Design Manual
NR/GN/CIV/200/05

Network Rail

Vertical Circulation

Document Verification

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First Issue

How to use this document

1

Section 1
Introduction:

Identifies the key challenges in providing successful VC, and sets out how this Design Manual can help at each stage of a project.

2

Section 2
Spatial Design:

Sets out key considerations for planning a VC scheme, and determining what types of VC to provide and where. Includes guidance on Inclusive Design, Space Planning, and Environmental Impacts.

3

Section 3
Vertical Circulation Elements:

Provides design detail on each VC element, along with common elements such as handrails. The section identifies common considerations, before providing specific detail for each element.

4

Section 4
Vertical Circulation Technical Design:

Gives guidance on areas including Environmental Design, Innovation, Fire Design, Safety, Material choices and Design Life.

A

Appendices A–C:

→ Definitions
→ References
→ Image Credits
→ Case Studies
→ Lift Requirement Assessment Aid

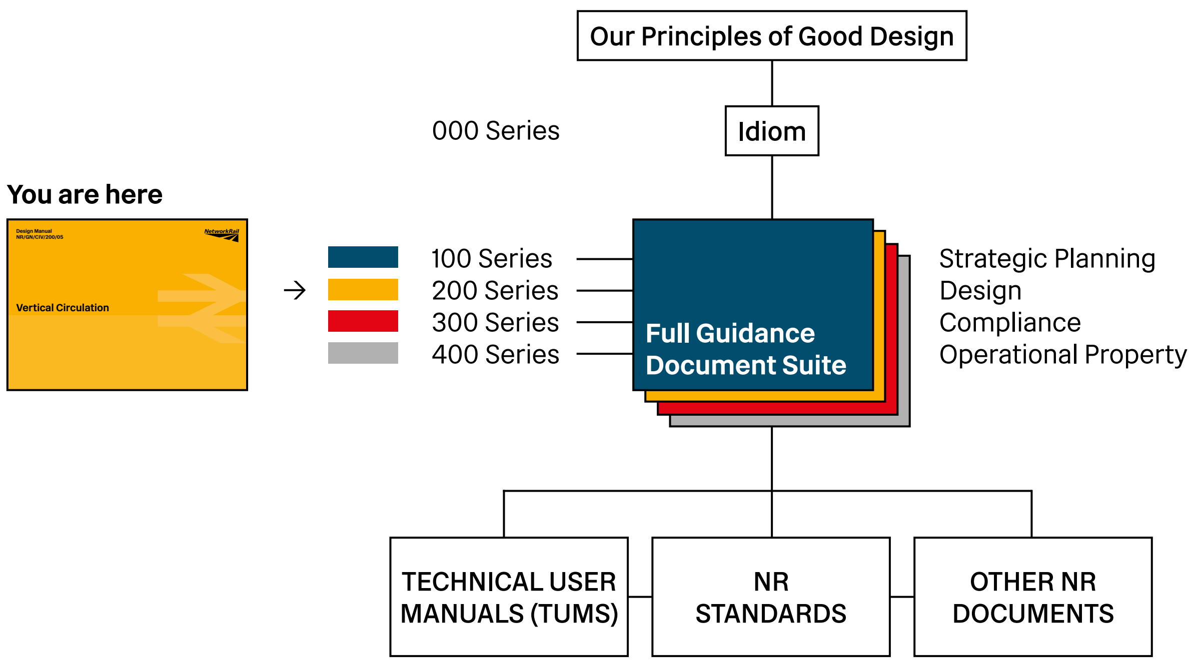
Hint and tips:
To quickly navigate this document click on any of the sections or titles on this page.

To return to the contents page you can click on the Double Arrow symbol.

3.1 Click on this symbol to navigate to the section indicated.

How to use the guidance

The Network Rail Document Suite



References to other documents

- Code of Practice Guidance
- National Standard
- Network Rail document
- European Standard

Example:

Standards Reference

National Technical Specification Notice:
Persons with Reduced Mobility (PRM) 2021

NTSN: Persons with Reduced Mobility

Design of an accessible and inclusive built environment — Code of Practice (2018)

BS 8300

This guidance has a Network Rail standards Green status, and the contents do not require derogation

A full list of relevant documents, and other guidance suite documents is contained in the appendix.

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Vertical Circulation

Purpose and Scope

1

Image 1.1
At Paddington Elizabeth line station lift access is prominently located for ease of wayfinding

1.1 Purpose of this Document

Network Rail stations contain over 1,500 lifts and almost 300 escalators, along with stairs at nearly all of the over 2,500 stations owned by Network Rail. There is a diverse portfolio of different types of vertical circulation that covers different types of internal and external environments, varying levels of footfall, and types of construction.

In 2019-20 the GB Railway network served 1.7 billion passengers each year, making this circulation amongst the most heavily used in the country.

It is rarely possible to design a station without vertical circulation. Making sure this is safe, accessible and intuitive to locate and use plays a large part in the experience and perception of the journey through a station, as passengers navigate their way to their train, or leave a busy platform.

Standards Reference

Department for Transport - A Code of Practice
Design Standards for Accessible Railway Stations (Version 4)

DfT National Technical Specification Notice:
Persons with Reduced Mobility (PRM) 2021

British Standards Institute:
BS 8300-2:2018 Design of an Accessible and Inclusive Built Environment - Buildings. Code of Practice

1.1.1 What is Vertical Circulation?

Vertical Circulation (VC), within this document refers to any means of changing level, from a short rise achieved through a ramp, through to high-rise lifts and escalators, and escape stairs.

1.1.2 Purpose of this Document

This document provides design considerations from spatial design principles and setting out through to technical design. It provides guidance for all stages in the lifecycle of a piece of vertical circulation, including inspection and maintenance and replacement.

Vertical Circulation will often be present on the obstacle-free route through a station, and this documents sets out how it can be accessible to all users. An obstacle free route is an accessible route that is free from steps and physical obstructions such as lighting and CCTV columns, station furniture and retail. The Department for Transport's Code of Practice (DfT ACoP) and National Technical Specification Notice (NTSN): Persons with Reduced Mobility further define the requirements for this route.

The document is intended to help project teams from the start of a project, and should be read alongside Network Rail technical standards that provide specific details on VC design, along with relevant legislation on accessibility, fire and circulation design. Relevant standards and legislation are highlighted throughout the document where they relate to a specific consideration, and more broadly within the document references section.

Key aims of this document include:

→ Promoting inclusive design, where accessible vertical circulation is intuitive to find, and given equal prominence to stairs and escalators

→ Setting out spatial considerations, so that Vertical Circulation is fully integrated in design development

→ Considering VC elements holistically within their surroundings, so that lighting, floor finishes and visual contrast of these surrounding spaces are considered as part of the VC design

→ Recognising that VC contributes to a large proportion of slips, trips, and accidents in stations and looking at measures that can be taken throughout the design process to reduce the likelihood of these

→ Informing decisions on different types of lifts and escalators, and their suitability to different site specific needs

→ Understanding the environmental footprint of vertical circulation in construction and usage, and how this can be reduced

→ Providing clear information on fire and evacuation design requirements, and where designers can find detailed information at each stage of their projects

→ Understanding how VC can be constructed and implemented in stations

→ Considering the access and maintenance requirements across the lifespan of VC, and how elements can be removed, replaced and recycled at the end of their lifecycle

1.1 Purpose of this Document

1.1.3 Who this document is aimed at?

This document is aimed at project sponsors, project teams and designers. This document can assist with VC schemes on new stations or significant upgrades, through to the refurbishment of a single stair or lift, or providing guidance on ongoing access and maintenance or removal.

1.1.4 The Relationship of this document to other Network Rail Design Manuals

This guidance forms part of a wider suite of Network Rail Design Manuals; the hierarchy of this is set out on Page 3. Throughout any VC project other standards and guidance such as on 'Inclusive Design' are likely to apply.

For bigger projects that contain wider works in the station, guidance documents such as 'Station Capacity Planning' and 'Station Design Guidance' also apply. Relevant links to the guidance suite are provided throughout the document.

Image 1.2
At Hayes and Harlington station new lifts are positioned so that they have equal visual priority with the adjacent stairs

1.2 Vertical Circulation Illustrated Examples

The following illustrations provide some typical examples of how Vertical Circulation may be configured at small stations (Category D-F)

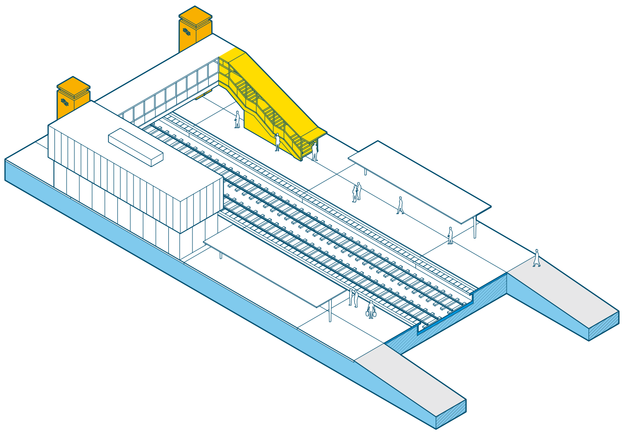


Image 1.3
Grade stations typically require an overbridge or subway to provide access to both platforms, or to the platform island. Exceptions include termini stations and those at level crossings.

Subways generally require less vertical displacement than overbridges, but are more disruptive to install in an existing station.

At side platform stations, access will usually be from one platform, with Vertical Circulation to additional platforms. The placement of VC should prevent passengers having to walk far along a platform in order to transfer to other platforms.

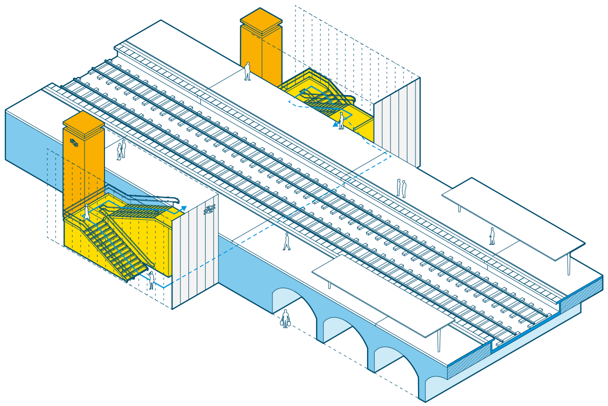


Image 1.4
Stations raised on a viaduct typically have independent Vertical Circulation to each platform from the lower level. This is more efficient than having to reach platform level and then transfer platform via an overbridge.

A key challenge is to make access to all platforms clear and legible, and not feel like there are separated entrances to different platforms.

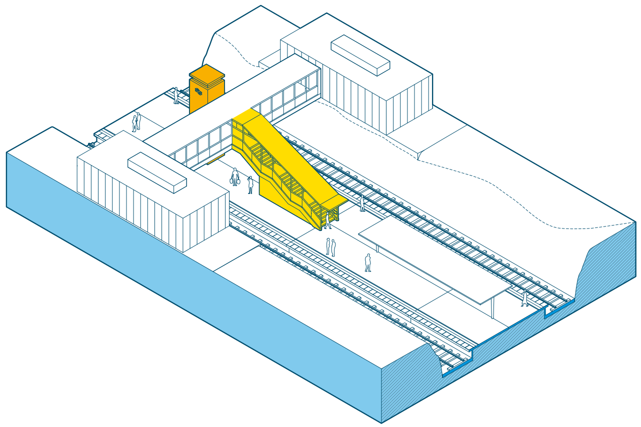


Image 1.5
Stations in a cutting or subsurface can allow for an efficient optimised VC arrangement, particularly if island platforms are used and allow for a single VC route to platforms.

Image 1.6
Stairway from overbridge to platforms at York station

2

Vertical Circulation

Spatial Design

Image 2.1
Triple staircase at
Pudding Mill Lane DLR station

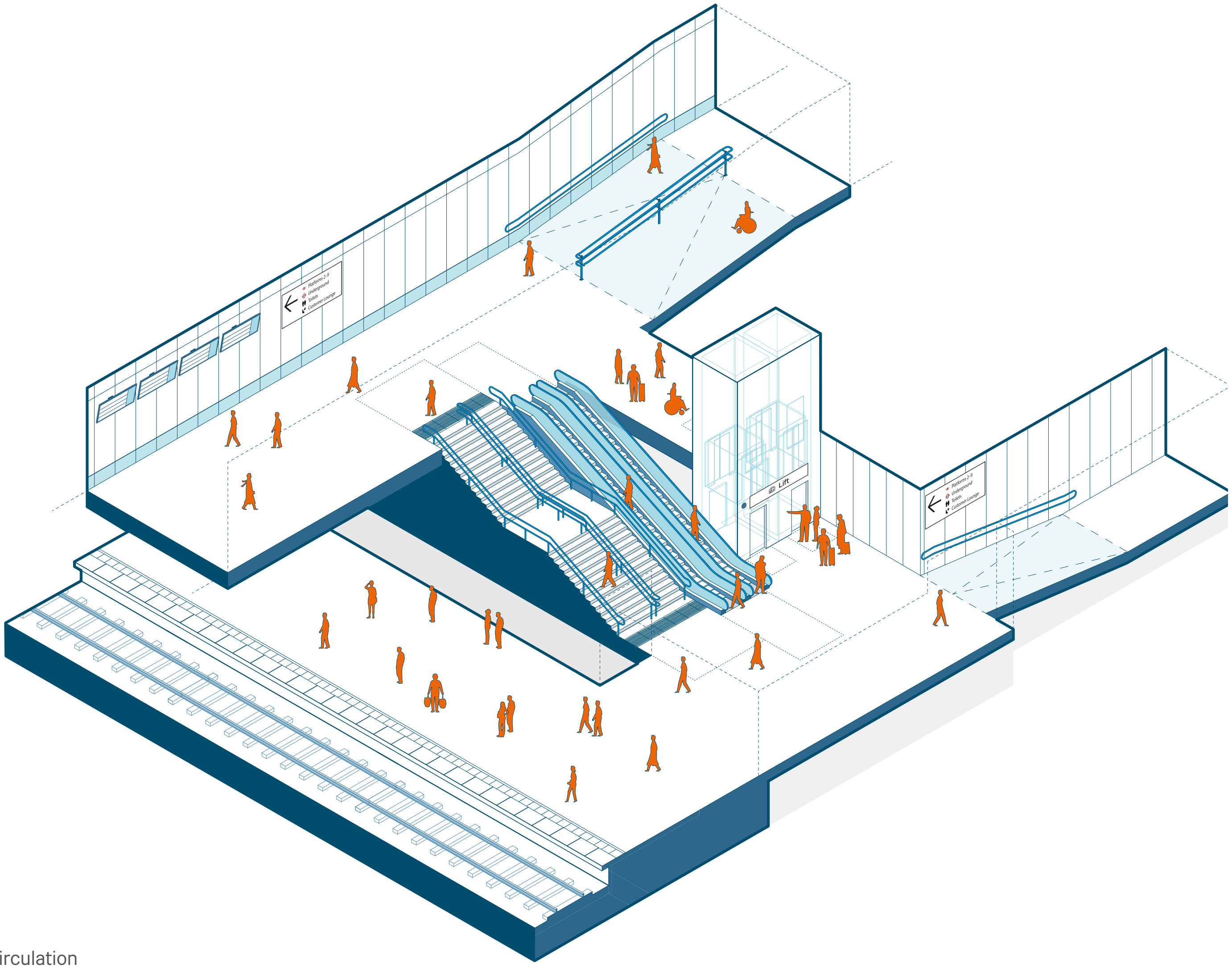


Image 2.2
Key Diagram - Elements of Vertical Circulation

2.1.1 Who are lifts for?

Lifts are necessary for large segments of the population, including those that are unable to negotiate steps, such as wheelchair users and some ambulant disabled people. Lifts are also helpful for older people, families with young children and people with large pieces of luggage.

In this Design Manual the term PRM (Person of restricted Mobility) is used. We understand this term has negative connotations, and is not the preferred term of all. We have chosen to use this term as it is defined in National Technical Specification Notice Persons with Reduced Mobility published by the DfT.

2.1.2 Providing equal visibility to accessible means of Vertical Circulation

Equal prominence and visibility should be given to accessible means of Vertical Circulation. This means that lifts should be located so that they are equally visible to stairs and escalators, both when approached from the top and bottom.

This is challenging as:

→ Stairs and escalators have horizontal displacement; this increases with the length of the rise

→ Spatial constraints, particularly in existing stations may limit the optimal placement of lifts.

Where lifts are not easily visible, those with luggage might use stairs and escalators when it may be less safe to do so, which is a frequent cause of accidents. Visibility of lifts can be improved through the use of wayfinding and supergraphics, this is covered in section 2.2.2 of this guide.

2.1.3 Through-lifts

Through-lifts allow a continual route, avoiding the requirement for wheelchair users to turn within the lift car. Through-lifts should be the first choice when designing a new lift. Where this is not possible, lifts should be large enough for a wheelchair user to turn around within the lift and a mirror should be provided on the wall opposite the door to assist wheelchair users when reversing.

Through-lifts can help with visibility of the lift, as they are typically approached from the same direction as adjacent stairs or escalators from both top and bottom.

2.1.4 Waiting Spaces

Waiting areas with a seat and space for wheelchair users should be provided at lift landings. On platforms, these should be sheltered. Shelter should also be provided to the lift threshold.

A minimum 1500mm turning circle should be provided at a lift lobby, however this may not be sufficient for a large powered wheelchair to manoeuvre, and therefore more space should be provided where possible.

NR Guidance Suite Reference

Inclusive Design
NR/GN/CIV/300/04

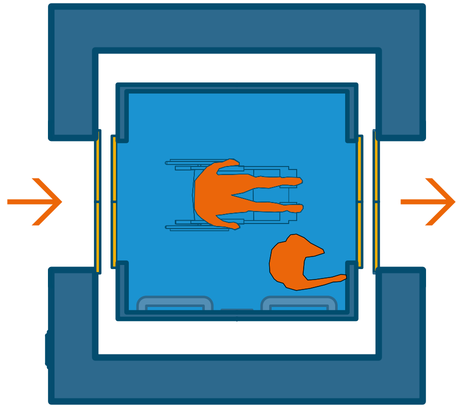


Image 2.3
Open through-lift plan

Image 2.4
At Liverpool Street Elizabeth line station, a new lift has been positioned in order to maximise visibility from both the upper and lower landings.

2.1.5 Diversity Impact Assessment (DIA)

A DIA is a structured information gathering and decision-making process used to assess and record the likely and actual impact of a current or proposed project, maintenance activity, policy or function on diversity and inclusion. DIAs should demonstrate due regard in response to Network Rails' Public Sector Equality Duty under the Equality Act 2010.

The DIA should identify potential barriers to access and inclusion and ways to mitigate their impact. DIAs should anticipate the likely effects of a project on people with the protected characteristics as defined by the Equality Act.

Undertaking a DIA should deliver evidence-based decision making.

DIAs should be an integral part of programme management and be included in the project plan. Potential impacts identified by DIAs should be used to create an action plan to mitigate them which should demonstrate that duties under the Equality Act have been met.

DIAs should be considered a 'living document' which are updated regularly and at each stage of a project. Carrying out the DIA early is important so that it can impact and feed into the design process early on.

2.1.6 Considerations for non-physical disabilities

Areas of circulation and decision making can be challenging for those with cognitive and sensory disabilities. Decision making can be aided by clear and intuitive wayfinding, along with providing simple uncluttered spaces.

Help points provide assurance and a direct contact to those that can provide assistance. Help points should be provided at areas of vertical circulation that are either unstaffed or less visible in staffed stations.

2.1.7 Tonal Contrast and Materiality

Tonal contrast to areas such as handrails, steps, and lift architraves against their surrounding surfaces helps to identify features, avoid visually noisy and reflective surfaces, and can also help to avoid accidents. More detail is provided on how these can apply to each element in Sections 3.2 — 3.6 of this guide.

2.1.8 Moving / Scrolling Text

Scrolling dot matrix style text at lift landings and within lift cars is often cited as difficult to read and can be visually confusing. Where possible, this should be avoided, with priority given to simple physical signage, as indicated in Image 2.5.

Where electronic text is used, the level description should align with that used on physical station signage.

Image 2.5
Lift at West Drayton station with clear simple signage

2.2 Wayfinding

2.2.1 Equality of Modes

Where possible lifts should have equal 'intuitive' prominence alongside stairs and escalators.

Lifts should be located where they are convenient and accessible and given equal prominence with escalators/stairs to encourage passengers to use them.

When travelling through a station passengers should be made aware of their VC options at the earliest stage.

Clear signposting should be provided to the lifts where escalators are installed. Where spatial constraints mean that modes are not equally visible, signage or other environmental cues should be used to compensate.

The location and direction of travel of any escalator should be clearly indicated by signs supported by pictograms. Clear visual and audible indication should be provided when approaching the start and end of escalators.

2.2.2 Visual Prominence

Wayfinding supports passenger movement on approach to lifts/stairs/escalators. Station Capacity modelling outputs can help identify decision making zones and inform Wayfinding sign locations. The accumulation of passengers at the head of stairs and escalators may cause slips, trips, and falls if passenger dispersal is not optimised. Suitably sized wayfinding signage should be provided without conflict or distraction from other station information and advertising.

Priority should be given to wayfinding graphics and passenger information. Art, retail signage, and advertising should not compete visually.

Architectural elements and other equipment at high-level such as CCTV cameras should be carefully considered and coordinated with the wayfinding information so there is no visual obstruction to the signs from passenger decision making points.

2.2.3 Passenger journey and local signage

The passenger journey should be considered for all user types arriving and departing. The VC route should be seamlessly connected to avoid gaps in the routing information. Wayfinding information should be provided using progressive disclosure as described in the Wayfinding Design Guidance. This assures the passenger is provided with the right information at the right time.

For stations with a large number of lifts a 'you are here' station wayfinding map which is appropriately oriented to the station layout can help passengers identify their route through the station.

NR Guidance Suite Reference

Wayfinding
NR/GN/CIV/300/01

Standards Reference

Wayfinding Assurance Procedure
NR/L2/CIV/150

DfT National Technical Specification Notice:
Persons with Reduced Mobility (PRM) 2021

2.2.4 Accessible Routes

Accessible step free routes to lifts should be clearly signposted, at regular intervals along the route, supported with pictograms depicting persons with reduced mobility.

Level access routes via lifts that divert from primary escalators and stair routes should be clearly identified and signposted to inform passengers in advance. This can improve passenger journeys and minimise risk of passengers mis-using stairs and escalators and/or indecision and dwelling at the top or bottom of escalators or stairs.

When provided, maps and information should clearly identify the location of lifts and PRM routes at the station information point/desk to allow for means of pre-planning.

For passengers alighting onto the platform, the way out illustrated on directional information should be combined with text to support alternative exit directions via step-free routes, including supporting pictograms indicating the mode of travel when required to aide passenger recognition.

Mobile Phone Apps such as TfL Go, and Citymapper can help passengers with their journeys through stations by identifying routes, parts of the train to board, Some apps, such as TfL Go offer a step-free mode for planning accessible journeys, including information on toilet availability, platform access and live status of lifts.

2.2.5 Identification of Vertical Circulation

Consider how passengers interpret architectural features. Lifts should be conspicuous and easy to locate within the station environment.

Voids can be used as an environmental cue to provide visual connections between levels.

Lift identification signage should be provided over the threshold of the lift in accordance with the Wayfinding Design Guidance. This should provide information regarding the destination/s the lift serves, to allow passengers to make an informed decision where the step free accessible route is located.

The lift user pictograms should be incorporated to encourage wider use by disabled people including wheelchair users, those travelling with luggage, buggies and cycles.

Supergraphics may be used on prominent lifts which can be viewed from a distance to identify the lift and the platforms the lift serves. Large format supergraphics may help passengers understand the logic of the platform arrangement to construct a mental map that supports intuitive wayfinding.

Sufficient contrast between supergraphic signs and background is necessary for legibility. Lessons can be learnt where the application of supergraphics to support PRM users identify lifts was shown to be ineffective, mainly due to the contrast of the graphics and the environment.

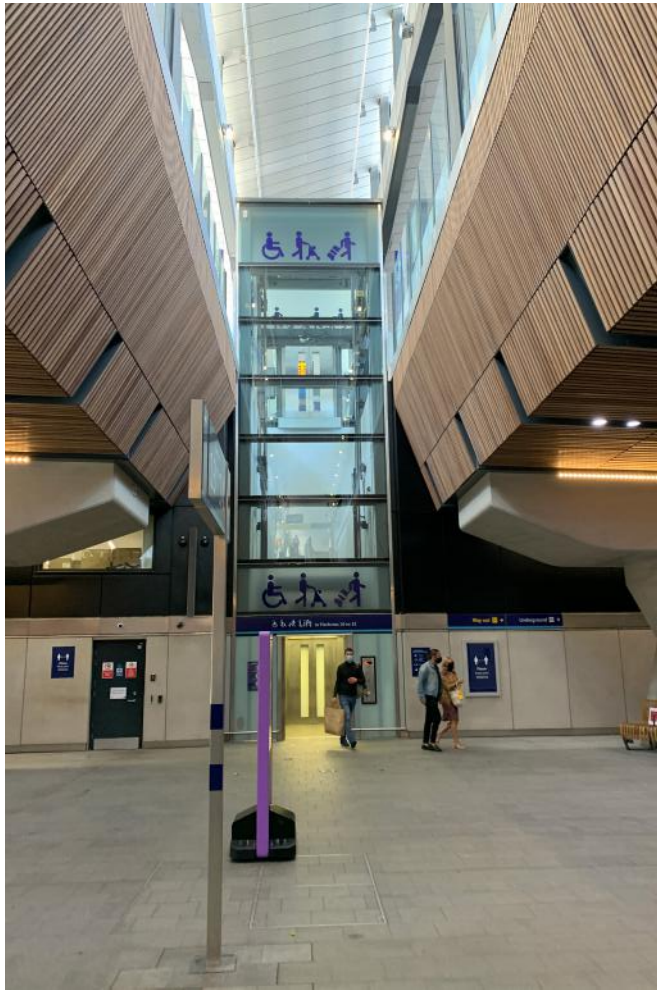


Image 2.6
London Bridge lift tower supergraphics

All VC iconography should be paired with a destination.

Indication of stairs should be clear through the use of pictograms. Including the number of steps on a route direction can be useful to allow passengers with reduced mobility to make an informed decision on which mode of VC to take.

The use of pictograms and icons should be in accordance with Wayfinding Design Manual.

Signage lettering should be large enough for passengers to read at a distance that avoids having to pause within a run-off zone. The Wayfinding Design Manual helps to identify what sizes should be used in each location.

2.2.6 Level information

Where a lift calls at more than two levels a sign indicating the number of the floor, and signage providing information on the main amenities on all other floor levels should be provided next to the lift landing doors. This is to equip passengers and staff with the decision-making information they require, and should be provided in an inclusive format.

Lifts should provide information regarding the destination/s the lift serves.

All naming and numbering of floors should be logical, consistent and understandable to all. Lift audio should align with floor numbers at all times, and should indicate the main destination on each floor e.g. 'Level 1, Station Concourse'.

2.2.7 Statutory signage

Signage in accordance with BS EN 115-1:2017 should be included at escalators to discourage mis-use by passengers with heavy luggage, pushchairs, cycles etc. and to improve safety for all passengers. Consider providing the statutory signage earlier in the passenger journey to avoid indecision in run-off zones.

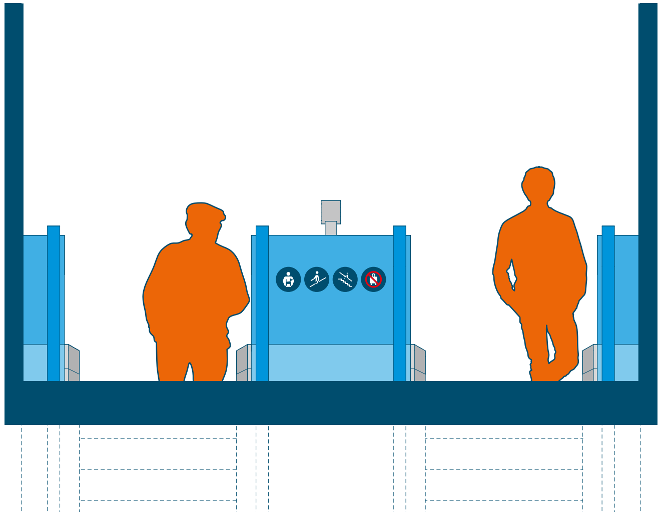


Image 2.7
Examples of statutory signage provided on approach to an escalator

2.3.1 Choice of Modes

Height
Image 2.8 below sets out the different vertical rises that can be achieved by each vertical circulation mode.

Travelling up stairs is more challenging than travelling down. Therefore, for rises that are on the threshold of 5m, a single escalator can be provided in the up direction, with stairs providing downwards travel. The stair should be two-way in the event the escalator is out of use.

Capacity
Stairs and escalators provide a higher capacity than standard lifts, without the waiting and dwell times that occur at lift landings. For this reason, lifts are usually accompanied by stairs or escalators.

Escalators effectively have a fixed capacity, that can only be varied slightly by speed. Capacity is increased by additional escalators. Stairs and lifts can be sized more accurately and efficiently to meet capacity calculations

Accessibility for All
Where space allows, high capacity lifts can be considered as an alternate to escalators and stairs. For stations near airports, where a large number of passengers have luggage, lift provision should be greater than at other stations.

Environmental and Energy Considerations
For rises of a height that can be achieved by a ramp instead of a lift, or by a stair instead of an escalator/lift, consider the sustainability impact and energy in construction, use, and maintenance as part of the decision. Non-mechanical means of circulation should nearly always have a smaller environmental impact, and can be cheaper to operate and maintain than lifts or escalators.

2.3.2 Safety Considerations

Significantly more injuries occur on escalators than stairs or lifts, and this should be factored into any assessment of whether to provide escalators.

2.3.3 Short Escalator Spans

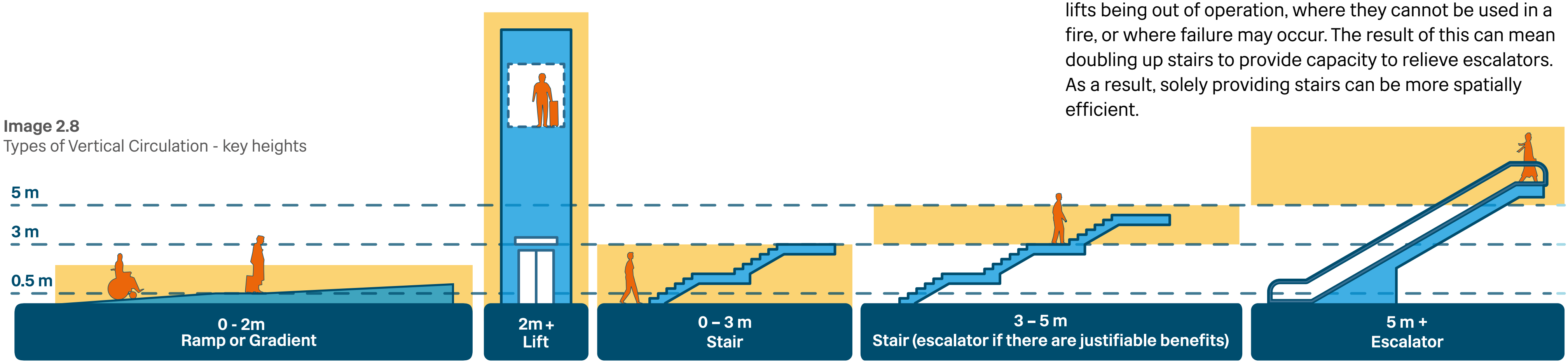
The use of escalators for short spans should generally be avoided. Escalators are not for level changes below 3m in height, and for 3-5m in height a staircase with an adjacent lift is preferable.

For mezzanines below 5m in height, stairs and lifts are the preferred means of access.

2.3.4 Evacuation Requirements

Vertical Circulation capacity should consider escalators and lifts being out of operation, where they cannot be used in a fire, or where failure may occur. The result of this can mean doubling up stairs to provide capacity to relieve escalators. As a result, solely providing stairs can be more spatially efficient.

Image 2.8
Types of Vertical Circulation - key heights



2.4.1 Determining quantity and strategy for VC

The capacity requirements for the station should be clearly defined. This should consider any special scenarios that may apply, such as planned events.

The Station Capacity Planning Design Manual provides further detail on demand forecasts, passenger demand concepts, and what to include in a capacity assessment.

2.4.2 Location of VC assets

Determining the location of VC elements should come early in the design process. In addition to meeting run-off and cross flow requirements and providing clear visibility, they should be positioned to minimise the time it takes for alighting passengers to leave the platform and encourage boarding passengers to spread evenly along the platform. This can both reduce journey times for passengers and support good train performance through spreading passengers evenly on both trains and platforms.

The VC elements should be highly visible for ease of identification and to encourage passengers to use the most appropriate choice for their journey. In addition, lifts should be in relatively close proximity to stairs and escalators, to provide passengers with a choice to suit their individual requirements.

NR Guidance Suite Reference

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

The positioning and capacity of VC elements should be informed through an understanding of the passenger demand at the station. An understanding of the amounts and demographics of passengers as well as their origins and destinations can help to determine the answers to design questions such as:

- What capacity of VC is required?
- What are likely to be the primary station entry/exit or interchange routes to and from the platform?
- Where are passengers likely to be boarding or alighting services depending on rolling stock types/lengths and their origins and destinations?
- Are boarding passengers expected to wait on the platform or away from the platform?
- What's the planned train service frequency and how can the VC contribute to it being maintained through efficient platform clearance and even passenger spreading?

Additionally, understanding passenger routes and destinations can help to inform decisions that should be made around the locating of VC elements to accommodate fire evacuation requirements.

2.4.3 One way or switch-able station operation

Where vertical circulation is part of a single direction route through a station, consider:

- Resilience to operate under a wider range of operational scenarios.
- The station's 'Concept of Operation' plan
- Resilience to continue to allow station operation in the event that an escalator isn't working, or where another route is unavailable

2.4.4 Behavioural considerations and design

Spatial planning should take account of the expected passenger demographic and how it may be used. This should inform lift capacity – for example:

- → The number of passengers with heavy luggage at a station may be impacted if it is on a primary route to an airport,
- → The number of passengers who are wheelchair users may be impacted if connecting routes are also step-free.

Alongside capacity, VC arrangement and design are known to have an impact on passenger behaviour and uptake in lift usage. Observations have shown that when passengers are unaware of the provision and/or location of lifts they resort to "normal behaviours" - using the stairs or escalators as the obvious fastest choice. This can lead to unnecessary risks and mis-use – such as carrying heavy luggage or buggies on escalators or stairs.

The aim should be to prioritise lift placement that provides all passengers with good visibility of the lift entrance and lift shaft from the lower and upper levels (e.g. platform and concourse). The lift should adopt a design language that makes it intuitively identifiable as a lift (supported by wayfinding and supergraphics as necessary). Convenient placement, lift entrance visibility and being identifiable as a lift may encourage passenger use.

2.4.5 Challenges of fitting to VC in constrained existing stations

This document sets out the objective of making accessible routes equally prominent. However, in many existing stations there can be spatial limitations on what can be achieved. In these instances the role of Wayfinding as set out in section 2.2 is a key design tool.

Image 2.9 shows a typical access arrangement to a platform, whereas image 2.10 shows how this might be improved if there is sufficient space. Where existing conditions might preclude a similar approach, alternative provisions are to be risk assessed by the project team

2.4.6 Visual Impact

The spatial requirements of Vertical Circulation (particularly lift overruns) can add height and have a visual impact in low rise areas. The impact of lift overruns should be considered on their setting, including the impact on conservation areas or listed neighbouring buildings. The height that lift overruns add can provide an effective visual identifier for the station, so where appropriate they should be considered as a feature, with careful selection of materials and design detailing. The double arrow symbol can be added to signal the station.

Standards Reference

Rail Industry Standard: Interface between Station Platforms, Track, Trains and Buffer Stops (2022)
RIS-7016-INS Issue 2

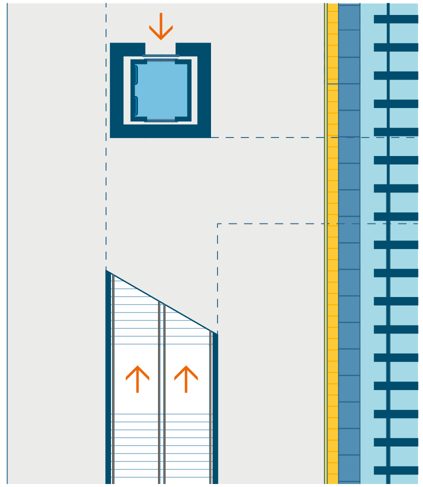


Image 2.9
Typical access arrangement from platform to overbridge/interchange level

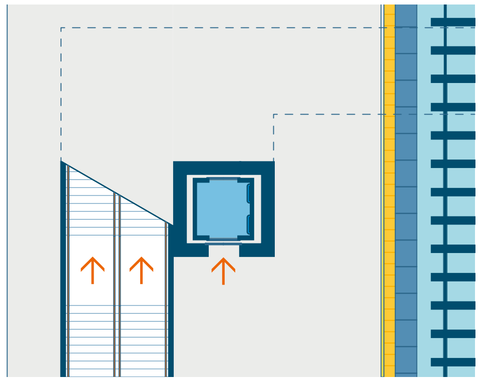


Image 2.10
Improved access arrangement that improves visibility of the lift - however this cannot be achieved at most existing stations where platforms do not have sufficient width.

2.5.1 Space Proofing

Key Considerations for **Lifts:**

→ Lift pit type spatial requirements

→ Overrun type spatial requirements

→ Can a through lift be achieved?

→ What are the capacity requirements?

→ Is there space for lift electrical equipment rooms (LEERs)?

→ Is the power supply sufficient?

Section 3.5 sets out different types of lift, and their different spatial requirements

Key Considerations for **Escalators:**

→ Escalator pit and motor spatial requirements

→ Escalator run off spatial requirements

→ Can a lift be sited with equal visual prominence?

→ What are the capacity requirements? Is one escalator sufficient or is an additional escalator required?

→ Is the power supply sufficient?

Section 3.6 sets out different types of escalators, and their different spatial requirements

2.5.2 Run Off Requirements

Run off zones should be provided at the top and bottom of all stairs, escalators, and ramps. Run off zones provide:

→ Clarity of orientation, helping passengers to identify their route and move around the station in a safe way.

→ Space for decision and actions, for example to get tickets ready after leaving an escalator or stair

→ Space for passengers to accumulate and queue during busy periods

Run off areas should be kept free of cross flows and disruptions such as retail.

Table and illustration 2.12 set out the run off zones between escalators, stairs, and different station areas.

Run off zones vary between different VC elements to take into consideration the different speeds and capacities of (for example) an escalator vs a stair, and the different amount of time and space needed to orientate around each element.

Further detail can be found on run-offs and waiting area requirements in the Station Capacity Planning Design Manual.

NR Guidance Suite Reference

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

	Run Off Distances Between elements		Minimum lengths
A	Stairway	Passageway / Street	4 - 6m
B	Stairway	Gateline	6 - 10m
C	Stairway	Concourse / Platform	4 - 6m
D	Gateline	Passageway / Street / Concourse / Platform	6m
E	Escalator	Gateline	8 - 12m
F	Escalator	Stairway	6 - 10m
G	Escalator	Escalator	8 - 12m
H	Escalator	Passageway / Street / Concourse / Platform	6m

Table 2.11
Table of minimum run off distances

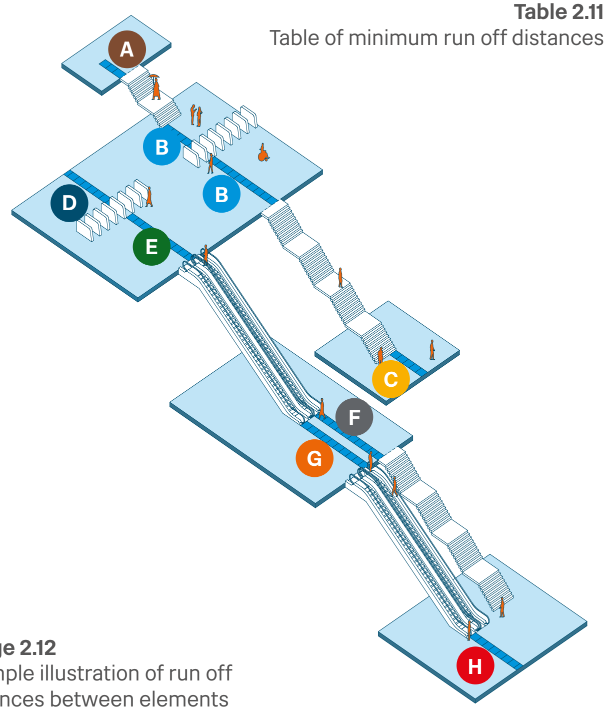


Image 2.12
Example illustration of run off distances between elements

2.6 Spatial Adjacencies

2.6.1 Considerations for stairs adjacent to escalators

→ Stairs and escalators require different angles and setting out, meaning they may not require the same horizontal travel differences

→ Staircases above a certain height require landings, which when placed between escalators can often create a 'canyon' type scenario where the escalator is much higher than a staircase where a landing occurs, and the staircase can feel enclosed

2.6.2 Consolidating Space

→ Placing lift motor rooms under staircases can avoid additional structures being constructed for the motors, providing efficiency and reducing space take at platform level

2.6.3 Security

The DfT has published Security in the Design of Stations (SIDOS) guide for sponsors and designers and aims to inform how the protection of station users can be enhanced.

Each station will have different security concerns and the security measures implemented should be proportional to the threat.

Security solutions should be designed as an integral, positive, flexible and creative part of the station design. The Network Rail Security Assurance Framework (SAF) sets the security requirements for all projects and includes the safety triage as the starting point for managing security threats.

The National Railways Security Programme (NRSP) sets out the government approach to protect the national railway network from terrorism.

Consult with NR Group Security (groupsecurity@networkrail.co.uk) to identify the designated regional security contact so arrangements are in place to meet the requirements of the NRSP.

Image 2.13
Provision of two lifts on a high footfall route, providing additional capacity but also resilience should one lift be out of service. It is recommended that the control panels are both to the same side of each lift, so both to the left or both to the right, for consistency for accessible users.

Standards Reference

Rail Industry Standard for Station Infrastructure (2018)
RIS-7700-INS

Standards Reference

Department for Transport
Security in the Design of Stations (SIDOS) 2018

2.7.1 Considerations to determine energy use

- Embodied energy in production and installation on site
- Energy use over whole lifecycle
- Energy use and embodied energy in maintenance and replacement of parts
- Life span and strategy for disposal and replacement
- Making comparisons with other suitable modes (eg. stair instead of an escalator, or ramp instead of a lift)

2.7.2 Design considerations to reduce energy use

- Use of low energy LED lighting as standard
- Regenerative drive systems where they can save energy

2.7.3 Design considerations to reduce material use

- Consider materials across their full lifecycle and make the most sustainable and resilient choice
- Where possible, reuse material from other sources
- If material cannot be reused, material should be sourced with a high recycled content

2.7.4 Environmental and Social Appraisal (ESA)

The ESA is an NR tool that generates project checklists and requirements for a range of environmental and social considerations. This is tailored to each project, based on project scope and activities. This tool should be used from the very beginning of project planning, and then iteratively throughout the design process.

2.7.5 Third-party Environment Assessments

BREEAM (Building Research Establishment Environmental Assessment Methodology) is an internationally recognised independent environmental assessment methodology for rating and certifying the sustainability of buildings. NR Standard NR/L2/ENV/015 stipulates the use of BREEAM Refurbishment and Fit or New Construction for buildings.

Any new or refurbishment work should attain a minimum 'very good' BREEAM rating, and should ideally aspire to achieve an 'Excellent' rating. Clear guidance for how to achieve certification is available from BREEAM.

Climate Change (kgCO2e) and ReCiPe (Points) can also be used as a method of analysing life cycle impact assessment. This measurement methodology uses midpoint indicators and endpoint indicators. Midpoint indicators cover single environmental issues global warming, water use, particulate matter, ozone depletion etc. Whilst endpoint indicators focus on areas of protection /damage Ie. human health, ecosystems and resource availability.

2.7.6 Energy Saving Operations

Lifts and Escalators often include low energy modes. For example escalators can have a reduced speed mode when not in active use. This is effective in reducing energy usage, particularly on escalators in the exit direction, where escalators can be unused for long periods between train arrivals and departures. However, the speed increase when the escalator is then in use can increase the likelihood of accidents on the escalator.

All operations that reduce energy consumption should be explored and encouraged, but they should be considered holistically, and they should not be achieved at the cost of reduced safety or by a failure to meet standards.

For the purposes of energy monitoring and energy reduction VC equipment should be provided with a means of energy monitoring. For smaller stations without Building Management Systems (BMS) this can be provided via energy meters fitted to the lifts electrical sub mains supplies. For larger stations with BMS the VC equipment can be linked to the stations wider building management / energy monitoring system.

2.7.7 Economic Case for Sustainable Vertical Circulation

The Leonard Cheshire disability charity commissioned economic research to capture the financial commitment required to fully implement the UK Government's target to achieve inclusive transport by 2030 in Britain, with a focus on making train stations step-free. The 'Get on Board' report (2020) presents an economic case for the railway network to be made more accessible by reducing barriers experienced by disabled people. In particular the inaccessibility of the network prevents a significant proportion of disabled people joining the workforce and contributing to the economy.

NR Guidance Suite Reference

Climate Action Design Manual for Buildings and Architecture
NR/GN/CIV/100/04

Environment and Social Minimum Requirements for Projects – Design and Construction Issue 9
NR/L2/ENV/015

3

Vertical Circulation

Vertical Circulation Elements

Image 3.1
Escalators at Reading station

Vertical Circulation Elements

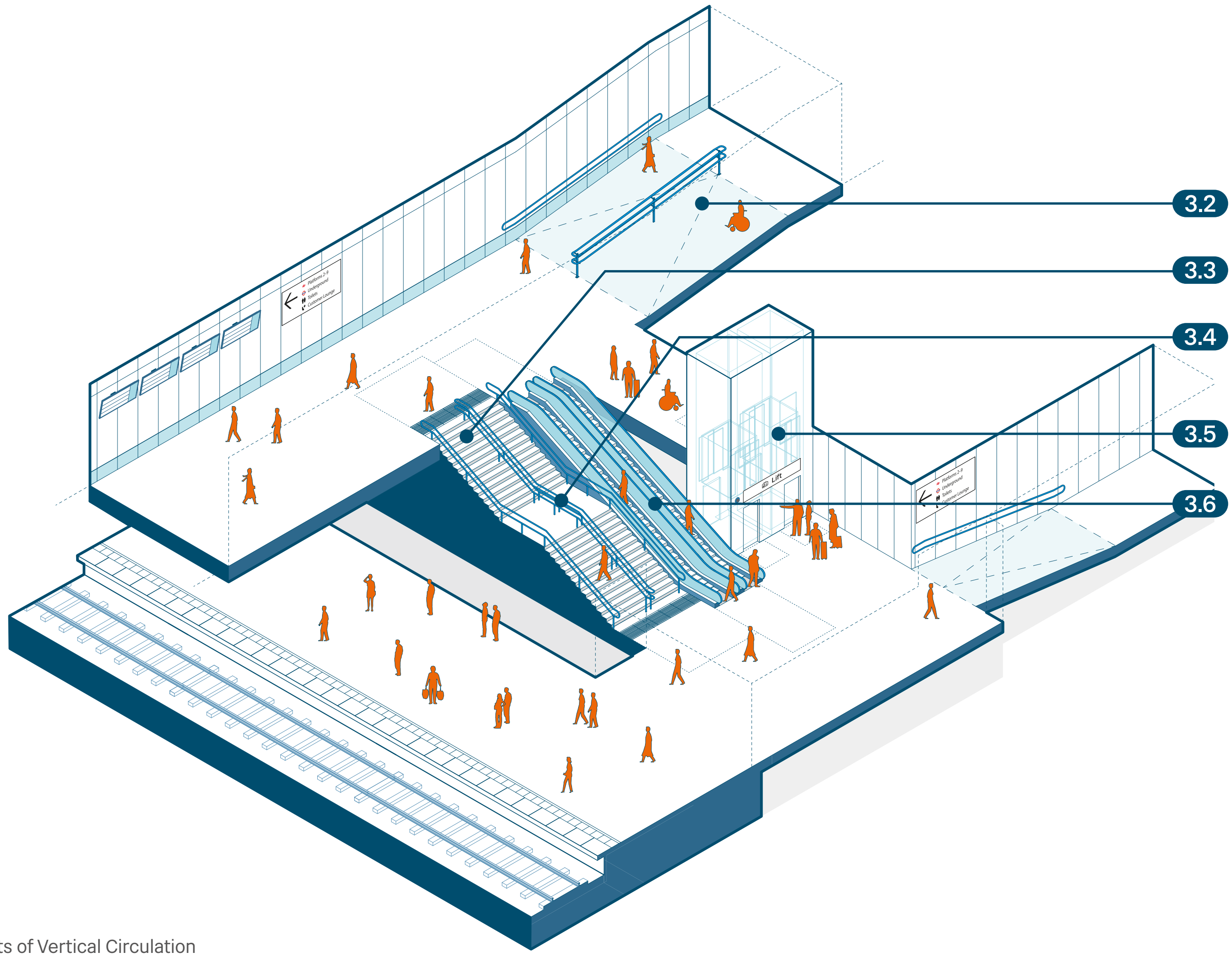


Image 3.2
Key Diagram - Elements of Vertical Circulation

3.1 Design Considerations

This section of the Design Manual sets out specific guidance by Vertical Circulation Element as well as handrails and guarding, discussing the common design parameters to be considered for each. This is expanded upon throughout the section where extra requirements apply.

3.1.1 Lighting

→ Vertical Circulation requires higher levels of local lighting than other areas of the station. Detail on Lux levels can be found in BS EN 12464 1:2021 and BS EN 12464 2:2014

→ Where lighting is provided above stairs and escalators, consideration should be given to how these can be accessed and maintained, and whether low level lighting (eg. on walls, or within escalators or handrails) could be considered instead.

→ Where lighting is provided inside lift cars or escalator decking, consideration should be given to how easily this can be accessed and maintained, and whether it requires specialist personnel to do so.

3.1.2 Tonal Contrast

Vertical Circulation is one of the areas where passengers are most susceptible to accidents, including slips and falls. Providing visual contrast between key elements, such as a handrail and a wall, or a lift architrave and a door, improve visual perception of these items.

Where contrast is required, it typically requires a Light Reflectance Value (LRV) of 30 points. This means a contrast in tone rather than necessarily a contrast in colour. The measuring of LRVs is also determined by the surrounding light conditions and reflectivity. Some colours have defined LRV values, and these can be found in BS 4800. BS 8493 sets out the method of testing to determine the LRV of different surface materials.

Further detail is provided on areas that require a visual contrast under each Vertical Circulation Element (3.2 — 3.6) in this section.

3.1.3 Security Considerations

Vertical circulation elements and any interfaces with them should be designed as smooth and clean, without flat tops (particularly at height), deep reveals or shadow gaps that might provide space for items to be thrown or concealed.

Panels should all be fixed securely, with anti-tamper fixings, to avoid these providing opportunities for concealment.

Voids underneath vertical circulation should either be kept open for easy inspection or, where they may present opportunities to hide, have insufficient head-height, or be difficult to clean, they should be sealed so that the public do not have access.

The roof of a lift car should be equipped with anti surface detection system and connected to the safety circuit of the lift. The detection system will also activate the lift alarm which will be registered by lift monitoring system and station operator. Once activated the lift will become inoperative.

Standards Reference

British Standards Institute
BS EN 12464 1:2021 Light and lighting — Lighting of work places Part 1: Indoor work places
BS EN 12464 2:2014 Light and lighting — Lighting of work places Part 2: Outdoor work places

Rail Industry Standard for Lighting at Stations (2013)
RIS-7702-INS
Department for Transport
Security in the Design of Stations (SIDOS) 2018

3.2 Ramps

3.2.1 Ramps Introduction

A ramp is classed as any rise with a gradient of 1:20 or greater. Ramps are effective at providing small changes in level, avoiding the requirement for a single step.

3.2.2 How to avoid Ramps

Ramps can be eliminated by providing a gradient that is less than 1:20. Gradients of less than 1:40 are preferred, as they are less noticeable and are a more comfortable angle on the foot.

Grading floors to avoid ramps is the best option, it provides a more accessible route, reduces the risk of slips and falls that are more likely on ramps, and it also removes the requirement for handrails and a change in floor treatment.

3.2.3 Standards for Ramps

The following standards apply for ramps, however the DfT Code of practice 2015 - Accessible Stations should take priority over Building Regulations within station environments, and should take priority where any conflicts occur.

Standards Reference

DfT Code of practice 2015 - Accessible Stations
BS 8300 - Internal and External Ramps
Approved Document Part M
Approved Document Part K - Section 2

3.2.4 Gradients and Rise

Steeper gradients can be more space efficient, however a lower gradient is preferable and more comfortable to use. Key Design Points:

→ Ramp flights should have a consistent gradient

→ Be aware of the different limits on rises and goings, dependent on the choice of gradient - refer to image 3.3.

3.2.5 Landings

Landings should be provided at the top and bottom of ramps a minimum of 1500mm deep, level, and clear of obstructions.

Ramps over a certain length require intermediate landings. Steeper gradients of ramp require more frequent landings External landings should have a crossfall to allow for surface water drainage.

3.2.6 Finishes and Slip Resistance

Ramped surfaces require a higher degree of slip resistance, the values given in LU Standard 1-133 (Section 3.5) should be adopted.

Ramps should have a slip resistant finish, that performs when wet and dry. When choosing a floor surface, consider whether the space includes ramps, so that the same floor surface can be throughout.

Finishes should be matt to avoid reflections and to avoid causing glare.

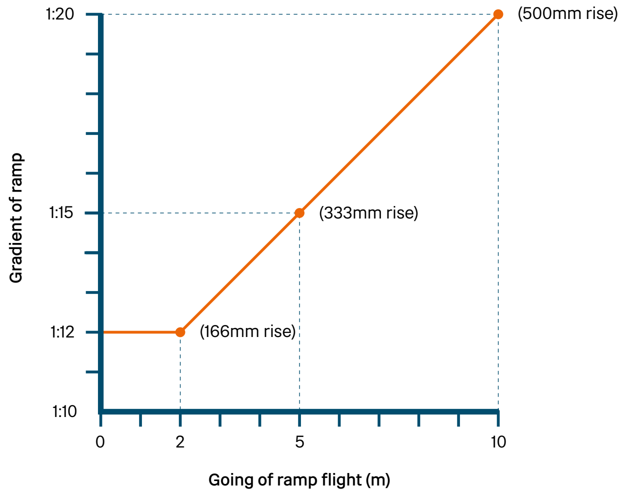


Image 3.3
Relationship between Ramp Gradient and Going

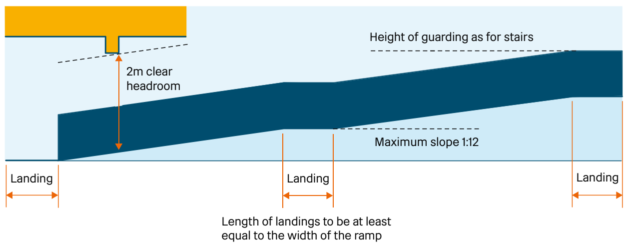


Image 3.4
Design of Ramps and Landings - Key Dimensions

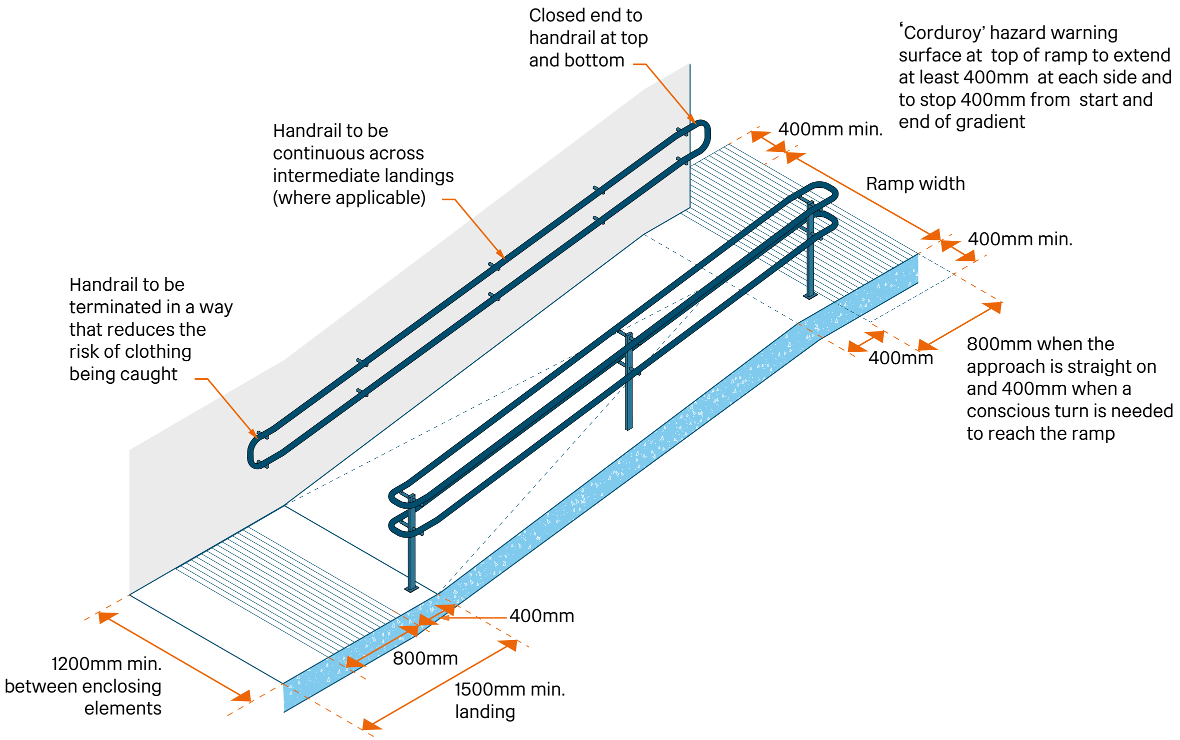


Image 3.5
Safety Handrail and Ramp Tactile Finish Setting Out

3.2.7 Visual Contrast

A visual contrast between the surface of the ramp and adjacent floor and landings helps to identify the ramp.

3.2.8 Existing Non-Compliant Ramps

Many stations have long, steep gradient ramps without landings as the sole means of access to platforms. These are not considered accessible, and without regrading they cannot be made complaint with current legislation.

However steps can be taken to improve them and make them more accessible to use, these include:

→ Providing handrails, designed to current standards, with visual contrast and warm to the touch

→ Providing a slip resistant floor surface

→ Visual contrast to demarcate the start and finish of the ramp

→ Use of corduroy tactile surfaces at the start and end of the ramp

→ Provide a run off zone at the top and base of the ramp to reduce cross flows

→ Reduction of visual distraction such as advertising along the ramp

→ Upgrading lighting to provide consistent light levels, and to meet current lux requirements

3.3 Stairs

3.3.1 Stairs Introduction

Stairs are the primary means of vertical circulation across the UK railway network. They can provide for a wide range of passenger numbers, and can be both internal and external.

In stations that are primarily served by lifts and escalators, stairs will typically be required as part of the emergency escape strategy, and also to provide resilience for when escalators are out of use.

3.3.2 Standards for Stairs

The following standards apply for stairs, however the DfT Code of practice 2015 - Accessible Stations should take priority over Building Regulations within station environments, and should take priority where any conflicts occur.

Standards Reference

DfT Code of practice 2015 - Accessible Stations
GEGN 8615 - PRM NTSN
BS 5395
BS 8300
Approved Document Part M
Approved Document Part K - Section 1

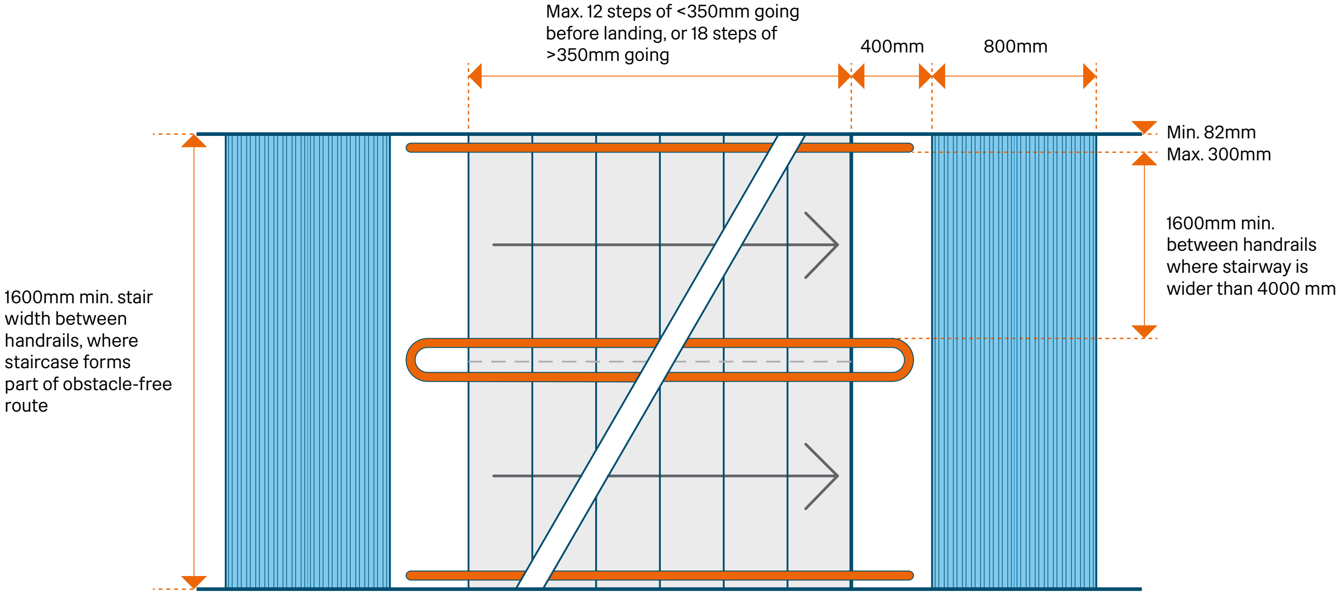


Image 3.6
Key stair setting out dimensions

3.3.3 External Stairs

Uncovered external stairs are at risk of becoming wet and slippery. Light conditions will vary from day to night, and they may be susceptible to glare from direct sunlight, and poor lighting at night-time. Changes in temperature can make handrails cold or overheated.

Ideally, stairs should be covered. Where they are fully open, they should be well drained, with cross flows at landings. Slip resistance is crucial for external stairs.

Stairs that are at the entry of a building or just have local cover are also at risk of becoming slippery, and may become wet from footfall.

Providing cover but not fully enclosing stairs requires less structure and saves energy where the space is unheated. It can also provide passive security benefits by feeling more open. This eliminates direct rainfall to the stairs, but can leave them subject to temperature fluctuations and wind-driven rain.

3.3.4 Stair Configuration and positioning

Straight stairs provide the best visibility and intuitive wayfinding. Where these are not possible, a 90 degree half-landing change in direction is best. 180 degree half-turn (dog-legged) stairs are a suitable solution when travelling up several levels.

Helical or spiral staircases should be avoided. When a stair contains more than 36 risers, a change in direction of 30 degrees or more should be provided, in line with Approved Document Part K.

Where space allows, stairs are best located at a 90 degree change in direction from a concourse/corridor, so that they represent a clear change in direction.

Stairs should have landing spaces free of obstructions and cross flows that meet the run off dimensions set out in Section 2.5.

3.3.5 Key factors in accidents on stairs

Most accidents on stairs occur in the downwards direction. Travelling down stairs represents a greater risk as there is more risk of falling further. Key risks on stairs include:

- Inconsistent rises and goings on stair treads
- Individual step profile of the stairs - see images 3.7 and 3.8
- Poor visibility (poor lighting, high reflectivity, visual distraction)
- Weather - rain, snow/ice, condensation
- Change in slip resistance of surface
- Overcrowding or conflicting flows of movement
- Mobility or visual impairment
- Distractions, encumbrance, and impact of alcohol

3.3.6 Advertising along stairs

A stair can be an attractive location for advertising, however this adds to visual distraction, and therefore can increase the likelihood of accidents. Advertising along stairs should be weighed up against how busy the stair is, and whether there are other visual distractions and challenges, such as crossflows, that may also increase the chance of accidents.

Step band advertising is where advertising text or pictures is included on stair risers. This can make the stairs confusing and less legible to use, and should be avoided.

3.3.7 Stair Setting Out

Stair Width:
Where stairs form part of an accessible, obstacle free route they should have a minimum stair width of 1600mm, measured between handrails, in line with the DfT ACOP - Design Standards for Accessible Railway Stations and NTSN PRM 2021.

Goings and Rises:
The going of each step should be between 280mm and 425mm in order to satisfy Approved Document Part M. BS 8300 requires a minimum going of 300mm, and this should be provided wherever possible.

The rise of each step should be between 150mm and 170mm. The goings and risers of steps along a stair should be consistent, and where practicable, the numbers of risers in successive flights should be uniform

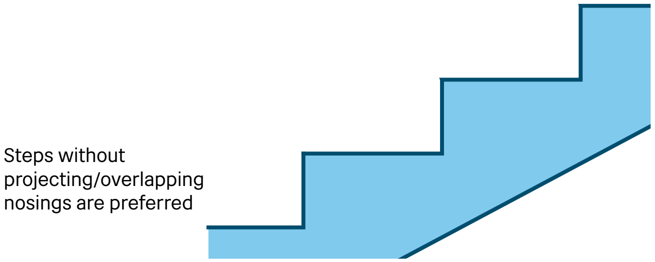
The maximum number of steps in a flight before requiring a landing are: 12 if the going of each step is less than 350mm, and 18 if each going is greater than 350mm.

3.3.8 Open Risers

Open Risers should be avoided. They are not permitted under Approved Document Part M. They are also not permitted on electrified lines.

3.3.9 Step Profile

Where practicable a step should not overlap the one below. Where this cannot be achieved steps should have simple square profiles, or simple profiles with a maximum overlap of up to 25mm. They should not be sharp edged, or excessively rounded, as this can make it more difficult to judge the edge of the step.



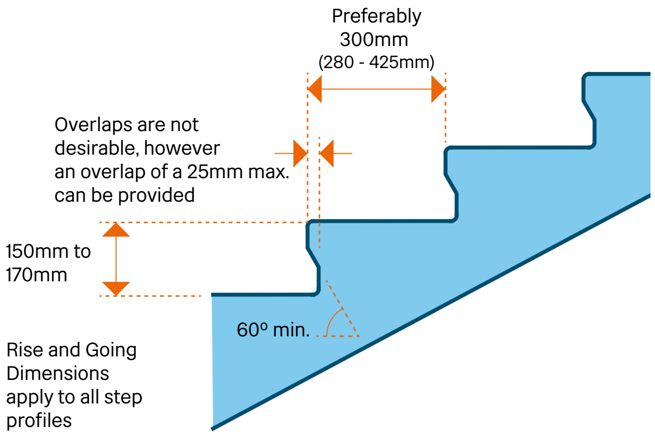


Image 3.7 (top)
Step Profile without Overlap

Image 3.8 (above)
Example Step Profile with Overlap

3.3.10 Step Nosings

All steps should have visually contrasting continuous bands across the full width of each step, on both the tread and the riser. This helps to visually identify the step. This should be 55mm on both the tread and the riser, in order to meet Approved Document Part M.

These bands of visual contrast can quickly wear away where heavily trafficked. The most durable solutions are those that are integrated into the stair nosings. Continuous, preformed stair nosings and treads are recommended as they avoid a change in material between the nosing and the rest of the going. This is beneficial as it provides a consistent, simple step finish for passengers, and it eliminates an installation junction of two materials coming together. Network Rail prefers cast aluminium step and nosing profiles with a full depth of the stair going, as shown in 3.10. Refer to TUM4000.

Applied nosings should be fixed securely and flush with the rest of the step.

A different colour is often used to differentiate nosings on the top and bottom steps of each flight, however there is no requirement to do so.

A nosing should have a wet Slip Resistance Value (SRV) of greater than 36. Ideally, applied nosings should contain carborundum as an additive in their composition. The use of carborundum should prolong the durability of a nosing.

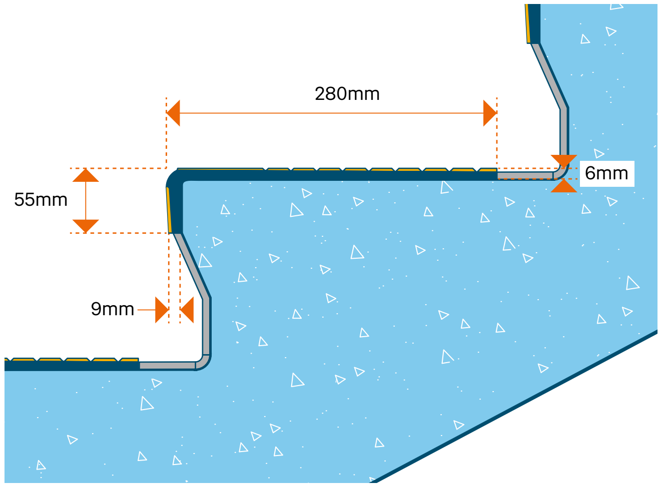


Image 3.9
Anti-Slip Nosings and Treads - Key Dimensions

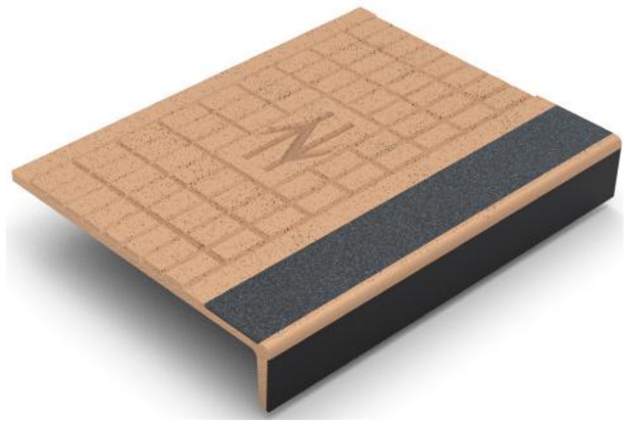


Image 3.10
Anti slip pre-formed floor tread with the double arrow logo

3.3.11 Landings

A level landing should be provided at the top and bottom of flights of stairs, and between flights.

Landings should be at least 1200mm long (1800mm where possible) or the clear width of the stairs if this is greater.

Landing width should match the width of the stair, with handrails continuing unless the landing is long enough to be a break in the stair and not considered to be a continuous stair. Landings should be clear of obstructions.

3.3.12 Tactile Finishes to Landings

Corduroy tactile tiles at the top and base of stairs act as an indication that there is a change in floor level.

These should be applied in an 800mm band that starts 400mm away from the nosings. The tactiles should extend by 400mm in each direction beyond the width of the stair.

Tactiles should not be applied to intermediate landings, except where this is a long landing and handrails are not continuous. In these instances, a single 400mm wide band should be applied at the start and finish of the landing.

Standards Reference

Department for Transport
Guidance on the Use of Tactile Paving Surfaces 2021

3.3.13 Finishes and Slip Resistance

The surface materials should be slip-resistant, durable and easy to maintain. A wet Slip Resistance Value (SRV) of 36 should be achieved.

A going of 300mm or greater reduces the risk of overstepping and the risk of slipping.

Finishes should not be too reflective. Where metal staircases are used, care should be taken when positioning lighting to avoid reflections and glare.

Avoid highly patterned surface finishes, as these can be misleading and cause confusion, particularly for people who are partially sighted and people with sensory/neurological processing difficulties.

3.3.14 Acoustics

Hard, durable finishes mean that staircases are acoustically reflective. Where acoustic requirements apply, acoustic absorption is best achieved through acoustic panels on walls or in the soffit.

3.3.15 Cleaning and Maintenance

The stair design should minimise spaces where rubbish can accumulate, this means avoiding gaps at the edges of stairs, and around handrail fixings and supports. Internal corners of stairs are easier to clean if they are rounded or chamfered.

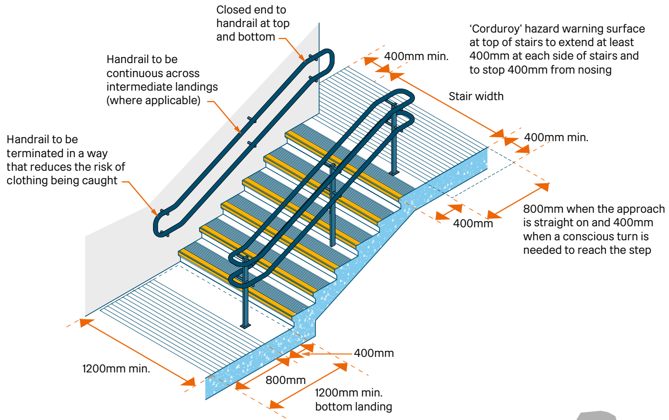


Image 3.11
Tactile Finish Setting Out

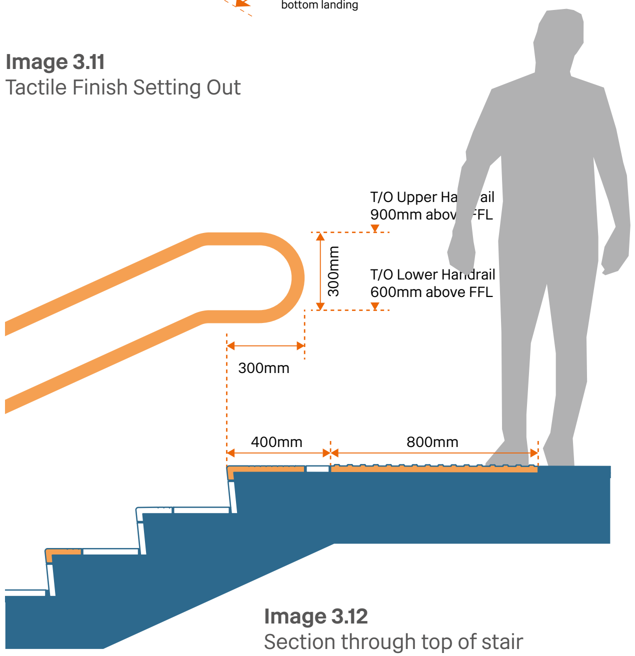


Image 3.12
Section through top of stair

Image 3.13
Hackney Wick station

Handrails play an important role in the safe use of stairs and ramps and avoiding slips and falls. This section sets out criteria to design handrails that are effective and comfortable to use. Some people may feel more able to use a handrail on a certain side, and so handrails should be provided to both sides of a stair.

3.4.1 Lower Handrail

A lower handrail for use by children and persons of restricted stature is typically set at 600mm above floor finishes, at a consistent distance from the upper handrail.

The lower handrail is not required to be the same diameter as the upper, but typically is as this may create awkward junctions where handrails loop to join each other. If a smaller diameter is adopted for the lower handrail, the detailing should be carefully considered to mitigate awkward junctions.

Lower handrails can act as a climbing aid, so should be avoided where the handrails are used as part of guarding (or the guarding should be sufficiently high to mitigate against this).

3.4.2 Handrail Termination

Handrails should extend by a minimum of 300mm at the top and bottom of the stair or ramp. They can extend beyond this, and it often makes sense to continue them where a column or other local obstruction is at the end of the stair or ramp. Looping and joining upper and lower handrails prevents the end of the handrail snagging on clothing. Looping double central handrails horizontally neatly closes off the space between double handrails - refer to image 3.15.

3.4.3 Handrail Finishes

Handrail finishes should be durable, as most stations have high levels of traffic.

Insulated finishes should be provided to avoid handrails that are cold to the touch. Most station areas are unheated, so this applies internally as well as externally. Insulated finishes include:

→ Timber (typically hardwood for durability)

→ Nylon Coated Steel

Where handrails are in an internal environment, brushed stainless steel can be used, and provides very good durability.

3.4.4 Visual Contrast

Handrails should have a visual contrast of 30 points from surrounding surfaces. This is important as they are often relied upon for orientation, and act as a visual cue to determine the top and bottom of stairs, even by those that do not use the handrail to hold onto.

Contrast is often achieved by brightly coloured handrails, but handrails can also be darkly coloured if contrasting against a light surface. Note that dark coloured handrails may overheat if in direct sunlight. Contrast can also be achieved tonally, or by a contrasting band on the surface behind the handrail.

Handrails should not be reflective, if stainless steel is used a brushed finish is preferred. Lighting design and placement can further mitigate any impacts of reflectivity.

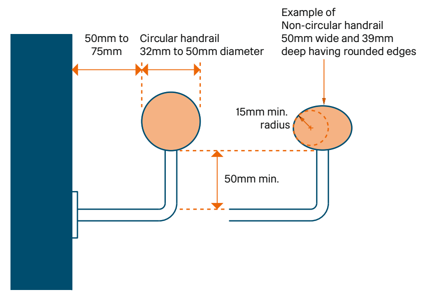


Image 3.14
Single handrail design - Key dimensions

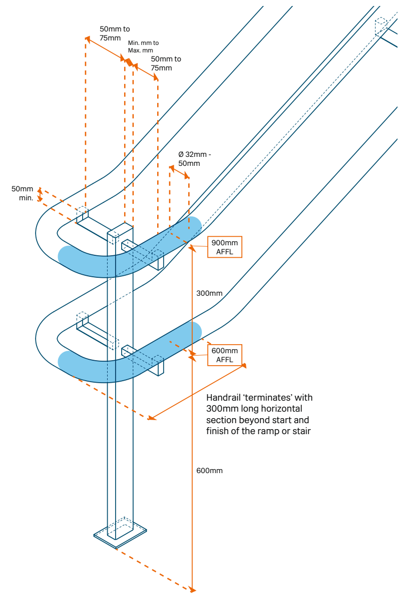


Image 3.15
Double handrail design - Key dimensions

3.4.5 Handrail Supports and Fixings

Handrail supports should be on the underside, with the connection spigot continuing a minimum of 50mm below the handrail before connecting to the wall or post. Any fixings or baseplates on the underside of the handrail should be flush The handrail should be fixed so that it is completely secure.

Handrails should be continuously graspable along their entire length without obstruction, gaps should be avoided except where required for thermal expansion or movement.

3.4.6 Handrail Profiles

A circular cross section profile is most common, and widely available. Oval and lozenge profiles can be used provided they meet the criteria set out in Approved Document Part M.

3.4.7 Loading Requirements

Crowd loading requirements for handrails may vary between lightly used stations and higher traffic stations. Refer to **BS6180:2011** to determine loading requirements and how they are applied. These should typically be 1.5kN/m or 3kN/m.

3.4.8 Handrail Lighting

Lighting units can be integrated into the underside of handrails. This can help to provide a uniform, consistent illumination across the stairs, and is useful in areas that are uncovered, or where a high soffit above stairs makes it difficult to access and maintain luminaires. Lighting units within handrails can also be complex to maintain and the following points should be considered:

- → Can power supplies be easily provided to the location where they are required?
- → How frequently may luminaires have to be maintained or replaced?
- → Are replacements/parts readily available? (Consider products that have been used widely)
- → Are specialist tools or expertise required to maintain luminaires?
- → Are luminaires completely flush with handrail?
- → Do luminaires provide a uniform and consistent level of light cover whilst avoiding glare?
- → Is lighting needed to cover people and faces for CCTV, and does this require additional lighting?

3.4.9 Guarding

Guarding is required where there is a change of level greater than 380mm. The height of the guarding is dependent on the fall that it protects against. 1100mm, 1800mm and 2400mm are typical heights.

Handrails are only required where the guarding is alongside a ramp or stair. However, where glazing is used as guarding, adding a rail can help to achieve crowd loading requirements and to provide colour contrast manifestation. It can therefore make sense to include a handrail, even if it may not be required from an accessibility perspective.

When guarding is over tracks and especially where there is Over Head Line Electrification (OHLE) the guarding should be solid, and to a minimum of 1800mm.

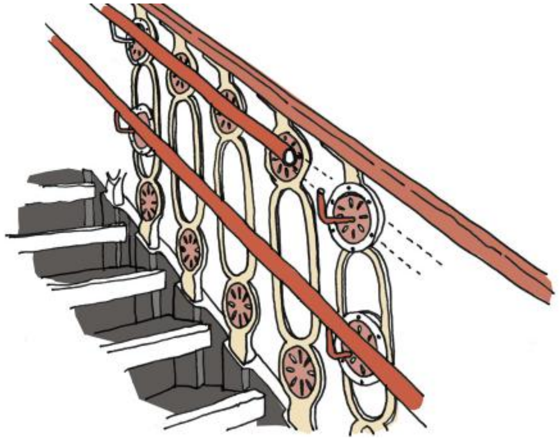


Image 3.16
Upgrading Handrails - example from Llanfairpwll station footbridge

Image 3.17
Example of lighting integrated into the underside of a handrail

3.5.1 Lift Types & Critical Dimensions

Network Rail has an ambition to be a Net Zero Carbon organisation by 2050 (2045 in Scotland) and intends to move away hydraulic drive systems for new lift installations. Hydraulic drives are being phased out for a number of reasons one of them being their intensive use of hydrocarbons which contribute to climate change. Where feasible, and in order to reduce the risk of a single point of failure in a passenger journey, a dual drive arrangement should be selected for a lift shaft so there is a backup in the event of a car failure. Dual drive arrangements should generally be utilised to provide asset resilience. However, this does not remove the need for multiple lifts where the vertical circulation strategy determines the number of cars required.

Typical Minimum Shaft Measurement Requirements				
Drive System	Internal Shaft Width	Internal Shaft Depth	Internal Pit Depth	Overrun Head Clearance (FFL to Lifting Beam)
Electric Traction UMR	2500mm	2400mm	1500mm	4300mm
Electric Traction LMR	2800mm	2400mm	1500mm	4300mm
Electric Traction MRL - Hybrid	2800mm	2400mm	1600mm	4300mm
Rigid Chain Drive - VLB	2400mm	2400mm	Model 1 = 1500mm Model 2 ** = 500mm	4300mm
AVA Lift System	2860mm *	3140mm *	582mm	3681mm

* External Shaft dimensions only
**Where maintenance can be conducted outside of the pit then can be reduced to

3.5.2 Selecting Lift Type and Number of Lifts

For category D-F stations provided with up to two platforms, a minimum of one passenger lift installation should be provided for use by Persons with Restricted Mobility (PRM). To address redundancy, a minimum of two lifts should be considered to address a situation when a lift is out of service due to repair, refurbishment or maintenance. These stations should be subject to a vertical transportation strategy to inform the required VC design.

For category A-C stations provided with more than two platforms, the lift type, size, number and location of lifts should be determined from a detailed lift traffic analysis based upon the agreed station VC operating strategy and station capacity (including PedFlow data and calculations). The VC strategy, design and station capacity should consider the passenger demand when a station is in close proximity to hospitals, airports, bus or tram stations, sports arenas and stadia in the surrounding area.

The lifts may be required to serve other purposes, such as:

→ Goods / service

→ Plant replacement & removal

→ Firefighting

→ Evacuation

The lift type may also requirement to consider the results of the VC BREEAM Assessment in respect of the requirements of ENE 06 Energy efficient transportation systems.

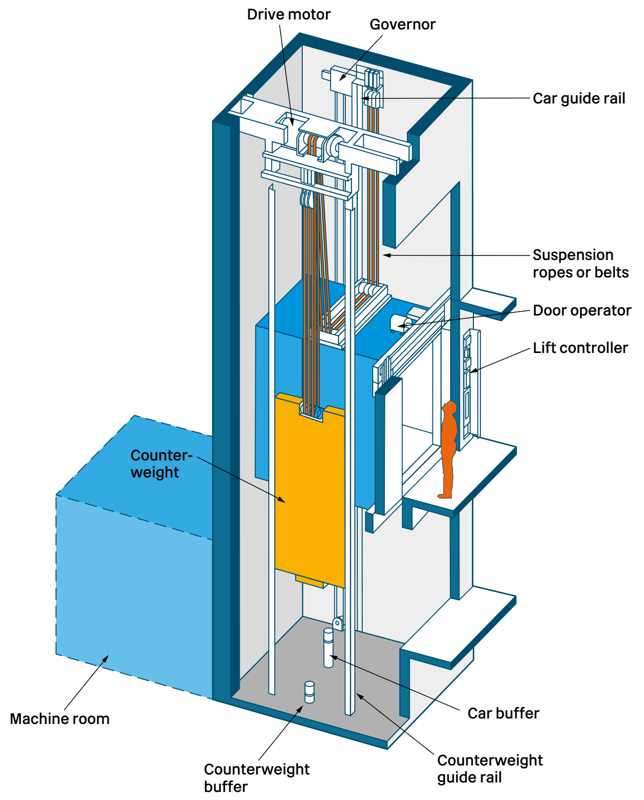


Table 3.17 (Left)
Double handrail design - Key dimensions

Image 3.18 (Above)
Typical equipment arrangement for an Electric Traction / Machine Roomless Lift Hybrid - note that NR require a separate machine room.

3.5.3 Codes & Standards

The lift installations should be designed, manufactured, installed and commissioned in accordance with the following two NR lift design standards, and the codes standards and regulations listed therein:

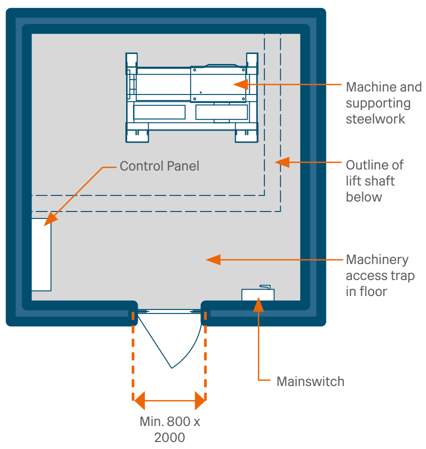
Standards Reference
Standard Specification for New and Upgraded Lifts
NR/L2/CIV/193
Selection and Design of New and Upgraded Lifts
NR/L3/CIV/194
Lift Construct, Commission and Decommission
NR/L3/CIV/198

3.5.4 Electric Traction & Machine Room Lifts

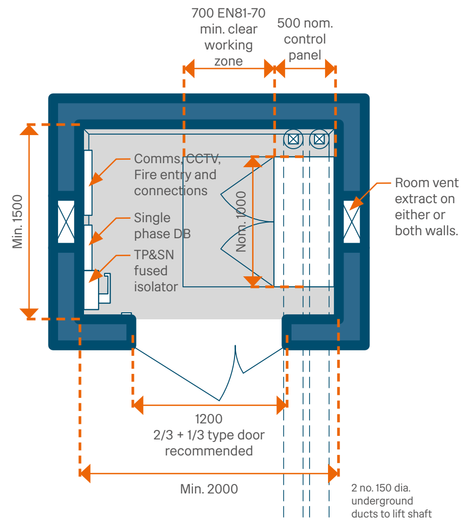
Conventional top drive electric traction lifts are used to address vertical movement of both goods and passengers for a wide range of building types with long lift travels requiring fast operating speeds.

This type of drive system requires an independent Lift Equipment Room (LER) to house the lift controller and lift machine unit which should preferably be located directly above the above the lift shaft. Refer to 3.19 showing a typical installation assembly. Whilst other machine room locations are possible by utilising top or bottom side drive design configuration, this may be prohibitive due to spatial constraints. Operation cycles are typically between 180 and 240 starts per hour. This type of drive system may require heating, cooling and mechanical extraction systems to control the machine room within the required temperature range.

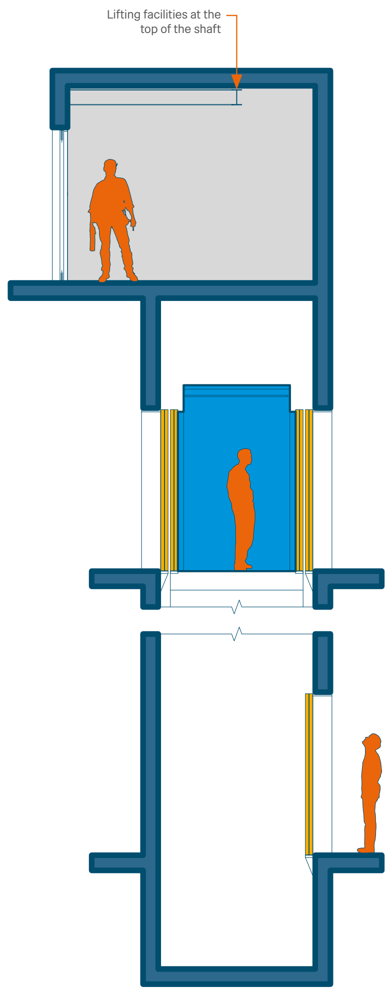
Refer to image 3.19 showing typical plan and elevation details.

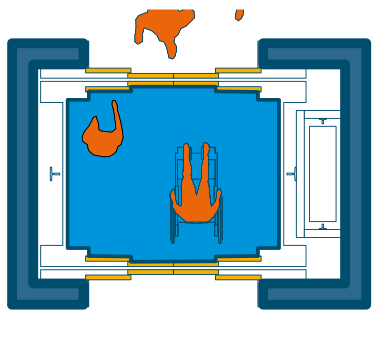


Plan of Machine Room



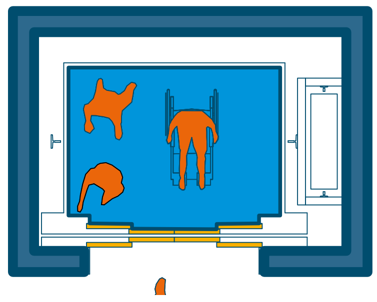
Plan of typical NR MRL Hybrid Lift Equipment Room





Note: Drawn for 4 PCO type entrances, smaller lifts may have 2 PCO type entrances.

Plan of Shaft: Open Through Car



Note: Drawn for 4 PCO type entrances, smaller lifts may have 2 PCO type entrances.

Plan of Shaft: Open Front Car

Section through Shaft

Image 3.19
Electric Traction & Machine Room Lift - Plans and Section

3.5.5 Electric Traction Machine Room Less Lifts

This type of drive system can typically provide a maximum rated capacity and operating speed of 2500kg and 2.5 m/s respectively, which is adequate to achieve certain design criteria and performance on NR stations. Whist rated lift capacities in excess of 2500kg can be provided by some manufacturers, there would be restrictions on the maximum operating speed which could be as low as 1.0 m/s.

With this type of drive system, all functioning lift equipment is located within the shaft footprint. However the lift controller, TP&N fused isolator, single phase distribution board, and Comms, CCTV, and Fire Alarm Interface connections are housed within the Lift Equipment Room (LER). The purpose of this arrangement is to facilitate easier access to this equipment for maintenance and replacement.

Operation cycles are typically between 180 and 240 starts per hour. This type of drive system may require heating, cooling and mechanical extraction systems to control the machine space area within the required temperature range.

The location of the lift controller and maintenance access panel is usually positioned adjacent to the lift landing entrance on the uppermost floor served. This should be considered during the design process as access for maintenance, repair and refurbishment activities will require a clear maintenance zone possibly within public areas, this may prove unsuitable or impractical, depending upon specific station design requirements.

Refer to image 3.20 showing typical plan and elevation details.

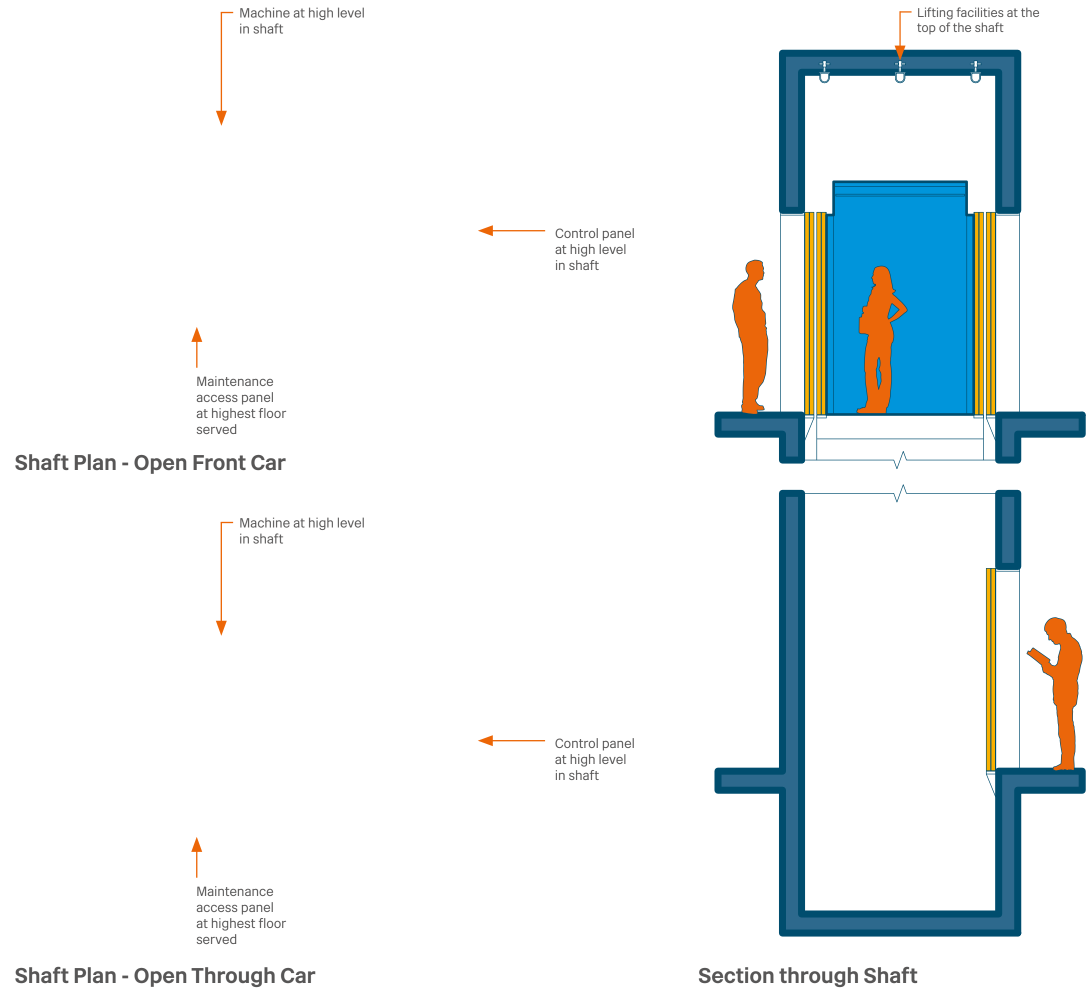


Image 3.20
Electric Traction Machine Room Less Lift - Plans and Section

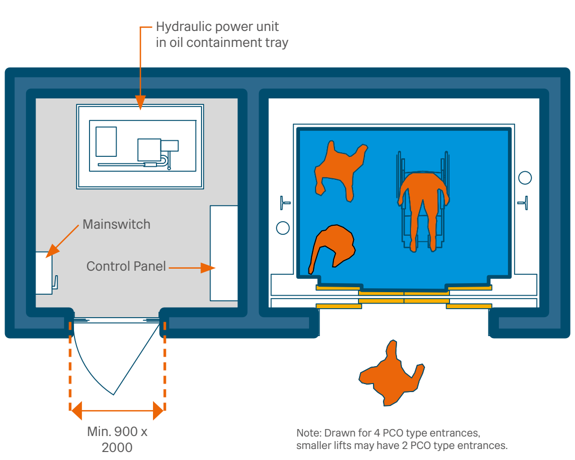
3.5.6 Hydraulic Lifts

Hydraulic lift drives are suitable for low rise applications typically up to 4 floors with a maximum travel distance of 15 metres, and an operating speed of 0.75 m/s. As this type of drive system is ideally suited for high rated lift capacities, it is an appropriate solution if the passenger lift also acts as a heavy duty goods or service lift.

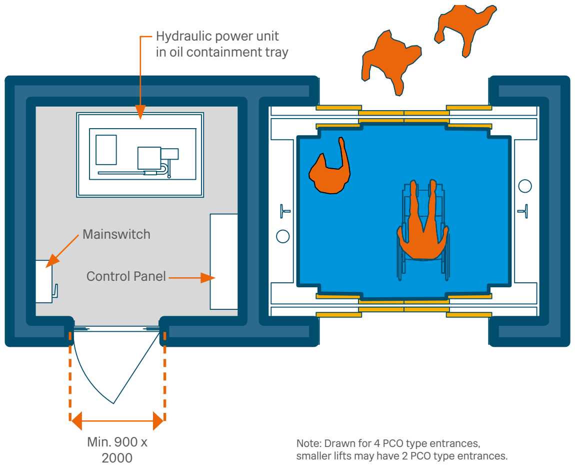
This type of drive system requires an independent Lift Equipment Room (LER) to house the lift controller and hydraulic power pack consisting of the oil tank, motor, pump and control valve. The machine room should preferably be located adjacent to the lift shaft on the lowest floor served. Whilst remote machine room locations are possible with this type of drive system, the greater the distance between the lift shaft and machine room can result in a pressure drop which may affect lift ride comfort and overall performance.

Operation cycles are restricted to a nominal 60 motor starts per hour, 120 lift journeys. To increase this, oil coolers vented to outside air will be required. Hydraulic drive systems typically require heating cooling and mechanical extraction systems to control the machine room within the required temperature range.

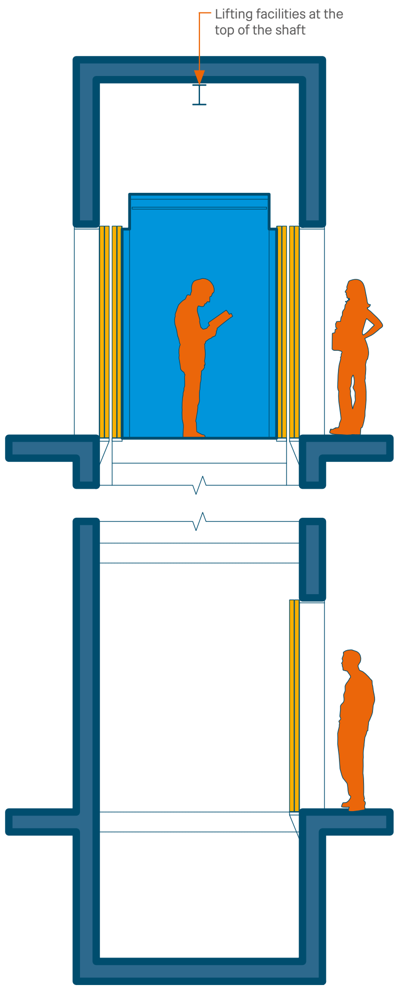
Refer to image 3.21 showing typical plan and elevation details.



Machine Room and Shaft Plan - Open Front Car



Machine Room and Shaft Plan - Open Through Car



Section through Shaft

Image 3.21
Hydraulic Lift - Plans and Section

3.5.7 Rigid Chain Technology (RCT) Drive System

An alternative design solution is a Rigid Drive Chain Technology (RCT) drive system, which is designed to fold in the horizontal plane, whilst forming a rigid pushing and pulling bar in the other vertical plane. An example of the chain type is detailed in image 3.22.

As the chain is turned through the drive housing, the links are 'locked' over the axle. This locking action prevents the chain from opening, even when subject to side shock loads. This operation provides a rigid column which performs in much the same way as a structural beam or column.

A key benefit of this drive system is that an independent lift machine or lift equipment room is not required as most of the of the lift equipment, including drive motors, is located within the lift shaft and lift pit areas.

This arrangement makes sure that all structural loads act directly on the lift pit floor and not the building structure. Minimal guide rails loads, however, are exerted onto the lift shaft travels within the lift shaft.

The only items of equipment that are not located within the lift shaft and pit areas are the lift operating control and inverter cabinets, the dimensions of which are:

- → Lift Controller Cabinet: 800mm wide x 400mm deep x 1800mm high
- → Inverters: 550mm wide x 500mm deep a 1200mm high

A minimum clear space of 700mm is required in front of the lift controller and inverter cabinets for lift maintenance purposes.

Whilst this drive system can be designed to accommodate duty loads of up to 40,000kg, it is restricted to a maximum operating speed of 0.3 m/s. This may not meet certain lift traffic analysis performance criteria, particularly in respect of round-trip and passenger waiting times.

With the electrical equipment and drive motors located within the lift pit area, this type of drive system may not be suitable for lift installations exposed to water ingress. Another key benefit is that the drive chain is incompressible when in the 'locked' position. This eliminates differential compression caused by uneven loads which is typical with other drive systems such as hydraulic and electric traction; refer to image 3.23

As Rigid Chain Technology is not currently covered in NR/L2/CIV/193, 'Standard Specification for New and Upgraded Lifts' and 'NR/L3/CIV/194, 'Selection and Design of New and Upgraded Lifts', it will require formal Network Rail acceptance and approval.

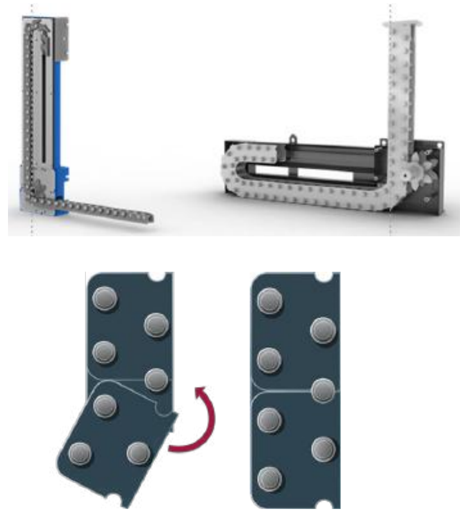


Image 3.22
Rigid chain assembly and links arrangement

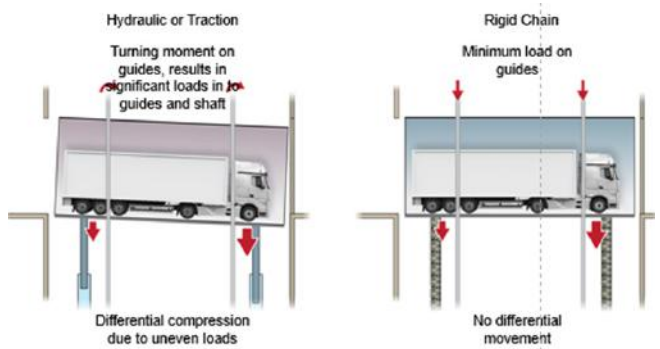


Image 3.23
Example of differential compression

3.5.8 AVA Lift

This concept is based on implementation of the rigid chain drive system using vertical liner beam technology. The lift can achieve contract load of 33 persons/2500 kg with speed of 0.63 m/sec and 25m of maximum car travel. These are considered to be adequate specifications for NR stations. The advantages of this system compared to widely used hydraulic lift systems are:

- No hydraulic fluid
- Not affected by environmental conditions
- No machine room required
- Shallower pit depth
- Unaffected by total load or load distribution
- No 'sinking' or re-levelling at floor level even after long stationary period
- Completely electromechanical
- Low maintenance
- Quick and simple to install
- Type test approval against EN81-20, 31,41 and 50 and the Machinery Directive

The AVA Lift concept presents a modular type of lift which is specifically designed to suit NR installation with a new or existing footbridge. It is manufactured and assembled in a factory from a configurable kit of parts to suit AVA bridge variables. It is also fully factory pre-commissioned with its integral cladding structure.

The unit(s) can be delivered on site complete with integral installation equipment, minimising on-site work. The interface between an existing or new bridge and the lift is to be considered at design stage.

Design

- Optimised for all people, walking, wheelchair, bike, trolleys.
- Pre-configured factory tested ready to install lift.
- Minimal disruption to the platform for foundation, common to AVA bridge, whilst ensuring compliance to BS EN 81-20.

Reliability

- Redundant drive system allowing for 100% backup of lift car drive reliability
- New robust curved door and drive with minimum of moving parts, compared to existing sliding doors.
- Modular build allowing for proven design and maximum design reuse.

Safely and Maintenance

- Maintenance from ground level or within the lift car or via video playback for safety
- Condition Monitoring
- Monitored drive tension to enable condition monitoring via dial-up/mobile broadband connection.

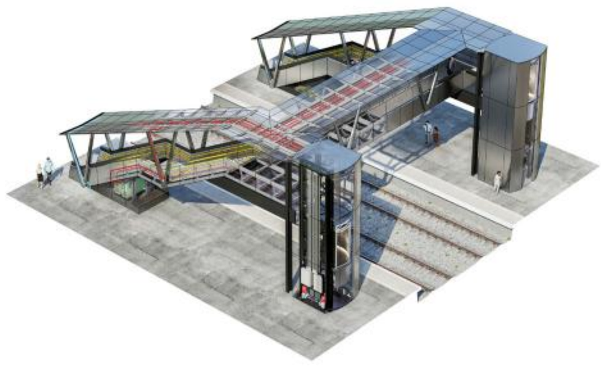


Image 3.24
AVA Footbridge

Image 3.25
AVA Footbridge

Selection Principles for Different Types of Station

3.5.9 Rated Capacity and Lift Size

The minimum rated capacity specified in NR Design Standards NR/L2/CIV/193, Standard Specification for New and Upgraded Lifts, is 1200kg / 16 persons with internal car dimensions of 1600mm wide x 1600mm deep x 2300mm. As this size of lift can enable a wheelchair to rotate 180° within the lift car, it is particularly suitable for single entry configurations where it is not possible to provide a through car arrangement.

The lift selection should also consider other lift uses, as highlighted in section 3.5.10, which may determine that the minimum NR rated capacity and size may not be suitable to fully meet a particular station needs and demand. Additionally, it may not be physically possible to replace a lift installation in an existing station with a new lift meeting the minimum NR design standard requirements. Where such a situation occurs, a derogation route to provide a smaller capacity and size may have to be considered.

Image 3.26 provides indicative lift shaft and Lift Equipment Room (LER) spatial requirements to meet the NR minimum rated lift capacity and size of 1200kg / 16 persons. These dimensions are a worst case scenario which cover different lift types and drives systems for both single entry and through car lift car configurations for multiple manufacturers. This includes:

- Electric Traction Machine Room
- Electric Traction Machine Room-Less
- Hydraulic
- Rigid Chain
- AVA

An alternative rated lift capacity of 1600kg / 21 persons that may be suitable to accommodate the stretcher sizes detailed in 'Evacuation Lifts', is also included.

3.5.10 Lift Type Selection

For smaller stations provided with up to two platforms, a minimum of one passenger lift installation should be provided for use by persons with restricted mobility (PRM). To address redundancy, a minimum of two lifts should be considered to address a situation when a lift is out of service due to repair, refurbishment or maintenance.

For larger stations provided with more than two platforms, the lift type, size, number and location of lifts should be determined from a detailed lift traffic analysis based upon the agreed station VC operating strategy and station capacity (Including PedFlow data and calculations).

The VC strategy, design and station capacity should consider the passenger demand when a station is in close proximity to hospitals, airports, bus or tram stations, sports arenas and stadia in the surrounding area.

The lifts may be required to serve other purposes, such as:

- Goods / service
- Plant replacement & removal
- Firefighting
- Evacuation

The lift type may also require consideration of the BREEAM Assessment in respect of the requirements of ENE 06 Energy efficient transportation systems.

Capacity		Car Size (mm)			Door Type	Door Width (mm)	Door Height (mm)	Shaft Width (mm)	Shaft Depth S/E (mm)	Shaft Depth T/C (mm)	Lift Pit (mm)	Headroom (mm)	Lift Equipment Room (mm)		
kg	People	Width	Depth	Height									Width	Depth	Height
1200	16	1600	1600	2300	2PCO	1100	2100	2700	2100	-	1600	4300	2000	3000	2500
1200	16	1600	1600	2300	2PCO	1100	2100	2700	-	2300	1600	4300	2000	3000	2500
1600	21	1600	2100	2300	2PCO	1100	2100	2700	2600	-	1600	4300	2000	3000	2500
1600	21	1600	2100	2300	2PCO	1100	2100	2700	-	2800	1600	4300	2000	3000	2500

S/E: Single Entry
T/C: Through Car
2PCO: Two Panel Centre-Opening

Table 3.26
Electric Traction Machine Room Less Lift - Plans and Section

3.5.11 Structural Loadings

The structural loadings and the areas where they are imposed can vary between lift drive systems. For hydraulic lifts the main loads will act down onto the pit floor, whereas this will be at the shaft head and lift pit for electric traction machine room-less (MRL) designs. For top drive electric drive systems, this will be the machine room floor slab and lift pit. Additional loads for all drive systems are also imposed on the guide rails. All structural loadings should be determined during detailed design.

3.5.12 Persons with Restricted Mobility (PRM Lifts)

All PRM lifts should be designed to accommodate persons with restricted mobility, minimally consisting of:

→ A through lift car design incorporating both front and rear lift entrances where possible / practical, refer to image 3.27.

→ A clear dimension of 1500mm in front of lift landing entrance frames

→ A type 5 lift car as defined by Table 3 of EN1-70:2021, 'Accessibility to lifts for persons including persons with disability'

→ Design functions features and finishes as required by EN81-70:2021

→ Narrow lifts are not recommended as these cause issues with PRM movement and security concerns regarding direction of facing.

3.5.13 Goods / Service Use

Where a lift is designed to serve as a goods / service lift, it should be sized accordingly to accommodate the largest and heaviest items of goods services and plant equipment to be transported.

The lift design and finishes should be robust and heavy duty and suitable for either an internal or external application operating environment. Where a lift is located back of house, a secure access control function may be required to restrict access only to authorised users.

In accordance with NR Design Standards, goods lifts should not be designed with a through car configuration.

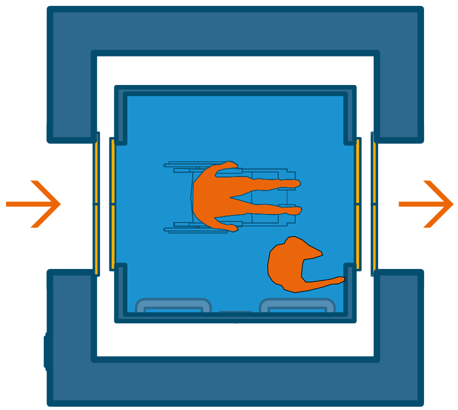


Image 3.27
Open through lifts avoid having to turn around within or outside the lift

3.5.14 Lift Equipment Rooms [LER's]

The lift equipment rooms should be of adequate size to accommodate the following lift electrical operating equipment:

→ Lift control panel

→ Lift ATS unit for A and B power supplies

→ Fire alarm interface unit

→ Hand winding unit

→ Comms unit

→ Consumer unit

→ Isolator unit

→ Lift interface panel containing the lift monitoring and communication system and CCTV camera data and logs

→ Bus bar, castell isolator, main switch

Where lift equipment rooms are located remote of the lift shaft, a suitable route for hydraulic hosing and / or electrical wiring and cabling may have to be provided; this could be in the form of underground ducts or overhead cable tray.

3.5.15 Scenic / Glass Lift Design

The main design interface issues to consider for scenic / glass lift installations installed in a structural steel and glass shaft enclosure are:

- → Guide bracket and landing entrance frame interface and connection to the primary and secondary structural steelwork
- → Visible lift equipment painted to match the finish of the lift shaft steelwork
- → Finish to the lift pit floor enclosure
- → Measures to prevent dragging and trapping of children's hands during movement of the lift doors
- → Concealment of visible lift shaft steelwork equipment and wiring; this may consist of sandblasting sections of the lift shaft and car interior glass panels
- → Lift shaft glass cleaning and maintenance (internal and external)
- → Lift car exterior cleaning which is typically undertaken from the lift car top
- → Safe and easy removal of lift shaft and car interior glass panels, ensuring minimum downtime periods
- → Obscuring of glazing at low level for privacy

3.5.16 Open Protocol Operating Systems

Open protocol operating systems should be provided to allow full diagnostic interrogation to detect and rectify operating faults. This requires all applicable diagnostics tools and equipment to be provided for each operating system, to assure that all maintenance activities are easily transferable to other lift companies.

3.5.17 Lift / Lift Shaft Maintenance & Cleaning

The lift design should establish all maintenance activities within the lift shaft can be undertaken safely and should consider:

- → Locating Lift Equipment Rooms (LER's) on the lowest level served where possible / practical
- → Where lift equipment rooms are located overhead, they are provided with a safe means of access and egress
- → A safe method of working for Machine Room-Less (MRL) lifts on the landing where the lift maintenance access control panel is located. Consider certain maintenance activities which may be undertaken from this location which could be accessible to members of the public
- → Where the design incorporates glass lifts shafts and / or car interiors, a safe method of cleaning the inside of the lift shaft and lift car exteriors; additionally, a safe method of glass removal and replacement should be considered as part of the station design planned maintenance program.

3.5.18 Lift Replacement

The lift shaft, pit and headroom dimension should be suitable to accommodate future multiple lift manufacturers equipment, which should establish a competitive tender process with any future full lift replacement works.

The lift design should establish that component parts can be safely and easily removed / replaced from the lift shaft and machine room, with a clear access route for equipment collection, delivery, and removal. Design proposals should consider permanent or temporary lifting devices to be provided to assist with this operational process.

NR Guidance Suite Reference

Wayfinding Design Guidance
NR/GN/CIV/300/01

3.5.19 Environmental Design

A BREEAM assessment should be undertaken early in the design process to attain the full points accreditation ENE 06 Energy Efficient Transportation Systems. This minimally requires the lift design to incorporate:

→ Regenerative drive systems where they can be proven to save energy

→ Low voltage LED lift car and shaft light fittings

→ Lift car lighting and standby operation energy saving measures

→ Photo voltaic charge of the back-up batteries

→ Use of secondary supplies in lieu of battery back supply systems

3.5.20 Signage / Way Finding

Clear visible signage should be provided throughout the station detailing the location of all public passenger lifts. See NR/GN/BDG/300/01 for further information.

Image 3.28
Glazed lifts at Paddington Elizabeth line station

3.6.1 Escalator Types & Drive Systems

Escalators provide a mechanical means of continuously transporting passengers between levels and except for deep underground systems, provide for short range movement in a wide range of building types.

As escalators are not suitable for use by some persons with disabilities, wheelchair users, push chairs, buggies and luggage transfer, each escalator or bank of escalators should be accompanied by an appropriate number and size of lifts to provide an alternative method of transfer for persons who are unable to use the escalators.
Escalators should only be accessed from adjacent corridors / walkways and lobby areas where pedestrian circulation routes cannot be obstructed and space should be available to accommodate queuing at the boarding point. The intention is to confirm that the vertical and horizontal modes of circulation can merge smoothly.

The above mentioned two NR design standards specify a Heavy-Duty Metro Drive System where the machinery is integral with the escalator structure, and where access to the machinery is gained from the motor box and return station compartments. Additionally, a dedicated Electrical Equipment Room (EER) or an extended truss design to form the dedicated space to house the electrical control equipment, drive systems, and interface connections may be required.

Refer to image 3.29 detailing a typical elevation view of this type of escalator drive system.

There are alternative escalator drives systems such as ‘Heavy Duty Non-Compact’ and ‘Commercial Duty’ type. The ‘Heavy Duty Non-Compact’ design requires a separate machine room to house the machine drive unit and controller; this omits the requirement for an extended truss assembly. The ‘Commercial Duty’ design incorporates all the escalator equipment within the escalator truss and upper and lower chamber areas; this omits the requirement for either a separate escalator machine room or extended truss assembly.

3.6.2 Codes & Standards

The escalators should be designed, manufactured, installed and commissioned in accordance with the following two NR escalator design standards, and the codes standards and regulations listed therein:

Standards Reference
Standard Specification for New and Upgraded Escalators
NR/L2/CIV/196
Selection and Design of New and Upgraded Escalators and Moving Walks
NR/L3/CIV/197
Escalator and Moving Walk Construct, Commission and Decommission
NR/L3/CIV/199

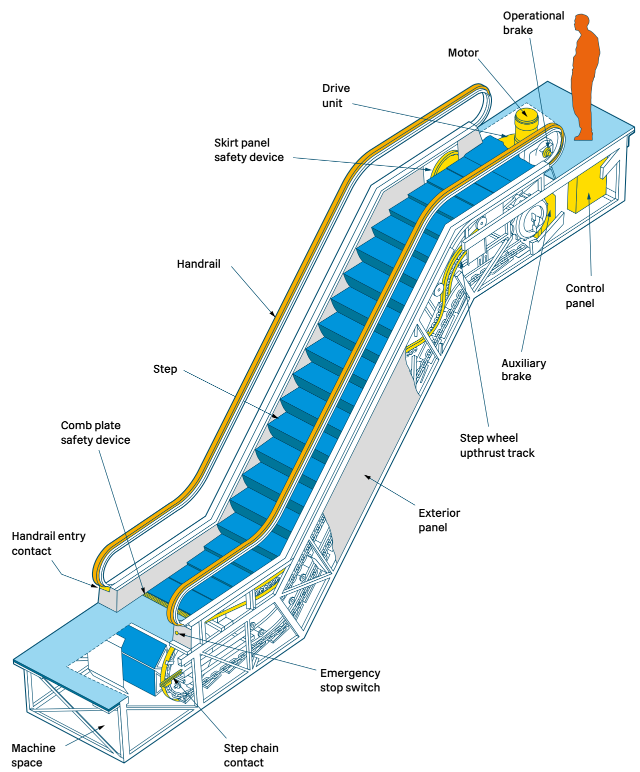


Image 3.29
General arrangement of a typical escalator

Image 3.30
Escalator Fabrication and Testing

3.6.3 Escalator Selection

For category A-C stations provided with more than two platforms, the type, size, number and location of escalators should be determined from a detailed lift traffic analysis based upon the agreed station VC operating strategy, in addition to station capacity (including PedFlow data and calculations). Key factors to be considered in respect of the escalator locations would be station access and egress and lift and stair location.

In accordance with NR Design Standards, the minimum escalator design parameters require a 1000mm wide step, an angle of incline of 30^0, and an operating speed of 0.5 m/s.

An escalator speed of 0.65 m/s is also available providing a handling capacity of 5850 persons per hour; however, this operating speed may require additional space due to additional flat steps or a reduction in the angle of incline to 27.5^0.

Escalator Design Considerations
3.6.4 Anti-fall Protection

Where escalators are located in open atrium areas, there is a potential risk of persons or objects falling over the escalator balustrades, either intentionally or unintentionally. To address this, a detailed risk assessment should be undertaken to determine whether the height of a standard code compliant escalator balustrade provides sufficient edge protection for all station users, or whether there is any benefit in fitting additional higher edge protection.

If it is determined that the escalators should be provided with an appropriate escalator anti-fall protection system to prevent or mitigate the risk of injury to passengers and other station users, this should cover the following design and performance criteria:

- → A decorative aesthetic design and finish commensurate with the station appearance and finishes
- → A minimum height of 1300mm made up of a balustrade height 1000mm + anti-fall protection height of 300mm
- → Arranged to prevent trapping of persons or objects, and positioned to both sides of the escalator balustrades within 80mm and 120mm of the escalator handrails
- → Arranged to enable ease of replacement, maintenance and cleaning from the escalator steps, particularly relevant where no direct access for a Mobile Elevating Work Platform (MEWP) is available

3.6.5 Escalator out of operation barriers

When escalators are out of operational use a barrier should be in place. The type of barrier should be risk assessed by the project team, with due consideration to what is appropriate in each location.

Image 3.31
Escalator Anti-Fall Protection System

3.6.6 Oblique approaches onto escalators

Where it is possible to approach the escalator obliquely, barriers should extend 1.5 metres in front of the escalators. The barriers affect passenger movement and change behavior by typically slowing users down and intuitively creating a focus on the steps ahead. The barriers should help exclude luggage and prams on to the escalator. However, the provision of any proposed passenger traffic control measures should be reviewed against the station operating strategies and pedestrian flow movement.

As escalator landing barriers are not typically provided by the Escalator Contractor, the above design criteria may have to be considered in respect of the escalator design and spatial requirements. The Architect is responsible for the design and finish of the escalator landing barriers.

3.6.7 Escalators used as stairs or working platforms

Escalators are not designed to be 'locked' off and used as stairs; they should therefore not be used as stairs or as an emergency access / egress route. Emergency evacuation procedure should be read in conjunction the Fire Life & Safety Report and Evacuation Strategy which may require escalators to be used for this purpose.

The escalator steps are not designed to accommodate temporary working platforms or scaffolding which should be considered as part of the station future maintenance cleaning or replacement strategies.

3.6.8 External escalator / escalator equipment room locations

Where escalators and / or escalator equipment room are located externally, they should be designed to address the environmental conditions. A minimal requirement will be to include raised ramps at the escalator equipment room door threshold and measures to remove to remove water from the escalator pit. The escalator equipment should incorporate oil separators, step heaters and IP66 rated (minimum) electrical escalator components.

3.6.9 Escalator equipment rooms

The escalator equipment rooms should be of adequate size to accommodate the following escalator electrical operating equipment:

- Escalator control panel
- Escalator ATS unit
- Fire alarm interface unit
- Bus bar, castell isolator, main switch
- Escalator consumer unit
- Escalator interface panel containing escalator monitoring and communication systems
- Any other escalator equipment that may be identified during the respective design stages

Where escalator equipment rooms are located remote of the escalator, a suitable route for electrical wiring and cabling may have to be provided; this could be in the form of underground ducts or overhead cable tray.

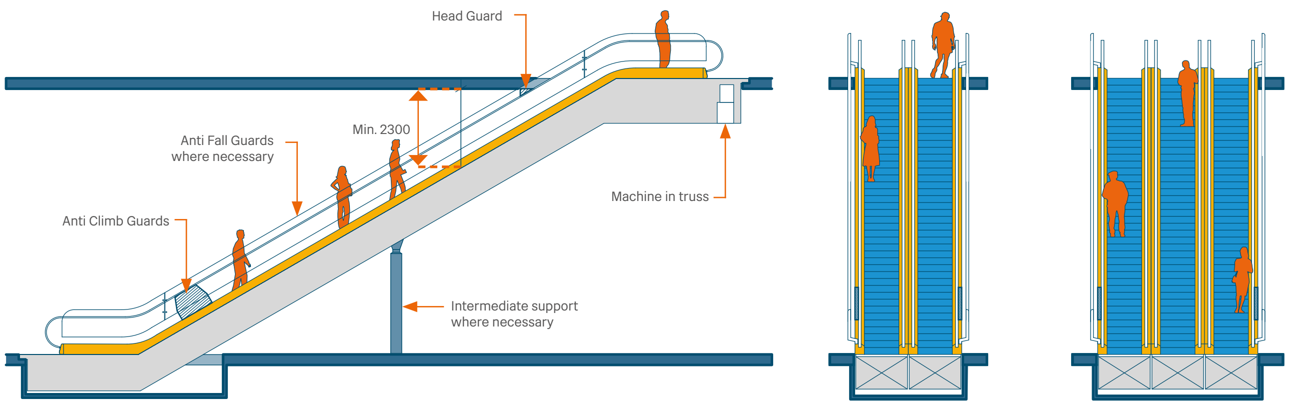


Image 3.32
Escalator Anti-Fall Protection System

3.6.10 Environmental Design

A BREEAM assessment should be undertaken early in the design process to attain the full points accreditation for ENE 06 Energy Efficient Transportation Systems. This minimally requires the escalator to incorporate:

→ Regenerative drive systems where they can be proven to save energy

→ Low voltage LED lighting

→ A load-sensing device that synchronises motor output to passenger demand through a variable speed drive or a passenger sensing device for automated operation such that the escalator operates in standby mode when there is no passenger demand

3.6.11 Signage / Way Finding

Clear visible signage should be provided throughout the station detailing the location of all escalators.
See NR/GN/BDG/300/01 for further information.

3.6.12 Key Service Interfaces

The escalator design should consider and make allowance for connection and interface with other building services, the key items summarised below:

→ Fire alarm operation

→ Dual power supplies where required

→ Pit sumps / pumps or gravity pit drainage for externally located escalator installations exposed to open environmental conditions

→ Escalator equipment room lighting levels (200 lux minimum)

→ Underground ducts for electrical cabling or overhead cable trays for remote location escalator equipment rooms

→ Escalator monitoring systems

→ Barriers, guarding, rails interfacing with the escalators

NR Guidance Suite Reference

Wayfinding Design Guidance
NR/GN/CIV/300/01

Vertical Circulation

4

Vertical Circulation Technical Design

Image 4.1
Escalator Installation at Liverpool Street Elizabeth Line station

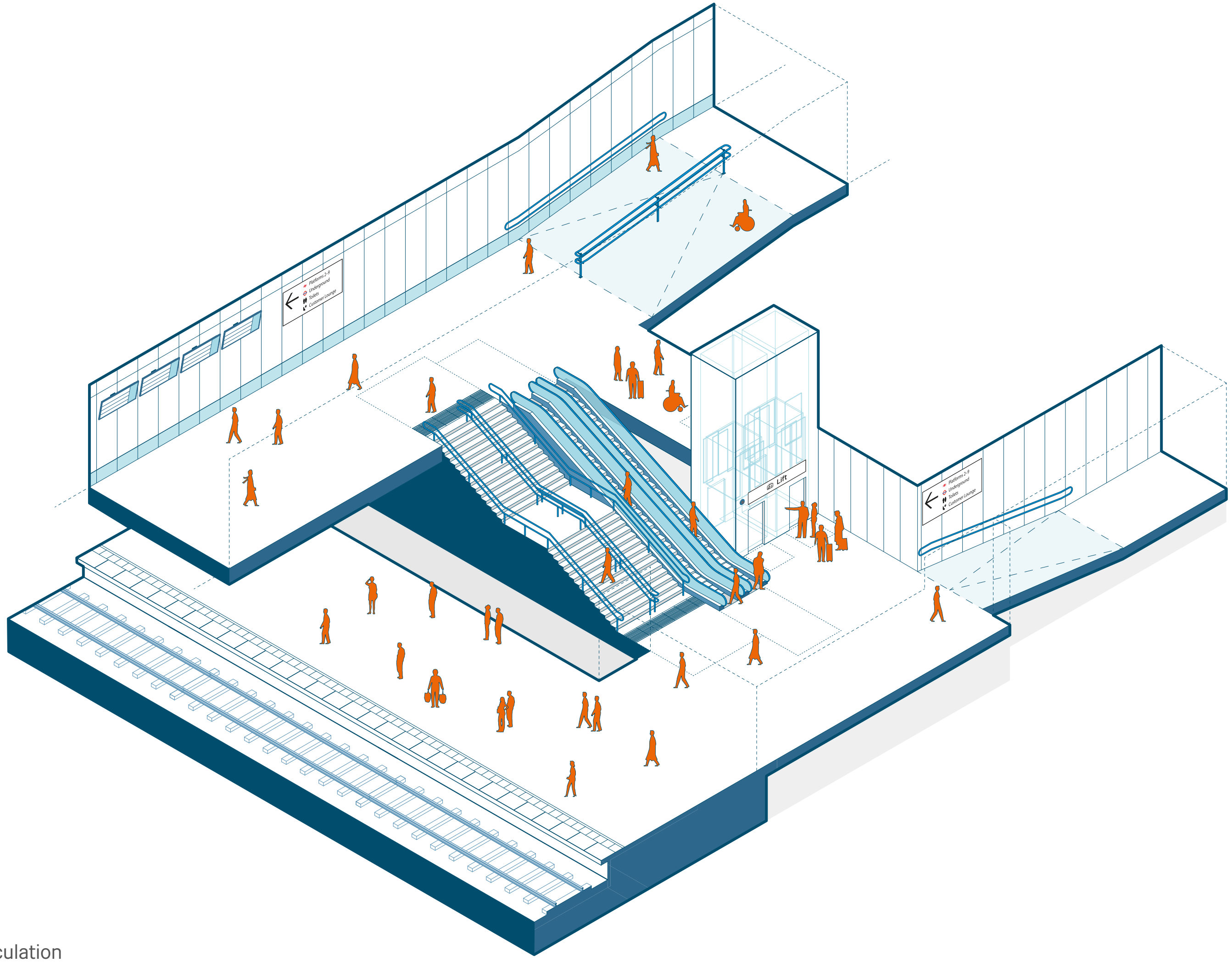


Image 4.2
Key Diagram - Elements of Vertical Circulation

4.1 Environmental Design & Sustainability

LIFTS

4.1.1 Energy Saving

A BREEAM assessment should be undertaken to attain the full points accreditation Ene 06 Energy Efficient Transportation Systems. This minimally requires the lift design to incorporate:

- → Regenerative drive systems where they can be proven to save energy
- → Low voltage LED lift car and shaft light fittings
- → Lift car lighting and standby operation energy saving measures
- → Photo voltaic charge of the back-up batteries
- → Use of secondary supplies in lieu of battery back-up supply systems

Ideally, BREEAM clause Ene 06 Energy efficient transportation systems should be targeted at the scoping stage of the project in order for the following to be independently validated:

- → Anticipated energy consumption
- → Anticipated intensity of lift use (following traffic analysis)

4.1.2 Design

- → Designing out lift machine rooms eliminates machine room services, reducing energy consumption
- → Machine room-less (MRL) designs require less construction materials and energy consumption
- → The building flat roof of a MRL design can easily accommodate expansive green areas with plantings and solar panels
- → Regenerative drive systems that divert power back to the lift or to the electrical grid
- → Solar and wind power battery powered drive systems
- → New drive system technologies such as magnetic motors where a magnetic field instead of cable, ropes, or belts is used to propel the lift between floors.
- → Replacing conventional cables / ropes or belts reduces the weight and should further reduce heat friction resulting in energy savings
- → Sourcing materials locally reducing transportation and shipping costs
- → Biodegradable fluid as a substitute for petroleum and diesel used in the vehicle fleet
- → Reduction of fuel consumption of the vehicle fleet through local material sourcing and hub distribution, which reduces overall transport emissions
- → Water soluble paint
- → On site metering to demonstrate to businesses and tenants that the energy savings is real

4.1.3 Reuse / Refurbishment Existing Components

Where possible, existing components still within their design life replacement period, should be refurbished and re-used unless newer technologies provide more energy efficient benefits and savings.

There works should generally consist of:

- → Refurbishment of the lift car interior and controls; this may involve cladding the existing wall panels
- → Upgrade and refurbish the lift car ceiling to incorporate low voltage LED light fittings
- → Refurbish the landing entrance frame and doors; this may require the removal of the existing cladding material involving both on-site and off-site works
- → For glass / scenic lift, repaint visible part of lift shaft, lift pit and top of car lift equipment
- → Planned and preventative re-sealing of hydraulic jacks

4.1.4 Recycling of Lift Components

It should be possible to recycle at least 80% of the lift equipment, materials and components at the end of their life. This should consist of the following, as a minimum:

- → Hydraulic oil
- → Mild steel and stainless steel
- → Timber (lift car floor subbase and wall panels)
- → Vinyl (lift car flooring)
- → Ceramic tiles (lift car flooring)
- → Aluminium (door tracks)
- → Glass (door panels and mirrors)
- → Copper & plastic (electrical cables / wiring)

ESCALATORS

4.1.5 Energy Saving

A BREEAM assessment should be undertaken early in the design process to attain the full points accreditation Ene 06 Energy Efficient Transportation Systems. This minimally requires the escalator to incorporate:

→ Regenerative drive systems where they can be proven to save energy

→ Low voltage LED lighting

→ A load-sensing device that synchronises motor output to passenger demand through a variable speed drive or a passenger sensing device for automated operation such that the escalator operates in standby mode when there is no passenger demand

4.1.6 Renewable Energy

Photovoltaic Panels (PVs) should be considered as part of new VC schemes, along with other renewable energies such as ground source heat pumps where possible.

For Step Free Access (SFA) schemes in particular, PVs can be incorporated on new lift shafts, stairways, and overbridges.

Consideration should be given to how these are accessed, installed, and maintained - particularly when adjacent to the operational railway.

4.1.7 Design

→ Designing out escalator machine rooms eliminates machine room services, reducing energy consumption

→ Regenerative drive systems that divert power back to the escalator drive or to a grid

→ Solar and wind power battery powered drive systems

→ Sourcing materials locally reducing transportation and shipping costs

→ Biodegradable fluid as a substitute for petroleum and diesel used in the vehicle fleet

→ Reduction of fuel consumption of the vehicle fleet through local material sourcing and hub distribution, which reduces overall transport emissions

→ Water soluble paint

→ On site metering to demonstrate to businesses and tenants that the energy saving is real

→ Considering embodied energy, and energy over the life cycle (this is covered in more detail in Section 2.7.1.)

4.1.8 Reuse / Refurbishment Existing Components

Where possible, existing components still within their design life replacement period, should be refurbished and re-used unless newer technologies provide more energy efficient benefits and savings. There works should generally consist of:

→ Reuse of an existing escalator truss with modification to suit new equipment

→ Reuse and refurbishment of the escalator balustrades

→ Reuse and refurbishment of escalator steps including step rollers replacement

4.1.9 Recycling of VC Assets

It should be possible to recycle at least 80% the escalator equipment, materials and components which should minimally consist of:

→ Machine oil

→ Mild steel and stainless steel

→ Aluminium (steps and inspection covers)

→ Glass (balustrades)

→ Copper & plastic (electrical cables / wiring)

→ Rubber (handrails)

4.2 GHG Emission & Rail Carbon Tool

The purpose of conducting whole life carbon / Greenhouse House Gas (GHG) assessments if to quantify emissions to establish a baseline and identify opportunities for GHG emission reductions.

4.2.1 Assessments

GHG assessments should be undertaken in line with Network Rails Capital Carbon Guidance Note document reference NR/GN/ESD07. Assessments are used to identify GHG 'hotspots' to allow informed decisions about material choices to be made to identify opportunities for GHG reduction. GHG emissions are expressed in terms of carbon dioxide equivalents (CO2e) according to their relative global warming potential. For this reason, the shorthand 'carbon' may be used to refer to GHGs although for clarity the term GHG is often used as carbon doesn't just mean carbon the big 6 GHGs are

- → Carbon Dioxide
- → Methane
- → Nitrous Oxide
- → Perfluorocarbons
- → Hydrofluorocarbons
- → Sulphur Hexafluoride

Standards Reference

Managing whole life carbon in infrastructure
NR/GN/ESD07

Material	RSSB Rail Carbon Tool (RCT) Emissions Factor	Unit	Name	Source
Aluminium	13	kgCO2e/kg	Aluminium - Sheet	Bath ICE (3.0)
Concrete	0.138	kgCO2e/kg	Concrete - 32/40 MPa - Average UK Additions	Bath ICE (3.0)
Glass	1.44	kgCO2e/kg	Glass - General	Bath ICE (3.0)
Glass Reinforced Plastic	8.59	kgCO2e/kg	Glass Reinforced Plastic (GRP) - Fibreglass - General	Bath ICE (2.0)
Plywood	0.681	kgCO2e/kg	Timber - Plywood - Excluding Carbon Sequestration	Bath ICE (3.0)
Polycarbonate	7.62	kgCO2e/kg	Polycarbonate	Bath ICE (2.0)
Polyisocyanurate	4.26	kgCO2e/kg	Polyurethane - Rigid Foam	Bath ICE (2.0)
Polythene	2.54	kgCO2e/kg	Polyethylene - General	Bath ICE (2.0)
Polyurethane coating	4.84	kgCO2e/kg	Polyurethane - Flexible Foam	Bath ICE (2.0)
Rockwool	1.12	kgCO2e/kg	Insulation - Rockwool (Stonewool)	Bath ICE (2.0)
Rubber	2.85	kgCO2e/kg	Rubber - General	Bath ICE (2.0)
Steel	2.76	kgCO2e/kg	Steel - Sheet - Hot-Dip Galvanized Steel	Bath ICE (3.0)
Timber	0.493	kgCO2e/kg	Timber - General - Excluding Carbon Sequestration	Bath ICE (3.0)
UPVC	3.16	kgCO2e/kg	UPVC - Film	Bath ICE (2.0)

Table 4.3
Material Emission Factors

4.2 GHG Emission & Rail Carbon Tool

4.2.2 The Rail Carbon Tool

The rail carbon tool (RCT) is an online portal provided by RSSB to our railway industry. The purpose of the tool is to review and quantify GHG emissions for rail projects, compare alternative designs and material selections and inform decision making.

4.2.3 When to Use The Rail Carbon Tool

The rail carbon tool is required for any works over and above £1 million. Applicable works can include civil, mechanical or electrical engineering. The purpose of the tool is to identify and record opportunities to reduce whole life GHG emissions.

However it is advised throughout any project the planning, development, design and delivery of any projects the goal of reducing whole life carbon emissions is considered.

Standards Reference

Environment & Social Minimum Requirements
NR/L2/ENV/015

4.2.4 Materials

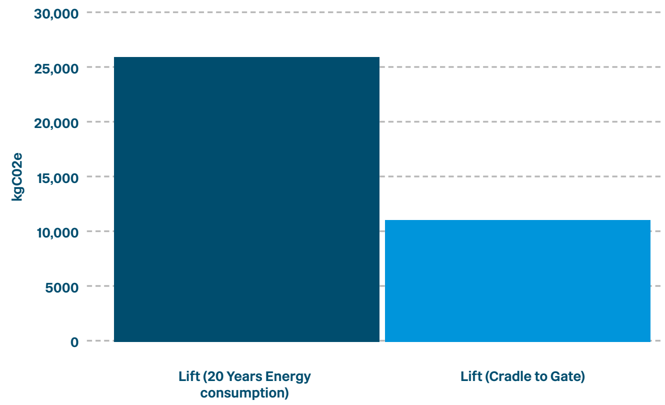
The Rail Carbon Tool contains embodied emission factors for materials with the typical unit of measurement being kgCO2e per kg of material. The transportation of materials from supplier to site can also be accounted for with the unit of measurement being kgCO2e per tonne.km. In order to access material of measurement at take-off consisting of total material mass is required. An example of various material emission factors is provided in the following schedule

4.2.5 Lift Case Study

Lift carbon assessment using Environmental Product Declaration (EPD)

4.2.6 Main Findings

- Environmental Product Declarations (EPD) are available for a large range of products, including some passenger trains
- The EPD provides the embodied carbon data (cradle to gate) as well as operational carbon data (energy consumption during use), where applicable.
- For a lift system (e.g. Schindler 5500 elevator), the EPD shows how operational carbon compares to embodied carbon over its lifecycle.
- The EPD allows for quick carbon assessment by importing the carbon data into the Rail Carbon Tool as 'external package



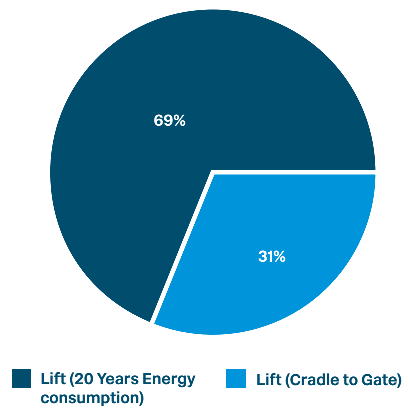


Image 4.4
Lift carbon assessment using Environmental Product Declaration (EPD)

Source: Sustainable Development – Rail Carbon Tool A Practitioners Introduction © Rail Safety and Standards Board

4.2.7 Conclusion

- Suppliers should provide an EPD for their products as part of the procurement process
- The EPD would allow the embodied and operational carbon impacts of complex equipment to be included. These are currently outside the scope of NR carbon assessment.

4.2.8 Ramp Case Study

To demonstrate a comparison between emission factors for various ramp constructions, Image 4.5denotes approximate total kgCO2e for a steel ramp and a concrete ramp. These summaries are based on approximate quantity of materials required and a high level carbon assessment and are not based on a finalised bill of quantities level of design detail. This is not a whole life carbon assessment, it considers the embodied carbon of the materials only.

Image 4.5 demonstrates that the steel ramp option at this initial stage of design and carbon assessment has a higher embodied carbon impact than the concrete ramp option. This is mainly a result of a higher emissions factor for steel when compared to concrete, even despite the saving in mass when comparing concrete vs steel ramp options.

Steel Ramp

Material	Mass (kg)	RSSB Rail Carbon Tool (RCT) Emissions Factor	Unit	Name	Embodied Carbon of Material - Total ($kgC0_2e$)
Concrete	500	0.138	kgCO2e/kg	Concrete - 32/40 MPa - Average UK Additions	69
Polyurethane coating	3	4.84	kgCO2e/kg	Polyurethane - Flexible Foam	14.52
Rubber	5	2.85	kgCO2e/kg	Rubber - General	5.7
Steel	1000	2.76	kgCO2e/kg	Steel - Sheet - Hot-Dip Galvanized Steel	2,760
UPVC	3	3.16	kgCO2e/kg	UPVC - Film	9.48
				Total kgC02e	2,858.7

Concrete Ramp

Material	Mass (kg)	RSSB Rail Carbon Tool (RCT) Emissions Factor	Unit	Name	Embodied Carbon of Material - Total ($kgC0_2e$)
Concrete	1500	0.138	kgCO2e/kg	Concrete - 32/40 MPa - Average UK Additions	207
Plywood	50	0.681	kgCO2e/kg	Timber - Plywood - Excluding Carbon Sequestration	34.05
Polythene	5	2.54	kgCO2e/kg	Polyethylene - General	12.7
Polyurethane coating	3	4.84	kgCO2e/kg	Polyurethane - Flexible Foam	14.52
Rubber	5	2.85	kgCO2e/kg	Rubber - General	14.25
Steel	250	2.76	kgCO2e/kg	Steel - Sheet - Hot-Dip Galvanized Steel	690
UPVC	3	3.16	kgCO2e/kg	UPVC - Film	9.48
				Total kgC02e	982

Table 4.5
Comparative emission factors for Steel and Concrete Ramp constructions

4.2.9 Design Considerations

The following design strategies are considerations which could be applied to improve vertical circulation ramps and staircases emission factors. The scale the considerations have been appraised against is scale of 1 very easy, to 3 very difficult scale 1 large reduction in carbon to 3 minimal reductions

4.2.10 Public Available Specification (PAS) 2080

The Infrastructure Carbon Review completed in 2013 identified infrastructure was responsible for 515 MtCO2e/year carbon emissions per year this is greater than 50% of the United Kingdoms carbon emissions. The PAS 2080 was introduced to specially target the management of carbon in infrastructure. Through specifying requirements for the management of whole life carbon within transport, energy, water, waste and communication sectors for both new assets and refurbishment of existing assets PAS 2080 aims to reduce carbon emissions. PAS 2080 requires carbon management processes that quantify GHG emissions, develop target setting, baseline setting and monitoring, reporting and promote continual improvement. The potential for carbon reduction can be summarised as –

→ Build nothing

→ Build less

→ Build clever

→ Build efficiently

The following chart denotes carbon reduction potential throughout an infrastructure projects planning to operation and maintenance stages.

Recommendation	Ease of Implementation	Potential to Reduce Carbon	Total
GHG emissions from the use of concrete could be reduced by specifying concrete with a higher portion of recycled content e.g. ground-granulated blast furnace slag (GGBS)	2	1	3
Prioritise wider spacing for structures e.g posts and handrail supports therefore reducing associated GHG emissions.	3	2	5
The emissions from steel could be reduced by specifying and procuring steel with a higher average recycled content (UK steel is typically 50 -60% recycled content). Preferably the recycled content of steel should be between 70-100%	2	2	4

Table 4.6
Carbon Reduction Design Strategies

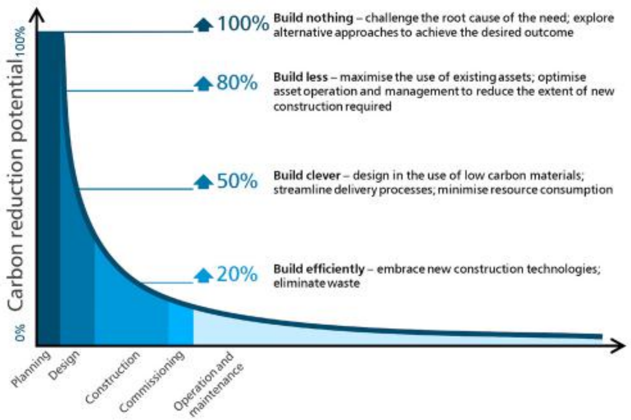


Image 4.7
Carbon Reduction Curve

Source: HM Treasury – Infrastructure Carbon Review (2013) p.11
© Crown copyright

4.3.2 Super Capacitors

To increase the efficiency of a hydraulic lift drive system, it is possible to incorporate super-capacitors to accumulate electric charge when the lift traveling in down direction. The principle is similar to gas accumulators which are conserved as pressure vessels which are bulky heavy items requiring special product knowledge and training to enable effective maintenance.

4.3.3 Lift and Escalator Remote Modelling

In addition to the readily available and widely incorporated Lifts and Escalator monitoring systems within NR, it has been proposed to construct and implement a new lift and escalators data pipeline with Azure Platform. The new system should enable NR to:

→ Construct a new Intelligent Power BI Tool, capable of predicting asset failures and enhancing intervention decisions

→ Construct an Application Programming Interface (API) for mobile devices which provides real-time asset availability to 3rd party developers for point-to-point journey planning. This can allow passengers to see if lifts or escalators are in service at particular stations before they embark on their journey

The benefits of such a system can be summarised as follows:

→ Passenger experience

→ End-to-end journey time

→ Safety

→ Stakeholder reputation

→ Data management

→ Asset management

The schematic architecture of the system is shown in diagram 4.8

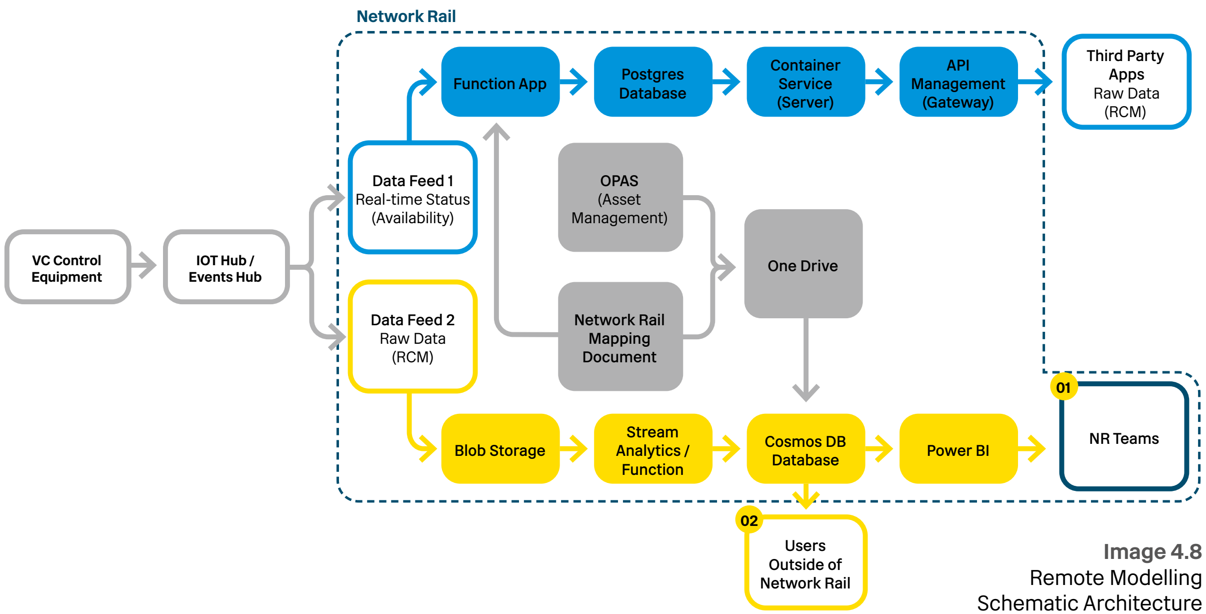


Image 4.8
Remote Modelling
Schematic Architecture

4.4 Fire and Evacuation

4.4.1 Vertical Circulation & Emergency Egress Coordination - Large and Medium Stations

When considering means of escape for large and medium stations with multiple platforms, the following design principles are to be taken into consideration.

- → 1 **Stairs**: As a means of escape, stairs offer the passenger a fixed route to evacuate the station in the direction of travel. To promote the most efficient escape route for passengers, the width of the stairs should be calculated on a worst case basis in either an AM or PM peak. Passengers will egress from the stairs in the same direction and in a greater number than in normal station operations therefore if the escalators are adjacent to the stair, to avoid congestion, the furthest escalator from the stair should be identified as the escalator to be used in an emergency.
- → 2 **Escalators**: Escalators can be used as a means of escape in a railway premises and move a greater number of passengers quicker than any other means of vertical circulation due to the travel speed being greater than the evacuation via a staircase or lift. Most pairs of escalators have an escalator moving in each direction. In an emergency evacuation, the escalators can continue to operate in the same direction of travel. This prevents slips, trips or falls if the escalator that is not travelling in the direction of travel is stopped and passengers use the stationary escalator as a fixed stair.
- → 3 **Evacuation Lifts**: PRM evacuation via lifts in large and medium stations is preferred as opposed to evac chairs due to operational and manual handling requirements. The PRM evacuation will be assisted by the station operation team and the lifts will be key operated to enable safe evacuation. In stations with multiple lifts from platform to concourse, a risk assessment should be prepared by the NR fire engineer and station operations team in collaboration with the design team, to identify the location of the evacuation lift and the safe access route. This should inform the fire strategy for the station and should be included in the Concept of Operations Plan.
- → 4 **Ramps**: Ramps within a station environment are considered to provide a level access to the final place of ultimate safety. The width of the ramp should be calculated on the same premise that determines the width of a stair.
- → 5 **Horizontal egress routes**: Passengers that use a large or medium station on a regular basis should be familiar with the general circulation routes. Where possible these circulation routes should also form the same routes in the event of an evacuation.

Standards Reference

British Standards Institute

BS 9999 Code of practice for fire safety in the design, management and use of buildings

BS 9992 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

National Fire Protection Association

NFPA 130 Standards for Fixed Guideway Transit and Passenger Rail Systems

4.4 Fire and Evacuation

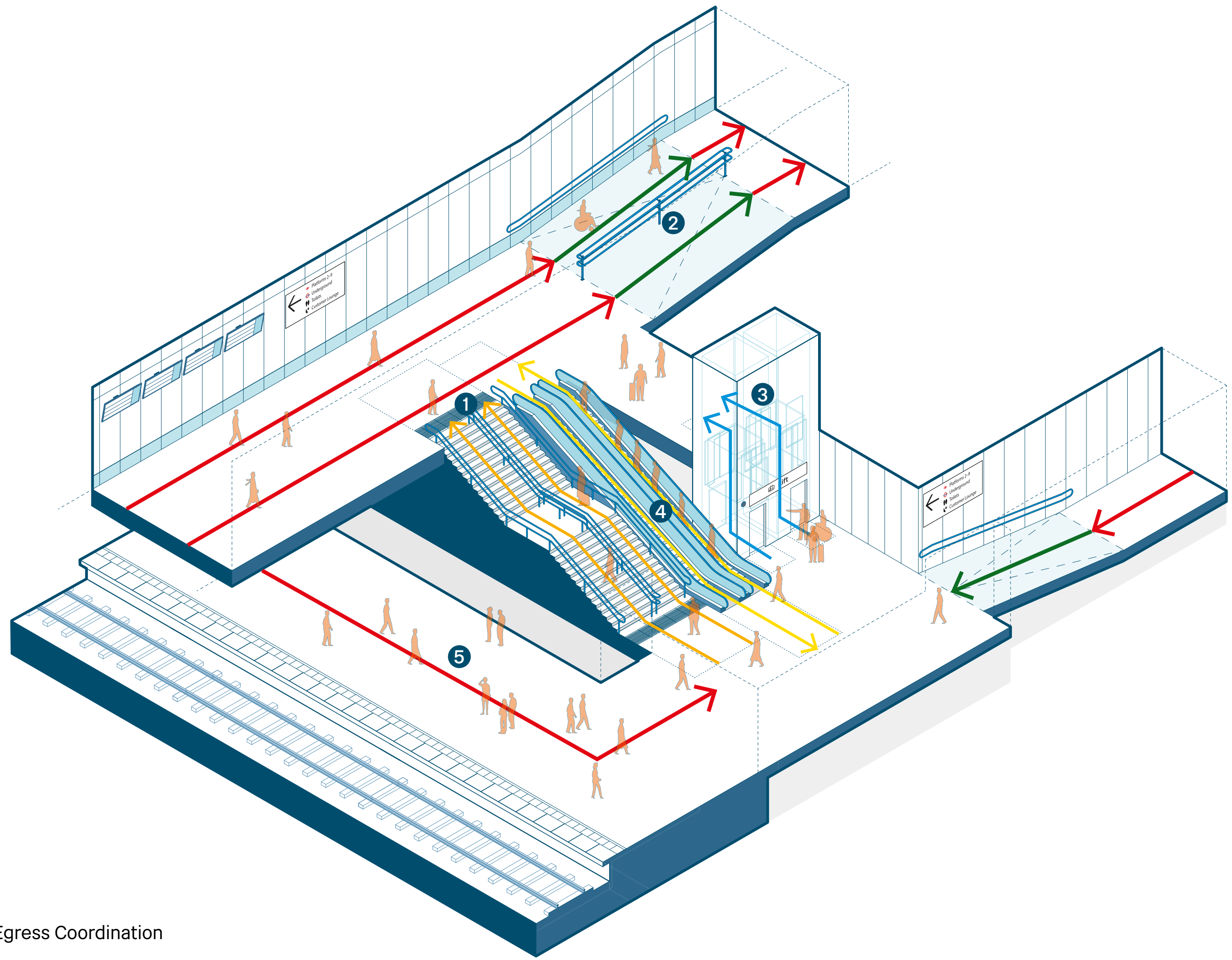


Image 4.9
Vertical Circulation Emergency Egress Coordination
Large and Medium Stations

4.4.2 Vertical Circulation & Emergency Egress Coordination - Small Staffed and Unstaffed Stations

When considering means of escape for small regional staffed / unstaffed stations, the following design principles are to be taken into consideration.

→ 1 **Evacuation by Lifts**: In smaller, regional stations (staffed and un-staffed) with dual platforms accessed via a footbridge, PRM evacuation via lifts is preferred as opposed to evac chairs due to operational and manual handling requirements. However, these stations are unlikely to be provided with bespoke evacuation lifts.

These lifts are usually located in open air and not in a station building and therefore a risk assessment where risks are mitigated to 'as low as reasonably practicable' (ALARP) should be undertaken by the NR fire engineer and the station operator in collaboration with the design team. This should inform the fire strategy for the station and should be included in the Concept of Operations Plan / Emergency Plan.

Standards Reference

British Standards Institute

BS 9999 Code of practice for fire safety in the design, management and use of buildings

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

National Fire Protection Association

NFPA 130 Standards for Fixed Guideway Transit and Passenger Rail Systems

→ 2 **Emergency Voice Communication / Help Points**: Emergency Voice Communication / Help Points should be located at the platform and footbridge level for PRM requiring assistance in an emergency evacuation. These should be positioned in the same area on each level to enable unsighted passengers to locate them easily.

→ 3 **Stairs**: In the smaller regional stations, there are normally a limited means of vertical circulation and the access stair to platforms should be the primary means of escape. This can offer passengers a familiar route to exit the station in the event of an evacuation.

→ 4 **Gradients:** Many smaller stations are considered to be external and therefore should offer gradients to provide a level access to the final place of ultimate safety. These stations may often have one of two operational step free entrance / egress to the platform area and may be familiar to the passenger. Where possible these should be the same egress points in the event of an evacuation.

→ 5 **Horizontal egress routes**: In the smaller regional stations, passengers will be familiar with the general circulation routes along the platform. Where possible these circulation routes should also form the same routes in the event of an evacuation and should allow a PRM to evacuate the station unaided.

→ 6 **Platform Furniture**: Platform furniture should be placed so as not to impede the egress routes from the station.

→ 7 **Refuge Areas**: Refuge areas may be required at platform ends. Refuge areas are not considered acceptable if the occupants are required to wait for emergency services or remote located staff assistance to assist with evacuation. A risk assessment should be prepared by the NR fire engineer and station operations team in collaboration with the design team, to establish a safe evacuation from the dedicated refuge areas. This should inform the fire strategy for the station and should be included in the Concept of Operations Plan.

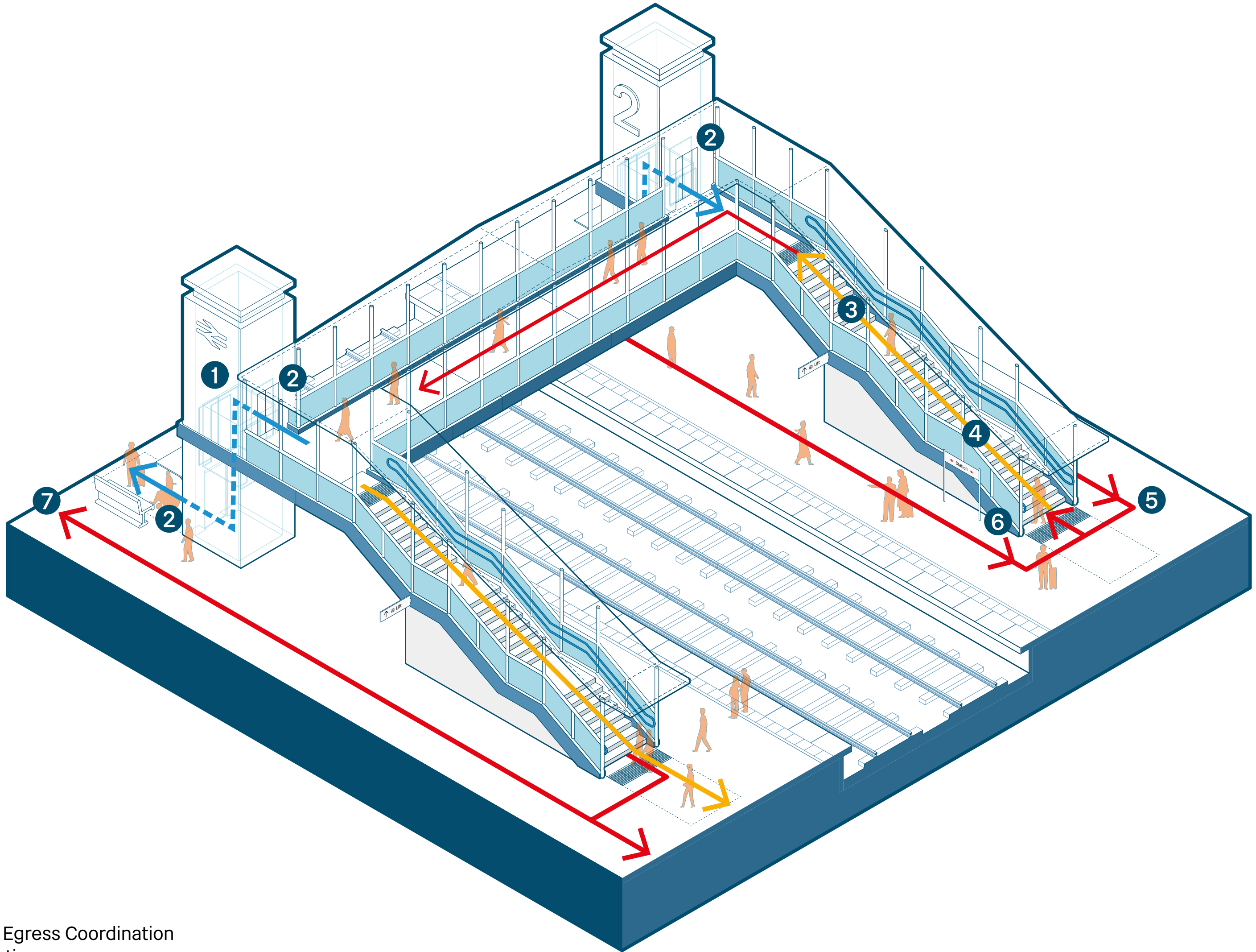


Image 4.10
Vertical Circulation Emergency Egress Coordination
Small Staffed and Unstaffed Stations

LIFTS

4.4.3 Firefighters Lifts

An evacuation lift is determined to be suitable for use as a means of escape in the event of an emergency evacuation or fire and should be designed in accordance with EN81-72:2020, 'Firefighters lifts' and BS 9999:2017, 'Code of Practice for Fire Safety in the Management and Use of Buildings'.

The lift design should be fully coordinated and aligned with the Fire Life & Safety Report which should address the behaviour of the lifts in the event of a fire.

The lift design should include connection and interface with other building services and requirements such as:

- Dual power supplies
- Refuge designated areas
- Water prevention methods consisting of raised ramp landing sill thresholds, landing threshold drainage, pit drainage and pit sumps / pumps

4.4.4 Evacuation Lifts

Where a lift is designed to serve as an evacuation lift, it should be designed full in accordance with BS 9999:2017, 'Code of Practice for Fire Safety in the Management and Use of Buildings'.

Standards Reference

Managing whole life carbon in infrastructure
NR/GN/ESD07

The lift design should be fully coordinated and aligned with the Fire Life and Safety Report which should address the behaviour of the lifts in the event of a fire, in addition to the strategy to evacuate persons with disabilities in the event a lift is not operational due to maintenance repair or redundancy.

The lobby depth which is measured from the face of the lift doors and includes the depth of the shaft walls, should be of a suitable size to allow a stretcher to be loaded and unloaded from the lift car.

Two typical stretcher length dimensions are:

- Wheelbase stretcher: 1950mm
- Long spinal board: 1980mm

The lift design should include connection and interface with other building services and requirements such as:

- Dual power supplies
- External intercom at each lift landing entrance
- Refuge designated areas

The lift size for using stretcher evacuation is detailed within BS EN81-70:2021 as a Type 3 lift. A recent ergonomic study of lifts at HS2 Old Oak Common, Evacuation Lift Stretcher Ergonomics Study, document reference number no.: 1SN02-WSP-HF-REP-SS07-000002, determined a minimum lift car width of 1200mm which would accommodate an ambulance stretcher and paramedic. BS EN81-70:2021 recommends car width of 1100mm for Type 3 lift.

4.4.5 Self-Evacuation – BS9992:2020

The lift and escalator design should consider the requirements of BS9992:2020, 'Fire Safety in the Design, Management and Use of Rail Infrastructure. Code of Practice', particularly in respect of self-evacuation.

Self-evacuation of PRMs is assumed to be evacuation from a fire/smoke affected area to a refuge space within the evacuation lift lobby without assistance. Operation of the lift under evacuation control mode is a managed operation as this would involve an evacuation operative risk assessment and manual override of the evacuation lift.

The above requirements should be fully coordinated with the Fire Engineer during the respective design stages to confirm the lifts and escalators are designed to address the agreed station evacuation strategy and procedures.

ESCALATORS

4.4.6 Self-Evacuation – BS9992:2020

The escalator design should consider the requirements of BS9992:2020, 'Fire Safety in the Design, Management and Use of Rail Infrastructure. Code of Practice', particularly in respect of self-evacuation.

The evacuation via escalators may be only way of escape from fire/smoke affected area in addition to lifts. PRMs are usually evacuated by the lifts and escalators may be used as passenger escape route. In this case escalators are required to operate without stopping when power supply is changed over.

The above requirements should be fully coordinated with the Fire Engineer during the respective design stages.

A project team could determine that the BS 9992 requirements are not considered feasible for their particular scheme, and apply a risk assessment process to demonstrate alternative measures to manage the risk as much as reasonably practicable, and assure the risk is tolerable to those affected. The risk assessment process would be required to complete the standard network rail governance process and be confirmed as achievable with station operations.

4.4.7 PRM Evacuation

Persons with reduced mobility (PRM) should not be exposed to greater risk of fire then other persons who are able to readily use stairs or escalators to reach a place of safety. When designing VC strategies or equipment its fundamental to assure the above design requirement can be achieved.

Consideration should be given to the following factors –

- → Design preference is for all occupants including PRM's to be able to self-evacuate.
- → PRM evacuations should not be delayed for an extended period compared with the rest of the station's occupants
- → For unstaffed stations the means of escape route should allow PRM to proceed to a place of safety unaided.
- → Refuge areas are not considered acceptable if the occupants are required to wait for emergency services or remote located staff assistance to assist with evacuation.
- → The design should allow for the operational procedures for managing evacuation of PRMs to be achievable.
- → PRM does not only include wheelchair users but for a wider range of people who may be mobility impaired.
- → Consideration should be given to the use of emergency voice communication points to allow PRM communication to station operations.
- → The requirements of PRM evacuation are station specific and therefore the stations fire strategy plan, VC design, fire risk assessments, management strategy and operational plans should be closely coordinated.

4.5 Safety

4.5.1 Single point of failure for VC assets

Together with the location of VC assets a single point of asset failure is also an important design parameter for the vertical circulation strategy of NR stations. The single point failure of a VC asset should cause a passenger Ped flow imbalance, tailgating and restricting PRM access to and from platforms. To mitigate this issue, it is recommended to:

- → Provide a horizontal link with other VC assets on the station that can be used for access. This may be achieved by inclusion of subway or overbridge element in the station design
- → Provide additional VC assets which form part of the overall station VC strategy that is typically used
- → Mobile phone apps can be used to allow passengers to see if lifts or escalators are in service at particular stations before/ during their journey. It is the station operators duty to communicate when VC services are out of service.

An AfA footbridge lift failure is unlikely to have an alternative means of escape or access for PRM's and would be managed by comms.

LIFTS

Safety is achieved by the provision of a range of operational and maintenance safety functions and features such as:

4.5.2 Operation

- → 24/7 emergency communication system to an external rescue service
- → Light ray curtain which prevent physical contact with the lift doors
- → Measures to avoid dragging of children hands with power operated glass doors
- → Voice synthesiser message to advise lift action under a fire alarm event such as, 'Fire Alarm Activated, Lift Travelling to Concourse / Platform Floor; Please Exit the Lift'
- → Measures to prevent uncontrolled movement of the lift when the lift doors are open
- → Mechanical and electrical door locking devices
- → Lift car safety gear to prevent over speed
- → Safety switches for various lift components
  - → Over or under pressure switches for drives of hydraulic lift installations
  - → Brake switch for traction machines
- → Passengers' visibility through glass panels on the lift car and landing doors (passenger reassurance)
- → CCTV in lift cars and at lift landing lobbies

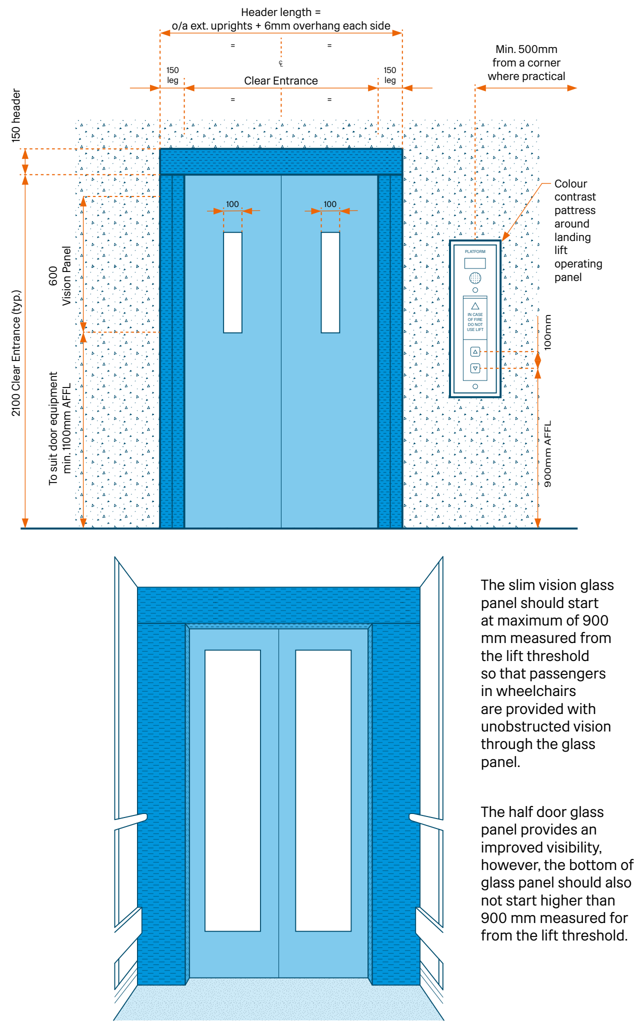


Image 4.11
Lift Vision Panel Key Dimensions

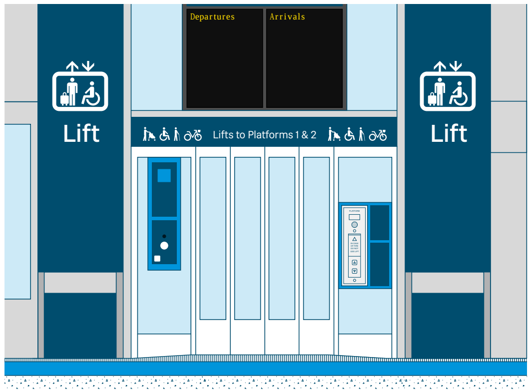
4.5.3 Passenger visibility in lifts

When the lift cars are installed in NR recommended steel enclosures, it is important that the lift car and landing doors have a clear means of visibility for the traveling passengers. The main benefits and importance of passenger visibility when using lifts can be summarised as follows:

- → Provides visual effect indicating the lift car movement
- → In case of breakdown, provides passengers safety reassurance in a stationary lift, and visible to Station staff who can raise the alarm
- → Mitigates issues with vandalism associated with non-manned NR Stations

Where glass door panelled lift doors are provided, it is important the glass is fire rated as per NR requirements.

Currently, NR has two proposed glass door panelling arrangements for the lift car and landing doors, as indicated in Image 4.12.



Full height glazed door panels which start at 400mm from the lift threshold provide greater visibility, as well as enabling an anti-kick assembly to be incorporated. This is recommended due to potential damage caused by passengers with heavy luggage, trolleys, or self-propelled wheelchairs.

Image 4.12
Lift Vision Panels in glazed shaft

ESCALATORS

The escalators should be provided with a range of operational and maintenance safety functions and features such as:

4.5.4 Operation

- → Emergency stop buttons
- → Balustrades and anti-fall protection system
- → Anti-climb / anti-slide barriers
- → Skirt deflectors
- → Handrail speed monitoring device
- → Comb safety device
- → Operational and auxiliary brakes
- → Broken chain device
- → Speed control device to prevent the escalator from over speeding
- → Safety warning notices / signs
- → Barriers to control passenger access and movement

4.5.5 Maintenance

- → Escalator maintenance barriers
- → Inspection control device
- → Emergency stop switches in escalator upper and lower chambers
- → Lighting in escalator upper and lower chambers
- → Electrically interlocked upper and lower inspection covers

This section covers materials, that can be used as finishes internally and externally to clad VC elements.

Image 4.13
Transparent glass with lower section obscured.

4.6.1 Transparent Glass / Opaque Fritted Glass

Glass is hard-wearing, and a good choice for internal and external use. Glare should be considered, and also the cleaning strategy when over the railway. Attention should be given to how glass performs when damaged. A wide variety of specifications and performances are available, however consider how easy these are to source for replacement. When opaque it should be ceramic fritted as some back painting can deteriorate. Coloured inter-layers can also be used.

Note that glazing should meet National Railway Security Programme mandatory specification and follow SIDOS recommendations where required.

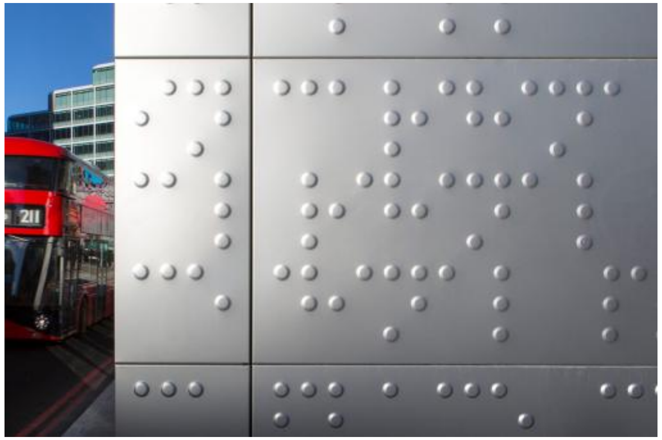


Image 4.14
Metal Cladding panels

4.6.2 Metal cladding panels

Metal cladding panels can be used with a variety of finishes and effects, such as anodising, vitreous enamel and powder coating. Many proprietary panel systems and fixings are available.

Consider durability, maintenance and replacement strategy, and glare if using highly reflective finishes such as stainless steel.

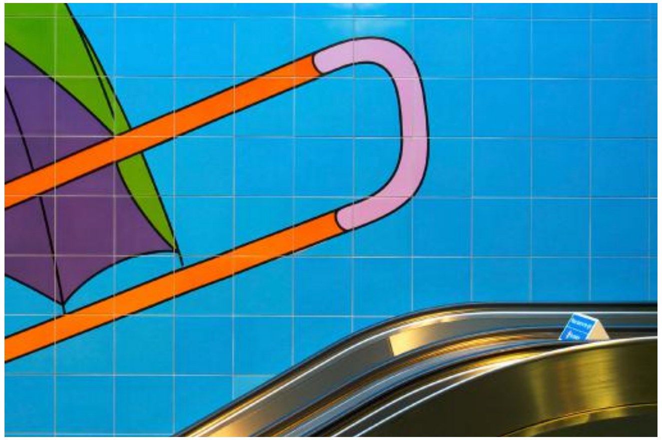


Image 4.15
Ceramics

4.6.3 Ceramics

Ceramics are available in a wide range of finishes and colours, from unglazed terracottas through to colourful glazed ceramics. They require very little cleaning or maintenance, and are robust, long lasting and when glazed easy to use.

They can be cost effective used in a traditional tiled format as well as in many contemporary and innovative ways i.e. hung in modular panels or cassettes.

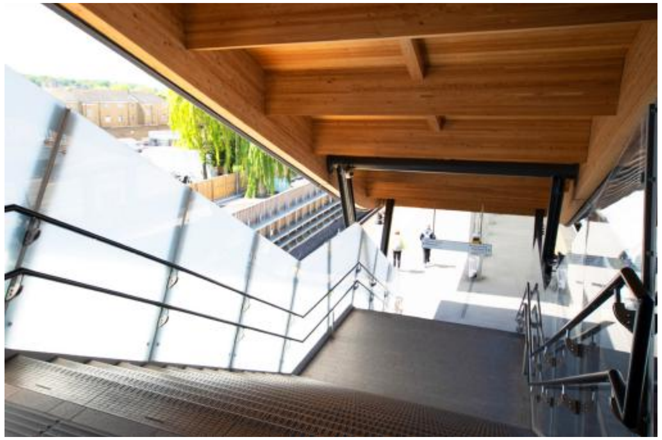


Image 4.16
Timber

4.6.4 Timber

Timber can provide a sense of warmth and a natural variable finish. Different types of timber can provide a range of colours, and the use of different timber treatments provides further options. Timber can be locally sourced, and provide a smaller carbon footprint than most other materials. Timber has comparatively good acoustic absorbance.

Fire design should be considered both for the timber and any treatments, and this may restrict use, particularly in sub-surface stations.

Image 4.17
GFRC Precast Concrete

4.6.5 Glass Fibre Reinforced Concrete (GFRC)

GFRC is available in a wide range of colours and finishes, is durable and it is much lighter weight than typical precast /in-situ concrete as it can be used in much thinner applications of around 50mm.

The reduced weight makes it ideal for use on an overbridge. Glass Reinforced Concrete (GRC) and GFRC is not as robust as in-situ/precast concrete, so care should be taken at using it at ground level, where exposed edges and corners could be at risk of damage in a rail environment.

Image 4.18
Brick

4.6.6 Masonry

Masonry can be used both structurally and as a finish. A wide variety of colours and textures can be achieved. Much of the existing station estate is brick, and therefore it is a good choice when trying to complement existing features. Contemporary detailing and palettes can be used to distinguish new elements from older parts of the station.

4.7 Construction

LIFTS

4.7.1 Future Proofing

The lift shaft, pit and headroom dimension should be suitable to accommodate multiple lift manufacturers equipment as this should establish a competitive tender process with any future full lift replacement works.

4.7.2 Installation

The lifts should be designed for ease of installation, repair, maintenance, cleaning, replacement, sustainability and minimally should consider:

- → Elimination of manual handling where possible
- → Safe working at height
- → Lift pit and lift shaft head structural loads
- → Lifting beams / eyes within the lift shaft and Lift Equipment Room (LER) for installation and future maintenance activities
- → Access for the largest and heaviest items of lift equipment; these are typically the lift car floor assembly (if single piece), lift machine and guide rails which are normally manufactured in 5 metre lengths
- → Secondary steelwork required to support and fix the lift equipment
- → Minimal down time during repair activities
- → Coordination and interface with all relevant building services

4.7.3 Replacement

The lift design should establish that component parts can be safely and easily removed and replaced from the lift shaft and machine room, with a clear access route to a point of collection / delivery. This may require permanent or temporary lifting points to be provided to assist with this operational process.

Replacement works require a DIA (as outlined in section 2.1.5) to document impacts on station operation and, any mitigations required as part of the replacement cycle.

Any replacement works should be undertaken outside of normal station operating hours. These works may require appropriate protection being applied to prevent against damage occurring to floors and walkways along the access and egress route.

When removing expired equipment, there may be a requirement for oversized compartment parts be cut down in situ. Where this situation arises, all works should be undertaken in accordance with an approved hot works permit and detailed method statement and risk assessment.

ESCALATORS

4.7.4 Future Proofing

The escalator upper and lower chambers dimensions should be suitable to accommodate multiple escalator manufacturers equipment as this should establish a competitive tender process with any future escalator replacement works.

4.7.5 Installation

The escalators should be designed for ease of installation, repair, maintenance, cleaning, replacement, sustainability, and minimally should consider:

→ Elimination of manual handling where possible

→ Safe working at height

→ Escalator loads on upper and lower structural slab levels

→ Clear access for a complete escalator assembly; this may require delivery prior to the station roof being constructed to allow crane use and access

→ Where the size of a complete escalator assembly cannot permit a single section delivery, the escalator may necessitate delivery in multiple sections; this is usually 2, 3 or 4 depending on overall rise of the escalator

→ Where escalators are delivered with multiples sections, the Escalator Contractor should establish correct site alignment, so as to replicate the factory results where the escalator assembly was erected and offsite testing works were undertaken

→ Secondary steelwork required to support and fix the escalator equipment

→ Minimal down time during repair activities

→ Coordination and interface with all relevant building services; refer to section heading, 'Key Service Interfaces

4.7.6 Replacement

The escalator design should establish that component parts can be safely and easily removed and replaced with a clear access route to a point of collection / delivery. This may require permanent or temporary lifting points to be provided to assist with this operational process.

Any replacement works should be undertaken outside of normal station operating hours. These works may require appropriate protection being applied to prevent against damage occurring to floors and walkways along the access and egress route.

The replacement works should consist of either:

→ Partial replacement involving the replacement of the handrails, comb plates, skirtings, steps, drive assembly and escalator's external cladding

→ In-truss replacement involving the complete replacement of all escalator equipment excluding the truss. The truss can be modified to suit new equipment where necessary

→ Full replacement involving the complete replacement of all escalator equipment including the truss

There may be a requirement to for oversized compartment parts be cut down in situ. Where this situation arises, all works should be undertaken in accordance with an approved hot works permit and detailed method statement and risk assessment.

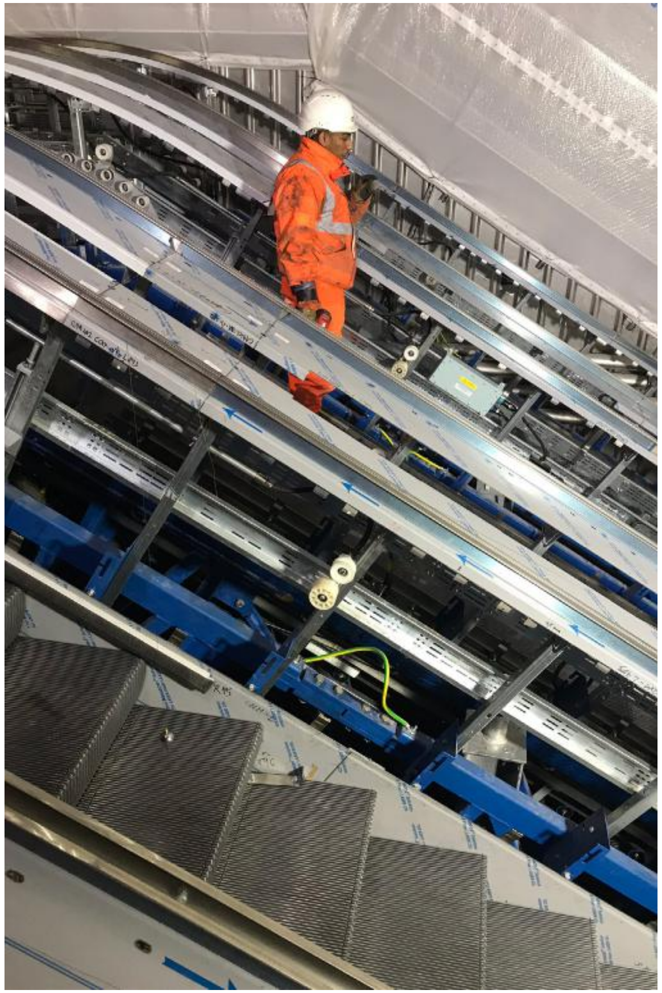


Image 4.19
Escalator Installation at Liverpool Street Elizabeth line station

4.8 Design Life & Design Life Requirements

LIFTS

4.8.1 Equipment / Component Replacement Periods

The life expectancy of the lift components vary and can be greatly influenced by level of usage, quality of maintenance, cleaning and passenger handling. Based upon a typical station demand, image 4.20 provides an indication for the major lift component replacement intervals.

All components with a design life of less than 5 years should be replaceable within a single 4 hour engineering shift, or the station lift system should provide redundancy to enable longer shutdown periods without compromising on safety or customer requirements.

The expected serviceable lifetime of the lifts should not be less than be 25 years. However, for structural elements a longer life span should be considered to allow the lift to be replaced without replacing all elements.

Standards Reference

Standard Specification for New and Upgraded Lifts
NR/L2/CIV/193
Selection and Design of New and Upgraded Lifts
NR/L3/CIV/194

4.8.2 Maintenance

Each lift installation should be provided with a fully comprehensive maintenance agreement full in accordance with the requirements of NR/L2/CIV/193, 'Standard Specification for New and Upgraded Lifts' and NR/L3/CIV/194, 'Selection and Design of New and Upgraded Lifts'.

Maintainability and reliability of the lifts are crucial operating issues which should be considered in equipment type and selection.

The planned service and maintenance regime of each lift should minimally consist of:

→ Regular equally spaced preventative maintenance visits which should be based upon monthly visits (minimum of 12)

→ All scheduled maintenance activities should be undertaken during non-operational hours

→ Regular inspections and adjustments to confirm satisfactory operation of lift machines, controllers, door gears and door operators and car and landing controls

→ Regular inspection of all safety equipment and electrical circuits / switching

→ Regular lubrication

→ Regular inspection of floor levelling accuracy

Lift Equipment	Replacement Interval
Lift Controller including drive unit	15 - 20 years
Hydraulic power unit (motor, pump, control valve)	15 - 20 years
Traction machine (gearless)	20 - 25 years
Hydraulic jack (single stage)	25 - 30 years
Door operating mechanism	10 - 15 years
Lift car enclosure and Car sling	25 + years
Lift signalisation	10 - 15 years
Safety gear and Over-speed governor	20 - 25 years
Machine room less lift complete	15 - 20 years

Table 4.20
Lift Equipment Replacement Intervals

4.8 Design Life & Design Life Requirements

4.8.3 Cleaning

It is important that cleaning of external elements of the lifts is undertaken with particular emphasis on the following two areas:

→ The landing sill tracks should be regular cleaned out to prevent a build-up of rubbish and debris that could cause the lift landing doors to malfunction

→ The car sill tracks should be regular cleaned out to prevent a build-up of rubbish and debris that could cause the car doors and door operator to malfunction

The frequency of cleaning out the car and landing sill tracks may vary between each respective lift / station and in some instances may have to be undertaken on a nightly basis.

The lift landing entrance frames, doors and architraves should be cleaned in accordance with an approved cleaning method and propriety cleaning substance at weekly intervals.

The maintenance contract should also include cleaning of the internal glass shaft and structural steelwork elements which would be carried out by the Lift Maintenance Provider. Alternatively, the Lift Maintenance Provider could provide attendance to drive the lift car for a Specialist Contractor to undertake the cleaning works.

The lift shaft construction should establish ease of access to all visible areas and designed such that any build-up of dirt and debris is kept to any absolute minimum.

ESCALATORS

4.8.4 Equipment / Component Replacement Periods

The life expectancy of the escalator components vary and can be greatly influenced by level of usage, quality of maintenance, cleaning and passenger handling. Based upon a typical station demand, 4.21 provides an indication for the major escalator component replacement intervals:

All components with a design life of less than 5 years should be replaceable within a single 4 hour engineering shift.

The expected serviceable lifetime of the escalators should not be less than be 30 years. However, for structural elements a longer life span should be considered to allow the escalator to be replaced without replacing all elements.

Escalator Equipment	Replacement Interval
Steps and Rollers	5 - 10 years
Handrails	5 years
Balustrades	25 years
Step Chain	10 - 15 years
Drive Chain	15 - 20 years
Motor & Gearbox	20 - 25 years
Controller & Drive	15 - 20 years
Guidance system	15 - 20 years
Truss	Over 60 years

Table 4.21
Escalator Equipment Replacement Intervals

4.8.5 Maintenance

Each escalator installation should be provided with a fully comprehensive maintenance agreement full in accordance with the requirements of NR/L2/CIV/196, 'Standard Specification for New and Upgraded Escalators' and NR/L3/CIV/197, 'Selection and Design of New and Upgraded Escalators and Moving Walks'.

Maintainability and reliability of the escalators are crucial operating issues which should be considered in equipment type and selection.

The planned service and maintenance regime of each escalator should minimally consist of:

→ Regular equally spaced monthly preventative maintenance visits (minimum of 12)

→ All scheduled maintenance activities should be undertaken during non-operational hours

→ Regular inspections and cleaning of the drive and return stations and replacement of defective lighting systems to maintain satisfactory operation

→ Regular inspection of all safety equipment and electrical circuits / switching

→ Regular lubrication

→ Regular inspection of step alignment and accuracy

→ The steps should be regularly checked for build-up of rubbish at the interconnecting sections and removed as required

→ The step / comb plate intersection should be regularly checked for build-up of rubbish and removed as required

→ The balustrades should be regularly cleaned with an approved proprietary cleaning product

→ Handrails should be regularly checked and cleaned to remove unwanted 'bodies' such as chewing gum.

4.8.6 Cleaning

It is important that cleaning of external elements of the escalators is undertaken with particular emphasis on the following three areas:

→ Cleaning of steps should be undertaken at regular intervals to generally prevent the build-up of dirt deposits, especially the step / comb interface

→ Lower and upper chambers including access panels

→ The glass balustrades and cladding should be cleaned in accordance with an approved cleaning method and propriety cleaning substance

The frequency of undertaking the above cleaning operations may vary between each respective escalator / station and in some instances may have to be undertaken during non operational hours.

4.9 Whole Life Cost - Lifts and Escalators

'Whole Life Cost' relates to the total cost of ownership over the life of each individual asset. Costs considered include the initial capital outlay which is usually clearly defined and a key factor influencing product / supplier selection, in addition to operating, maintenance, cleaning, refurbishment, renewal and sustainable disposal costs.

The initial capital outlay is only a portion of the costs over an asset's life cycle which should be considered during the product selection process.

4.9.1 Life Cycle Cost Analysis

A life cycle cost analysis involves the analysis of the costs of lifts or escalators component over its entire life span as follows:

- Acquisition (Capital) Costs
- Operating Costs
    - Cost of repairs
    - Cost for spares
    - Downtime costs
- Energy costs (this can be negligible between lift and escalator manufacturers)
- Maintenance Costs
    - Cost of corrective maintenance
    - Cost of preventive maintenance
- Refurbishment Costs
    - Lift refurbishment costs considers replacement of lift machine, controller, lift car and signalisation
    - Escalator refurbishment costs considers replacement of escalator machine, controller, steps, guidance system, newel ends and step and drive chains
- Renewal Cost
    - Lift renewal cost considers complete lift replacement with minor building works to the lift shaft
    - Escalator renewal cost considers complete escalators replacement with minor works to the escalator truss
- Disposal Cost

Image 4.22
Vertical Circulation at Grand Central, Birmingham New Street station

Document References

A

Vertical Circulation

Definitions

References

Image Credits

Accessible Route
A primary public access route to a building, station or train also referred to as Unobstructed Route in the DfT COP. There should be at least one such route in a station from the entrance to the train. It should not exceed 400m and be at least 1.6m wide with no obstacles (including steps) that might impede the movement of any passenger.

ACOP
Approved Code Of Practice documents are approved by the Health and Safety Executive. They give practical advice on how to comply with the law. Dimensions provided in ACOP documents should be followed in railway environments.

AfA
The DfT 'Access for All' programme is delivered by Network Rail and provides accessibility improvements at selected stations.

ALARP
'as low as reasonably practicable'

CDM
Construction Design and Management refers to regulations issued in 2015 by the Health and Safety Executive that place legal duties on clients, designers and contractors involved in construction activity.

CSM and CSM REA
Common Safety Method for Risk Evaluation and Assessment is an ORR imposed European regulation that places duties on those in charge of projects who wish to implement a change to a technical, operational or organisational aspect of the railway system.

DIA
Diversity Impact Assessment is the process by which Network Rail assesses and consults, under the Equality Act (2010), on the effects that a project can have on different groups in the community.

Deviation or Derogation
For Network Rail and Railway Group Standards, a deviation and derogation is defined as "a departure or alternative approach" from the originally specified requirement. The Network Rail process is defined in NR/L2/EBM/STP001/04 'How to manage deviations to Network Rail and Railway Group Standards'

FRP
Fibre-reinforced plastic

GRC/GFRC
Glassfibre Reinforced Concrete

LRV
Light Reflectance Value

MMC
Modern Methods of Construction

ORR
The Office of Rail and Road is the independent safety and economic regulator for Britain's railways. www.orr.gov.uk

OHLE/OLE
Over Head Line Equipment refers to the electrification lines of trains that occur above the track and over the train.

PRM
Persons with Reduced Mobility - This term is used to define different user classifications including wheelchair users, passengers with an ambulant disability (a physical mobility impairment which doesn't require use of a wheelchair), passengers with heavy or large luggage and passengers with young children.

This term has been used in this Design Manual as it is defined in the Technical Specification Notice Persons with Reduced Mobility published by the DfT

PRM NTSN
'Persons with Reduced Mobility — Technical Specification for Interoperability' is a European standard which provides the accessibility requirements of rail vehicles and railway stations. Since January 2021 the NTSN has been replaced and reproduced the provisons of the Technical Specification for Interoperability for Great Britain. TSIs continue to have direct effect in Northern Ireland.

RDG
The Rail Delivery Group is an association of train and freight operators, Network Rail and other companies in the railway industry.

RRD
Route Requirement Document is the project brief. This was previously known as project requirement specification (PRS).

Route Asset Manager (RAM)
Route asset managers are responsible for defining the scope of work via the RRD. They participate in the selection and approval of the selected design (Approval in Principle forms 001 & 004) as they will be eventually in charge of the new infrastructure.

RSSB
The Rail Standards and Safety Board measure safety performance and analyse risk for the UK rail industry, and publishes Railway Group Standards. www.rssb.co.uk

Security in the Design of Stations (SIDOS)
Policy and best practice guidance from the Department for Transport on land transport security for industry, transport operators, and local authorities.

SfA
Step Free Access - This term is commonly used to refer to Step Free Access Implementation projects.

SFAIRP
An acronym for " So Far As Is Reasonably Practicable ". Reasonably practicable involves weighing a risk against the trouble, time and money needed to control it. www.hse.gov.uk/risk/theory/alarpglance.htm

SFO or TOC
Usually the Station Facilities Operator or Train Operating Company franchises the station from Network Rail and is legally responsible for its operation. Hence it has a major interest in all design stages. In managed stations, it is not uncommon for Network Rail to be the operator of the station (the SFO) that provides service to a number of train operators (TOCs) using the station.

Station Category
The DfT's station categorisation reflects the number of passengers using the station and the importance of the station.

SRV
Slip Resistance Value

Third Rail
A rail electrification system that uses an electrified rail at track level, rather than an overhead line.

References

DfT Code of Practice
'Design Standards for Accessible Railway Stations'. (2015)

NTSN
Railway interoperability: National Technical Specification Notices
Persons with reduced mobility, (2021)

BS 5400
Steel, Concrete and Composite Bridges (1983-2000) BS 6180 Barriers in and about buildings – Code of Practice (1999)

BS 8300
Design of an accessible and inclusive built environment – Code of Practice (2018)

BS 9992
Fire safety in the design, management and use of rail infrastructure – Code of practice (2020)

BS 9999
Code of practice for fire safety in the design, management and use of buildings (2017)

BS 7974
Application of fire safety engineering principles to the design of buildings – Code of practice (2019)

BS EN 50122
Protective provisions relating to electrical safety (1999)

Equality Act 2010
The Equality Act 2010 legally protects people from discrimination in the workplace and in wider society

Network Rail
Station Design Principles for Network Rail (2014)
Inclusive Design Strategy (2015)
Station Flooring Guidance & Floor Selection (2014)

FIB
Guidelines for the design of Footbridges (bulletin 32, 2015)

DfT
Guidance on use of tactile paving surfaces (1998)

HSE
Assessing Slip Resistance of Flooring

BRE
Review of Cambridge footbridge design and defects

CIRIA
Fibre-reinforced polymer bridges C779

Highway Structures & Bridges Design
Design of fibre reinforced polymer bridges and highway structures CD368

Railway Bridge Construction
F A W Mann (1972) Hutchinson Educational

RSSB Standards:
RIS/7016/INS Issue 2
Interface between Station Platforms, Track and Trains (2022)

GI/GN7616
Guidance on Interface between Station Platforms, Track and Trains (Issue 2, 2014)

RIS-7700-INS
Rail Industry Standard for Station Infrastructure (2018)

GL/RT1210
AC Energy Subsystem and Interfaces to Rolling Stock Subsystem (2019)

NR Standards:
NR/BS/LI/331
Requirements for parapet heights on over bridge and footbridge structures spanning overhead line electrification equipment *(Issue 3: 2020)*

NR/L2/CIV/003
Engineering Assurance of Building & Civils Engineering works (2021)

NR/L3/CIV/020
Design of Bridges

NR/L3/CIV/151/F010
Standard Designs and Details for Building and Civil Engineering (2020)

NR/CIV/TUM/4000
Technical User Manual for Railway Footbridges in Stations (2020)

NR/L2/CIV/140
Model Clauses for Specifying Civil Engineering Works (2017)

NR/L3/CIV/040
Specification for the use of protective coating systems (2009)

NR/L1/CIV/192
Policy Management of Lift Assets
Module 01 Lift Asset Data/Information Management
Module 02 Lift Design
Module 03 Lift Construct, Commission and Decommission
Module 04 Lift Maintenance
Module 05 Lift Measure
Module 06 Lift Assure
Module 07 Lift Product Approval

NR/L1/CIV/193
Standard Specification for New and Upgraded Lifts

NR/L1/CIV/194
Work Instruction Selection and Design for New and Upgraded Lifts

NR/L1/CIV/198
Work Instruction Lift Construct, Commission and Decommission

NR/L1/CIV/195
Policy Management of Escalator and Moving Walk Assets
Module 01 Escalator and Moving Walk Asset Data and Information Management
Module 02 Escalator and Moving Walk Design
Module 03 Escalator and Moving Walk Construct and Commission & Decommissioning
Module 04 Escalator and Moving Walk Maintenance
Module 05 Escalator and Moving Walk Measure
Module 06 Escalator and Moving Walk Assure

NR/L1/CIV/196
Standard Specification for New and Upgraded Escalator and Moving Walk

NR/L1/CIV/197
Work Instruction Selection and Design for New and Upgraded Escalator and Moving Walk

NR/L1/CIV/199
Work Instruction Escalator and Moving Walk Construct, Commission and Decommission.

NR/GN/CIV/002
Use of Protective Treatments and Sealants (2009)

Network Rail Station Capacity Assessment Guidance (2016)

NR/L2/ELP/21085
Specification for the Design of Earthing and Bonding Systems for 25 kV A.C. Electrified Lines (Issue 5: 2021)

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Appendices

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Inside Cover Images

Front Hoxton station
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Back AVA lift and footbridge - proposed design
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Image B.1
Woolwich Arsenal DLR station

Case Studies

B

Existing Condition - Lift Difficult to see on approach

Image B.2 (Left)
Lift Location when approaching head-on

At Birmingham New Street station, the lift to platforms 1, 1a and 1b are recessed from the concourse. It would have been clearer to identify the lifts if they were in the line of the concourse, however there may be structural and space proofing reasons why this could not be achieved.

The lifts are visible head-on but obscured at a side-on view, where signage has to be relied upon, and at present is easy to miss.

Image B.3 (Above)
Internal view of new stair, with lift beyond as part of vertical circulation scheme

Suggested Improvement

Image B.4
Whilst the lack of visibility of the lift from this angle cannot be overcome, the use of supergraphics can help to identify the lift in a much clearer way to passengers.

For supergraphics to be effective, they should be placed in areas free of advertising, signage, and visual clutter, and positioned so that they can clearly be seen from a distance, to allow decision making.

Appendix B — Case Study 2 - Lessons Learnt
Bristol Parkway Stairs

Avoiding factors that cause dis-orientation

At Bristol Parkway station, the stairs have a higher ratio of accidents than most stairs, which has contributed to a sense of dis-orientation when using.

There are several factors that make these stairs challenging, here are some of the key ones:

- Lack of visual connection to the platforms - passengers cannot see when trains are arriving, and this causes a sense of rushing in case their train has arrived
- Lack of visibility of Customer Information Screens (CIS) adjacent to stairs, causing passengers to rush across stairs to platform
- Lighting that is perpendicular to stairs can cause uneven lighting, at this station there are large gaps between some of the luminaires
- The undulating roof creates an alternating height at different parts of the stair, which can be dis-orientating
- The ribbed profile of the cladding is visually confusing as the horizontally and spacings make the cladding appear similar to the stairs
- Handrails do not contrast against the surrounding wall finishes
- Retrofitted step nosings can raise the step profile, and lead to trips where the nosing and rest of the going is inconsistent

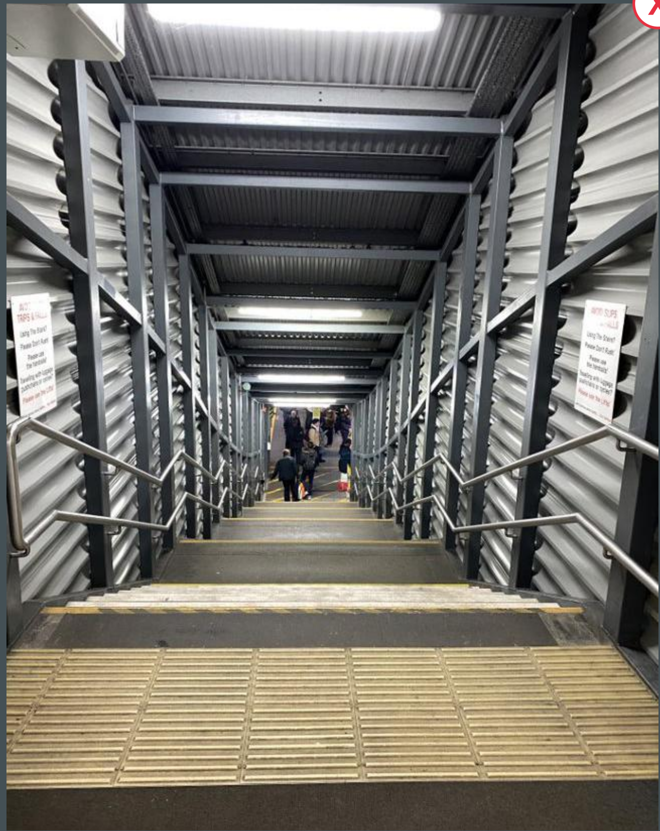

Image B.5 (Above)
View from top of staircase

Image B.6 (Top Right)
View from base of staircase

Image B.7 (Below Right)
View of a well designed staircase at Seven Kings

Appendix B — Case Study 3 - Best Practice
Denmark Hill station New Entrance

At Denmark Hill station, a new entrance and cycle hub has been provided onto Windsor Walk to the north of the station.

The new entrance has photovoltaic panels over the entrance building and vertical circulation, that provide more energy than the new entrance requires, making it a carbon net positive addition to the station.

The entrance is below the station overbridge level, with a small level change of under 2m.

The level change is provided as a ramp and as a set of stairs.

The ramp is provided alongside the stair, providing equal visibility. The ramp is a largely straight run, that returns round to meet the top of the stair.

The design has been considered so that the ramp is fully open and is visible at most points along its length.

Visual treatment has been provided by a tiled artwork that has been developed in collaboration with Camberwell Society and Camberwell Art. This is an effective way of making the ramp feel site specific, and engaging to use.

What could have been improved upon:
Ramps should have a tonal contrast with their landings, and this has not been provided in this example. Additionally, the handrails to the stairs should extend horizontally beyond the end of the stairs.

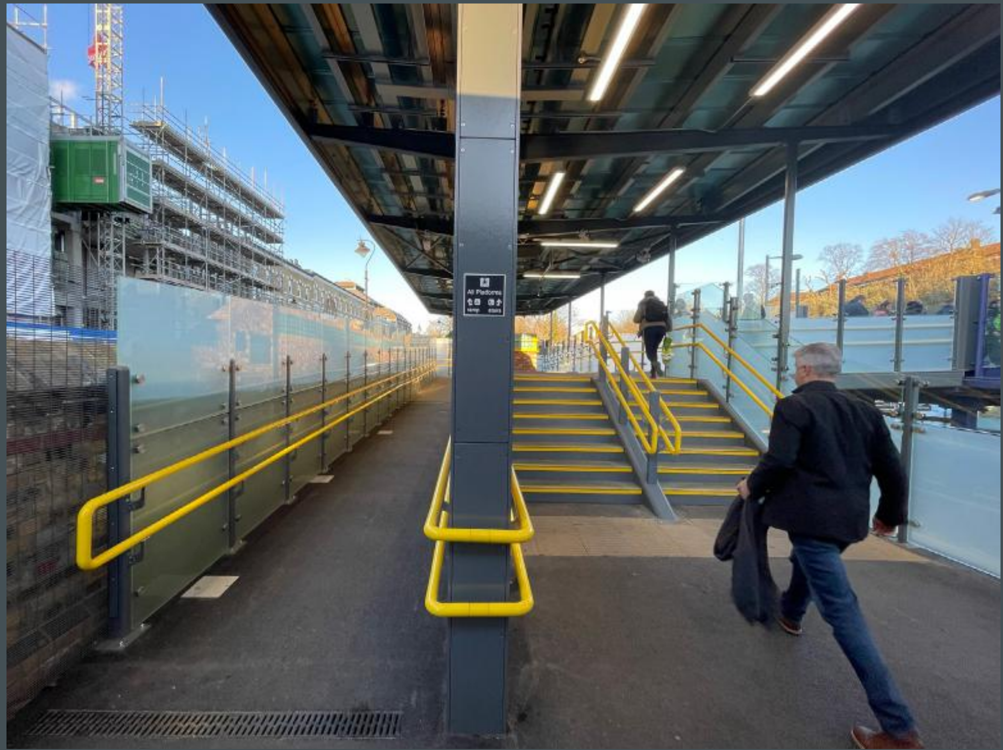

Image B.8
Approach to ramp and stairs when entering via Windsor Walk entrance.

Appendix B — Case Study 3 - Best Practice
Denmark Hill station New Entrance

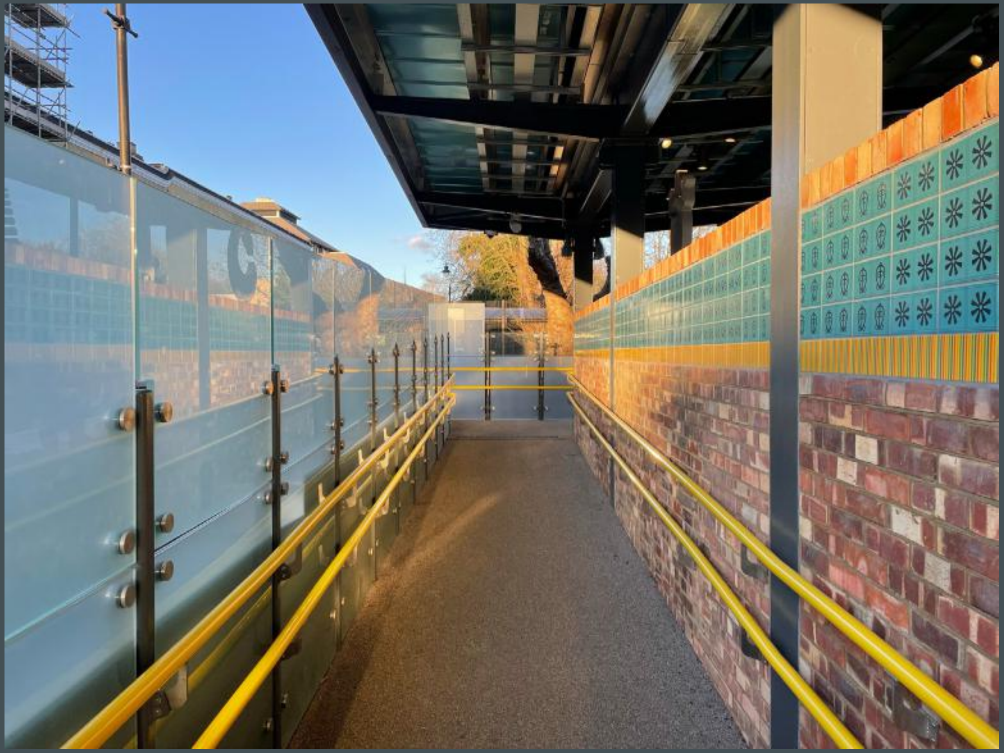

Image B.9
View of ramp, with robust tiled artwork along the length of the ramp on the right hand side. This has been developed in collaboration with Camberwell Society and Camberwell Art

Image B.10
Waiting/resting space at the landing space of the ramp

Appendix B — Case Study 4
Lift Machine Room Placement

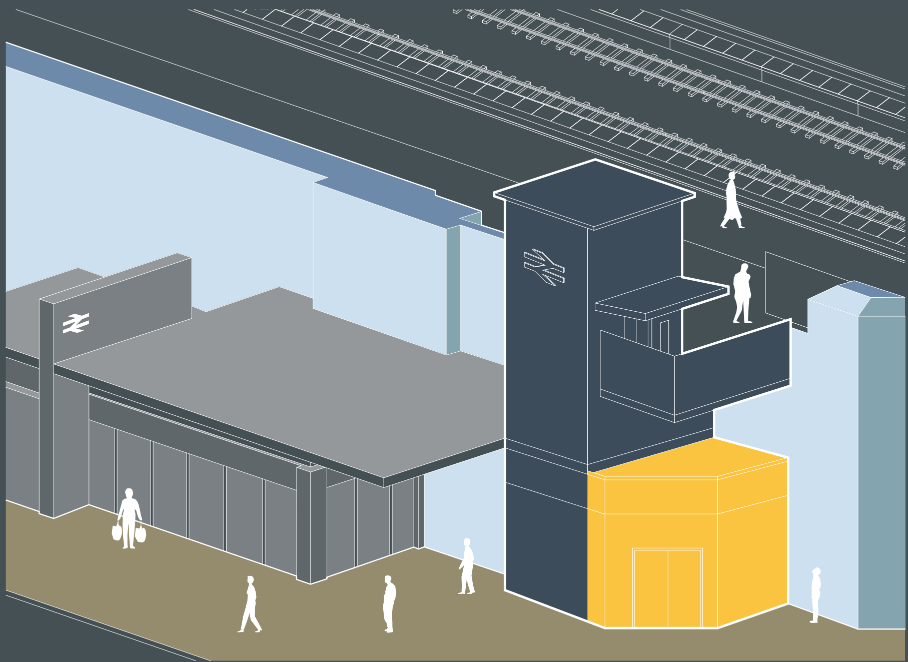

Image B.11
Constructed version

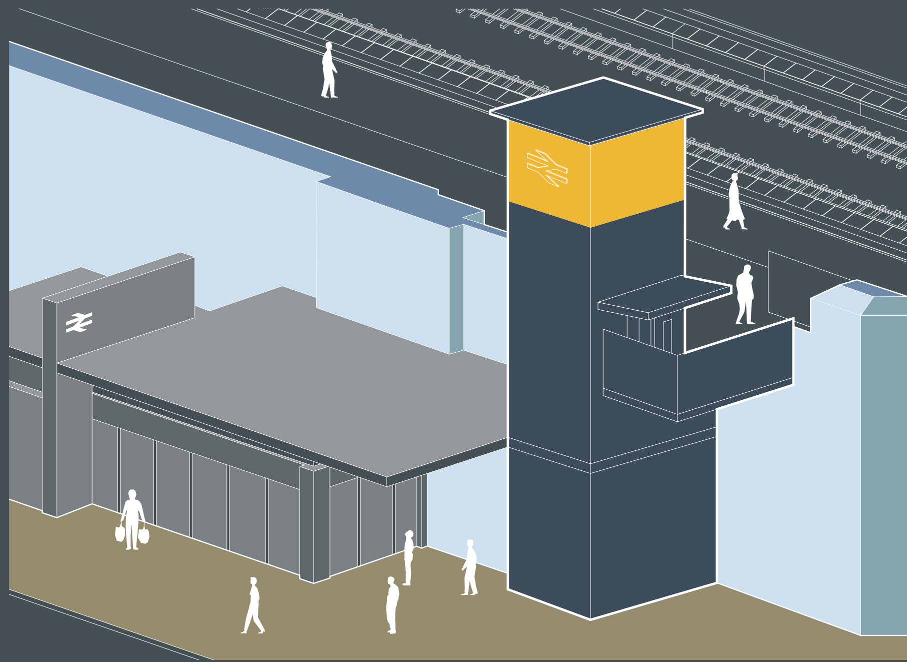

Image B.11
Preferred version - locating the lift machine room elsewhere would reduce space take at street level

The images, based on the addition of a lift at Wandsworth Town station identify some of the spatial challenges of locating lift machine rooms:

- → Some lifts require more space at lower level, which can be challenging to accommodate in constrained locations such as this.
- → Other lifts require overrun space above. This can provide a visual presence for the lift and the station, which can be useful for identification. This extra presence can also be challenging in visually sensitive settings.
- → Locating machine rooms at high level can present access and maintenance challenges

Assessment Aids

C

Vertical Circulation

Lift Requirement Assessment Aid

Lift Requirement Assessment Aid

Network Rail's policy of requiring a DIA for every project assures that the decision to provide a lift on a footbridge or subway will be thoroughly considered in a way that takes into account the users and locality. The following criteria will assist projects in assessing if they may have any grounds for not providing a lift to a public or station footbridge:

1. **Ramp Feasibility —** In cases where the vertical height does not exceed 2m, the provision of a ramp can be considered subject to a DIA.

2. **Gradient Feasibility —** Gradients with slopes of 1:20 (or less) can be a preferable alternative to ramps with landings and should be considered.

3. **Alternative Route —** If an alternative acceptably accessible route already exists in the location, stairs may be sufficient. This alternative route would be subject to a DIA assessment and should include rest points at 50m intervals.

4. **Usage —** If the usage of the bridge is very low, this could be grounds to consider omitting lift access to the bridge, subject to the DIA outcome. For station locations the PRM NTSN Appendix B states: When renewed or upgraded, existing stations that have a daily passenger flow of 1000 passengers or less, combined embarking and disembarking, averaged over a 12 month period are not required to have lifts or ramps where these would otherwise be necessary to provide a step-free route if another station within 50 km on the same route provides a fully compliant obstacle-free route. In such circumstances the design of stations should incorporate provision for the future installation of a lift and/or ramps to make the station accessible to all categories of PRM.

5. **Environment —** If the area or destination either side of the bridge is inaccessible and difficult terrain, this could be grounds to consider omitting an accessible vertical route to the bridge, subject to the DIA outcome.


Welcome to
Widmerpool

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