Design Manual for Roads and Bridges

Highway Structures & Bridges
Design

CD 353
Design criteria for footbridges

(formerly BD 29/17)

Revision 0

Summary
This document contains the requirements for the design criteria for footbridges.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	CD 353 replaces BD 29/17. This full document has been re-written to make it compliant with the new Highways England drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes BD 29/17 which is withdrawn.

Contractual and legal considerations

This document forms part of the design specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

BD 29/17 has been reviewed as part of the general revision and update of the DMRB. There are few material changes, and most of the amendments have been made to improve consistency and clarity of the requirements and advice.

Assumptions made in the preparation of the document

The assumptions made in GG 101 [Ref 11.N] apply to this document.

Terms and definitions

Terms

Term	Definition
Bridleway	Public right of way open to pedestrians, equestrians and cyclists
Cycle path	Part of a road or footbridge designated and marked as intended for use by cyclists
Cyclist	A pedal cyclist
Desire line	Line likely to be taken by pedestrians, cyclists or equestrians finding the shortest or most desirable route between two points
Footbridge	A pedestrian bridge
General highway terms	For the definition of the general highway terms used in this document such as trunk road, motorway, carriageway, verge etc., refer to BS 6100 [Ref 1.I]
Goal orientated users	Users making a journey to reach a specific destination
Pedestrian bridge	For the purpose of this document, a pedestrian bridge is a bridge, or any part of a bridge, specifically intended to be used by pedestrians, cyclists and/or equestrians
Recreational users	Users making a journey for leisure purposes

1. Scope

Aspects covered

1.1 This document shall apply to the design of pedestrian bridges.

NOTE *This document deals mainly with geometric and user requirements, other design aspects such as strength and properties of materials being covered by other documents within the DMRB Series.*

1.2 This document shall be used where appropriate in conjunction with the relevant parts of the Eurocodes, except where otherwise specified herein.

1.3 This document specifies criteria which shall be used for the design of urban or rural footbridges, which are intended for use by pedestrians, cyclists and equestrians and includes those parts of highway bridges specifically intended for such use.

NOTE *Guidelines for the selection and design of other suitable forms of pedestrian crossings are outside the scope of this document. However, "Provision for Non Motorised Users" CD 143 [Ref 5.N] contains advice on the selection of appropriate crossings.*

Implementation

1.4 This document shall be implemented forthwith on all schemes involving pedestrian bridges on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 11.N].

Use of GG 101

1.5 The requirements contained in GG 101 [Ref 11.N] shall be followed in respect of activities covered by this document.

2. General principles

2.1 The design of the bridge shall primarily ensure the safety of its users and those in its environs.

2.1.1 The footbridge and the approach footpaths should facilitate and encourage its use by all the intended user groups as a means of crossing the obstacle crossed by the structure.

2.2 The selection of alignment, layout, structural form, details and finishes shall be assessed against the full range of relevant design criteria, including:

1) the type of use;
2) accessibility;
3) safety;
4) aesthetics;
5) environment;
6) environmental impact;
7) cost;
8) robustness;
9) durability;
10) sustainability;
11) buildability; and
12) the ease of operation, inspection and maintenance.

2.3 The design shall take account of all likely users and observers of the bridge, and of the obstacle to be crossed, before deciding on its location, alignment and form.

2.3.1 The obstacle spanned by the bridge may include a road, railway, and watercourse.

NOTE *For goal-orientated users, an alignment which addresses the main desire line(s) and avoids obstacles and sharp bends is likely to be a high priority. For recreational users, the design can include features which add value to the bridge user, such as an alignment or form which reduces exposure to traffic, enhances new views, creates a new cycle route, or provides occasional resting places. Such features are part of the overall aesthetic and experience of the bridge.*

2.4 The potential risks arising from wilful misuse, vandalism, graffiti, and other types of anti-social behaviour shall be taken into account in the design.

NOTE *Some bridges attract attempts at vandalism, anti-social behaviour, suicide or self-harm, perhaps due to their location, seclusion, height or other local characteristics. Where this is perceived to be a potential problem, consultation with relevant local bodies such as the police, neighbourhood watch, community groups, local health boards, Samaritans etc. can assist in arriving at appropriate solutions. Non-engineering solutions are preferred, such as clearing vegetation or removing visual barriers which reduce visibility. Avoid the use of enclosures, wherever possible, unless they are required for other reasons.*

2.5 Where footbridge materials or components have a potentially high second-hand or scrap value and can therefore be at risk of theft, the design shall incorporate suitable measures to minimise the risk of their unauthorised removal.

2.6 Measures that minimise the risk of theft and require the use of special tools or procedures, shall be designed such that they remain effective throughout their required design life.

2.6.1 Any special maintenance requirements of the measures incorporated for minimising the risk of theft should be described within the maintenance manual for the structure.

3. Layout and appearance

General

3.1 Where a footbridge crosses a dual carriageway carrying traffic with permitted speeds in excess of 30 mph, the bridge shall have a single span crossing both carriageways where possible to avoid the need for a support in the central reserve.

3.2 Where intermediate piers cannot be avoided, the structural layout, including any vehicle impact protection around the piers, shall be justified at the concept stage.

3.3 Where any part of a footbridge and its supports is located close to a highway such that an errant vehicle could cause damage, the design of the footbridge shall include appropriate vehicle impact protection in accordance with BS EN 1991-1-7 [Ref 6.N] and PD 6688-1-7 [Ref 12.N].

3.4 The design shall follow the advice given in "The Appearance of Bridges and Other Highway Structures" CD 351 [Ref 16.N] and comply with the requirements of CD 351 [Ref 16.N] in relation to all aspects of the appearance of the bridge and the experience of its users and observers.

NOTE *Elegant proportions, a logical structural form, visual clarity and attractive details are among the essential visual characteristics of any good footbridge design, as well as sensitivity to its context and its environmental and social impact.*

3.5 The design shall carefully evaluate the following factors:

1) appearance of the bridge from all angles;
2) views of and from the bridge; and,
3) the experience of the user on the bridge and approaching it.

NOTE *Such factors are particularly important for footbridges because a pedestrian interacts slowly and directly with the bridge in a way that does not happen for those using a highway bridge in a vehicle for example.*

3.6 The design shall minimise the visual and environmental impact of the bridge, access ramps and stairs.

3.6.1 In certain topographies, this requirement may be achieved by visual screening using existing or new planted hedgerows or tree lines as illustrated in Figure 3.6.1.

Figure 3.6.1 Use of visual screening to minimise visual and environmental impact of the bridge

3.6.2 The advice of a landscape architect may be sought in relation to any proposed planting.

3.6.3 Planting schemes which create enclosed areas causing potential anxiety or security risk to users, or which can eventually cause trip or slip hazards from root and branch growth or leaf-fall, should be avoided.

3.7 The design shall take into account any effects on future maintenance liabilities for the structure.

3.8 The location and arrangement of the footbridge shall be selected to make maximum use of the local topography, placing the abutments at or close to adjacent ground level, where possible, so as to minimise the need for stairs and ramps as illustrated in Figure 3.8.

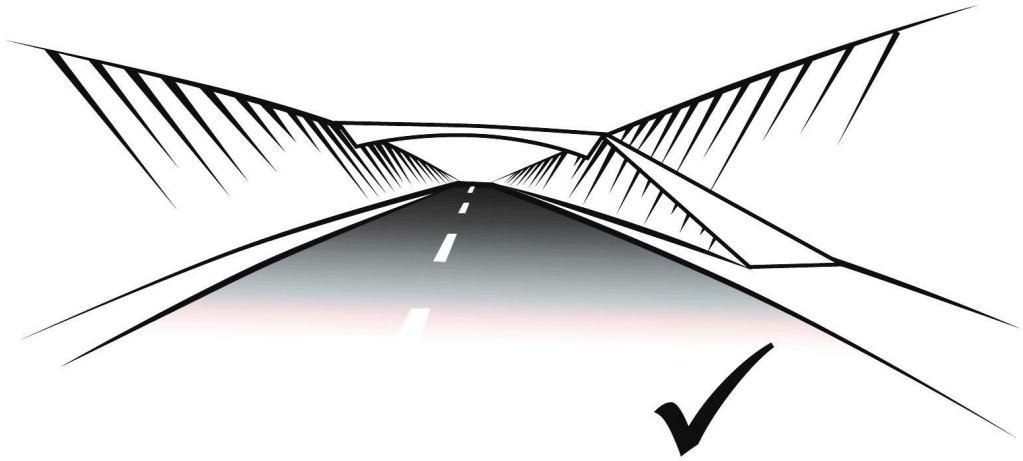
Figure 3.8 Illustration of maximum use of local topography to minimise the need for stairs and ramps

3.9 Wherever possible, the design shall make use of natural and man made slopes and topography, such as cuttings and embankments, to accommodate the access ramps and stairs in order to minimise the need for them to be supported by additional structural elements.

NOTE *Good and bad footbridge access provisions are illustrated in Figure 3.9N1a and Figure 3.9N1b.*

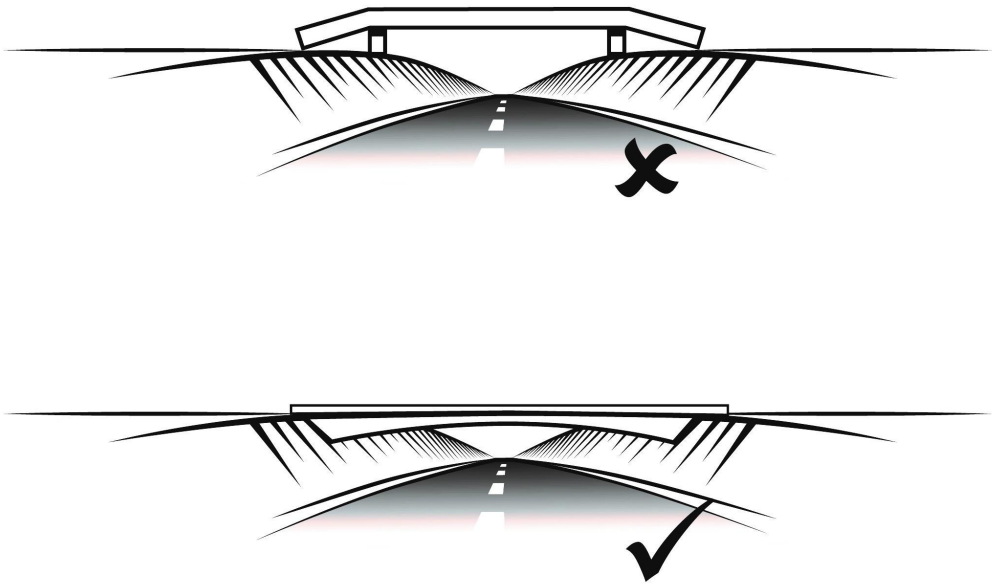
Figure 3.9Na Illustration of bad footbridge access

Figure 3.9Nb Illustration of good footbridge access



3.10 Where the footbridge crosses a road which is in a cutting, particularly when the bridge is visible from a distance on the skyline, the cutting slope shall extend up to deck level where possible in accordance with Figure 3.10.

Figure 3.10 Footbridge crossing a road in a cutting



3.11 Where the bridge is to carry an existing rural footpath, bridleway or byway, any diversion of that route shall be such as to minimise the total route length and maintain the existing desire line so as to make the path more pleasant, provide better accessibility and help exploit the topography.

3.11.1 Where it is necessary to divert an existing route, the diversion may need to start a long way from the bridge to achieve the desired outcomes.

3.11.2 Rural footpaths frequently follow field boundaries and historic rights of way and the layout should avoid diversions that cut directly across fields.

NOTE *Further guidance on the diversion of existing rights of way can be found in Section 3 of CD 143 [Ref 5.N] "Provision for Non-Motorised Users".*

3.11.3 Rural footpaths, bridleways and byways should not be diverted to run beside unscreened, busy roads.

3.11.4 The design should avoid any inaccessible or confined spaces where rubbish and detritus can accumulate or inspection and maintenance are made difficult.

Access

3.12 Access to the deck of a footbridge shall take account of the provisions of the Equality Act 2010 Acts 2010 c.15 [Ref 5.I].

3.12.1 The provisions of the Equality Act 2010 Acts 2010 c.15 [Ref 5.I] may require access to be provided by both ramps and stairs.

3.12.2 Where ramps alone provide the most direct route to the deck, the stairs may be omitted.

3.12.3 Access by stairs alone should only be evaluated in exceptional circumstances and with the agreement of local access and disability groups.

3.13 Access ramps and stairs shall be simple, short and direct wherever possible, following the main desire line and avoiding long detours or unnecessary climbing.

3.14 The choice of gradients and landings (rest areas), and the radii of turns and manoeuvring spaces, shall suit the needs of all potential users, including mobility-impaired users, cyclists and equestrians and particular requirements are given in section 5.

3.15 Where a footbridge crosses a road, the design shall be such as to encourage pedestrians to use the footbridge rather than to cross the road at grade.

NOTE *Pedestrians can be encouraged to use the footbridge rather than to cross a road at grade by providing suitable guardrails, fencing or appropriate planting to act as a physical barrier alongside the road.*

3.16 Where a footbridge or footway passes close to an adjacent structure or footpath, the design shall assess the hazard to persons attempting to jump or climb across the gap between the structures.

3.16.1 The design should be such as to prevent or deter attempts to climb between adjacent structures where such action presents a risk.

3.16.2 Where possible, a gap should be provided between the bridge and the adjacent structure of at least 2 metres.

3.17 Unauthorised access onto the footbridge by motor vehicles shall be prevented, without hindering access by the intended users of the footbridge, by the use of suitable measures such as bollards or staggered railings at the ends of the bridge.

3.17.1 Unauthorised access measures should be appropriate to the particular context and environmental setting.

3.18 Restrictions on footbridges shall be adequately marked in a contrasting colour to assist visually impaired users.

NOTE *Further information can be obtained from Inclusive Mobility [Ref 4.I].*

4. Design standards

General

4.1 Steel, concrete, timber and aluminium footbridges shall be designed in accordance with the relevant parts of the Eurocodes.

4.2 Where other materials are employed, the design shall be in accordance with:

1) an equivalent codified guidance; or,
2) current best practice.

4.3 Where footbridge sub-structures are sited on railway or waterway property, the design shall satisfy the appropriate authority's requirements.

Vibration and dynamic response

4.4 The design shall meet the vibration serviceability requirements set out in BS EN 1990 [Ref 9.N], NA to BS EN 1990 [Ref 8.N], BS EN 1991-2 [Ref 7.N], NA to BS EN 1991-2 [Ref 18.N], and PD 6688-2 [Ref 13.N], as implemented by DMRB CD 350 [Ref 17.N].

NOTE Modern lightweight footbridges can be susceptible to vibrations caused by bridge users, whether deliberately or unintentionally. Footbridges with vertical modes of vibration less than 5 Hz and/or lateral modes of vibration less than 2.5 Hz can be particularly susceptible, and the resulting motions can cause discomfort to bridge users and even lead to structural damage in extreme cases.

4.5 Accelerations shall be calculated for lateral and torsional modes of vibration with natural frequencies of less than 2.5Hz in response to single pedestrian (and small pedestrian groups) when walking and jogging and to crowded conditions.

NOTE 1 A methodology for the determination of dynamic lateral responses arising from pedestrians is given in Appendix A.

NOTE 2 The methods in Appendix A are additional to the provisions of BS EN 1991-2 [Ref 7.N], its National Annex NA to BS EN 1991-2 [Ref 18.N], and PD 6688-2 [Ref 13.N], as implemented by DMRB CD 350 [Ref 17.N].

NOTE 3 The dynamic response of footbridge structures is a relatively specialist area of work. Obtain specialist advice where necessary to derive an appropriate prediction of the structural response and pedestrian comfort.

4.6 Where dampers are required to control vibration amplitudes, they shall be robust, durable, accessible for routine inspection but not to anyone other than authorised inspectors, and designed for easy maintenance.

NOTE Obtain specialist advice where necessary to determine the most appropriate damper to suit the application.

Minimum thickness of metal sections

4.7 The minimum thickness of metal structural elements shall be as defined in table 4.7.

Table 4.7 Minimum thickness of metal sections

Steel plates and sections other than hollow sections effectively sealed by welding	6 mm
Steel hollow sections effectively sealed by welding	5 mm
Aluminium alloy plates and sections	4 mm

5. Dimensional standards

Clearances to highway beneath the bridge

5.1 The vertical clearances to a highway beneath the bridge shall be in accordance with CD 127 [Ref 2.N].

5.1.1 The vertical and horizontal clearances to railways, canals and watercourses should be agreed with the Technical Approval Authority.

5.2 The horizontal clearance from the edge of the carriageway to the footbridge supports shall be a minimum of 4.5 metres over the full height of the carriageway clearance envelope.

5.3 Where there is a possibility that the hard shoulder can be used as a running lane in the future, the design shall account for any specific allowances which have to be made for this.

Minimum width

5.4 The minimum clear width of the footway, ramps and stairs shall be the greater of 2.0 metres or the dimension determined from the following in relation to predicted peak pedestrian traffic:

1) on the level or where the gradient is 1:20 or shallower: 300 mm of width per 20 persons per minute;
2) on steps, or where the gradient is 1:15 or steeper: 300 mm of width per 14 persons per minute; or,
3) for gradients between 1:15 and 1:20, a dimension derived by linear interpolation between 1 and 2.

5.5 Where the footbridge is for shared use by cyclists or equestrians, the design shall also comply with the requirements of section 11.

Headroom clearance on the bridge

5.6 The minimum headroom to the underside of overhead obstacles such as stay cables, roof enclosures or other overhead features, measured vertically from the footway surface across the full width between handrails, shall be in accordance with Table 5.6.

Table 5.6 Minimum headroom clearance on the bridge

For use by pedestrians only	2.3 m
For use by pedestrians and cyclists	2.4 m
For use by dismounted equestrians (dismounting provisions in accordance with section 11)	2.7 m
For use by mounted equestrians	3.7 m

5.7 Where the overhead obstacle is a potentially vulnerable or critical structural component, such as a slender stay cable, or where an important or sensitive feature such as a sign gantry is close to the bridge, the clearance shall be such that it is not easy to reach when standing anywhere on the footbridge, including on raised benches or other raised features where these are provided.

Maximum gradients

5.8 The maximum gradient on the bridge and approach ramps shall not be steeper than 1 in 20 unless special circumstances apply.

5.8.1 Where special circumstances apply, a relaxation in ramp gradient to 1 in 15 may be permitted, or even to 1 in 12 in cases of extreme difficulty.

NOTE *Such special circumstance include locations where a maximum slope of 1 in 20 cannot be achieved for the desired bridge and ramp alignment without either creating a long diversion, causing unacceptable environmental impact, or requiring excessive use of space.*

5.9 Where a relaxation in gradient is applied, landings and changes in direction shall be provided in accordance with section 5.

5.10 Gradients steeper than 1 in 12 shall not permitted.

Landings and horizontal alignment on ramps

5.11 Intermediate horizontal landings shall be provided as follows:

1) for gradients shallower than 1 in 22: intermediate landings are not required;
2) for a gradient between 1 in 20 and 1 in 22: at equal vertical rise intervals of not more than 2.5 metres; and,
3) for gradients steeper than 1 in 20: at vertical rise intervals of not more than 0.65 metres.

5.12 The length of a landing shall not be less than 2.0 metres, measured along the centreline for straight ramps or at 900 mm from the handrail on the inside edge for curved ramps.

5.12.1 Where the gradient is steeper than 1 in 20, there should be a significant change in plan alignment at intervals corresponding to a vertical rise of 3.5 metres.

5.12.2 A change in plan alignment may be achieved by either a change in direction of at least 30 degrees or an offset in the horizontal alignment of at least the width of the footway.

5.12.3 Where ramps have a gradient steeper than 1 in 20, successive sloping ramps in one line may be used where no other arrangement of ramps is possible on the site or where such an arrangement provides more encouragement to pedestrians to use the footbridge by shortening the walking distance or improving the desire line.

Spiral and curved ramps

5.13 The effective gradient and governing dimensions for spiral and curved ramps shall be measured 900 mm from the edge of the footway on the inside of the curve.

5.14 The requirements of the subsection 'Maximum gradients' for plain ramps shall apply to the effective gradient on spiral and curved ramps.

5.15 The minimum inside radius of the footway for curved and spiral ramps shall be 5.5 metres.

5.15.1 Where bridges are designed for use by cyclists and/or equestrians, a larger curve radius may be required.

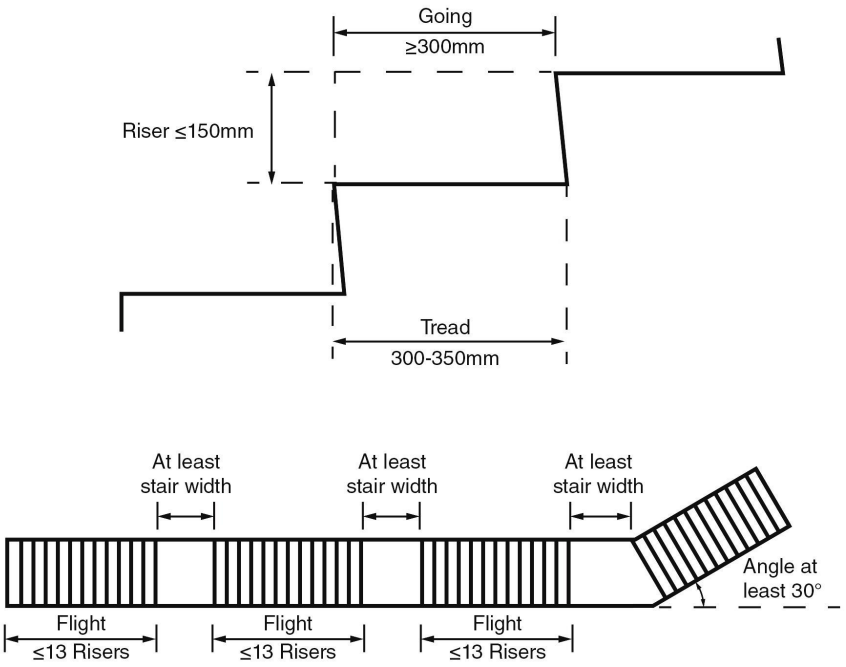
Stairs

5.16 Dimensions and safety requirements for access stairs to footbridges shall comply BS 5395 [Ref 1.N] for 'public' stairs, except as amended in accordance with figure 5.17.

5.17 Public stairs complying with figure 5.17 shall have the following characteristics:

1) number of risers in a single flight: $\leq$ 13;
2) riser dimension: $\leq$ 150 mm be constant over the width of the stair;
3) going dimension: $\geq$ 300 mm;
4) risers and goings of each step in a flight of stairs to be uniform;
5) have a maximum of three successive flights provided any adjacent flights create a change in direction of at least 30 degrees; and,
6) landing lengths to be not less than the width of the stairs or 2 metres, whichever is the greater, measured along the centre line of the stairs.

Figure 5.17 Plan and section of public stair with amended characteristics



5.17.1 Further guidance for dimensional and safety characteristics of public stairs further may be obtained from Dept. for Transport publication Inclusive Mobility [Ref 4.I].

5.18 Stairs shall not have completely open risers.

5.18.1 Risers may be solid or perforated.

5.19 Where perforated risers are provided, the openings shall meet the following requirements:

1) maximum principal dimension of the perforation = 50 mm;
2) maximum ratio of the open area to the total area of the riser = 0.4.

6. Parapets

General

6.1 All bridge spans, ramps and stairs shall be provided with parapets.

6.2 Parapets are an integral part of the bridge and shall be in accordance with CD 351 [Ref 16.N].

NOTE *In addition to providing an essential, robust and durable safety fence, the parapets are a conspicuous visual feature and one that significantly affects the appearance of the bridge and the experience of the user. Their design requires careful assessment and attention to detail.*

6.3 Parapets shall conform to the requirements of CD 377 [Ref 14.N] and the further provisions in this document.

6.4 The height of the edge upstand under the parapet for plain or spiral ramps shall be not less than 25mm and no more than 50mm.

NOTE *An upstand is not required under the parapet on stairs.*

6.5 Where a stair parapet is provided with a bottom rail, the clearance from the rail to the nose of the stairs shall be at least 50mm but not greater than 100mm.

NOTE *The height of a stair parapet is measured vertically above the line joining the noses of the stairs.*

6.6 Glass parapets shall be made of laminated and toughened glass.

6.7 Where a glazed system is proposed, it shall be made from laminated and toughened glass.

6.7.1 Laminated and toughened glass panels should retain sufficient post fracture strength to remain in place within its fixings when they are damaged such that shards created during shattering are retained by the laminated materials.

6.8 A risk assessment shall be undertaken during the selection of the glazing system.

6.8.1 Where a footbridge is exposed to particularly strong winds (such as where it is unusually high above the surrounding ground level), the height of the parapet may be increased to 1.30m with a solid or partially solid infill panel to provide extra protection to users.

6.8.2 As an alternative to raising the height of the parapet an enclosed form of superstructure may be evaluated in order to provide enhance user protection against strong winds.

NOTE *Advice on enclosed footbridges is provided in Section 7 of this document.*

6.8.3 Where parts of the footbridge, ramps or stairs pass close to buildings, the design should incorporate solid parapet infill panels or suitable screening to protect the privacy of bridge users, adjacent residents and others where necessary.

6.9 Where structural members of a footbridge serve as a parapet, the height of the parapet, the infilling of open areas, the upstand at the edge of the walkway surface and the climbability of any part shall be in accordance with the requirements for parapets.

NOTE *The climbability aspect requires particular attention where diagonal members occur at intermediate heights.*

Handrails

6.10 Handrails designed in accordance with BS 8300-1 [Ref 3.N] shall be provided on both sides of:

1) stairs; and,
2) the footway on bridge decks and ramps wherever the gradient exceeds 1 in 20.

6.10.1 Additional central handrails should be provided where the width of the footway exceeds 3 metres.

6.11 The top of the handrail shall be between 900 and 1000 mm above the footway surface, measured vertically.

NOTE *On stairs this height is measured vertically above the line joining the noses of the stair treads.*

6.12 All handrail surfaces shall be smooth and free from sharp edges, and have a clear distance behind the handrail of at least 60 mm to any part of an enclosure or solid obstacle in between the handrail attachments, to allow hands to slide freely along its surface without risk of injury.

6.13 Handrails of circular section shall have a diameter of between 40 and 50 mm.

6.14 Handrails of non-circular section shall have a depth and shape which enables them to be grasped easily by hand.

6.14.1 Non-circular handrails should not be less than 50mm wide by 38mm deep with rounded edges.

6.15 Handrails shall be of contrasting colour or texture from the parapet to which it is attached to assist those with visual impairment.

NOTE *Further guidance on provision of handrails can be obtained in Inclusive Mobility [Ref 4.I].*

6.16 The handrail and its fixings shall be designed to resist a uniformly distributed load of 0.7 kN/m applied separately in the horizontal and vertical directions in such a way that the system is designed for the most severe effects.

NOTE *The loadings applied to the handrail are not to be assessed in addition to the loadings defined for the parapet as a whole.*

7. Enclosed footbridges

7.1 Footbridges shall be designed with full or partial enclosure where it is assessed that there is a particularly high risk of the following:

1) objects being dropped or thrown from the footbridge; or
2) persons jumping onto the carriageway from the footbridge.

7.1.1 Depending on the issues relevant at a particular site, a high parapet with an inward canted top may suffice in place of full enclosure.

7.1.2 Where a footbridge is exposed to very adverse weather or strong winds, such as where it is unusually high above the surrounding ground level, or where it is so high above the road that pedestrians can feel insecure, then full or partial enclosure may be required.

7.2 Where full or partial bridge enclosure is proposed, the aerodynamic and other effects of wind both on the structure and on the comfort of its users shall be investigated and analysed.

7.2.1 Specialist advice may be necessary to assess the aerodynamic and other effects of wind on the structure and comfort of its users.

7.3 Wind tunnel testing shall be considered where reliable design guidance is not available for the form of bridge design.

NOTE *Guidance for wind tunnel testing is given in CD 363 [Ref 4.N].*

7.4 Cladding and infill panels shall be suitable for their use and location, with a robustness and durability appropriate for the intended lifespan of the footbridge.

7.4.1 Panels (perforated or otherwise) can be of any suitable material, but solid panels which are above the handrail should be transparent, unless otherwise required such as in the case of some equestrian bridges.

7.5 Where cleaning of the outside surfaces of the enclosure is required, the design shall enable this to be carried out in a safe manner.

7.6 The design shall prevent unauthorised public access to the outside of the enclosure.

NOTE 1 *Particular care is needed to prevent access to the outside at the ends of the bridge where it is over a cutting.*

NOTE 2 *Flush glazing on the outside face of the structure is an acceptable form for enclosure of the walls, and arched mesh roofs are an acceptable form for preventing roof access. Other solutions are also possible.*

7.7 The minimum clearance inside the enclosure shall comply with Section 5.

8. Drainage

8.1 Provision shall be made for the drainage of water from the footbridge, and from its roof in the case of enclosed footbridges.

8.2 All walkway surfaces, steps, ramps and roof shall have sufficient falls and suitable detailing to allow water to run off in the manner intended by the design.

8.3 With the exception of stair treads and structures with perforated decks, water from the footbridge shall be carried away to a:

1) drainage system; or,
2) soakaway.

8.4 Drainage outlets shall project a suitable distance beyond the adjacent structure to prevent water splashing onto the structure.

NOTE *These requirements are to prevent discharge or spill onto the carriageway or footpaths below the bridge, or staining of adjacent exposed surfaces.*

8.5 Positive drainage shall be provided beneath all deck movement joints, with water being directed away from bearings and bearing shelves.

8.6 Steel decks shall be carefully detailed to ensure the fabrication process does not induce distortions caused by weld shrinkage which could lead to water ponding on the deck.

NOTE *Measures that can be considered to avoid deck distortions include the use of 8mm deck plate spanning no more than 800mm. The deck plate can be cambered to provide a transverse cross fall to the edges of the deck to ensure surface water is shed to the sides and directed to a positive drainage system.*

8.7 The longitudinal profile of the bridge shall be designed with precamber to overcome self-weight and live action deflections whilst maintaining a positive fall to drainage outlets.

8.7.1 The precamber should be sufficient to ensure positive fall to the drains under SLS load conditions including snow loading.

8.8 The design shall ensure that drainage paths and deck camber profiles at landings prevent the possibility of ponding (particularly at corners where the landing is used to allow a change in direction).

8.9 Where a flight of stairs is included within the structure the drainage paths shall be detailed to prevent water ponding at the top and bottom of stair landings and prevent the possibility of water discharging down the steps from adjacent ramps.

8.10 Steps and nosings shall be detailed to prevent water getting trapped on the step (for example due to a nonslip nosing upstand or back fall on the step occurring due to inadequate construction tolerance).

8.11 Where there is a risk of leaf debris falling onto the deck, and also at the base of long ramps, the use of proprietary channel drains with gratings covers shall be avoided.

NOTE 1 *The slots can be become blocked with debris resulting in the drainage becoming ineffective.*

NOTE 2 *On long ramps or steep gradients a large percentage of water can run over the top of any grating.*

8.12 The possibility of water running over the top of any grating system shall be assessed in any drainage design.

8.12.1 A drainage system should, where possible, be provided off the structure upstream of the deck or expansion joint to capture and prevent surplus surface water from reaching the structure from adjacent paved surfaces.

8.13 Erosion protection at drainage discharge points shall be provided to prevent damage to structure foundations and adjacent soft surfaced areas.

8.14 When designing a drainage system, the provision of access shall be evaluated to allow safe periodic/routine maintenance operations to be undertaken.

9. Walkway surface

9.1 The fitness for purpose and choice of the combined substrate/surfacing system for the respective user type shall be:

1) assessed in accordance with the requirements in this section; and,
2) agreed with the Overseeing Organisation.

9.2 The nature of the walkway surfacing system represents a vital part of the overall appearance, character, performance and durability of the bridge, and shall be assessed as an integral part of the design to suit the particular application.

9.3 The suitability of the surfacing system shall be assessed in line with all performance requirements such as corrosion resistance, slip resistance, environmental deterioration, noise transmission, free drainage and durability.

9.3.1 Noise attenuation may be required in some cases, such as on equestrian bridges close to sensitive noise receivers.

NOTE *Proper adhesion of surfacing materials with all parts of the structure is necessary, including with painted elements, ducts, etc.*

9.4 The upper substrate surface of bridge decks, ramps and stairs shall be waterproofed or otherwise protected against deterioration due to water or surface contaminants.

9.5 All traversed surfaces shall be designed to have minimum slip resistance for the life of the walkway surfacing equivalent to a mean corrected pendulum test value of 45 units using a standard skid resistance pendulum test in accordance with BS EN 13036-4 [Ref 15.N].

9.6 Cover plates to expansion joints at deck level shall be flush with the walkway surface and provided with a suitable slip resistant coating or be profiled to provide a non-slip finish.

9.7 The width of any exposed gap in the walkway surface, such as at movement joints, shall not exceed 12mm, taking into account movements due to temperature.

9.8 Where the bridge is designated for use by cyclists, any gap, joint or discontinuity in the bridge deck surface that is aligned within a plan angle of less than 30^{o} to the normal line of travel shall be flush with the surface and such that a bicycle wheel cannot be caught or deflected when it passes over.

NOTE *Gaps, joints and discontinuities include the edges of manhole covers, for example.*

9.9 The installation date and minimum expected life of the surfacing and waterproofing system shall be given in the maintenance manual for the structure.

10. Lighting

10.1 Footbridges shall be illuminated where they are located in areas where public lighting is provided.

10.2 Lighting shall conform to the requirements of BS 5489-1 [Ref 2.I].

10.3 The design shall take into account not only the level and nature of illumination necessary for safety reasons, but also the visual impact and aesthetic character of the lighting scheme when viewed both by users of the bridge and those passing or living nearby.

NOTE 1 Footbridge lighting, where required, is an important aspect of the design and can be a highly significant visual feature during hours of darkness. Refer to the recommendations of CD 351 [Ref 16.N] in respect of the appearance of the bridge at night.

NOTE 2 Lighting design is a specialist field, and in certain cases the input of a specialist lighting designer is needed to achieve the quality of lighting demanded by the bridge and its environment.

10.4 The design shall avoid unnecessarily excessive illumination, and in particularly any direct glare in the eyes of bridge users, drivers passing beneath or other observers.

10.5 Where illumination is provided on the bridge, it shall be consistent to ensure that all walkway surfaces, stairs and handrails are visible.

10.6 Footbridge lighting shall be on a circuit that can be isolated.

10.6.1 Footbridges may be illuminated by means of existing adjacent road or footway lighting, augmented where necessary by additional ground level mounted lighting columns and lanterns.

10.6.2 Where it is not possible or appropriate to illuminate a footbridge by means of existing lighting from the adjacent road or footway, the footbridge may be illuminated by:

1) light fittings incorporated into the parapet or handrail; or,
2) other light fittings mounted on the bridge.

NOTE A covered walkway cannot be lit from existing lighting from the adjacent road or footway.

10.7 All components of the lighting system, including all fittings, connections, wiring and switchgear, shall be robust and tamper proof.

10.7.1 Parapet members should not be used as cable ducts.

10.8 Wherever possible, luminaires shall be accessible by authorised personnel for maintenance without the need to provide special access facilities.

11. Combined use footbridges

General

11.1 The layout and surfacing of the footbridge approaches beyond the ramp and stair ends shall be in accordance with the guidance in CD 143 [Ref 5.N].

NOTE *Further guidance on the layout and surfacing of the footbridge approaches beyond the ramp and stair ends can be obtained in CD 143 [Ref 5.N] .*

11.2 The design for cycle traffic shall be in accordance with CD 195 [Ref 3.I].

11.3 Tactile surfacing for combined use situations shall be in accordance with the requirements of Guidance on the use of tactile paving surfaces PPU 1622RB [Ref 10.N].

Combined use by pedestrians and cyclists

11.4 Footbridges designed for combined pedestrians and cyclists use shall be either segregated or unsegregated.

11.5 The form of segregation shall be consistent over the full length of the footbridge and its approaches.

11.5.1 The form of segregation may not involve a physical dividing barrier.

11.5.2 Differing surface textures and colours may also be used, subject to the requirements of section 9, to differentiate the footway from the cycle path and aid visually impaired users.

11.6 Where the bridge is part of a pedestrian and cycle route, specific provision shall be made in accordance with any guidance on shared use by cyclists and pedestrians provided by the Overseeing Organisation.

11.7 The minimum clear usable widths for the footway and cycle path on shared use bridges and ramps shall be in accordance with Table 11.7.

Table 11.7 Minimum bridge widths for shared use

	Footway	Cycle path	Total
When segregated by a kerb not less than 50mm high	2.0 m	2.7 m	4.7 m
When segregated by a physical barrier not less than 900mm high	2.0 m	3.0 m	5.0 m
When segregated by a white line and/or contrasting surface colours or textures	1.5 m	2.5 m	4.0 m
Unsegregated	-	-	3.5 m

11.8 On bridges designed for use by cyclists, the minimum height of the parapet shall be 1.40 metres.

11.9 Where cyclists are segregated from pedestrians by a physical barrier, the increased parapet height shall only be provided on the cycle track side of the bridge, unless an assessment justifies otherwise.

NOTE *Section 6 contains other requirements for the parapet.*

11.10 Where there is a risk that fast moving cyclists can present a safety hazard to other bridge users, the design shall include suitable features to slow the speed of cyclists to reduce this risk, without hindering the passage of:

1) prams;
2) wheelchairs or mobility and visually impaired users; and,
3) other bridge users such as tandems and cyclists with trailers.

11.10.1 Features for slowing the speed of cyclists may include bollards, chicanes or other devices.

11.10.2 Features for slowing down speed should be located on level landings especially where ramp gradients are steeper than 1 in 20.

11.10.3 Features for slowing should encourage cyclists to slow down without forcing them to dismount.

11.10.4 Unless there is an immediate justification for using barriers or chicanes, they should be omitted.

11.11 The geometry of the bridge approaches shall be such that installation of barriers and chicanes at a later date is possible.

NOTE *Further requirements and advice regarding designing for cycle traffic can be obtained in accordance with CD 195 [Ref 3.I].*

Combined use by pedestrians and equestrians

11.12 Where a bridge is designated for equestrian use, it shall be designed in accordance with the relevant parts of the Eurocodes as implemented by DMRB CD 350 [Ref 17.N].

11.12.1 All bridges catering for equestrians should be designed for combined pedestrian/equestrian use, and can very often be required to accommodate cyclists too.

11.13 The minimum width of a footbridge for combined pedestrian/equestrian use shall be 3.5 metres.

11.13.1 Where a large number of horses are expected to cross the bridge at the same time (such as where the bridge is adjacent to a riding school or stables, for example) a larger width may be required.

11.13.2 In some cases of very frequent use by equestrians as well as pedestrians and/or cyclists it may be necessary to provide suitable physical segregation.

11.14 Where the headroom on the bridge does not conform to the requirements of section 5, suitable signs shall be provided requiring equestrians to dismount.

11.15 The design shall incorporate mounting/dismounting blocks in the approaches to the bridge to assist those who prefer to lead their horse across the bridge.

11.16 Mounting blocks shall not reduce the clear width required for combined pedestrian/equestrian use.

11.16.1 Where mounting blocks are intended they should be located such that the passage of users, including prams and wheelchairs or mobility and visually impaired users is not restricted.

11.16.2 Mounting/dismounting blocks are intended for the convenience of equestrians and may also be provided where the crossing is not part of a designated bridleway.

11.17 Where solid infill panels higher than the minimum height required by section 6 are used in order to reduce the risk of horses being startled by traffic on the carriageway below, the design shall assess the effects on bridge appearance and the potential loss of utility to other users.

11.18 Wherever possible, the design shall provide suitable equestrian waiting areas off the bridge, and permit all users approaching the bridge to see the entire length of the structure, so as to allow mounted users the option of crossing when the deck is clear.

11.19 Suitable signs shall be erected on the approaches to the footbridge to warn other users of the likely presence of horses, and requesting cyclists to take particular care or give way to equestrians.

11.20 On designated bridleways, where the deck is constructed of steel, timber or any other material which can resonate with the sound of horses' hooves and potentially alarm them, a noise attenuating surfacing system shall be used.

11.20.1 On non-designated bridleway bridges, warning signs may be installed to alert equestrian users of sound resonance from the impact of the horses' hooves with the surfacing of the deck.

11.20.2 Such surfacing systems may include dense rubber paving blocks for example.

NOTE *Additional information on tactile surfacing for combined use situations can be obtained in accordance with DETR publication 'Guidance on the use of tactile paving surfaces' PPU 1622RB [Ref 10.N].*

12. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	BSI. BS 5395, 'Code of practice for the design of stairs for limited access'
Ref 2.N	Highways England. CD 127, 'Cross-sections and headrooms'
Ref 3.N	BSI. BS 8300-1, 'Design of an accessible and inclusive built environment, Part 1: External environment - Code of practice'
Ref 4.N	Highways England. CD 363, 'Design rules for aerodynamic effects on bridges'
Ref 5.N	Highways England. CD 143, 'Designing for walking, cycling and horse riding (vulnerable users)'
Ref 6.N	BSI. BS EN 1991-1-7, 'Eurocode 1 - Actions on structures - Part 1-7 General actions - Accidental actions'
Ref 7.N	BSI. BS EN 1991-2, 'Eurocode 1. Actions on structures. Traffic loads on bridges'
Ref 8.N	BSI. NA to BS EN 1990, 'Eurocode: Basis of structural design'
Ref 9.N	BSI. BS EN 1990, 'Eurocode: Basis of structural design'
Ref 10.N	DETR - Dept of the Environment, Transport & Regions. PPU 1622RB, 'Guidance on the use of Tactile Paving Surfaces'
Ref 11.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 12.N	BSI. PD 6688-1-7, 'Recommendations for the design of structures to BS EN 1991-1-7'
Ref 13.N	BSI. PD 6688-2, 'Recommendations for the design of structures to BS EN 1991-2'
Ref 14.N	Highways England. CD 377, 'Requirements for road restraint systems'
Ref 15.N	BSI. BS EN 13036-4, 'Road and airfield surface characteristics. Test methods. Part 4-Method for measurement of slip/skid resistance of a surface: The pendulum test'
Ref 16.N	Highways England. CD 351, 'The design and appearance of highway structures'
Ref 17.N	Highways England. CD 350, 'The design of highway structures'
Ref 18.N	BSI. NA to BS EN 1991-2, 'UK National Annex to Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges'

13. Informative references

The following documents are informative references for this document and provide supporting information.

Ref 1.I	BSI. BS 6100, 'Building and civil engineering vocabulary'
Ref 2.I	BSI. BS 5489-1, 'Code of practice for the design of road lighting, Part 1: Lighting of roads and public amenity areas'
Ref 3.I	Highways England. CD 195, 'Designing for cycle traffic'
Ref 4.I	Department for Transport (UK Gov). Inclusive Mobility, 'Inclusive Mobility'
Ref 5.I	The National Archives. legislation.gov.uk. Acts 2010 c.15, 'The Equality Act 2010'

Appendix A. Pedestrian induced dynamic response

A1 Lateral response calculations

Peak lateral deck accelerations induced by pedestrians should be calculated by following the approach described in NA to BS EN 1991-2 [Ref 18.N] and PD 6688-2 [Ref 13.N], but with certain parameters modified to relate to lateral response, rather than vertical.

A1.1 Direction of loading

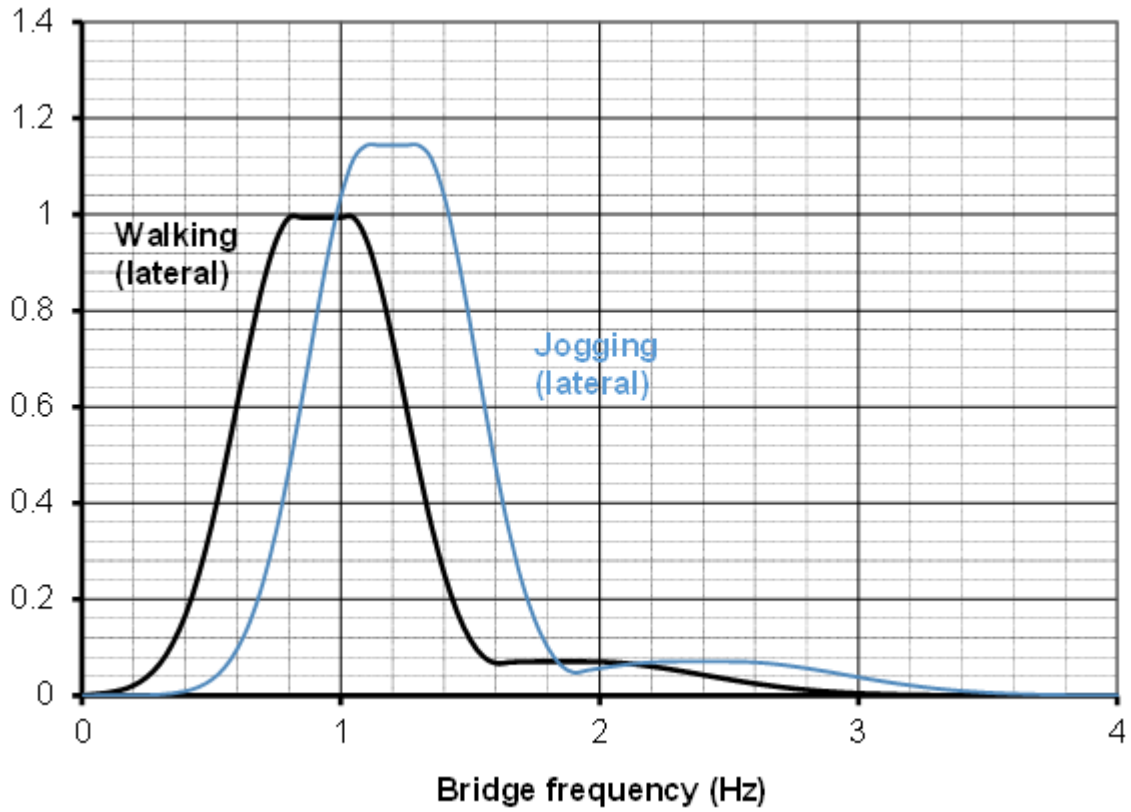
Lateral dynamic loads due to pedestrians should be taken to be in the horizontal plane, orthogonal to the longitudinal axis of the bridge deck.

A1.2 Reference load

The reference load for use in lateral response calculations is F_0 = 70N, for both the walking and jogging cases.

A1.3 Combined population and harmonic factor

Figure A.1 Combined population and harmonic factor for use in lateral response calculations



The combined population and harmonic factor $k(f_v)$, as obtained from figure NA.8 in NA to BS EN 1991-2 [Ref 18.N] for vertical response calculations, should be substituted for a similar parameter $k'(f_{v,lat})$, where $f_{v,lat}$ is the natural frequency of the lateral deck mode being considered. $k'(f_{v,lat})$ to be obtained from figure A.1.

A1.4 Lateral deck acceleration limits

Peak lateral deck accelerations, calculated according to the method described in this appendix, should be compared against the limit recommended in BS EN 1990 [Ref 9.N].

Measures to provide damping should be introduced if the accelerations are above the recommended limits.

Highway Structures & Bridges
Design

CD 353
England National Application Annex to CD 353
Design criteria for footbridges

(formerly BD 29/17)

Revision 0

Summary
There are no specific requirements for Highways England supplementary or alternative to those given in CD 353.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Highways England National Application Annex to CD 353.

Department for Infrastructure
An Roinn Bonneagair

Highway Structures & Bridges
Design

CD 353
Northern Ireland National Application Annex to CD 353 Design criteria for footbridges

(formerly BD 29/17)

Revision 0

Summary
There are no specific requirements for the Department for Infrastructure, Northern Ireland supplementary or alternative to those given in CD 353.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated team in the Department for Infrastructure, Northern Ireland. The email address for all enquiries and feedback is: dcu@infrastructure-ni.gov.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Department for Infrastructure Northern Ireland National Application Annex to CD 353

Highway Structures & Bridges
Design

CD 353
Scotland National Application Annex to CD 353 Design criteria for footbridges

(formerly BD 29/17)

Revision 0

Summary
There are no specific requirements for Transport Scotland supplementary or alternative to those given in CD 353.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Transport Scotland National Application Annex to CD 353.

Llywodraeth Cymru
Welsh Government

Highway Structures & Bridges
Design

CD 353
Wales National Application Annex to CD 353 Design criteria for footbridges

(formerly BD 29/17)

Revision 0

Summary
This National Application Annex contains the Welsh Government specific requirements related to design criteria for footbridges.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Welsh Government National Application Annex to CD 353.

Foreword

Publishing information

This document is published by Highways England on behalf of the Welsh Government.

This document supersedes BD 29/17, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex outlines the implementation requirements for CD 353 Design of footbridges for Wales and should be read in conjunction with the main document

Assumptions made in the preparation of the document

The assumptions made in GG 101 [Ref 2.N] apply to this document.

W/1. Special requirements for Wales

Requirement (CD 353, 2.4)

W/1.1 The following text shall be inserted after Clause 2.4 in CD 353 [Ref 1.N].

W/1.2 In Wales, during the project development and design, a risk assessment shall be undertaken by the designers.

W/1.3 In Wales, when the risk assessment has identified a particular risk associated with unauthorised access then designers shall consider what reasonable measures could be taken to restrict access to the means of suicide.

W/1.3.1 Subject to the agreement of the Technical Approval Authority, consultation may be required with the Local Health Board and health stakeholders to identify reasonable measures to restrict access to the means of suicide.

W/1.3.2 Reference should be made to the current Suicide and Self Harm Prevention Strategy for Wales. Suicide Prevention 2015-2020 [Ref 3.N].

W/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CD 353, 'Design criteria for footbridges'
Ref 2.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 3.N	Welsh Government. Suicide Prevention 2015-2020, 'Talk to me 2: Suicide and Self Harm Prevention Strategy for Wales 2015-2020'