81-28: 2018 - Safety rules for the construction and installation of lifts - lifts for the transport of persons and goods. Remote alarm on passenger and goods passenger lifts (Incorporating corrigendum January 2019)
- BS 5839-1: 2017 - *Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises*
- BS EN 81-73: 2020 - *Safety rules for the construction and installation of lifts - particular applications for passenger and goods passenger lifts.*
- BS 5839-6: 2019 +A1:2020 - *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises*
- BS 5839-8: 2023 - *Fire detection and fire alarm systems for buildings - Design, installation, commissioning and maintenance of voice alarm systems. Code of practice*
- BS EN 1995-1-2: 2004 - *Eurocode 5: Design of timber structures. General - Structural fire design (incorporating corrigenda June 2006 and March 2009)*
- BS 8524-1: 2013 - *Active fire curtain barrier assemblies. Specification*
- BS EN 13501-2: 2023 - *Fire classification of construction products and building elements. Classification using data from fire resistance and/or smoke control tests, excluding ventilation services*
- BS EN 13501-1: 2018 - *Fire classification of construction products and building elements.*
- BS EN IEC 61730-1 - *Photovoltaic (PV) arrays - design requirements*
- BS 5839-1: 2017 - *Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises*
- BS EN 12845: 2015 +A1:2019 - *Fixed firefighting systems - automatic sprinkler systems - design, installation and maintenance*
- BS 8489-1:2016 - *Fixed fire protection systems - industrial and commercial watermist systems.*
- BS 5266-1: 2016 - *Emergency lighting. Code of practice for the emergency lighting of premises*
- BS 5499-4: 2013 - *Safety signs. Code of practice for escape route signing*
- BS 5499-10: 2014 +A1:2023 - *Guidance for the selection and use of safety signs and fire safety notices*
- BS 5839-9: 2021 - *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems.*

Network Rail documents

- *Fire Safety Policy* (NR/L1/FIR/100)
- *Certificate of Approval in Principle* (AiP) (Form A)
- *Certificate of Design and Check* (Form B)
- *Architectural and Layout Acceptance* (Form D)
- *Engineering and Architectural Assurance of Building and Civil Engineering Works* (NR/L2/CIV/003)
- *Station Design Guidance Manual* (NR/GN/CIV/100/02)
- *Station Capacity Planning* (NR/GN/CIV/100/03)
- *Inclusive Design Manual* (NR/GN/CIV/300/04)
- *Stations Design Manual* (NR/GN/CIV/300/02)
- *Implementation Strategy for Small and Medium Stations* (NR/GN/CIV/100/09)

Appendix E
Reference Documents

- *Fire Safety: Operational Estate* (NR/L3/FIR/102)
- *Fire Safety – Maintenance* (NR/L3/FIR/106)
- *Fire Safety – Risk Assessment* (NR/L3/FIR/107)
- *Fire Safety – Fire Extinguishers* (NR/L3/FIR/108)
- *Fire Safety – Fire Log Book* (NR/L3/FIR/109)
- *Fire Safety – Managed Stations* (NR/L3/FIR/101)
- *Design Manual for Electric Vehicle Charging Systems* (NR/GN/CIV/200/13)
- *Electric Vehicle charging points and associated infrastructure* (NR/L2/CIV/902)

Other Supporting Documents

- *CIBSE Guide E – Fire Safety Engineering,* 2019, Chartered Institute of Building Services Engineers
- *Fire Safety Management in Traditional Buildings, Guide for Practitioners 7,* Feb 2010, Historic Environment Scotland (Guide for Practitioners 7)
- *Fire Safety Guidance Note: Heritage and Buildings of Special Interest,* Rev 5, May 2022, London Fire Brigade (GN80)
- *RSSB Safety Management Intelligence System (SMIS) database*
- RSSB, Presentation: *Fire Forum Train Analysis 2019*
- *Common Safety Method for Risk Evaluation and Assessment* (CSM-REA)
- *ASFP Red Book,* Association of Fire Protection
- *The GRO Green Roof Code of Best Practice 2021*
- *Rail Industry Standard for Lighting at Stations* (RIS-7702-INS: 2013)
- *Fire Prevention and Protection – Emergency Do Not Enter Signs* (LUL S1087)
- *Fire Safety in Construction Guidance* 3rd Ed. 2022 (HSG 168)
- *Regulatory Reform (Fire Safety) Order 2005 Guidance Note 3: Fire safety on sub-surface railway stations* (Department for Communities and Local Government (DCLG) March 2009) (GN 3)
- *Managing Health & Safety in Construction: Guidance on Regulations* (L153)
- *Fire Safety Risk Assessment – Transport Premises and Facilities,* HM Government, 2007
- *Practical fire safety guidance for existing non-residential premises,* Scottish Government, 2022
- *The Control of Substances Hazardous to Health Regulations 2002* (COSHH)
- *Dangerous Substances and Explosive Atmospheres Regulations 2002* (DSEAR)
- *Covered car parks – fire safety guidance for electric vehicles,* UK Government, Office of Zero Emission Vehicles (T0194)

Fire Safety at Stations

Appendix F: Acknowledgments

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Appendix E
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Technical authors & reviewers:
A. Elliott
R. Taylor
N. Akhtar
R. Ramsamy
P. Woodburn
N. Troth

Graphic design and support:
C. Brumwell
C. Wilcox
D. McVee
B.Staley

Project Steering Group

The following Steering Group members have provided technical, operational and review input in the development of this document:

NR Technical Authority
J.Boyce
A.Brown
F.Anatole
B.Yariv
I.Grimes
P.Hearn
R. Sweeting-White
S.Collishaw
G.Harish
K.Singh
E.Lawler
D.Robinson
NR North West Central
E.Lawler
NR System Operator
M.Pitt
L.Brown-Owens
M.Jump
S.Patel
C.Parker
T.Pestell
NR Western & Wales
R.Cole
M.Smith
NR Southern
L.Barrow
NR Scotland
R.Kinsella
A.Macfarlane

NR North West Central
N.Jones
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C.Roberts
Scotrail
B. Doran
LNER
J.Rawcliffe
GWR
M.Crittle
C2C
B.Martin
Northern Rail
R.Jones
Transport for Wales
J.Bryce
East Midlands Railways
A.Edwards
TransPennine Express
D.Hook
I.Peacock
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Greater Anglia Railways
K.Cook
Rail Delivery Group
J.Brogden
RSSB
A.Chalisey
T. Ellis
K.Kopsalidou

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