When designing guards and barriers, consideration must be given to the applied loadings that the barrier will have to withstand during service.

Throughout the UK and Éire, local building regulation documents provide guidance on barrier requirements [1, 2, 3, 4, 5]. In all cases, they make reference to BS 6180:2011 [6], with additional references made to EN 1991-1-1 [7], PD 6688-1-1 [8] and relevant National Annexes where applicable [9, 10].

LOAD SCENARIOS

EN 1991-1-1:2002 defines buildings, and so associated load requirements, by categories based on building occupancy and sub-categories based on specific areas or utilisation of the space. Some detail for categories A to D are shown below, with further guidance available in the standard.

Table 1 – Load categories and occupancy types

Category	Occupancy	Area
A	Domestic & Residential	Residential buildings, hospital wards, hotel bedrooms, kitchens and toilets
B	Office Areas	---
C1	Areas Where People Congregate	Areas with tables; cafes, restaurants, dining halls, receptions
C2		Areas with fixed seats; theatres, cinemas, lecture halls, waiting rooms
C3		Areas with obstacles; museums, exhibition halls, access areas in hotels and hospitals
C4		Areas with physical activities taking place; dance halls, gymnasia, stages
C5		Areas susceptible to large crowds; concert halls, sports halls, railway platforms
D1	Shopping/Retail Areas	Areas in general retail shops
D2		Areas in department stores

Table 2 – Load sub-categories and area descriptors

Category	Sub-Category	Area
A	(i)	Single dwelling, including stairs and landings, but excluding external balconies and edges of roofs
	(ii)	Residential areas not covered by (i)
B C1	(iii)	Areas not susceptible to overcrowding in office and institutional buildings, reading rooms, and classrooms (including stairs)
	(iv)	Restaurants and Cafes
C2 C3 C4 D1 D2	(v)	Areas with fixed seating within 530 mm of the barrier
	(vi)	Stairs, landings, balustrades, corridors and ramps
	(vii)	External balconies and edges of roofs. Footways adjacent to sunken areas
	(viii)	All retail areas
C5	(ix)	Footways or paths less than 3 m wide adjacent to sunken areas
	(x)	Theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas and studios. Footways greater than 3 m wide adjacent to sunken areas
	(xi)	Grandstands and stadia

LOAD VALUES

Based on the load scenarios, the applicable line loads can be determined directly from the UK or Éire National Annex for EN 1991-1-1, with uniformly distributed loads (UDL) and concentrated point loads defined by PD 6688-1-1:2011. The below table is applicable to the UK and Éire, with the values in brackets showing the values from the Irish national Annex where different from the UK.

Table 3 – Load values

Category	Sub-Category	Horizontal Uniformly Distributed Line Load (kN/m)	Uniformly Distributed Load (kN/m²)	Concentrated Point Load (kN)
A	(i)	0.36 (0.50)	0.50	0.25
	(ii)	0.74 (0.75)	1.00	0.50
B C1	(iii)	0.74 (0.75)	1.00	0.50
	(iv)	1.50	1.50	1.50
C2 C3 C4 D1 D2	(v)	1.50	1.50	1.50
	(vi)	0.74 (0.75)	1.00	0.50
	(vii)	0.74 (0.75)	1.00	0.50
	(viii)	1.50	1.50	1.50
C5	(ix)	1.50	1.50	1.50
	(x)	3.00	1.50	1.50
	(xi)	See Requirements of Local Certifying Authority		

The load requirements for the UK above equate to the load requirements defined in BS 6180:2011 within the UK, allowing this standard to be used for guidance when considering the requirements of Eurocodes.

When using the loads for the design of barriers or guarding, BS 6180:2011, section 6.2 states that the loads are working loads for permissible stress design, and characteristic loads for limit state design. These design methodologies will be discussed in separate documents.

COMBINED LOADS

BS 6180:2011 states that loads "*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.*"

When considering Eurocodes, EN 1990:2002 [11] allows combinations of actions to be considered, where more than one unfavourable or favourable action is imparted on the glazing separately. Combinations of actions should be used where deemed applicable to the structure in question.

BUILDING CONTROL

When determining the load requirements for a building, local Building Control (or the equivalent certifying authority) should be consulted to ensure that the requirements for the specification will meet the requirements that will be placed upon the building when undergoing final approval.

Full consideration should be given to the requirements of Building Regulations as well as Eurocodes and any associated applicable documents.

REFERENCES

[1] HM Government, *The Building Regulations 2010 - Approved Document K - Protection from falling, collision and impact,* 2013.

[2] Riaghaltas na h-Alba, *Technical Handbook 2015 - Domestic,* Riaghaltas na h-Alba, 2015.

[3] Riaghaltas na h-Alba, *Technical Handbook 2015 - Non-Domestic,* Riaghaltas na h-Alba, 2015.

[4] Environment, Community and Local Government (Éire), *Building Regulations 2014 - Technical Guidance Document K - Stairways, Ladders, Ramps and Guards,* Government Publications (Éire), 2014.

[5] Department of Finance and Personnel, *Building Regulations (Northern Ireland) 2012 Guidance - Technical Booklet H - Stairs, ramps, guarding and protection from impact,* DFPNI, 2012.

[6] British Standards Institute, *BS 6180:2011 - Barriers in and about buildings. Code of practice,* BSI, 2011.

[7] European Committee for Standardization, *EN 1991-1-1:2002 - Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[8] British Standards Institute, *PD 6688-1-1:2011 - Recommendations for the design of structures to BS EN 1991-1-1,* 2011: BSI.

[9] European Committee for Standardization, *NA to BS EN 1991-1-1:2002 - UK National Annex to Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[10] European Committee for Standardization, *NA to IS EN 1991-1-1:2002 - Irish Annex to Eurcode 1 - Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[11] European Committee for Standardization, *EN 1990:2002 - Basis of structural design,* CEN, 2002.

[12] British Standards Institute, *BS 6262-4:2005 - Glazing for buildings - Code of practice for safety related to human impact,* BSI, 2005.

[13] Department of Finance and Personnel, Building Regulations (Northern Ireland) 2012 Guidance - Technical Booklet V - Glazing, DFPNI, 2012.

[14] Environment, Community and Local Government (Éire), Building Regulations 2013 - Technical Guidance Document D - Materials and Workmanship, Government Publications (Éire), 2013.

[15] European Committee for Standardization, *EN 12600:2002 - Glass in building - Pendulum test - Impact test method and classification for flat glass,* CEN, 2002.

[16] British Standards Institute, BS 6206:1981 - Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings, BSI, 1981.

[17] European Parliament, *Regulation (EU) 305/2011 - Construction Products Regulation,* Official Journal of the European Union.