Design Manual
NR/GN/CIV/200/07

Station Footbridges & Subways

Document Verification

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Purpose and Scope

Nearly all railway stations have to provide access for passengers across the railway line, and many different approaches to footbridges and subways have been taken across the rail network.

This guidance document sets out the principles and considerations for all new footbridges and subways, and offers advice on how existing structures can be adapted, renovated and brought in line with current standards.

Network Rail has commissioned standard footbridge designs, and these should be the first options when considering a new footbridge. This guidance sets out the principles of these designs, and identifies when a bespoke approach may be more appropriate.

The document explains the challenges faced when working with existing live infrastructure, or upgrading an existing structure.

Many existing subways are poorly illuminated and inadequate, with issues such as water ingress. This document advises on how these can be invigorated and made more user friendly. Guidance is also provided on how to create a new subway, and why subways can often provide greater benefits than footbridges.

The guidance refers to a range of Network Rail and external standards that can help the user with their project.

A summary of Footbridge Requirements is provided in Appendix B. Appendix C contains assessment criteria for establishing whether footbridges require Roof Cover and whether Lift provision can be dispensed with in certain locations.

How to use this document

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Section 1
Introduction:

Identifies passenger experience aims for footbridges and subways, Network Rail standard footbridge designs, and different development approaches and scopes of work

2

Section 2
Footbridge Considerations:

Sets out key considerations for planning a footbridge, including context and consents, security, electrical clearance, avoiding glare and whole life design and innovation

3

Section 3
Footbridge Design:

Provides detail on suitable choices of materials and on each element of a footbridge, in order to create successful and compliant designs

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Section 4
Subway Considerations:

Covers specific concerns for subways, such as lighting and space, security and challenges faced by existing subways. Features examples of improvement carried out to existing subways

5

Section 5
Subway Design:

Provides detail on subway finishes and cladding systems, and on overcoming challenges of water management and services and containment

A

Appendices A–C:

- → Definitions
- → References
- → Image Credits
- → Footbridge Summary of Requirements
- → Roof Cover Assessment Aid
- → Lift Requirement Assessment Aid

Hint and tips:
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To return to the contents page you can click on the Double Arrow symbol.

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How to use the guidance

The Network Rail Document Suite

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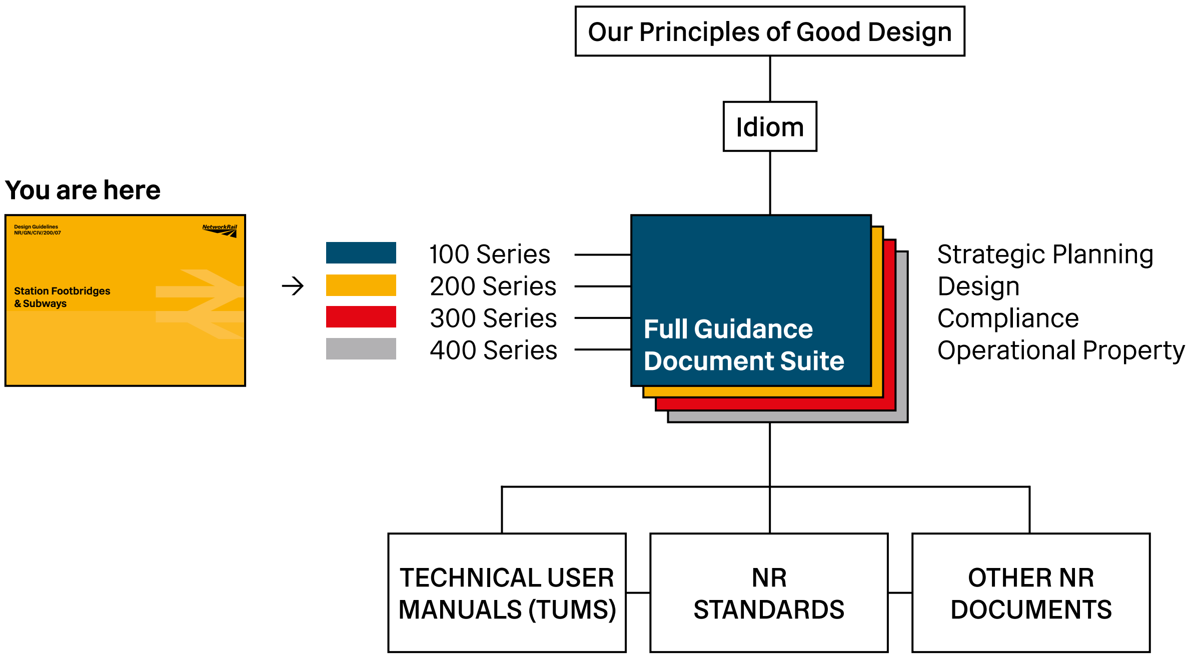


References to other documents

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

Example:

Standards Reference

Technical Specification for Interoperability: Accessibility for Persons with Reduced Mobility (2014)

TSI PRM

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.

Contents

Image 0.1
Stratford station

1

Footbridges & Subways

Introduction

Image 1.1
Southampton Airport station

1.1 Passenger Experience

Legible

Footbridge and subway purpose and access is clear, it is easy to find and use. Routes are direct, and open views and glazing help to provide a connection to where you are and where you are going.
In subways, routes are spacious and unconstrained.

Complementing Local Character

The materiality and design of footbridges should complement the station and surrounding area, whilst taking an approach which is contemporary and not pastiche.

Accessible

Suitable for all to use, and accommodating those with issues such as visual impairment. Using a lift should not feel inferior to using a staircase. Routes and access points are kept as close together as possible.

Well Maintained

This starts with good design, using resilient, robust materials, and designing to reduce the amount of required maintenance.
The design should minimise the requirement for maintenance over or across live infrastructure where possible.

Inviting to Use

Passengers should feel a sense of comfort and delight when using the footbridge or subway. Keeping it legible, accessible, clean and well maintained helps to create a sense of comfort and safety.
Maintaining visual openness with good sight lines and lighting helps passengers feel secure.

Innovative

New materials and construction methods that help to enhance the passenger experience, and to aid efficient construction.
In subways, creative use of lighting helps to animate dramatic and expansive spaces with limited intervention.

Introduction

1.2 Standard Footbridge Designs

Beacon Design

Image 1.2

The Beacon design is characterised by a high degree of enclosure and transparency. It is aimed primarily at smaller local and commuter stations.

The lift towers supporting the minimal steel structure are emphasised and illuminated internally as beacons. Ths is a very modern interpretation of the traditional railway footbridge expressing structural elegance.

Local variations are restricted to the choice of cladding for the lift towers and the lift motor rooms below the stairs.

This bridge is suitable for spans of up to 20m, and it is easily adaptable for locations with multiple spans or staggered platforms, maximising potential use.

The generic design is by Haskoll and Davies Maguire.

Ribbon Design

Image 1.3

This footbridge design is characterised by the seamless continuation of the station environment when crossing the tracks. The lifts and stairs are orientated to reduce the pedestrian travel distance, creating a very inclusive passenger experience when crossing the tracks.

The key design innovation is a 30-degree rotation of the lift shaft, which improves visibility and natural wayfinding. This requires a slightly wider platform by the stairs, but the length of the stair block is short due to the bend of the third flight of steps.

The overall form is organic and continuous without emphasis on individual elements of the structure. Local variations are restricted to the choice of cladding for the lift towers and the lift motor rooms below the stairs.

The generic design is by Knight Architects and Arup.

Frame Design

Image 1.4

This footbridge design was the winner of the RIBA (Royal Institute of British Architects) footbridge competition. It is characterised by a strong architectural form creating a frame which is defined by the spans of the roof and the deck that are extended beyond the lifts. This emphasizes the horizontality of the bridge that is offset against the verticality of the lift towers.

The structure is subservient to the architecture. The roof and deck are structurally independent. The roof structures are concealed by metal cladding. This design has been demonstrated to be very modular, facilitating a great variety of possible configurations.

The stairs are fully enclosed, though a variation with open stairs also exists. The span is partially enclosed, as the glazing does not fully extend to the roof soffit.

The generic design is by Gottlieb Paludan Architects and Davies Maguire..

Standards Reference

Standard Footbridge Designs for Stations
NR/L3/CIV/151/F010

Technical User Manual for Railway Footbridges in Stations
NR/CIV/SD/TUM/4000

1.3 Criteria for Bespoke Footbridge Design

The standard footbridge designs should be used for the majority of new footbridge installations.

However, in some scenarios they may not be the preferred option. Below are some examples of situations where a bespoke design might be appropriate.

Where a standard design is not used a dispensation is required from Head of Buildings and Architecture of NR Technical Authority.

01 Larger stations

Where a station has more than four platforms.

02 Interfacing with existing structure

Where the new footbridge connects into an existing footbridge or concourse.

03 As part of a listed station

Generally, the standard footbridge designs would be suitable, however in some circumstances they may not offer sufficient design and materiality flexibility, or the footbridge may have a visual impact on the existing listed elements.

04 Internal footbridge

Where footbridges are internal, for example within a glazed trainshed, the open variants of the standard footbridges could be used, but a bespoke design may be more effective.

05 Upgrading a footbridge

Many scenarios could involve upgrading and providing step free access to an existing footbridge.

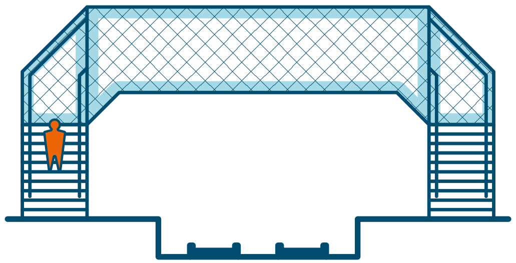
06 Site specific requirements

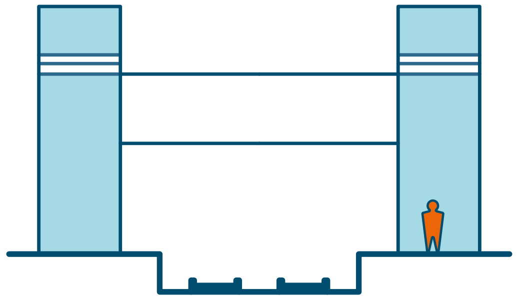
Certain stations cannot accommodate the standard designs as they exceed the parameters of the standard designs, for example by requiring longer spans across the track, having uneven levels between the platforms, or by having spatial constraints that prevent the standard designs being incorporated.

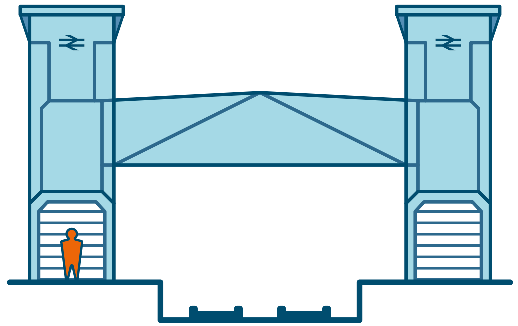
07 A Public right of way exists

In locations with a public right of way across the station footbridge a bespoke design or modification of the standard designs is required

1.4 Footbridge Development Approaches







Stabilisation / Maintenance

Limited works to be carried out to an existing footbridge.

This may include areas such as:

- → Improving floor surfaces and treads
- → Repainting
- → Structural works
- → Lighting and services upgrades

Some of these footbridges may be listed or in conservation areas, where the scope of the work that can be carried out is restricted.

02 Upgrade / Provision of Step Free Access

An existing footbridge requires substantial works.

This may impact the whole of the footbridge, such as replacing the roof, or may be a more focused adaption, such as providing lifts, with limited works to the rest of the structure.

03 New Footbridge

A new footbridge is required.

In the first instance, the Network Rail Standard designs should be considered.

Situations where a bespoke option is most appropriate are listed in Section 1.3.

1.5 Subway Development Approaches

Stabilisation / Maintenance

Limited works to be carried out to an existing subway.

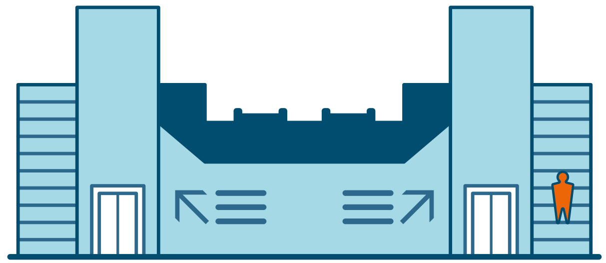
This may include areas such as:

→ Improving lighting and signage
→ Structural remediation
→ Management of water ingress and degradation

02 Upgrade / Provision of Step Free Access

An existing subway requires substantial works.

This may be an upgrade focused on improving accessibility, or a project to carry out structural upgrades or provide new finishes.



03 New Subway

A new subway is required.

New subways offer many advantages over footbridges, such as reduced travel distance, less interface with the live railway, and minimal visual impact.

New subways should create generous and legible space, where natural wayfinding is maximised, and natural lighting is used where possible.

Footbridges & Subways

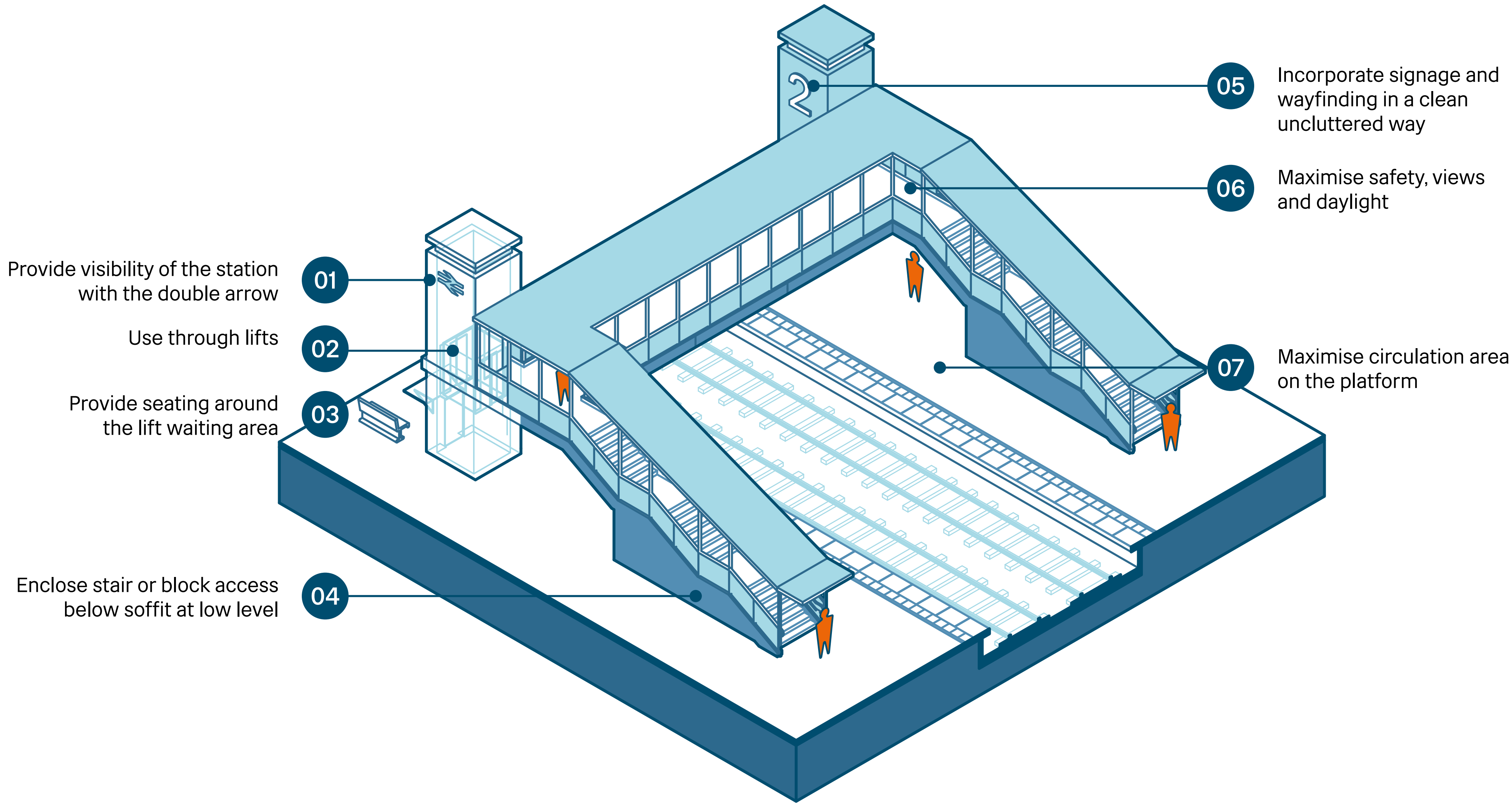
Footbridge Considerations

2

Image 2.1 - Llanfairpwll station
This heritage footbridge has been upgraded to incorporate compliant handrails, new treads, and has been refurbished and repainted

Footbridge Considerations

Navigation Diagram 1



2.1 Accessibility

2.1.1 Locating the Footbridge

Very often there are conflicting demands that ought to be reconciled when locating a footbridge.

The footbridge should be located in an area of the platform that is not overloaded, and where it doesn't interfere with the main passenger flows to and from the platforms.

The strategic location of the bridge is ideally in the centre of the platforms and near the entrance, but for reasons mentioned it might also end up being located at the ends of the platforms due to local constraints. However the travel distance to the footbridge and lift should be as short as possible, to assist all station users.

Stairs, lifts and ramps should all be visible, if possible, as intuitive wayfinding is much more effective than reliance on signage.

2.1.2 Accessibility

The design of stairs is very important. Poorly designed stairs can create a barrier for a large proportion of passengers including the frail elderly and those with cognitive, sensory and mobility disabilities.

Lifts are an essential feature for people who are unable to negotiate steps, including wheelchair users and some ambulant disabled people where the change in level is greater than 2 m and where there is no space to provide a suitable ramp. Lifts are also helpful for older people and families with young children.

Passengers with luggage should always have the option to use lifts rather than stairs and escalators, for safety reasons.

It is vital that a lift's size is appropriate for the intended pedestrian flow. It should be accessible for all users including people using mobility equipment.

Lifts should be designed to be obvious on the approach to stairs and escalators at all levels. This message should be emphasised by using colour, tone, lighting and signage.

Diversity and inclusion assessments (DIA) and consultations with the BEAP Panel are an integral part of the design process. In addition, an access consultant should be form part of the design team.

Standards Reference

Technical Specification for Interoperability: Accessibility for Persons with Reduced Mobility (2014)

TSI PRM

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

BS 8300

2.2 Existing Footbridges

2.2.1 Maintaining Existing Structures
Regular inspection and maintenance is vital for managing structures that are fit for purpose and not degrading. Coatings and paint finishes also have an important role to play in protecting structure from rust and weathering, in addition to maintaining the appearance.

Structures of different construction and from different periods require different maintenance regimes and have separate problems associated with them.

2.2.2 Upgrading Existing Structures
Existing structures often contain many non-compliant finishes and do not meet current standards for accessibility.

Some of these issues can be rectified by upgrading treads, deck surfaces, and installing modern handrails. Care should be taken with heritage structures so that upgrades do not harm the existing structure and that any changes are compliant with legislation and guidance. The Railway Heritage Trust may be able to advise and recommend the right approach in such instances.

Network Rail's Heritage Care and Development Guidance provides advice on the procedures to follow in case the station or railway property is listed or located within a conservation area.

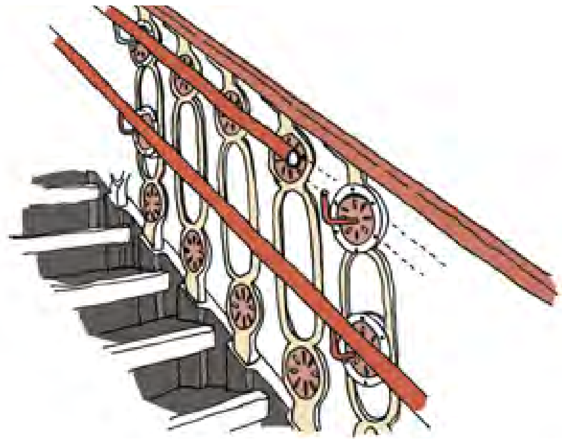


Image 2.2 Upgrading Handrails
Example from Llanfairpwll station footbridge

Image 2.3 Existing, Non-compliant Features
Example of open risers that are not permitted on electrified lines.

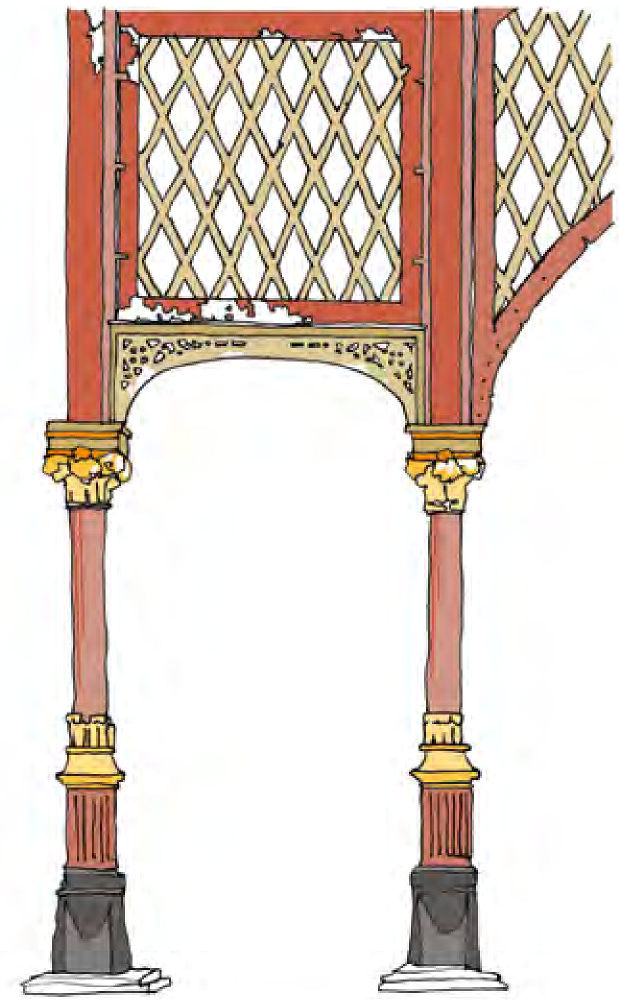


Image 2.4 Maintaining Structure and Finishes
Aging structures require appropriate treatment and finishes

2.3 Context

Image 2.5 Using Traditional Materials
Stone facing detailing to new lifts at Wellingborough station

Image 2.6 Modern approach to differentiate new additions
At King's Cross station the lift shafts have a modern simple aesthetic, with colour tying the lifts to existing structure

Image 2.7 Modern materials and detailing
At Clapham Junction station lift shafts and new staircases have been fitted to the existing footbridge.

2.3.1 Impact on Context

In most instances, the new footbridge will be built in an existing station which is likely to have a distinctive architecture related to the time of its construction. Many UK railway stations are listed or within conservation areas.

The addition of a footbridge has significant visual impact. The lift towers often are the tallest elements and are likely to have the highest visibility. Care should be taken to locate them in a way that minimises impact on the station and its setting. Siting of the footbridge and the choice of materials can help mitigate the visual impact .This should be done whilst balancing the accessibility needs of passengers.

Where possible, subways should be considered as an alternative approach to footbridges, due to the lower visual impact and vertical displacement.

2.3.2 Aesthetic Considerations

There is not one specific approach to designing in an existing station. Many successful examples use a modern style to contrast with existing elements.

Traditional materials should be considered, and these can also work well when combined with appropriate detailing to create a contemporary proposal that is respectful to the host. Section 3.2 of this document identifies how materials that are commonly used in stations, such as brick and ceramics can be used in a variety of ways.

Pastiche approaches should be avoided, particularly where there is not a clear distinction between new and existing elements.

2.4 Environmental Impact

The visual and environmental impact of railway footbridges can be considerable and in small stations they can be the most prominent visual element. It should be noted that where a subway is feasible, the vertical displacement can be halved in comparison with a footbridge (whose deck is typically 6m high), with great benefits to the passenger flow and accessibility. This advantage, not to mention its low visual impact and lower maintenance costs is why subways should always be considered as alternatives to footbridges.

Functionally, there are three generic types of footbridges on the network:

Public Path — These bridges do not serve stations and are typically simpler, often without the need for stairs and lift, and usually do not require roof cover.

Station — These bridges involve movement of passengers, sometimes in large numbers, between platforms and the station entrance. Normally they require roof cover (see Appendix C).

Combined — These bridges combine Station and Public use, usually with a separating barrier between the two. It is not uncommon also to see the two functions completely separated, with two bridges in one station location.

The proximity of the structures to residential premises, potential for loss of privacy and the impacts of lighting from the structures are key considerations that should be considered when designing the new structures.

Although Network Rail benefits from various permitted development rights, in all cases, stakeholders should be consulted and he necessary consents obtained. This should be done by first consulting Network Rail's town planning team regarding any proposals. This team can advise on relevant planning matters, including advice on any consent required. The following is a non-exhaustive list of potential stakeholders and consultees:

- → Local Authorities
- → Community groups
- → Train Operating Companies (TOCs)
- → Local Transport Authorities
- → Environmental Agency
- → Natural England
- → Rail Network Operations
- → Rail Asset Managers and Engineers
- → Rail Safety specialists
- → Station Capacity teams
- → Network Rail Fire Engineers
- → Network Rail BEAP Panel
- → British Transport Police
- → Property Managers and Retail clients
- → The Railway Heritage Trust

Image 2.8 Aristotle Lane, Oxford. The form and colour of this public crossing footbridge blends well into the landscape and is barely noticeable from a distance

Image 2.9 Listed bridge in Appleby station that was salvaged from another station

2.5 Security

2.5.1 Maximising visibility
Areas should feel open and be well lit, avoiding corners and changes in direction where possible in order to open up clear lines of site, and avoid blind spots. They should be at least partially transparent from 1m above floor level, and enclosed passageways on footbridges should be minimised.

The use of glazing on decks and stairs can open up visual connectivity, reduce the feeling of claustrophobia and increase passive surveillance and the perception of security. Lighting should provide uniform intensity and coverage, and allow all passengers to read information and signage clearly at all times of day.

2.5.2 Use of Materials
Durable finishes that perform well against everyday wear and tear, and are easy to maintain and replace also play a part in creating the feeling of a safe and secure environment. Advice should be sought to achieving the correct security ratings for windows and doors, and specifying materials that perform as expected in all anticipated scenarios.

2.5.3 Designing out unused spaces
Unusable and cramped spaces should be designed out, avoiding accessible spaces under the base of the stairs for instance, that are potential hiding places, and are also challenging to clean and maintain.

2.5.4 CCTV
CCTV coverage should be maximised, with blackspots minimised. CCTV should be postioned to maximise the amount of coverage from each camera.
Cameras should be discrete and integrated into the architectural finishes. Cameras that protrude should be avoided and small dome style cameras should be used wherever possible.

2.5.5 Secure Stations Scheme
British Transport Police (BTP) input is available through the Secure Stations Scheme, and guidance is provided online at the Secure Stations website.

Standards Reference

SIDOS — Security in the design of stations (2018)
Centre for the Protection of National Infrastructure

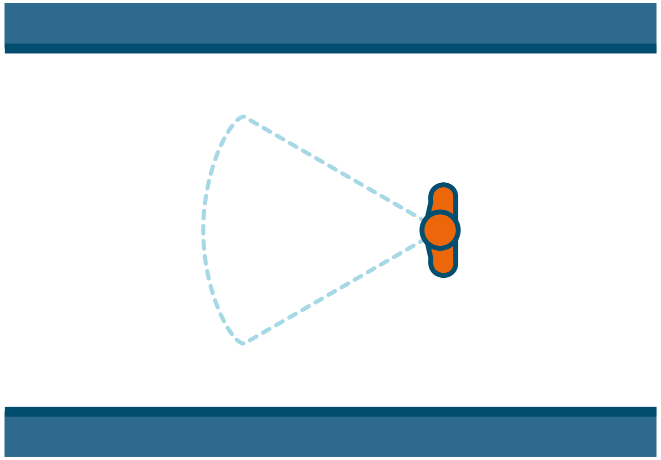


Image 2.10 Clear visibility of routes, no hidden corners

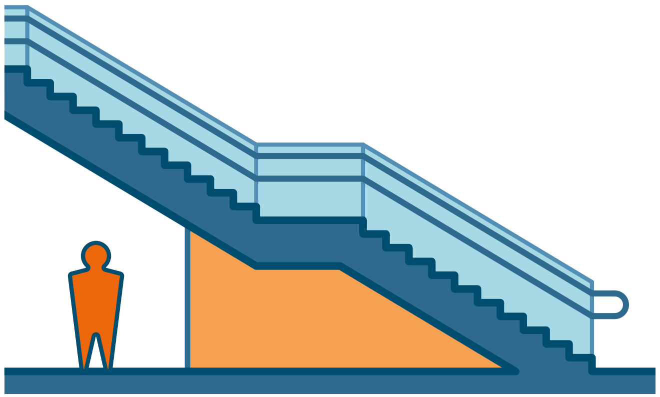


Image 2.11 Unusable space under stairs is avoided or sealed off

2.6 Provision for OHLE

Image 2.12 Example of footbridge over OHLE at Drem Station

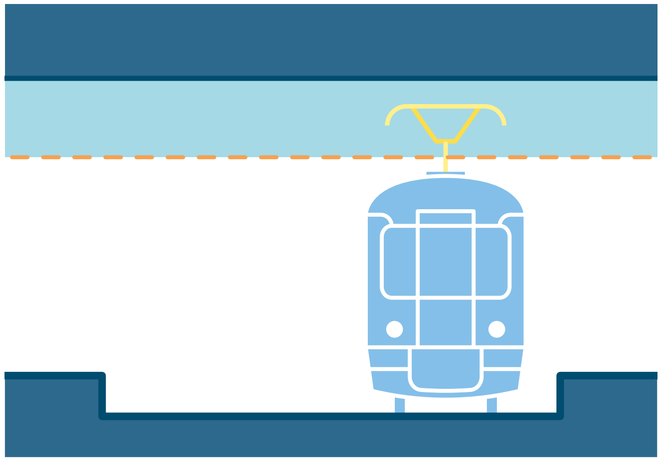


Image 2.13 Spaceproofing for provision for OHLE zone

Any new bridge being installed over a railway line that is on the Trans-European Network should be designed with the appropriate clearances and provision to allow for future (or existing) Overhead Line Electrification (OHLE), even if the OHLE is not present and a third rail line is in place. Any derogation from this TSI (Technical Specification for Interoperability) requirement can only be provided by the European Rail Authority.

For the design of footbridges this has the following major implications:

1. The height of the bridge should provide above track clearance of 4.8 to 5.6m, depending on location
2. If the deck is less than 3.0m above the live wires, the parapets should be a minimum of 1.8m above deck finish or 1.5m if the live wires are shielded below the bridge. If the deck is 3.0m or more above the live wires the parapets should be 1.5m above the deck
3. An appropriate safe methodology should be agreed for the cleaning of any glazed parapets
4. Materials used should be non-conductive or adequately bonded (see below)

NR/BS/L1/331 effectively mandated new requirements for all bridges over OHLE, illustrated in a drawing reproduced here as image 2.17. It requires non-conductive obstacles to be of solid wall design and prohibits use of mesh constructions made of metal.

The requirement for a 1.8m (or 1.5m) high solid parapet that provides visibility to and from the footbridge for the comfort and safety of the passengers, implies the use of glass for at least the upper part of the parapet (above 1m). This in turn raises the issue concerning a suitable method for the maintainer to clean the glass over the OHLE.
For each location it should be established if it is feasible to isolate the lines for the short time it takes to clean the glass, and this should be captured in the Operations and Maintenance Plan as part of the design.

2.6 Provision for OHLE

Image 2.14 Sheffield station — external walkway for maintenance

Image 2.15 Cambridge station — inwardly openable glass panels

Image 2.16 Godalming station — glazing at high level only

There are many examples of footbridges that are enclosed by full-height glass walls and these bridges tend in general to have a more modern and slick appearance. They are usually Vierendeel truss footbridges (3 examples shown above). If the glazing is fixed, the cleaning has to be from the outside, as image 2.14 of Sheffield station demonstrates. If this station had OHLE however, this arrangement would require a maintenance regime that allows for an isolation period of the lines while the glass is being cleaned.

In recent footbridge installations in Cambridge and Winchester stations, the glazed panels were fitted behind the structure and are open-able inwards, refer to image 2.15. However this solution also requires that overhead lines are not live when the glass is being cleaned.

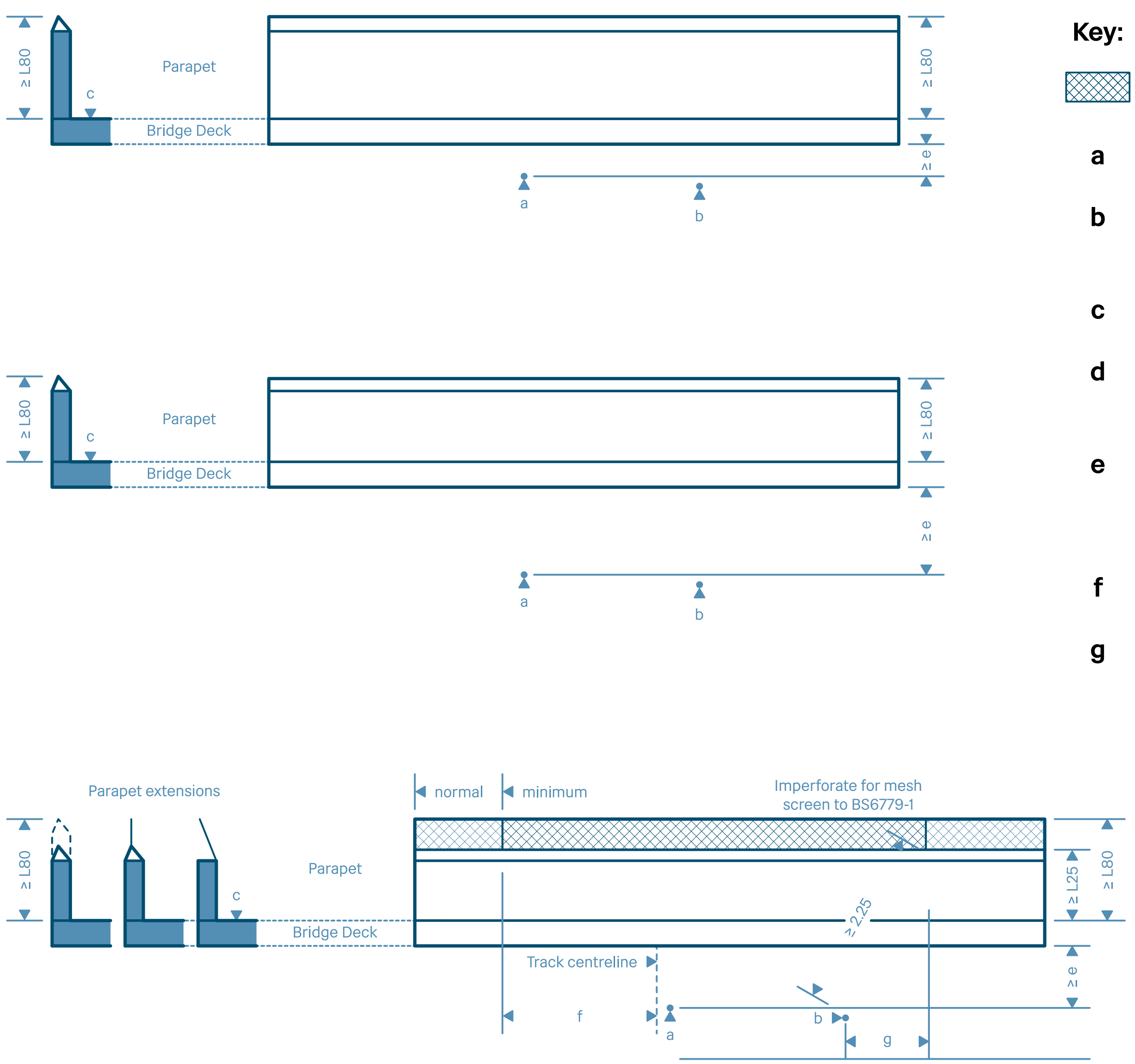
Different systems can have their own advantages and disadvantages, and the cleaning, maintenance and replacement strategies should be weighed up before deciding on a design approach.

In both Cambridge and Winchester stations there have been issues with the breakage of the glass, giving fully glazed bridges a bad reputation in the industry. However with the right design and specification, these issues can be overcome.

The BRE (Building Research Establishment) Defects Report for Cambridge Station contains recommendations for future glazed designs, including a demountable handrail installed in front of the glass as a safety feature that also avoids the toughened glass getting scratched by passengers.

At Godalming, shown in image 2.16 the glazed part of the parapet is limited to inward opening windows, avoiding glazing at low level. This provides an acceptable level of protection from any future OHLE provision. Although it integrates well with its location which is a listed station. it appears bulky in comparison with the fully glazed examples, .

2.6 Provision for OHLE



Key:

- (cross-hatched symbol) Parapet extension (perforate or imperforate)
- **a** Contact wire (or nearest live part)
- **b** Line feeder, bare feeder, auto transformer feeder or return conductor (or nearest live part)
- **c** Standing surface (public areas including motorways)
- **d** Minimum permitted clearance in air between obstacle and live parts in accordance with GT/RT1210 cl. 2.2.3.2
- **e** 'Safety by clearance' dimension to exposed live parts:
  - → for imperforate decks, 2.25m for HV, 1.45m for LV.
  - → for perforated decks, 3.00m for HV, 2.50m for LV
- **f** Minimum 3.00m from track centreline to end of obstacle
- **g** Minimum 1.40m where exposed conductors are being used for traction power supply (e.g. auto-transformer feeder or 0.500m (minimum) where they are not

Note:
All specified dimensions to live parts are minimum clearances under all operating conditions, i.e. temperature and dynamic movements (of both bridge and conductor) should also be added.
Inclined parapet extensions should not extend beyond the rear (railway) face of the parapet by more than 100mm.
BS6779-1 maximum aperture size for mesh screens is 25.0mm x 25.0mm for mesh, or 45.0mm x 20.0mm for expanded metal screens.

Image 2.17 Parapet illustration, from NR/BS/LI/331 (modification to NR/L3/CIV/020)

2.7 Glare

Glare is a harsh dazzling light that can affect safety and the ability to see. There are two significant types of glare commonly associated with sunlight. These are:

Discomfort Glare — this causes discomfort without necessarily impairing the visibility of objects.

Disability Glare — this impairs the visibility of objects without necessarily causing discomfort. This type of glare has the intensity to impair vision.

Glare issues should be considered early on for areas of glazing and materials with high reflectivity, such as glazed ceramics, stainless steel, and other metallic cladding systems. Sunlight Reflection Analysis should be used, and further site specific signalling assessments would be required in some locations.

Glass is vital to provide a safe and open environment on the footbridge, so glare reduction should not focus on reducing or eliminating glazing.

Glare can occur from lift shafts and stairs and in many cases these are the primary source of glare, not the overbridge. The angle of the glazing, or other materials can also impact the level of glare. East/West orientations have been found to have greater reflectivity issues over the course of the day and year than North/South.

The generic designs have undergone Sunlight Reflection Analysis to identify the orientations that might lead to glare issues from the train drivers' point of view.

These studies are not site specific but they give a good indication of the track orientations and times of year when reflections resulting solely from the footbridge might occur.

It should be noted, that in most cases, direct sunlight in the driver's direction is as likely to be an issue as any light reflection from the footbridge.

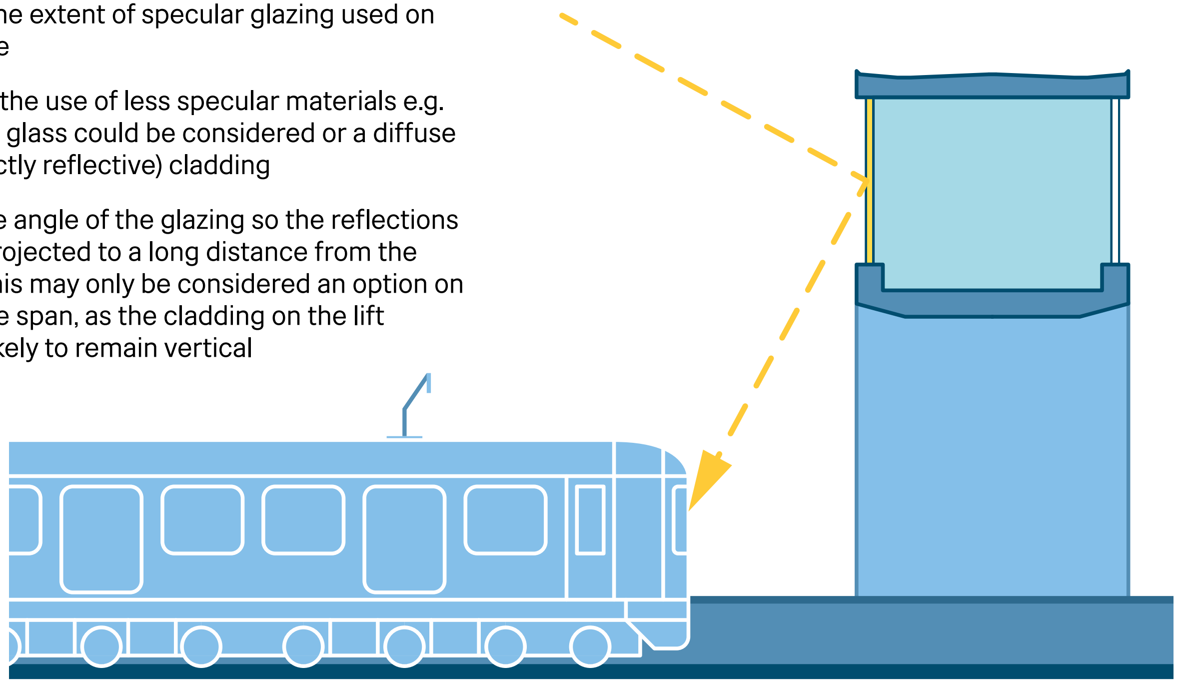
Where glazing is identified as a potential source of discomfort, the following three mitigation methods may be considered:

→ Reduce the extent of specular glazing used on the bridge

→ Consider the use of less specular materials e.g. acid-etch glass could be considered or a diffuse (less directly reflective) cladding

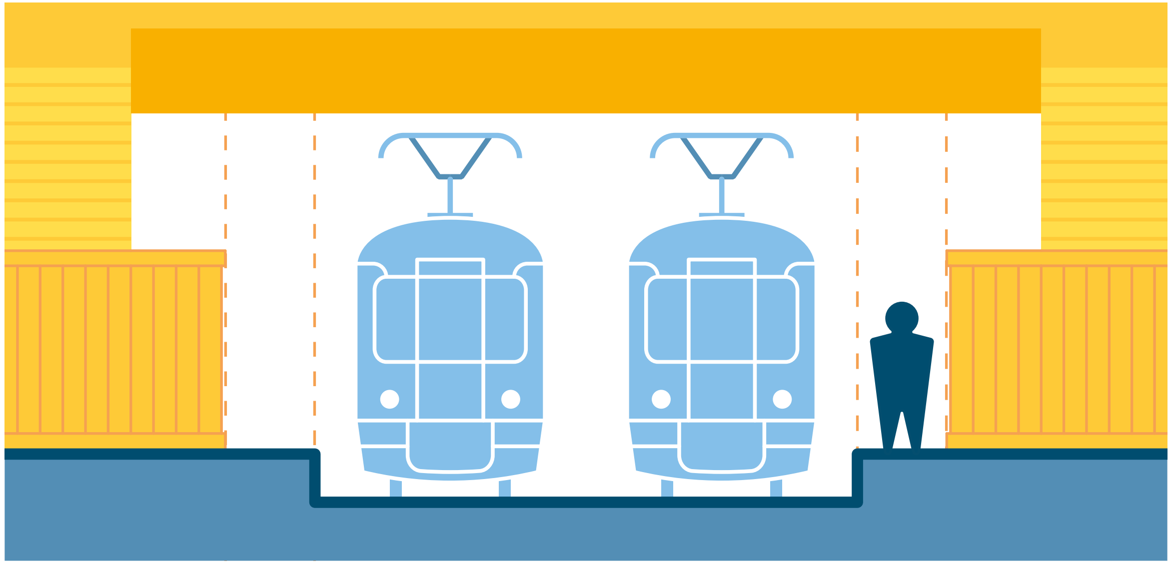
→ Adjust the angle of the glazing so the reflections are not projected to a long distance from the bridge. This may only be considered an option on the bridge span, as the cladding on the lift shaft is likely to remain vertical

Image 2.18
Illustration of glare on a footbridge



2.8 Constructibility

Work over live railway 01
Projects should be designed to minimise the need for possessions and other disruptions to the railway.



02 **Maintaining Platform Width**
Work sites should be located to maintain compliant platform widths and should be kept to a minimum with neat tidy hoardings.

Image 2.19
Illustration of construction hoardings

2.8.1 Separation of railway and construction
Safe access is to be provided to the construction site, which is to be segregated from both passenger areas and station operations. Work sites are to be separated from passenger areas using secure hoardings.

2.8.2 Maintaining passenger areas and station requirements
Passenger areas need to meet station design requirements for clear widths, and run-offs during construction works.

Consideration should be given to lines of sight, wayfinding, lighting and ambience for temporary works and scenarios with the same attention as the final condition. Hoardings should not impact lines of site to signalling equipment and train dispatch equipment. Passengers will be less familiar with temporary arrangements, so good wayfinding should not be forgotten..

2.8.3 Minimising construction over the railway
In the construction of a footbridge there is a need to build over the railway. Where the railway is operational, this should be minimised through using methods such as launching the footbridge or lifting it into place in one piece. The length and number of possessions should always be minimised.

Standards Reference

Interface between Station Platforms, Track, Trains and Buffer Stops (2019)
RIS-7016-INS

Image 2.20
New footbridge at Cambridge station

2.9 Whole Life Design

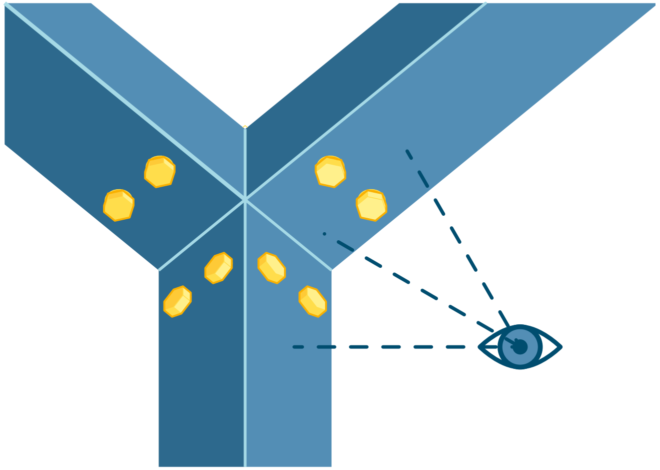


Image 2.21 Expressed Structure and connections: Elegant exposed structure is easier to inspect as it is always visible

Standards Reference

Design for Bridges
NR/L3/CIV/020
Design Requirements for Structures
GC/RT 5110

2.9.1 Maintenance and Inspection

In many cases maintenance can be the largest cost in the lifespan of a footbridge. The following methods can help keep make maintenance more efficient:

- Keep structural connections visible where possible, minimising the need to remove items or work at height to carry out inspections. Avoid items and finishes that require temporary access to clean or maintain, particularly where above the railway
- Use self-finished materials such as brick and stainless steel instead of applied coatings where possible, to avoid the need for regular repainting. Where applied coatings are used, consider products that can achieve a long service life without reapplication.
- Use standard sizes and components where appropriate. This is more cost effective for sourcing replacements

Consideration should be given at design stage as to how items can be repaired and replaced. This can be challenging for large items such as cladding panels and glazing, which can have substantial weight.

Consider the cleaning requirements and method for all elements. This is particularly demanded for glazing on footbridges, where access to clean is restricted when above live rail.

2.9.2 Operational Costs

Whilst large areas of glass can add to construction costs, maximising natural light reduces levels of artificial lighting required, leading to lower running costs. Energy usage and efficiency should be considered when comparing lift installations.

2.9.3 Sustainability

The embodied carbon of each element should be considered. Recycled or natural materials often have much lower embodied carbon, and some materials can be carbon negative. Conversely, robust materials and details with a long design life and low maintenance requirements may have higher embodied carbon but ultimately be lower carbon over their life span.

2.9.4 End of Life

Consideration should be given to how the footbridge can be dismantled and removed at the end of their operational life with the least impact to the operation railway. The pontential for reuse of elements and recycling of the materials should be considered at early stages of the design.

2.10 Innovation

Image 2.22
Staircase being craned into place at Sittingbourne station

Image 2.23
Footbridge element being connected to pre-installed base elements at West Drayton station

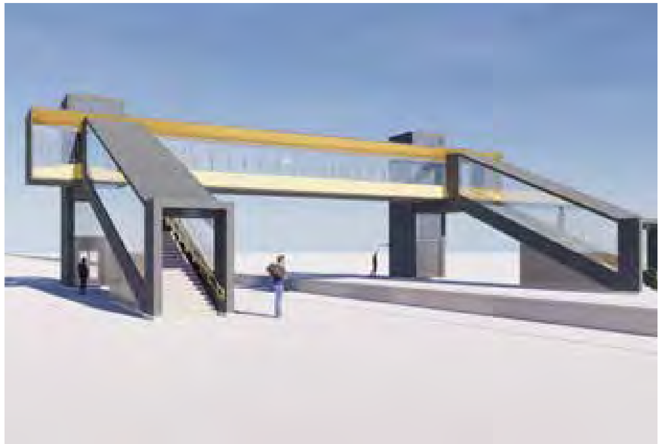


Image 2.24
The Framing Bridge — Gottlieb Paludan Architects, DK with Strasky, Husty and Partners Ltd, CZ

2.10.1 Modern Methods of Construction (MMC)
Off-site construction methods are particularly suited to footbridge construction, where staircase and overbridge elements are usually suitable dimensions to be delivered to site as a complete element and lifted into place by crane.

Off-site construction minimises the amount of time needed to maintain a presence on site. Site activities often require smaller worksites for the majority of the build, as site tasks are often more focused, for example installing foundations. At many stations space is very restricted, constructing as much as possible off-site can help manage site constraints.

Off-site fabrication has a good reputation for high quality of finish, as the construction process can be well controlled within a factory environment.

2.10.2 Building information Modelling (BIM)
The use of BIM in design can help aid the design and construction process, and the BIM model can be retained for building and facilities management (FM).

2.10.3Innovative Ideas — RIBA Competition
In June 2018, Network Rail held an international competition for footbridge design ideas. This attracted 121 entries from a range of architects, structural engineers, civil engineers and students of these design disciplines.

The winning entry, The Framing Bridge has been developed for use as one of the standard footbridge designs, and is described in Section 1.2.

The competition generated a huge range of ideas and different approaches. The full selection is available to view on the Network Rail website.

The ideas submitted cover a wide range of different material approaches, and ways to create great spaces. These entries show a creative variety of ideas and design considerations.

3

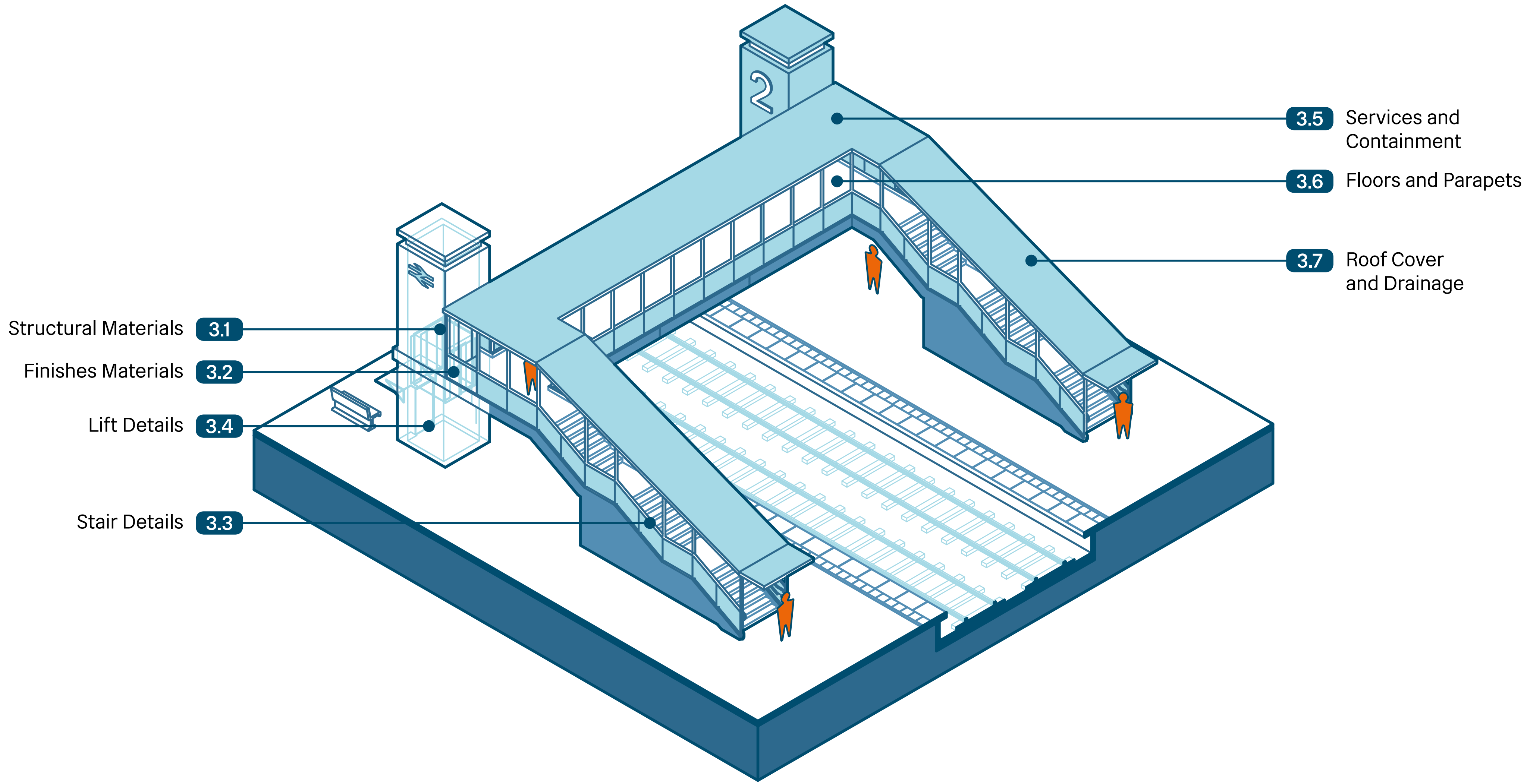
Footbridges & Subways

Footbridge Design

Image 3.1
Reading station

Footbridge Design

Navigation Diagram 2



3.1.1 Steel
Most railway footbridge structures are constructed from steel. The main advantage of using steel is that it is strong in tension and can provide relatively light structures. This is a prime consideration in a railway environment that requires off-site fabrication followed by a quick assembly operation on site.

A shortcoming of steel is its tendency to corrode. All critical elements that are likely to corrode should be simple to inspect. The electrical conductivity of steel necessitates special isolation measures so that the structure should be electrically continuous.

Typically steel bridges are painted in a factory environment to a strict specifications An alternative would be to use weathering steel that provides a natural protection of the steel that improves with time, but this require careful details that will not stain.

3.1.2 Concrete
Concrete is heavy in comparison to the alternatives and this makes it less suitable as a construction solution where quick assembly on site in pre-fabricated sections is required. However precast stairs can be used effectively in conjunction with a steel structure, for instance at Denmark Hill station.

3.1.3 Timber
Timber used to be the natural choice for the construction of railway bridges before it was replaced by steel, predominantly due to issues with the durability of timber.

With the new industrial processes of heat treatment and laminating, timber is again becoming an economically viable alternative to steel in the production of lightweight footbridges. Timber also has a less industrial look and feel. In the rail environment it has the advantage of being electrically non-conductive. Unless treated, timber fades to grey over time and this visual aspect has to be taken into account. Colour preserving maintenance treatments are generally not be suitable for a railway environment.

Timber is combustible and appropriate preventative measures should be agreed with a Network Rail Fire Specialist. Timber has a substantially lower carbon footprint than other materials, so should be considered where possible, despite its other disadvantages.

3.1.4 Fibre Reinforced Plastic (FRP)
Fibre reinforced plastic has the advantage of being extremely lightweight and durable. It can be designed to take any form or colour and has already been used at some locations. This is a very promising material for the future, however it should comply with all fire requirements, including BS 476 part 21 for fire resistance, and the proximity to other buildings should to be considered. The recycling aspects of this material can however be very problematic and should also be considered.

3.1.5 Aluminium
Aluminium is very light weight and therefore worth considering where weight is an issue. Aluminium is typically more expensive than stee, and is easier to dent and scratch.

Image 3.2
Timber bridge at Martins Heron station

Image 3.3
One of a series of FRP bridges in Rotterdam

3.2 Finishes Materials

With careful specification and detailing a wide range of materials can be suitable as finishes:

3.2.1 Timber
Timber can provide a sense of warmth and a natural variable finish. Different types of timber can provide a range of colours, and it has better acoustic absorbance than most other materials. Fire Design should be considered both for the timber and any treatments.

3.2.2 Expressing structure without finishes
Expressing structure such as steel or concrete as a finish can be effective for providing a low maintenance finish over the railway. Particular care should be paid to the detailing of junctions and visible fixings., and the formwork and grade of concrete. Coatings should have a long lifespan to avoid a regular maintenance regime.

3.2.3 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. Consideration should be given to durability, maintenance, replacement strategy, and glare.

3.2.4 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 can be used in contemporary ways and can be hung in panels or cassettes.

Image 3.4
Timber clad lifts in Peterborough Station

Image 3.5
Steel Footbridge

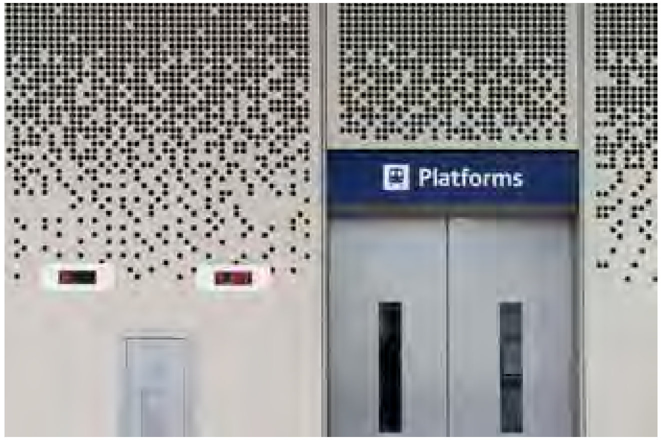


Image 3.6
Metal Cladding panels in Paddington Station

Image 3.7
Ceramics

3.2.5 Glass Fibre Reinforced Concrete

GRC/GFRC is available in a wide range of colours and finishes is very durable. It is much lighter than precast /insitu concrete as it can be used in much thinner applications of approx 50mm. The reduced weight makes it ideal for use on an overbridge. GRC/GFRC is not as robust as insitu/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.

3.2.6 Precast Concrete

Precast Concrete requires very little maintenance, but the weight may restrict where it can be used. Acid etching, sand blasting and different types of formwork can provide a wide range of surface finishes.

3.2.7 Transparent Glass / Opaque Fritted Glass

Glass is hardwearing, and a good choice for internal and external use. Glare should be considered, and also the cleaning strategy when over the railway. Attention should to be given to how glass performs when damaged. When opaque it should be ceramic fritted as some back painting can deteriorate. Coloured inter-layers can also be used.

3.2.8 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.

Image 3.8
Precast Concrete

Image 3.9
Transparent glass with lower section obscured.

Image 3.10
Brick

3.3 Stair Details

Stairs on accessible routes in stations should be designed in accordance with the DfT Code of Practice Standards that in stations take precedence over the Building Regulations and the Highway Standards. This includes stairs on platforms leading to access and interchange footbridges.

The minimum clearance between the stair and the platform edge should be established by capacity calculations, but it cannot be below 2.5m or 3m (depending on line speeds) without a derogation. In constrained situations, the right balance should be provided between the width of the stairs and the width of the platform beside it. Figure 3.11 demonstrates the constraints to be considered if a derogation is required. The freeway should at least allow the passage of a wheelchair outside the danger area.

The top of the stairs should always have a minimum landing of 1.2m depth before a turn onto the bridge span. Corduroy hazard warning surfaces should be provided at the top and bottom of stairs to give advance warning of change of level. The length should be 800mm measured in the direction of travel, spaced 400mm from first and last risers. Refer to image 3.12. The warning surface should extend transversely 400mm beyond the edge of the stair tread.

The roof of the stairs should extend past the top and bottom of the stairs to provide shelter, and ideally provide sufficient overhang to cover the platform.

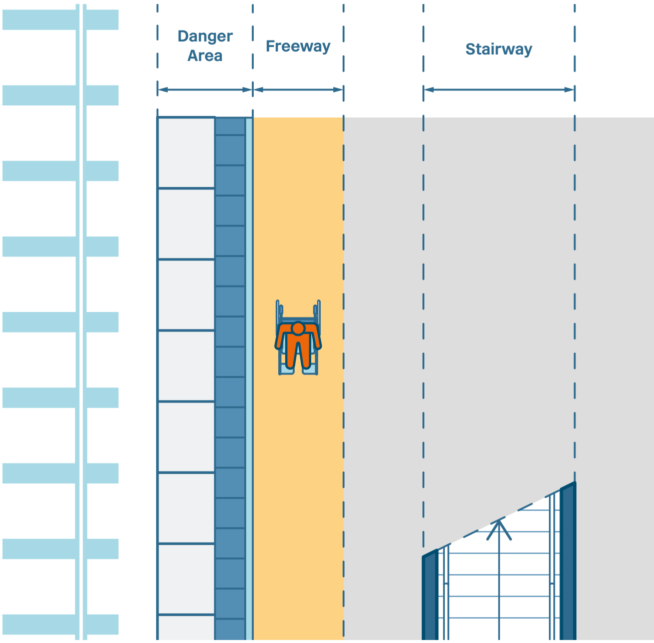


Image 3.11
Freeway clearance zone between stairway and platform edge.

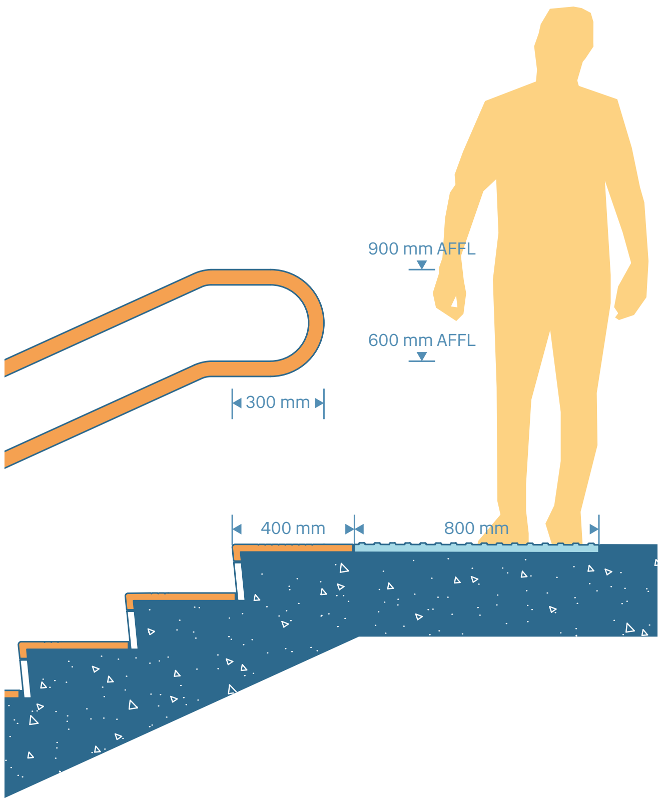


Image 3.12
Inclusion of tactiles at top and bottom of staircase, and robust slip resistant nosings to stair edges. Correct positioning of handrails, with a contrasting colour and a warm to the touch finish

Landings should have a cross-fall gradient towards the parapets of no more than 1:50 to drain any surface water that might collect. Landings should be square, but in situations where achieving this is problematic due to site restrictions a minimum of 1.6m depth could be justified, subject to dispensation from the DfT.

3.3.1 Slip Resistance

The choice of deck finish should be influenced by the extent to which it is protected from the weather.
The slip resistance value (SRV) should be at least 55 in wet conditions.

Perforated or open decking should not be used due to safety considerations on an electrified railway. For similar reasons metal floor finishes should be avoided.

3.3.3 Colour Contrast

A 30% colour contrast should be provided to stair nosings, threads and corduroy tactiles, between handrails and walls, and between stairs and skirtings.

Image 3.13
Staircase at Winchester station

Standards Reference

HSE Guidance
Assessing Slip Resistance of Flooring

3.4 Lift Details

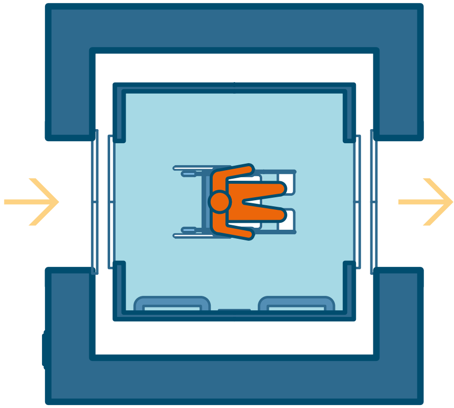


Image 3.14
Through lifts avoid the need to turn around within the lift or outside the lift

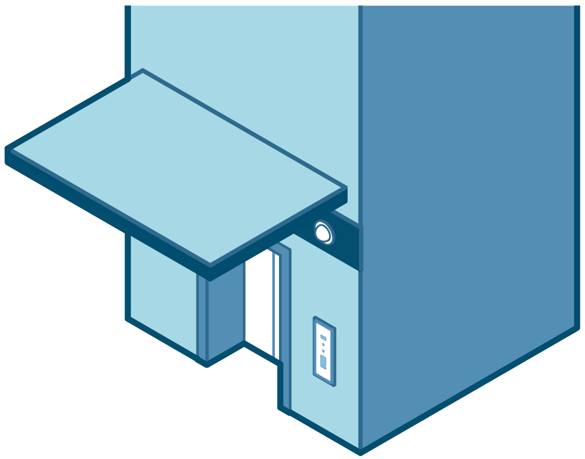


Image 3.15
A canopy at the lift entrance shelters the users and the lift threshold

Lifts are an indispensable feature for people who are unable to negotiate steps, including 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. Lifts should be accessible for all users including people with mobility equipment.

3.4.1 Design Requirements

Through lifts describe lifts with doors on opposite sides of the lift car at footbridge and platform level. They are preferable as they remove the need to turn around within the lift or outside the lift, where there is the potential for this to be busy with people waiting. Should a through lift not be possible lifts should be large enough for a wheelchair user to turn around within the lift. A run off and waiting space should be provided at the top off the footbridge, so that the lift does not open directly into the flow of people. A canopy should be provided over the lift entrance, and consideration should be given to allow rainwater drainage falls away from the lift doors . Waiting areas near lifts should be provided with seating that is preferably sheltered. The lift typically requires a lift equipment room. These requirements should be defined early on, so that the space can be provided in the design.

3.4.2 Accessibility Requirements

Tthe lift car should have handrails, and the control panel height and positioning should meet current accessibility legislation. At landings, the lift architrave should have a colour contrast with the surrounding wall treatments and the car doors.

3.4.3 Security

CCTV should be installed within the lift car. Some lifts can be controlled remotely, instead of the lift operating by the call button, a remote operator is notified who can operate the lift via CCTV images and using the lift remote monitoring system. This functionality may be suitable at quite times of day in areas of anti-social behaviour.

3.4.4 Provision of a ramp instead of a lift

In cases where the vertical height does not exceed 2m, the provision of a ramp can be considered, subject to a Disability Impact Assessment (DIA). Slopes with gradients shallower than 1:21 (or less) can be a preferable alternative to ramps with landings and should be considered.

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

Refer to the Lift Requirement Assessment Aid in Appendix C for guidance on when a lift may not be required.

Standards Reference

Policy Management of Lift Assets
NR/L1/CIV/192
Standard Specification for New and Upgraded Lifts
NR/L1/CIV/193

Image 3.16
Winchester station

Integration of Services

Many services may need to be included in a footbridge, including but not limited to cables for lighting, CCTV, power, fire detection and telecoms. Services should be concealed behind finishes wherever possible. This protects the services from damage, and prevents passengers from coming into contact with them.

Concealing the services helps to provide a clean, clutter free aesthetic, and stop the services from being exposed to grime and dirt. Many proprietary systems existing for lighting and cable management systems (CMS) that integrate the services within the lighting run. Cables should not be externally mounted to the footbridge parapet. This would not allow for safe access and maintenance of services.

For open footbridges, water ingress protection and exposure to the elements also should be considered.

Providing ease of access

Services should be secure but easily accessible to maintenance personnel, without reliance on working at height or hard to obtain specialist equipment.

Services should be accessed from the footbridge enclosure as much as possible, so that there is not a reliance on accessing services over a live railway. Ceiling and wall access are preferable, but access can also be from the floor deck. Where panels are provided in walls it is advisable to make these hinged, so that items are not fully removed for access avoiding them being damaged or reinstalled incorrectly.

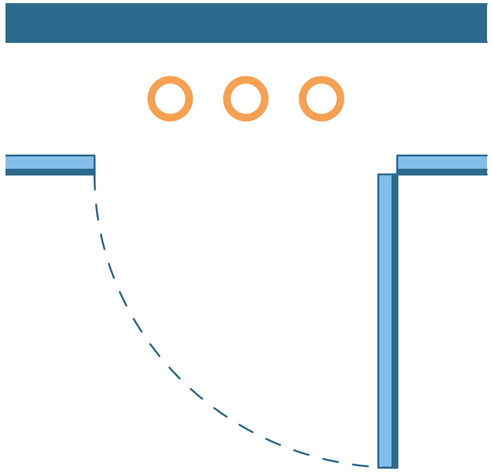


Image 3.17
Section showing services above ceiling finishes

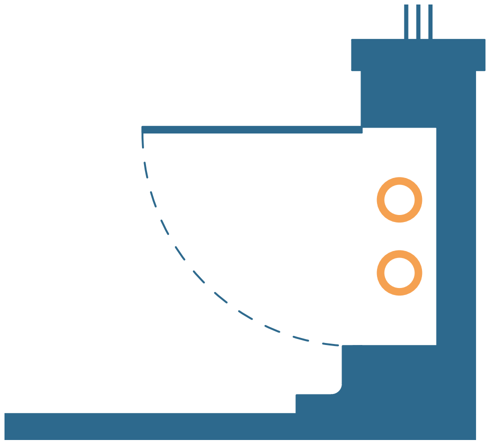


Image 3.18
Section showing services in wall zone accessible through hinged panels

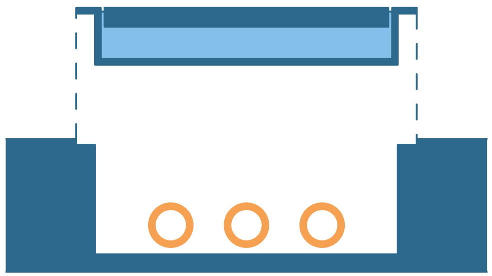


Image 3.19
Section showing services concealed in floor zone accessible from within footbridge with lift out covers

3.5 Services and Containment

The examples on this page highlight common bad practice in CMS (Cable Management Systems) and services integration.

Here are some considerations on how these could have been avoided:

→ Plan service routes early in the design, so that they can be integrated into structure or behind finishes

→ Run service above structure or through openings in beams

→ Group services into combined CMS where possible

→ Use integrated lighting booms with CMS where

X

Image 3.20
CMS should not duck and dive under structure, consider castellated beams or cut outs. An integrated lighting CMS lighting boom would have further improved this installation

X

Image 3.21
Poor integration of the lighting and service runs with the structural design, and an excess of services, that could have been grouped into a combined CMS and set our better.

X

Image 3.22
Vertical service routes not integrated with the design. Services should have been considered earlier in the design. This is particularly poor as the services are located next to a plant room.

3.6 Floors and Parapets

The choice of deck finish is influenced by the extent to which it is protected from the weather. The slip resistance value (SRV) should be a minimum of 40 under cover and minimum of 50 in the open. Perforated or open decking should not be used due to safety considerations on an electrified railway. For similar reasons metal floor finishes should be avoided. The colour of the floor finish should contrast with the colour of the parapet wall.

3.6.1 Screeds

Waterproof applications onto a solid deck can provide a lightweight finish that meets the slip-resistance value and not require much maintenance. Examples of such products are Asphalt, Resins (such as Flowcrete) or Gripfast Slurry.

3.6.2 Proprietary Panels

There are a range of slip-resistant floor panels that can be fixed to the structural deck including Fibre Reinforced Plastics or Composites such as Polydeck.

3.6.3 Tiling

Terrazzo, Ceramic or Stone tiling with the appropriate slip resistance can be used on covered footbridges. Lighter weight alternatives may be preferable to limit the loads imposed on the structure.

3.6.4 Parapets

Unlike other footbridges, the parapets of footbridges over OHLE lines have to be solid.
The upper part of the parapet (above 1m) should allow visibility and therefore has to be glazed or have a pattern of small perforations.

Image 3.23
Anti slip cast metal full depth tread is preferable

The degree to which the bridge should be enclosed is discussed in Appendix C.
The lower part of the deck and stair parapets fall into any of the following three categories:

- → As integral part of the Structure (eg. Steel trough, FRP, Steel lattice)
- → Infill panel in a frame structure (typically in Vierendeel trusses)
- → Part of a fully glazed wall

The materials used should be lightweight, resistant to pedestrian impact, durable and easy to clean.
The advantage of integrating the parapets into the structure is the potential for a more economical and lighter structure. It can also reduce the number of different materials being used.

Image 3.24
Internal view of Alton station footbridge

The following considerations should be taken into account for glazing:

- → All glazing should be heat-soaked-thermally-toughened laminated glass.
- → Due to the issues of cleaning glass over the railway it is recommended that all glazing that cannot be accessed easily from the platforms should be to a self-cleaning specification tested to EN1096-2. Typically the manufacturers' instructions require that the glass has to be exposed to UV light and rain in order to allow the cleaning of the glass to occur naturally (ie. not to be used under cover or overhangs).
- → It is possible to use obscured or back-painted glass for the lower section of the parapet. Films should be avoided on the exterior face of the glass.

3.7 Roof Cover and Drainage

On an open footbridge there is no option other than to slope the deck so that it drains towards the platforms where it can be picked up by the platform drainage network. This same principle should also apply to the drainage of roofs over footbridges. Unfortunately the roofs of most of the covered footbridges on the network incorporate built-in gutters. This is an unnecessary safety hazard and maintenance liability and should be avoided. Instead the whole roof should be set to a fall towards the platforms from a high point at the midpoint of the bridge. This simple measure should save a considerable amount of whole life and capital cost.

3.7.1 Considerations for Roof Cover

There is often confusion as to whether bridges and stairs should be covered by a roof and also about the extent of enclosure that is required above the parapets. Providing the requirement of roof cover is considered from the very start, evidence shows that the material cost of the cover does not have a major impact on the overall project cost. Refer to Appendix C for further guidance

From maintenance, whole life and asset protection point of view there are also advantages to the covering of the footbridges, avoiding chemical anti-frost treatments of the deck surfaces which are polluting and also known to damage the steel structure. Additionally, the current version of the DfT Code of Practice requires a dispensation for not covering the stairs on an accessible route in a station.

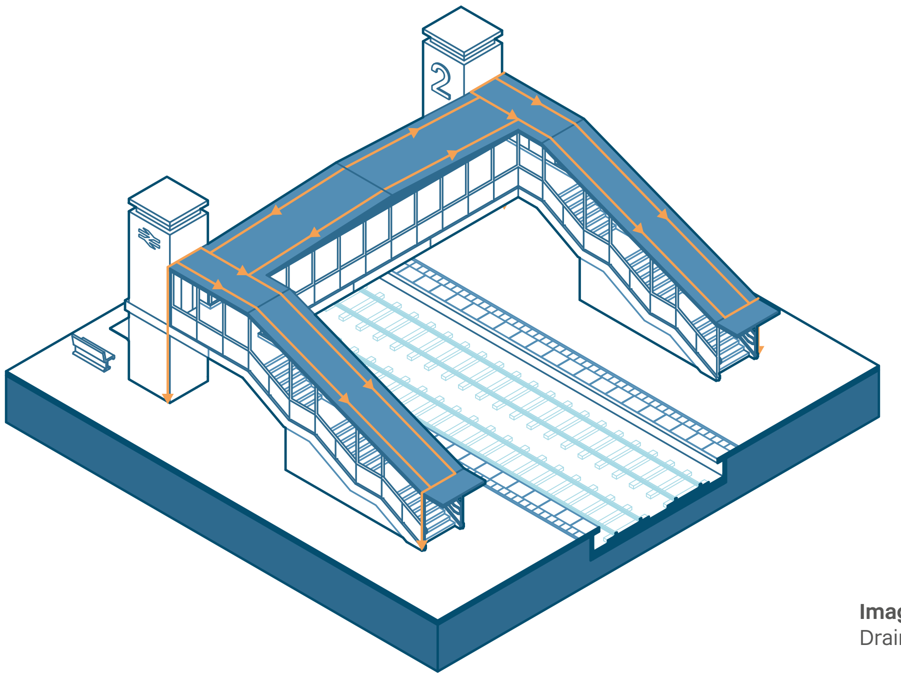


Image 3.25
Drainage flows on a footbridge

3.7.2 Roof Finishes

In most cases the roof finishes are not visible, except for the roof over the stairs that is visible from the platforms. However, in locations where the station is in a cutting or is surrounded by tall buildings, the roof appearance is visible and should be considered as another elevation.
Normally the roof finish can be of metal sheet, typically a proprietary steel or aluminium product. Even though there is no requirement to insulate the bridge, there have been cases of condensation on uninsulated bridge roofs.

For this reason, roofs covering stairs and footbridges should be thermally insulated. The underside of the roof is visible to the passengers and should be integrated visually with the other finishes under the roof.

Where the bridge is not fully enclosed a sufficient overhang should be provided. In this case the roof should be integrated with the station canopies as much as possible. Where access to the roof is required, a fall arrest system should be considered.

Footbridges & Subways

Subway Considerations

4

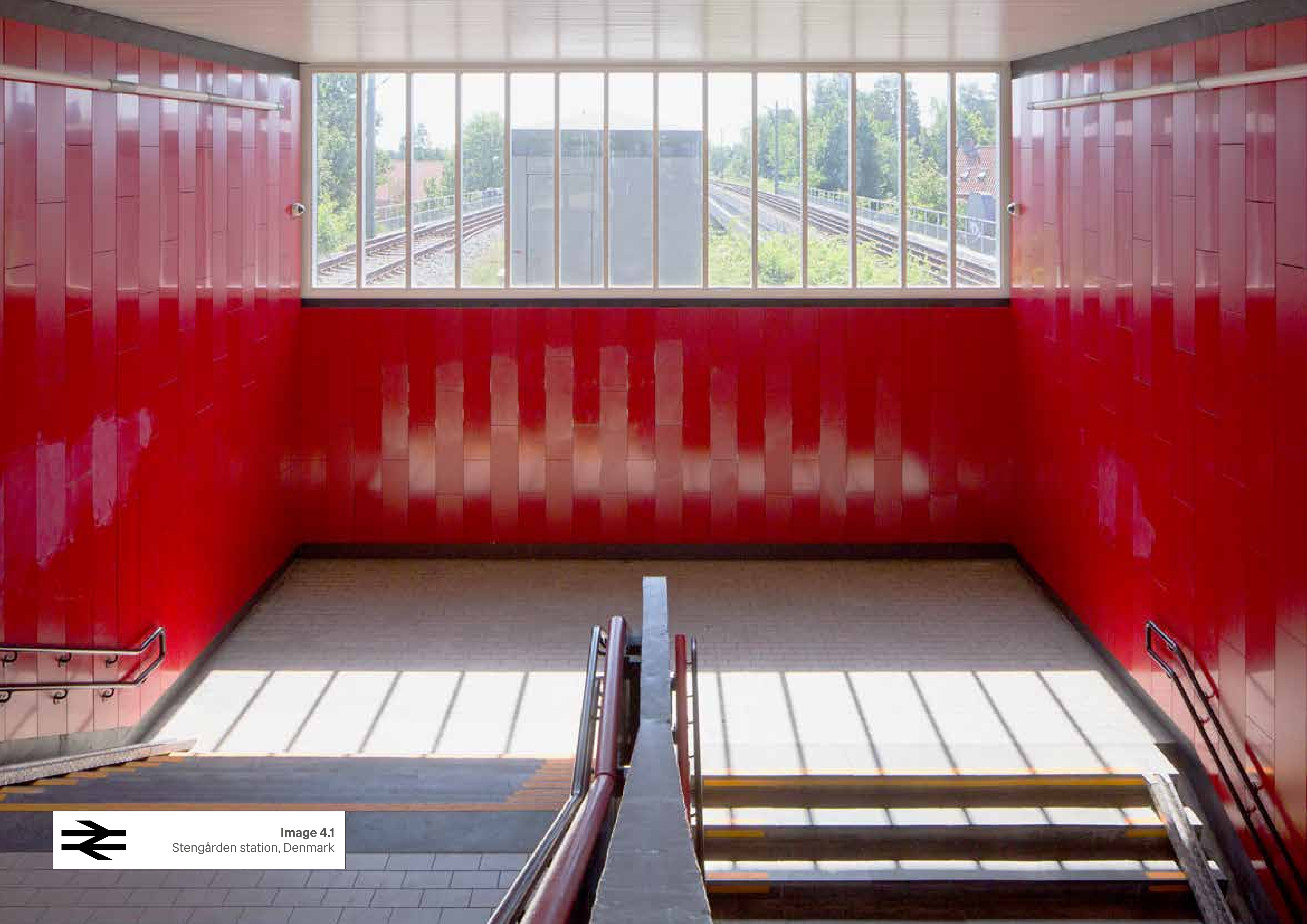
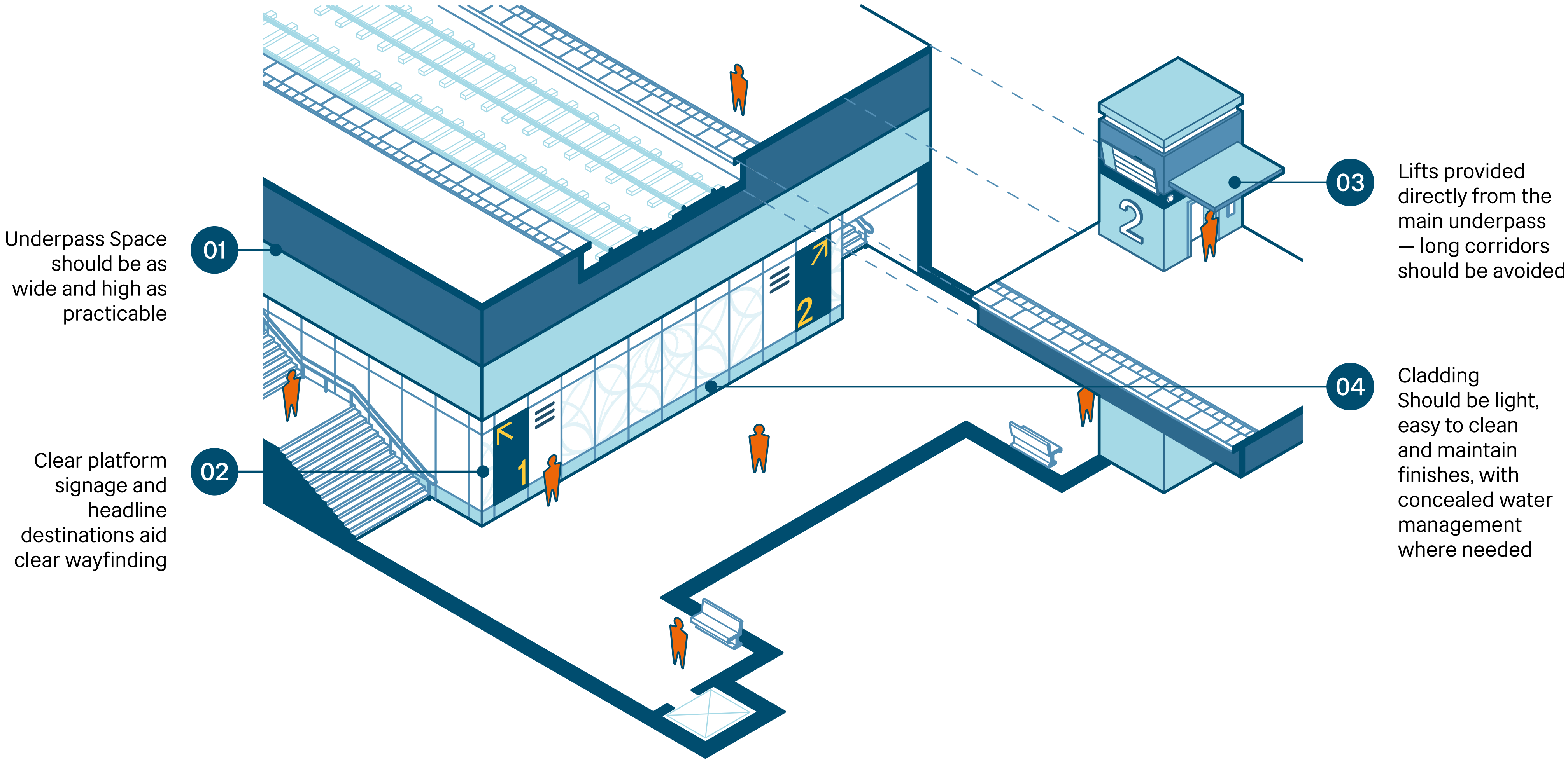


Image 4.1
Stengården station, Denmark

Navigation Diagram 3



4.1 Lighting and Space

Many subway space are constrained both in height and width. The use of creative lighting wall treatments can help to add drama to spaces and elevate them aesthetically.

This can help to counteract the common perception of these spaces as dark and oppressive, and can also help to aid wayfinding, where distinctions on colour and pattern are made.

Project scopes may vary from a comprehensive upgrade, through to the simple addition of a strong lighting scheme, for example in the Dark Arches at Leeds Station, or Clink Street Tunnel (image 5.13). In these examples, lighting has transformed the feel and quality of these spaces without any major changes to the walls, soffit or floor treatments.

Where wall treatments are introduced, improvements in lighting levels and colour rendering can contribute to the overall effect.

Natural daylight should be maximised wherever possible. This can be achieved through skylights and lanterns, and using extensive glazing over staircases. Maximising daylight over staircases is also an effective way to aid natural wayfinding.

Image 4.2 Light enhancing space — Leeds station
Colour changing uplighters enhance the 'Dark Arches' route below Leeds station

Image 4.3 Railway Bridge — Balham station
Strong direct light against the relief of the faience tiles provides a striking impact in this space

Image 4.4 Maximising Natural Light — Virum Street station
Daylight is maximised where possible, for example at staircases

Image 4.5 Impactful Lighting — Westfriedhof station
Strong colour and use of shape, along with a variation in colour that helps to aid wayfinding

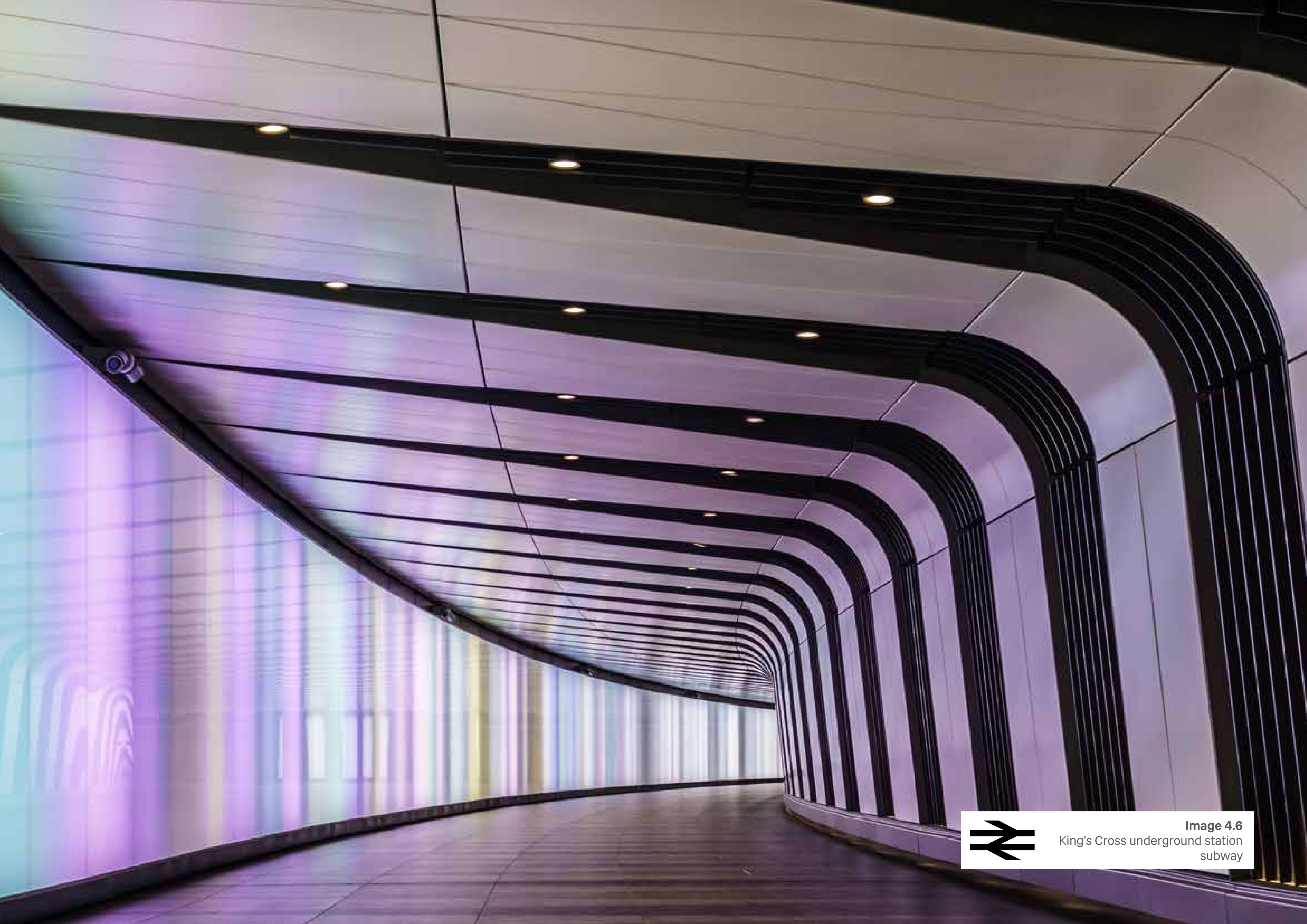


Image 4.6
King's Cross underground station subway

4.2 Existing Subways

4.2.1 Maintaining Existing Structures
Regular inspection and maintenance is crucial for ensuring structures are fit for purpose and not degrading. The biggest challenges to existing subways often are related to water ingress.

For local issues water management systems can be deployed to avoid water encroaching on the passenger environment. Specialist expertise should be sought where significant water ingress occurs, to identify the causes and to determine if this is causing structural degradation.

4.2.2 Upgrading Existing Structures
Historic structures can often contain many non-compliant finishes and that would not meet current standards
for accessibility.

Some of these issues can be rectified by upgrading floor surfaces, and installing modern handrails.

Care should be sought with heritage structures, and those that are listed or in a conservation area, that upgrades do not harm the existing structure and that any changes are compliant with legislation and guidance. The Railway Heritage Trust is able to advise and recommend in instances where a listed building application may be required.

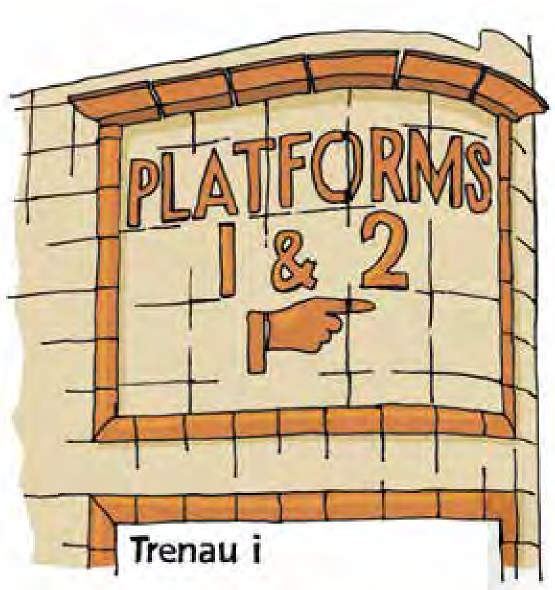


Image 4.7
Preserving heritage features,
Cardiff Central station

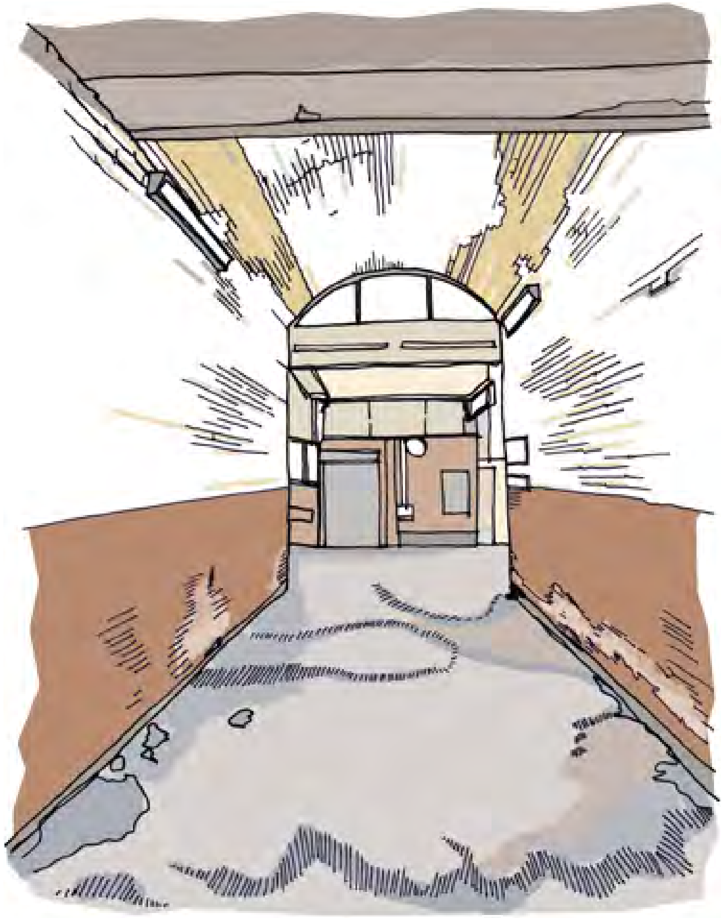


Image 4.8
Existing elements in need of care: At this station glazed bricks have discoloured due to water ingress, with stain damage at high level, and phosphorescence to the bricks below dado height

Subway Considerations

4.3 Subway Improvement

On some projects there may not be scope for a comprehensive upgrade covering cladding, floor finishes and lighting. Where scope is very limited, the projects here show how the user experience can be vastly improved in a cost effective manner.

4.3.1 Improving Wayfinding

Bold graphics and large lettering can direct passengers in a punchy manner that has more direct visual impact that conventional signage.

4.3.2 Creating Interest

The examples shown here all generate a visual surprise that lifts an otherwise drab setting that in some instances calls for a more comprehensive upgrade. Where less permanent finishes such as vinyl film are used there is less pressure to design in a timeless way — these projects can appeal to the here and now.

4.3.3 Generating Community Engagement

At Thessaly Road a competition was held, with six shortlisted proposals. The shortlisted practices were introduced to residents, members of the local community and key stakeholders in order to further inform their final proposals, and the process culminated with an exhibition.

At Baker Street Wonderpass by Bigg Design the history and attractions of the area are showcased, providing an engaging and informative experience.

Such projects help to engender a sense of community ownership and pride in these assets.

Image 4.9 Old Street Roundabout
Using colours to aid wayfinding around four different arms of the subway, and to enhance the passageways

Image 4.10 Baker Street Wonderpass
Creating an inviting entrance that makes users feel welcome and excited.

Image 4.11 Thessaly Road Bridge — Nine Elms
Revitalisation of a bridge under the railway as part of the London Festival of Architecture

Image 4.12 Baker Street Wonderpass
Featuring information and displays within the subway, so that there is visual interest and stimulation

4.4 Security

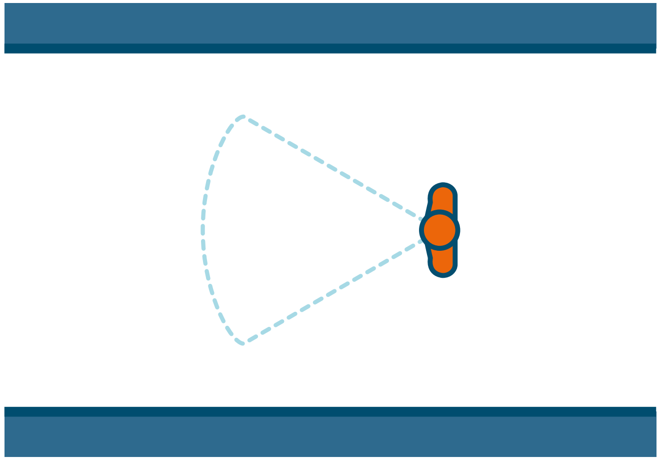


Image 4.13 Clear visibility of routes, no hidden corners

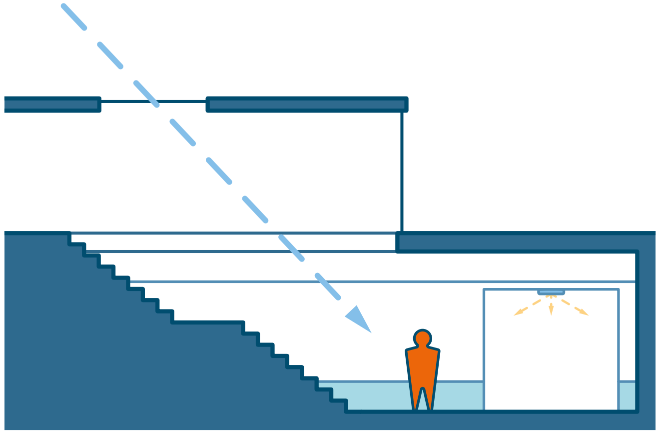


Image 4.14 Maximising Natural light

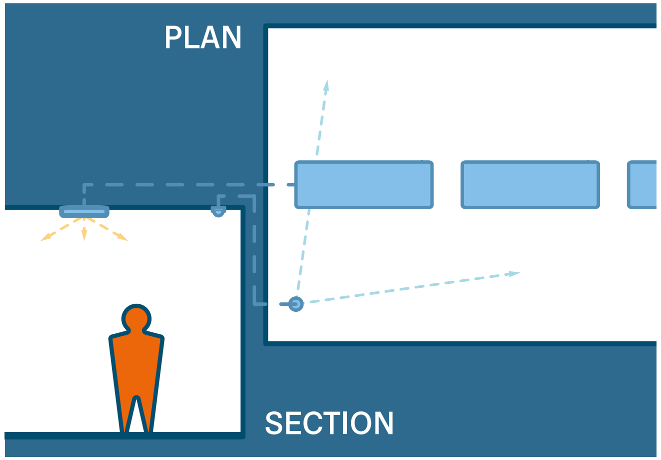


Image 4.15 Artificial Lighting

4.4.1 Maximising visibility
Subways should feel open, and provide clear lines of site, avoiding corners and changes in direction where possible. Wide passageways and keeping ceilings as high as possible create a more expansive feel that improves the perception of security.

4.4.2 Providing good lighting
Good lighting is crucial in subway spaces, which have traditionally felt cramped and under illuminated. Artificial lighting should have good colour rendering, and provide uniform intensity and coverage, at all times of day. Coloured lighting is good for providing feature lighting, but should not hinder passengers comfortably reading information and signage, or the function of CCTV

Natural lighting should be used wherever possible, and this helps to improve the perception of security and creates a connection with the outside. When natural light is maximised at routes in and out of subways such as over a stair, natural light can assist with intuitive wayfinding.

4.4.3 Use of Materials
Durable finishes that are easy to maintain and replace, perform well against wear and tear, play a part in creating the feeling of a safe and secure environment.

4.4.4 CCTV
CCTV coverage should be maximised, with blackspots minimised. Position CCTV to maximise the amount of coverage from each camera. Cameras should be discrete and integrated into the architectural finishes. Avoid cameras that protrude and use small dome style cameras where possible.

4.44 .Secure Stations Scheme
British Transport Police (BTP) input is available through the Secure Stations Scheme, and guidance is provided online at the Secure Stations website.

5

Footbridges & Subways

Subway Design

Image 5.1
Hackney Wick station, London

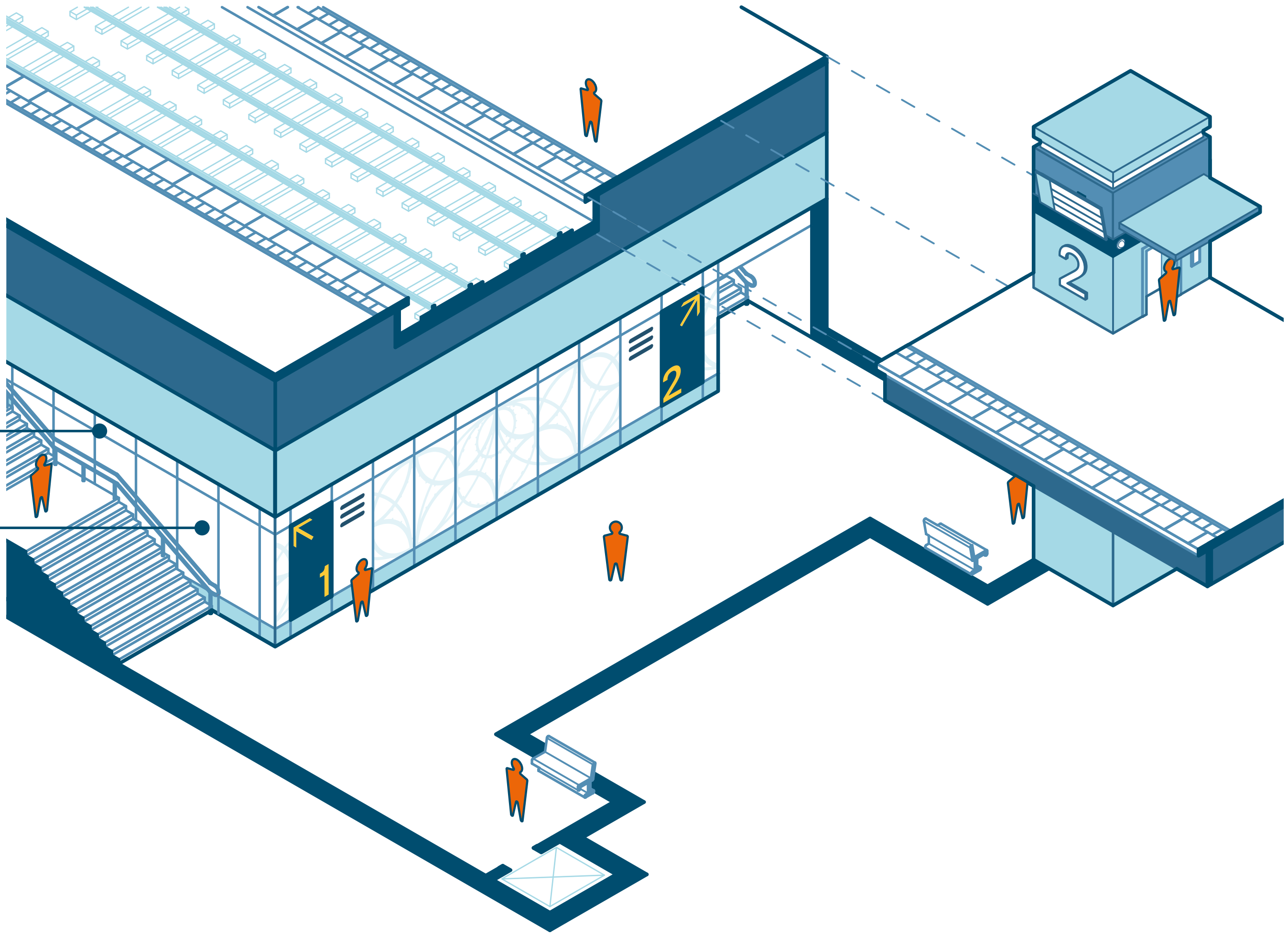
Navigation Diagram 4

Soffits, Floors and Wall Systems 5.1

Finishes Materials 5.2

Services and Containment 5.3

Water Management 5.4



3.3 Stair Details

3.4 Lift Details

Refer to Section 3

Subway Design

5.1 Soffits, Floors and Wall Systems

Image 5.2
Allerød station, Denmark

Image 5.3
Birkerød station, Denmark

Materials should be robust and hardwearing, and resist the impact of water for wet cleaning.

5.1.1 Soffits

Structure can be exposed where a high quality and consistent finish is achieved. However water management should be fully considered first.
It is preferable to leave existing structure and services exposed if appearance is acceptable.
Where access is required for accessing services or inspecting structure, demountable ceiling elements may be required. Excessive cladding that reduces unnecessarily the headroom or width of the subway should always be avoided.

Metal ceiling panel systems are easy to clean and allow for ease of access. Micro-perforations can be incorporated with an acoustic fleece behind to provide acoustic attenuation. When acoustic materials are used, the way they are assembled should be checked for meeting the fire requirements of the station.

Rendering and plastering can provide a robust finish, but dry lining boards should be robust, fire resistant and moisture resistant where necessary. Hatches can be used to provide access behind plastered ceilings or plastered ceilings can be used alongside accessible metal panelled ceiling systems. Rendering and plastering is also suitable for walls at high level where it is not be subjected to the same level of wear and tear as wall finishes that are at a reachable height.

5.1.2 Floor finishes

Terrazzo, Ceramic and stone can be used, provided they achieve the correct slip resistance. As stone is a natural material, its performance can be less predictable, and it can be harder to match replacements.

Concrete pavers and asphalt are discouraged as they do not contribute to a high quality station environment.

5.1.3 Wall systems

Consider how regularly access is required to areas behind the finishes zone and if there are any specific concerns or durability issues for the station. Section 5.2 discusses a range of appropriate finishes to consider.

5.2 Finishes Materials

Shown here are some suggested finish materials, however other materials choices are available.

5.2.1 Vitreous Enamel panels
Vitreous Enamel panels are suitable for use in subways as they are hard wearing and easy to clean, and available in light colours, with a glossy finish. Patterns can be screen printed onto the panels before firing. Panels can be hinged, providing access to services or for structural inspection.

5.2.2 Metal cladding panels
Metal cladding panels can be used with a variety of finishes and effects, such as anodising, powder coating and stainless steel. Many proprietary panel systems and fixings are available. Consider durability, maintenance, replacement strategy, and ease of access if services or water management is behind.

5.2.3 Ceramics
Ceramics can be used in the form of faience tiles, glazed bricks or applied tiling. They can be applied for both traditional and contemporary aesthetics, and are available in a wide range of formats, colours and textures. They are easy to clean and maintain.

5.2.4 Mosaic tiling
Mosaic tiling can create impressive visual effects, but can often require a higher level of maintenance than other ceramics, as the overall proportion of grout is larger.

5.2.5 Opaque Fritted Glass
Refer to Section 3.2 (Footbridges) .

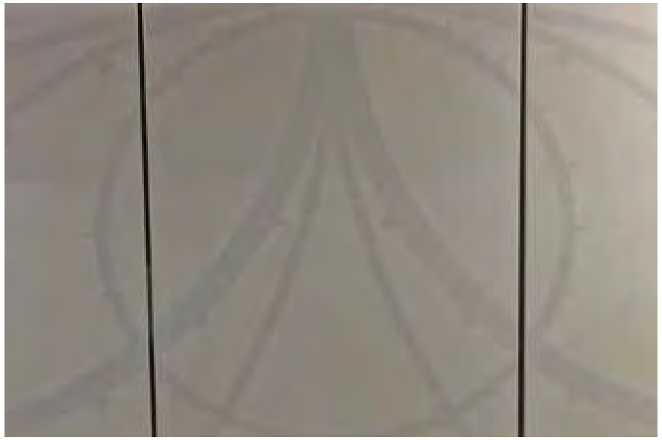


Image 5.4 — Vitreous Enamel
Large format openable panels with a striking graphic motif screen printed onto the panel before baking.

Image 5.5 — Mosaic Tiling
At Los Angeles airport, walls of mosaic tiles shift colour spectrum to aid wayfinding over long subways

Image 5.6 — Ceramics, Faïence tiles
Bold faience tiles used with relief designs in a contemporary interpretation of a traditional material

Image 5.7 — Metal Cladding Panels
Strong use of colour, and vertical staggered arrangement

5.3 Services and Containment

5.3.1 Integration of Services
Services should be concealed wherever possible. This can be achieved by concealing services behind cladding panels, ceiling panels, or integrated into fittings. Services can also be concealed within structure in cast in conduits.

Concealing the services helps to provide a clean, clutter free aesthetic, and could stop the services from being exposed to grime and dirt. It also reduces damage and help avoid passenger contact. In any instances where cables cannot be concealed, they should always be within conduit, and not mounted onto trays.

Many proprietary systems existing for lighting and cable management systems (CMS) that integrate the services within the lighting run.

Conduits can be cast in to structures for the provision of services, but how these are accessed, maintained, and future provision should also be considered.

5.3.2 Providing ease of access
Services should be secure but easily accessible to maintenance personnel, without reliance on working at height on hard to obtain specialist equipment.

Where panels are provided in walls it is advisable to make them hinged, so that items do not have to be fully removed for access. This risks them being damaged or reinstalled incorrectly.

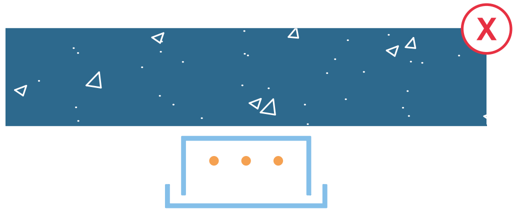


Image 5.8
Surface mounted conduit with lid, typically galvanised steel. Widely used but should be avoided in preference of more integrated solutions

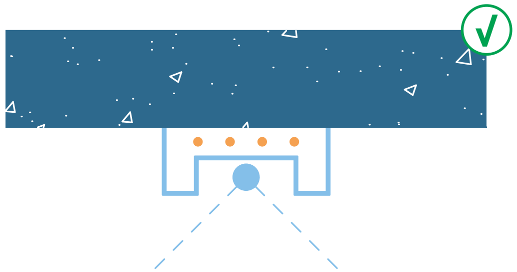


Image 5.9
Luminaire with integrated cable management to avoid secondary CMS.

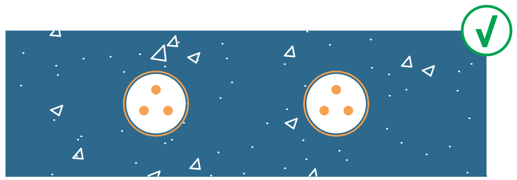


Image 5.10
Cast in conduits to allow services to be concealed. Access should be provided for change in direction.

5.4 Water Management

5.4.1 Water Ingress to existing structures
Many structures can suffer from water ingress to soffits and walls. Where working with existing structures, the first stage should be to verify that any water ingress is manageable, and is not having an unacceptable impact on structure or building fabric.

Water ingress should then be managed so that it is drained away safely, without causing any secondary impact to building fabric.The drainage should be concealed behind ceiling finishes or wall panels. Panels should be opened at regular intervals in order to allow access for inspection, monitoring and maintenance. Hinged panels are recommended where access is required as they can be easily accessed without having to lift heavy loads, or run the risk of panels being damaged or reinstated incorrectly.

Water ingress along a retaining structure can be captured with a half round drainage channel. This should be concealed behind full length wall panels so that it is not visible within areas occupied by the public or used as staff accommodation.

Pumps to manage and remove water ingress should be considered where necessary.

5.4.2 Designing New Structures
For new structures it is preferable to have a dry structure with high-quality exposed structural finishes, to reduce the build-up of layers that result in reducing the height of the subway. The design team should have sufficient structural expertise on the waterproofing of new structures. Measures such as re-injectable grout hoses can be designed in to new structures to allow for remediation.

A decision should be taken with new structures whether structure is exposed and how much is concealed behind finishes. Expressed structure and soffits are desirable, but there should be confidence that these would not suffer water staining and water ingress in the future.

5.4.3 Fire Regulations
Where wall and/or cladding systems are used, these should be compliant with all requirements for combustibility.

All voids created behind walls or above ceilings should be provided with fire separation at the required intervals to comply with regulations . Additionally, fire detection systems are required in voids over a certain size.

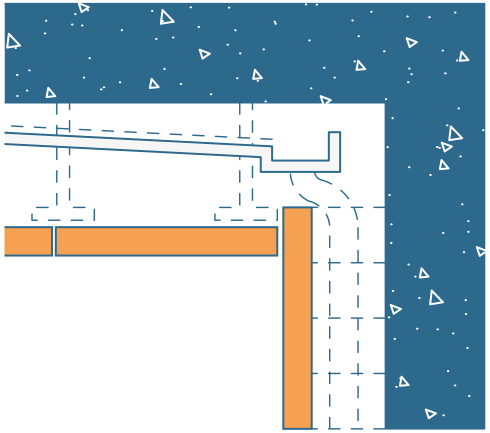


Image 5.11
Drip tray concealed above ceiling finishes, drained at low level

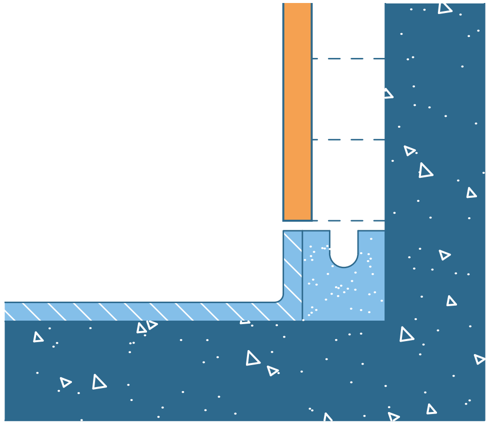


Image 5.12
Drainage channel in areas of water ingress, concealed behind wall finishes, but easily accessed

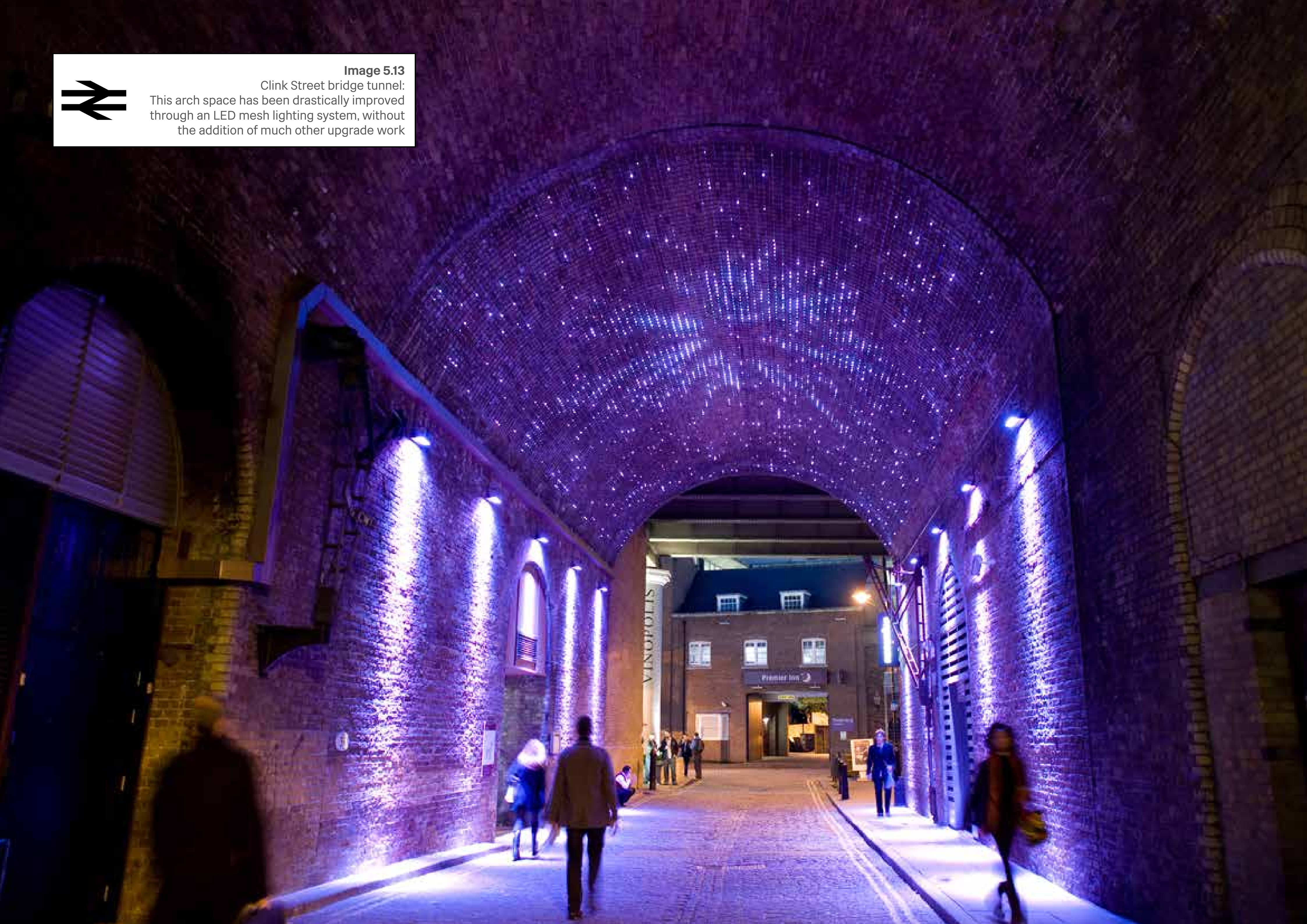


Image 5.13
Clink Street bridge tunnel:
This arch space has been drastically improved through an LED mesh lighting system, without the addition of much other upgrade work

Document References

A

Footbridges & Subways

Definitions

Relevant Standards and Guidance

Image Credits

Appendix A
Definitions

Accessible Route
A primary public access route to a building, station or train also referred to as Unobstructed Route in the DfT Code Of Practice. 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.

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

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

MMC
Modern Methods of Construction

ORR
The Office of Rail Regulation is the independent safety and economic regulator for Britain's railways. www.rail-reg.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 TSI
'Persons with Reduced Mobility — Technical Specification for Interoperability' is a European standard which provides the accessibility requirements of rail vehicles and railway stations. The TSI's apply to the entire UK rail network with the exception of the exclusions listed on the DfT website.

RDG
The Rail Delivery Group is an association of Train Operating Companies, representing the TOCs in the UK.

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

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.

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

Appendix A
Relevant Standards and Guidance

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

TSI PRM
Technical Specification for Interoperability: Accessibility for Persons with Reduced Mobility (2014)

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 EN 50122
Protective provisions relating to electrical safety

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
Interface between Station Platforms, Track ,Trains and Buffer Stops

GI-RT-7020
Guidance on Station Platform Geometry

GI-RT-7073
Requirements for the Position of Infrastructure and for Defining and Maintaining Clearances

RIS-7700-INS
Rail Industry Standard for Station Infrastructure

GL-RT-1210
AC Energy Subsystem and Interfaces to Rolling Stock Subsystem

Institute of Structural Engineers
How to calculate embodied energy (2020)

For dated references, only the edition cited applies.
For undated references, the latest edition of the reference (including any amendments) applies.

Relevant Standards and Guidance

NR Standards:
NR/BS/LI/331
Requirements for parapet heights on over bridge and footbridge structures spanning overhead line electrification equipment

NR/L3/CIV/020
Design of Bridges

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

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

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

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

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

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 Assurance
Module 07 Lift Product Approval

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

NR/L1/CIV/194
Selection and Design of New and Upgraded Lifts

NR/GN/CIV/002
Use of Protective Treatments and Sealants

Network Rail Station Capacity Assessment Guidance

NR/SP/ELP/21085
Specification for the Design of Earthing and Bonding Systems for 25 kV A.C. Electrified Lines

NR/L2/EBM/STP001/04 ‘How to manage deviations to Network Rail and Railway Group Standards’

Appendix A
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Section 5 Page

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Appendices Page

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Back Leeds station
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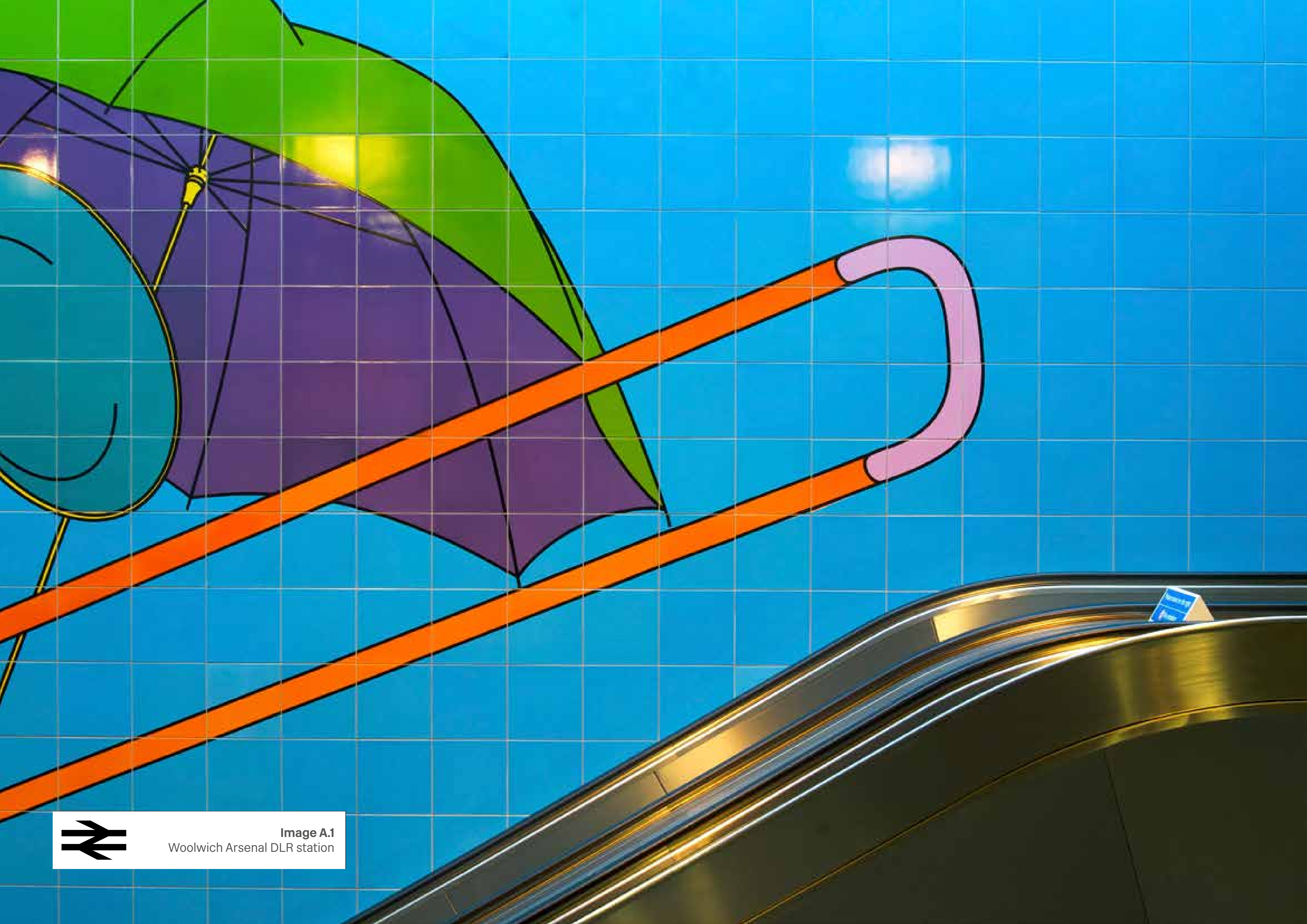

Image A.1
Woolwich Arsenal DLR station

Requirements

Footbridges & Subways

Footbridge Summary of Requirements

B

Appendix B
Footbridge Summary of Requirements

	All Network Rail footbridges should be designed to the following requirements:
01	Footbridges in stations should be designed to one of the Generic Designs and any departure from these design standards should be approved through the Network Rail standards Buildings and Civils derogation
02	The width of the bridge and the stairs should be determined by a capacity assessment but in any case, the clear passage on the bridge should be a minimum 2 m width and the clear passage on the stairs should be a minimum 1.6 m width.
03	Special consideration should be given to lighting of open footbridges which is more difficult due to the fact that there is no overhead roof to carry the light fittings and cable runs.
04	No handrails or footholds should be provided along the parapet of an open or unenclosed footbridge.
05	The top of the parapet on an open or unenclosed footbridge should be designed to prevent any foothold.
06	The minimum headroom on the footbridge should not be below 2.5 m (2.3 m under beams, bulkheads or signage allowed).
07	The users of the footbridge should be able to see out and also be seen from outside. Taking into account wheelchair users and children, the viewing zone (glazed or other) should be at least 1m to 1.8m above deck (if horizontal bars are required, they should be no lower than 1.8m above the deck).
08	Glazing should be heat soaked thermally toughened laminated glass. Self-cleaning glass tested to EN1096-2 is preferable where appropriate.
09	A methodology of cleaning and replacing the glazing should be agreed with the RAM at GRIP4 design stage.
10	Roof cover to footbridges should be insulated to prevent condensation and the eaves should be designed to provide continuous natural ventilation.
11	Special consideration should be given for maintenance and inspection access to the roof and to the rainwater gutters.
12	The base of covered stairs should have a minimum extended cover of 1.2m beyond the stairs.
13	The roof to a footbridge should be designed with falls towards the platform avoiding the need for gutters over the tracks.
14	A covered footbridge and stair should either be enclosed or have a sufficient roof overhang beyond the parapet.
15	All services (power, CCTV and data) should be integrated into the design at GRIP4 design stage.
16	Wherever it is possible, a dual-entry lift that allows passengers to enter and exit the lift without turning 180^0 is preferable.
17	The waiting area in front of the lift, minimum 1.5 m deep, should not be within the passage area of the footbridge span.
18	All lift entrances should be covered either by a roof or a canopy at least 1.5 m deep by 2.5 m wide.

Assessment Aids

C

Footbridges & Subways

Roof Cover Assessment Aid

Lift Requirement Assessment Aid

Appendix C
Roof Cover Assessment Aid

As mentioned in the Background section of this guidance, there is a certain amount of confusion as to whether bridges and stairs should be covered by a roof and also about the extent of enclosure that is required above the parapets. Image B1 to the illustrates the three stair options (open, covered, enclosed) and it follows that the spans would be treated in a consistent manner with any of these options.

A rough cost analysis of recent Access for All (AfA) bridge installations indicates that the cost of the roof and enclosure does not add significantly to the overall cost of a new footbridge project. This does not seem a high price to pay for a safer and more comfortable environment on the station platforms. From maintenance, whole life and asset protection point of view there are also advantages to the covering of the footbridges, avoiding chemical antifrost treatments of the deck surfaces which are polluting and also known to damage the steel structure. The DIA is a good process for establishing the needs and preferences of the local community.

In any case, the current version of the DfT COP of practice requires the stairs on an accessible route in a station to be covered or a dispensation from the DfT for not covering them. The DfT text is extracted from the BS8300 and the bridge span should be viewed, for all practical purposes, as a landing between a number of stairs and lifts.

Below are listed the criteria which should be considered when making the decision if to cover a footbridge. An assessment aid is suggested which could be used for making a request for a DfT dispensation, if the intention is to install an open footbridge. In any case the station operator should always be consulted for the final decision.

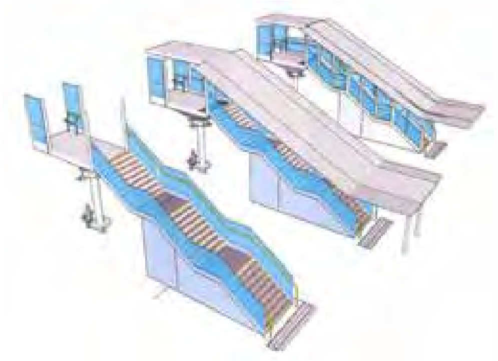

Image B.1
The 3 stair options (Extract from the 2009 guidance). If the roof cover has an overhang of at least 1m, there is no obligation to enclose the stairs

The Criteria suggested are :

1. **Station Category —** Number of people using the stairs (higher numbers increase risk of accidents).
2. **Futureproofing —** Likelihood of use increasing in the next 50 years.
3. **Staffing —** Degree of staff availability in the station in case of an accident and or vandalism.
4. **Weather —** Likelihood of frost or snow on the stairs (increased risk of accident).
5. **Exposure —** Likelihood of wind driven pollution or sea exposure rusting the structure.
6. **Canopy Provision —** On platforms without canopies, a covered footbridge might become a waiting area and this carries a new risk of overcrowding and rushing on the stairs when the train arrives.
7. **Heritage —** In some situations with listed stations, a covered bridge might impact negatively on the integrity of the station or an conservation area. (In such a case a written statement should be sought from the Railway Heritage).
8. **Feasibility —** In some very rare situations it might be physically impossible to provide the enclosure due to height or access restrictions.

Appendix C
Roof Cover Assessment Aid

Station Category	Cat A, B, and C	Cat D	Cat E and F
Score	**2**	**1**	**0**

Futureproofing	Very Likely	Possible	Very Unlikely
Score	**2**	**1**	**0**

Station Staffing	Unstaffed	Partly Staffed	Staffed
Score	**2**	**1**	**0**

Local Weather	Severe	Moderate (UK)	Sheltered
Score	**2**	**1**	**0**

Local Exposure	Exposed	Normal	Unexposed
Score	**2**	**1**	**0**

Platform Canopies	All Platforms	Some Platforms	No Canopies
Score	**2**	**1**	**-3**

Heritage		No planning restriction	Heritage Objection
Score	**Usually 0**	**0**	**-12**

Feasibility		Normal	Impossible
Score	**Usually 0**	**0**	**-12**

Sum of Scores	Above 2	0 to 2	Below 0
Bridge Type	Enclosed	Covered Only	Open

Example A:	Score
Category D Station	1
Likely to Expand	1
Staffed Regularly	0
Moderate Weather	1
Exposed to Sea	2
Some Platforms	1
No Heritage Issues	0
Feasibility	0
Total:	**6**

Bridge should be Enclosed

Example B:	Score
Category E Station	0
Likely to expand	1
Partly Staffed	1
Sheltered	0
Unexposed	0
No Canopies	-3
No Heritage Issues	0
Feasibility	0
Total:	**-1**

Bridge can be Open

Appendix C
Lift Requirement Assessment Aid

Network Rail's policy of requiring a DIA for every project ensures that the decision if to provide a lift on a footbridge or subway should be thoroughly considered in a way that takes into account the users and locality. The following criteria can 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 above of 1:21 (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 TSI 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.


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