

BS 6180:2011



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Barriers in and about buildings – Code of practice

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 46, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 March 2011. It was prepared by Subcommittee B/208/1, *Stairs and walkways – Industrial stairs*, under the authority of Technical Committee B/208, *Stairs and walkways*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 6180:1999, which is withdrawn.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- inclusion of Table 2.
- changes to the rules on deflection, given in 6.4.1.

In view of the variety of materials available for barrier construction and the wide range of possible uses for barriers, this British Standard does not attempt to standardize methods of design but refers instead to existing structural design codes. Clause 4 allows users freedom to choose materials and methods of design and construction not specifically mentioned in this code, subject to the provision of research data and test results.

The safety factors implicit in this British Standard provide adequate levels of protection in the circumstances given. However, in the case of multifunction buildings, for example, the recommendations should be considered with reasoned judgement to provide a suitable design.

Annex A and Annex B are normative.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Attention is drawn to the fact that statutory legislation such as the Building Regulations 2010 [1] (applicable to England and Wales), the Building (Scotland) Regulations 2004 [2], the Building (Amendment) Regulations (Northern Ireland) 2010 [3], the Safety of Sports Grounds Act 1975 [4], Fire Safety and Safety of Places Sports Act 1987 [5], the Safety of Places of Sport Regulations 1988 [6], the Football Spectators Act 1989 [7] and the Regulatory Reform (Fire Safety) Subordinate Provisions Order 2006 [8] might impose more stringent requirements in certain circumstances.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard gives recommendations and guidance for the design and construction of temporary and permanent barriers to be provided in and about buildings and places of assembly, such barriers being positioned and designed to protect persons from various hazards and to restrict or control the movement of persons or vehicles.

This British Standard applies to:

- a) barriers that indicate routes;
- b) barriers capable of stopping or diverting moving vehicles within areas where vehicle speed is restricted to a maximum of 16 km/h (4.44 m/s, 10 mile/h);
- c) walls, glazing and other elements of buildings or structures where such elements act as protective barriers;
- d) areas other than spectator areas of sports halls and buildings used for spectator sports.

This British Standard does not apply to:

- 1) barriers for resisting impact from vehicles travelling at speeds greater than 16 km/h, e.g. bridge parapets beyond the curtilage of a building, or highway safety barriers (see BS 6779);
- 2) barriers used in building operations and works of engineering construction;
- 3) safety barriers, with or without opening gate features, for the protection of children up to 24 months, where the safety requirement is covered by a specific safety standard, e.g. BS EN 1930;
- 4) permanent means of access to machinery (see BS EN ISO 14122, all parts);
- 5) barriers used in spectator areas of sports halls, and buildings used for spectator sports (see BS EN 13200, all parts).

2 Normative references

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

BS 476-7, *Fire tests on building materials and structures – Part 7: Method of test to determine the classification of the surface spread of flame of products*

BS 952-1, *Glass for glazing – Part 1: Classification*

BS 1449-1 (all parts), *Steel plate, sheet and strip – Carbon and carbon-manganese plate, sheet and strip*

BS 3416, *Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water*

BS 3987, *Specification for anodic oxidation coatings on wrought aluminium for external architectural applications*

BS 4592-0, *Industrial type flooring and stair treads – Part 0: Common design requirements and recommendations for installation*

BS 4842, *Specification for liquid organic coatings for application to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with liquid organic coatings*

BS 4921:1988, *Specification for sherardized coatings on iron or steel*

BS 5350 (all parts), *Methods of test for adhesives*

BS 6100 (all parts), *Glossary of building and civil engineering terms*

BS 6206, *Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings*¹⁾

BS 6262 (all parts), *Glazing for buildings*

BS 6496, *Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with powder organic coatings*

BS 7668, *Weldable structural steels – Hot finished structural hollow sections in weather resistant steels – Specification*

BS 8221 (all parts), *Code of practice for cleaning and surface repair of buildings*

BS 8417, *Preservation of timber – Recommendations*

BS EN 572-3, *Glass in building – Basic soda lime silicate glass products – Part 3: Polished wire glass*

BS EN 572-6, *Glass in building – Basic soda lime silicate glass products – Part 6: Wired patterned glass*

BS EN 1011-1, *Welding – Recommendations for welding of metallic Materials – Part 1: General guidance for arc welding*

BS EN 1011-2, *Welding – Recommendations for welding of metallic Materials – Part 2: Arc welding of ferritic steels*

BS EN 1090-1, *Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components*

BS EN 1090-2, *Execution of steel structures and aluminium structures – Part 2: Technical requirements for the execution of steel structures*

BS EN 1930, *Child care articles – Safety barriers – Safety requirements and test methods*

BS EN 1982, *Copper and copper alloys – Ingots and castings*

BS EN 1991-1-1:2002, *Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings*

BS EN 1991-1-4, *Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions*

BS EN 1992 (all parts), *Eurocode 2 – Design of concrete structures*

BS EN 1993 (all parts), *Eurocode 3 – Design of steel structures*

BS EN 1995 (all parts), *Eurocode 5 – Design of timber structures*

BS EN 1996 (all parts), *Eurocode 6 – Design of masonry structures*

BS EN 1999 (all parts), *Eurocode 9 – Design of aluminium structures*

¹⁾ This British Standard only applies to plastics materials.

- BS EN 10025 (all parts), *Hot rolled products of structural steels*
- BS EN 10029, *Specification for tolerances on dimensions, shape and mass for hot rolled steel plates 3 mm thick or above*
- BS EN 10088-2, *Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*
- BS EN 10088-3, *Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*
- BS EN 10143, *Continuously hot-dip metal coated steel sheet and strip – Tolerances on dimensions and shape*
- BS EN 10210 (all parts), *Hot finished structural hollow sections of non-alloy and fine grain structural steels*
- BS EN 10216-5, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes*
- BS EN 10217-7, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 7: Stainless steel tubes*
- BS EN 10219-1, *Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery requirements*
- BS EN 10219-2, *Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 2: Tolerances, dimensions and sectional properties*
- BS EN 10253-1, *Butt-welding pipe fittings – Part 1: Wrought carbon steel for general use and without specific inspection requirements*
- BS EN 12163, *Copper and copper alloys – Rod for general purposes*
- BS EN 12164, *Copper and copper alloys – Rod for free machining purposes*
- BS EN 12167, *Copper and copper alloys – Profiles and rectangular bar for general purposes*
- BS EN 12206-1, *Paints and varnishes. Powder coating of aluminium alloys for architectural purposes – Part 1: coatings prepared from coating powder*
- BS EN 12600, *Glass in building – Pendulum test – Impact test method and classification for flat glass*
- BS EN 13200 (all parts), *Spectator facilities*
- BS EN 15644, *Traditionally designed prefabricated stairs made of solid wood – Specifications and requirements*
- BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods (ISO 1461:2009)*
- BS EN ISO 2063, *Thermal spraying – Metallic and other inorganic coatings – Zinc, aluminium and their alloys*
- BS EN ISO 2560, *Welding Consumables – Covered electrodes for manual metal arc welding of non-alloy and fine grain steels – Classification*
- BS EN ISO 6158, *Metallic coatings – Electrodeposited coatings of chromium for engineering purposes*
- BS EN ISO 7599, *Anodizing of aluminium and its alloys – General specifications for anodic oxidation coatings on aluminium (ISO 7599:2010)*

BS EN ISO 14122 (all parts), *Safety of machinery*

DD CEN/TS, *Prefabricated timber stairs – Mechanical test methods*

PD 6484, *Commentary on corrosion at bimetallic contacts and its alleviation*

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 6100 (all parts) and the following apply.

3.1 barrier

element of building or structure, permanent or temporary, intended to prevent persons from falling and to retain, stop or guide persons or vehicles

3.2 datum

finished level on which people may stand on a floor, roof, wide parapet, balcony, ramp, pitch line of stairs, etc.

NOTE See Figure 1.

3.3 design level

level at which the horizontal force on the barrier is assumed to act for the purposes of design

NOTE See Figure 1.

3.4 juliette balcony

balcony which does not project from the side of a building and takes the form of a barrier in front of full-length openable doors

NOTE These are sometimes also referred to as “Juliet” balconies.

3.5 manifestation

technique for enhancing a person’s awareness of the presence of transparent glass areas

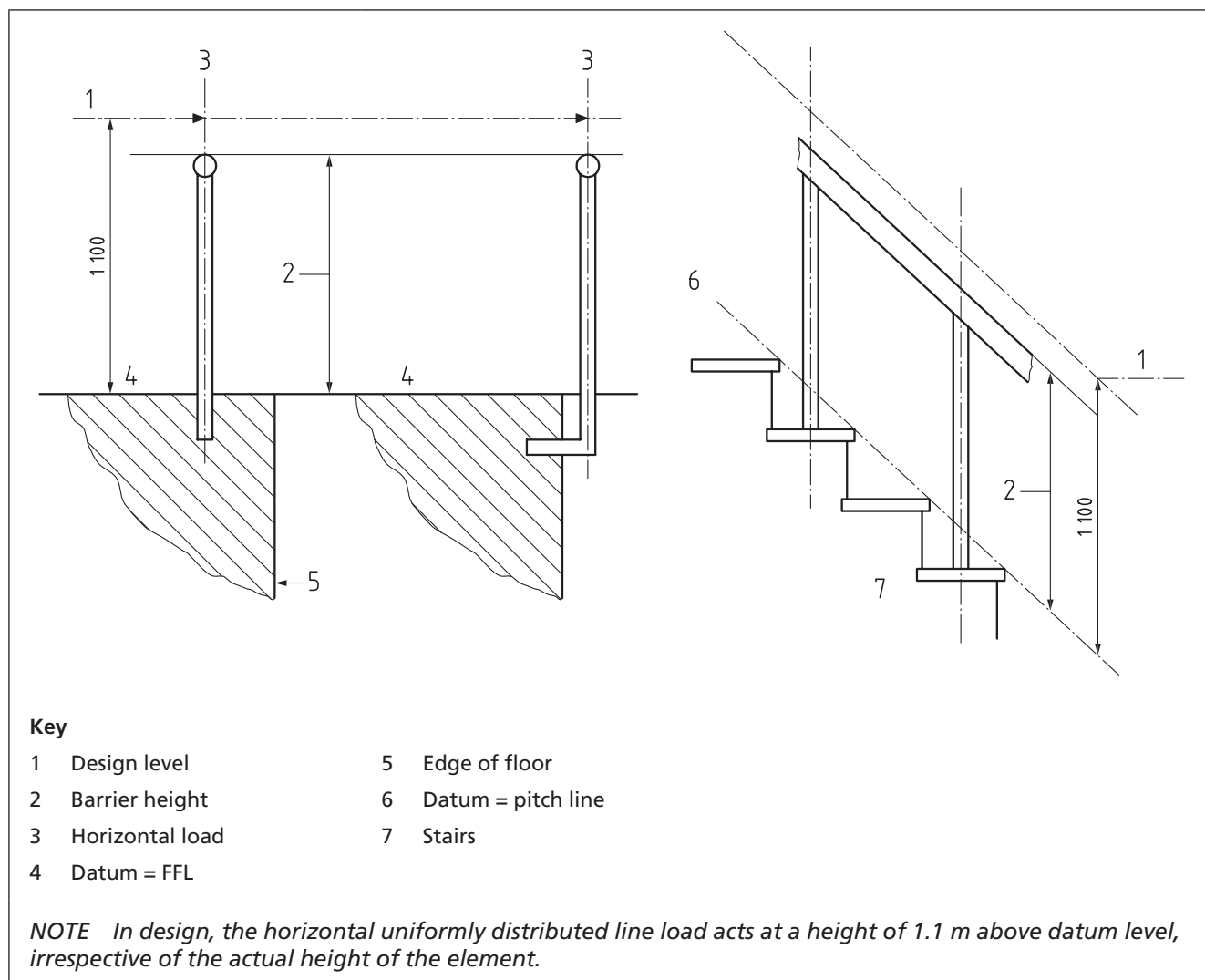
3.6 safety glass/plastics material

glass or plastics sheet material which remains unbroken or achieves a specified resistance or fails in a prescribed manner when tested in accordance with a relevant technical standard

3.7 top rail

structural rail which might also act as a handrail

Figure 1 Datum, barrier height and design height



4 Materials, components and methods of design and construction

NOTE Recommendations for the detailed design and construction of barriers using various materials, components and methods are given in Clause 7 to Clause 13.

Where materials, components and methods of design and construction are not specifically covered by these clauses or by any other British Standard, the designer should either be satisfied that the materials and methods to be employed are such as to ensure durability, integrity and a level of performance at least equal to that recommended in this British Standard, subject to the provision of research data and test results, or a test assembly should be built to test the material, component or method under consideration.

The test assembly should be representative, as to materials, workmanship and details, of the design and construction for which approval is desired, and should be built under conditions representative of the conditions in the actual building construction or curtilage involved.

The interaction of different materials used (e.g. bimetallic corrosion) should be considered in construction.

All coatings and decorative finishes to the barrier should not be composed of or contain toxic materials.

5 Preliminary considerations

5.1 Barrier design

In the assessment of the need for a barrier and the type of barrier to be provided, the designer should give consideration to the likely hazards, the building use and the risks to building users.

Where, in a building, more than one use of the building is anticipated, either the barrier design should be chosen to suit the worst case, or more than one type of barrier should be provided, as appropriate, to the location.

Where the hazard is a change in level, pedestrian guarding should be erected in dwellings where the difference in adjacent levels is greater than 600 mm. Guarding should also be erected in buildings other than dwellings where there is a difference greater than 380 mm, to take account of the greater number of building users and their possible lack of familiarity with the layout.

NOTE Guarding is covered by the Building Regulations and the appropriate technical documents for England and Wales [1], Scotland [2] and Northern Ireland [3].

5.2 Glazed elements

Where walls, glazing or other elements of buildings or structures perform the functions of barriers, the designer should either:

- a) ensure that these elements satisfy the criteria given in this British Standard; or
- b) provide additional barriers designed in accordance with this British Standard.

5.3 Hazard reduction

The barrier adopted should be designed so as to minimize the risk of persons falling, rolling, sliding or slipping through gaps in the barrier.

In dwellings and other buildings which can be accessed by children under the age of 5, gaps in a barrier or infill should not be large enough to permit a sphere of 100 mm diameter to pass through, making due allowance for deflection under load.

NOTE 1 Except inside dwellings and common stairs in blocks of flats, this does not apply to the triangular opening formed by the tread and riser and the bottom edge of the barrier or infill, if that bottom edge is not more than 50 mm above the pitch line.

The barrier and infill should be constructed so that a child cannot easily climb it. These recommendations should also be applied to barriers for stairs and landings which give access to the building.

NOTE 2 In non-domestic buildings, manifestation could be applied to clear glass barriers or infill panels that reach the floor (or nearly reach the

floor), at an appropriate height to make them visible to children whose eye level is below the top of the barrier (see 8.1.1).

Where a higher standard of safety is thought necessary, consideration should be given to the requirements of BS EN 1930.

5.4 Critical structural elements

The designer should consider the use of barriers to protect critical structural elements where there is a risk that vehicle impact could cause structural damage, e.g. around any cast iron column.

NOTE This is particularly important in buildings where pallet or fork lift trucks are used.

6 Design criteria

6.1 General

Barriers should be designed to resist the most unfavourable likely imposed loads and wind loads separately (see 6.3) without unacceptable deflections or distortions (see 6.4).

NOTE 1 Barrier heights are also covered by the Building Regulations [1], [2], [3]. The barrier height above datum is defined in Figure 1.

The minimum heights for each barrier location should be as given in Table 1.

The height of barriers installed on top of low parapet walls should be measured from the top of the parapet and not at walk level.

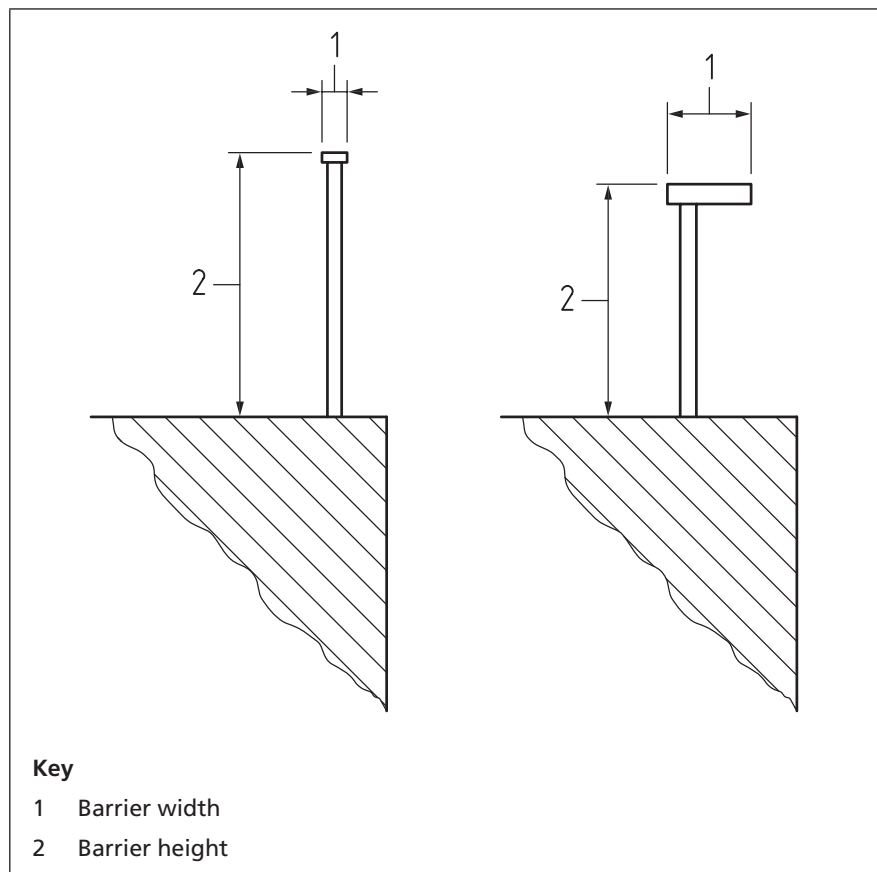
NOTE 2 Where a low parapet wall could constitute a step, it might reduce the effectiveness of the barrier.

Table 1 Minimum barrier heights

Use	Position	Height
Single-family dwelling	a) barriers in front of a window	800 mm
	b) stairs, landings, ramps, edges of internal floors	900 mm
	c) external balconies including Juliette balconies, edges of roofs	1 100 mm
All other uses	d) barrier in front of a window	800 mm
	e) stairs	900 mm
	f) balconies and stands, etc. having fixed seating within 530 mm of the barrier	800 mm
	g) balconies and stands, etc. having fixed seating within 530 mm of the barrier, provided the sum of the barrier width and the barrier height is greater than 975 mm	750 mm
	h) other positions including Juliette balconies	1 100 mm

NOTE See also 6.8 on sight lines and Figure 2.

Figure 2 Height and width of barriers in front of fixed seating



6.2 Design procedures

For barriers other than vehicle barriers, either permissible stress or limit state design procedures should be used, according to the recommended procedure given in the British Standard appropriate for the material to be used, treating the loads given in Table 2 as:

- a) working loads, for permissible stress design;
- b) characteristic loads, for limit state design.

When using limit state design, the partial safety factors for loads and materials should be those recommended by the appropriate British Standard for the relevant material. The strength of the barrier should be designed as ultimate limit state (ULS) and the deflection as serviceability limit state.

In designing barriers to resist equivalent static loads, such as those due to vehicular impact (see 6.3.2 and 6.4.2), the permissible stress procedure should not be used. In such cases, a limit state approach based on the partial safety factors for load and materials appropriate to accidental damage or misuse should be used. Where a standard makes no specific provision for design against impact loads, decisions should be made regarding the possible reduction of the overall factor of safety, according to the relative influence of dynamic loads compared with static loads on the properties of the material.

The designer should also be aware that the equivalent static force concept is related to an assumed mean deceleration. Validation tests on barriers constructed from the materials normally used in vehicle barriers, such as steel, aluminium, or reinforced concrete, show good correlation with calculated values. However, the performance of barriers constructed from other materials should be established in order to determine the equivalent static force against which they should be designed.

NOTE Information on the forces resulting from vehicle impact into yielding barriers is available from research papers published by the Transport Research Laboratory [9].

Table 2 Minimum horizontal imposed loads for parapets, barriers and balustrades

Type of occupancy for part of the building or structure	Examples of specific use	Horizontal uniformly distributed line load (kN/m)	Uniformly distributed load applied to the infill (kN/m ²)	A point load applied to part of the infill (kN)
Domestic and residential activities	(i) All areas within or serving exclusively one single family dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs	0.36	0.5	0.25
	(ii) Other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings	0.74	1.0	0.5
Offices and work areas not included elsewhere, including storage areas	(iii) Light access stairs and gangways not more than 600 mm wide	0.22	—	—
	(iv) Light pedestrian traffic routes in industrial and storage buildings except designated escape routes	0.36	0.5	0.25
	(v) Areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings except as given above	0.74	1.0	0.5
Areas where people might congregate	(vi) Areas having fixed seating within 530 mm of the barrier, balustrade or parapet	1.5	1.5	1.5
Areas with tables or fixed seatings	(vii) Restaurants and bars	1.5	1.5	1.5
Areas without obstacles for moving people and not susceptible to overcrowding	(viii) Stairs, landings, corridors, ramps	0.74	1.0	0.5
	(ix) External balconies including Juliette balconies and edges of roofs. Footways and pavements within building curtilage adjacent to basement/sunken areas	0.74	1.0	0.5

Table 2 Minimum horizontal imposed loads for parapets, barriers and balustrades (*continued*)

Type of occupancy for part of the building or structure	Examples of specific use	Horizontal uniformly distributed line load (kN/m)	Uniformly distributed load applied to the infill (kN/m ²)	A point load applied to part of the infill (kN)
Areas susceptible to overcrowding	(x) Footways or pavements less than 3 m wide adjacent to sunken areas	1.5	1.5	1.5
	(xi) Theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studio. Footways or pavements greater than 3 m wide adjacent to sunken areas.	3.0	1.5	1.5
	(xii) Grandstands and stadia ^{A)}			
Retail areas	(xiii) All retail areas including public areas of banks/building societies or betting shops	1.5	1.5	1.5
Vehicular	(xiv) Pedestrian areas in car parks, including stairs, landings, ramps, edges or internal floors, footways, edges of roofs	1.5	1.5	1.5
	(xv) Horizontal loads imposed by vehicles ^{B)}			

^{A)} See requirements of the appropriate certifying authority.

^{B)} See Annex A.

6.3 Loading

6.3.1 General

Minimum horizontal imposed loads appropriate to the design of parapets, barriers, balustrades and other elements of structure intended to retain, stop or guide people, should be determined in accordance with Table 2, which recommends a uniformly distributed line load for the barrier and a uniformly distributed and point load applied to the infill. These are not additive and should be considered as three separate load cases, all loads being determined according to the type of occupancy which reflects the possible in-service conditions.

Horizontal uniformly distributed line load should be applied at design height as presented in Table 1 or at design level (1 100 mm) for barriers higher than the design height.

Uniformly distributed load should be applied to the area below the design height.

Point load should be applied at the most onerous point anywhere on the barrier structure.

NOTE 1 Additional recommendations for glazing in barriers are given in Clause 8.

NOTE 2 For clarity, the design level (the level at which the horizontal uniformly distributed line load ought to be considered to act) is shown in Figure 1.

6.3.2 Imposed loading due to vehicles

When designing barriers to resist vehicular impact, an estimate of the characteristic mass m of the vehicle should be made. Ideally, this should be determined statistically. If this is not possible, the characteristic mass should be taken to be equal to the maximum mass anticipated.

Annex A should be used to estimate the equivalent static force F for a given characteristic mass and displacement.

Simplified design recommendations for car parks should allow for a characteristic mass of 1.5 t to be taken for car parks designed for vehicles not exceeding 2.5 t in mass.

NOTE 1 A graphic interpretation derived from these recommendations is given in Annex A.

NOTE 2 Further information to enable the designer to derive equivalent static forces for cases where different parameters apply is given in Annex A.

The anticipated area and position of contact should be used in calculating the ultimate strength of the barrier if the pattern of vehicle or barrier deformation can be reliably predicted.

The assumed distribution of the impact force and the design level at which it is applied should be related to the likely area and position of initial contact.

NOTE 3 Angular impacts might give rise to additional forces directed along the line of the barrier. Where the construction of the barrier is such that frictional contact between it and the vehicle is likely to be high, or such that projections might restrain the vehicle, these additional forces can reach three times the lateral applied forces.

NOTE 4 Annex A provides data for vehicles impacting at 20° to a barrier.

6.3.3 Wind loads

External barriers should be designed to resist the wind loads given in BS EN 1991-1-4.

6.4 Deflection

6.4.1 Barriers for the protection of people

Barriers for the protection of people should be of adequate strength and stiffness to sustain the applied loads given in Table 2. In addition, a barrier that is structurally safe should not possess sufficient flexibility to alarm building users when subject to normal service conditions. Therefore, for serviceability considerations, the limiting condition for deflection appropriate for a barrier for the protection of people is that the total horizontal displacement of the barrier at any point from its original unloaded position should not exceed the deflection limits determined from the relevant structural design code (where applicable) for the material used, or 25 mm, whichever is the smaller.

Where the infill of a barrier is subjected to imposed loads given in Table 2, or if appropriate, other calculated design loads, the displacement of any point of the barrier should not exceed $L/65$ or 25 mm, whichever is the smaller where L is the given in 8.3, 8.4 or defined in 8.5. A suitable fracture load, factored by a minimum partial safety factor of 4.0 (as recommended in BS 4592-0) should be obtained from the material manufacturer when considering glass barrier design.