PD CEN/TR 1317-6:2012

BSI Standards Publication

Road restraint systems

Part 6: Pedestrian restraint system — Pedestrian parapets

National foreword

This Published Document is the UK implementation of CEN/TR 1317-6:2012. BS 7818:1995 includes provisions for pedestrian parapets and guardrails and will be revised when PD CEN/TR 1317-6 becomes an EN.

The UK participation in its preparation was entrusted by Technical Committee B/509, Road equipment, to Subcommittee B/509/1, Road restraint systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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TECHNICAL REPORT

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Dispositifs de retenue routiers - Partie 6: Dispositif de retenue pour piétons - Garde-corps

Rückhaltesysteme an Straßen - Teil 6: Fußgängerrückhaltesysteme - Brückengeländer

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Contents

Foreword

This document (CEN/TR 1317-6:2012) has been prepared by Technical Committee CEN/TC 226 "Road equipment", the secretariat of which is held by AFNOR.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 1317 consists of the following parts:

— EN 1317-1, *Road restraint systems — Part 1: Terminology and general criteria for test methods*;

— EN 1317-2, *Road restraint systems — Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets*;

— EN 1317-3, *Road restraint systems — Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions*;

— ENV 1317-4, *Road restraint systems — Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers* [1)];

— EN 1317-5, *Road restraint systems — Part 5: Product requirements and evaluation of conformity for vehicle restraint systems*;

— CEN/TR 1317-6, *Road restraint systems — Part 6: Pedestrian restraint systems — Pedestrian parapets* [2)];

— prEN 1317-7, *Road restraint systems — Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers*;

— CEN/TS 1317-8, *Road restraint systems — Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers*.

1) ENV 1317-4:2001 will be superseded by future EN 1317-4, *Road restraint systems — Part 4: Performance classes, impact test acceptance criteria and test methods for transitions of safety barriers* (under preparation).

2) Under preparation.

Introduction

The safety considerations of pedestrians using road bridges, footbridges and similar elevated structures require the installation of special road restraint systems, so called pedestrian restraint systems or pedestrian parapets.

Pedestrian parapets are used to prevent people from falling off a bridge or other type of elevated structure

Aspects included in the Technical Report are:

a) safety in use for pedestrians and other highway users (excluding motor vehicles);

b) the safety considerations of pedestrians using road bridges and footbridges and similar structures;

c) analysis and test methods;

d) durability;

e) labelling and marking.

1 Scope

This Technical Report specifies geometrical and technical requirements for the design and manufacture for pedestrian parapets on road bridges, on footbridges, on top of retaining walls and on similar elevated structures.

This Technical Report also specifies test methods and provision for the labelling and marking of these products.

This Technical Report does not cover:

— vehicle restraint systems;

— pedestrian restraint systems in residential, commercial or industrial buildings and within their perimeter;

— non-rigid rails i.e. rope, cables.

This Technical Report may be used for pedestrian parapets on structures which cross over railways, rivers and canals.

2 Normative references

The following documents, in whole or in part, are normatively referenced in 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.

EN 1317-1:2010, *Road restraint systems — Part 1: Terminology and general criteria for test methods*

EN 1990:2002, *Eurocode — Basis of structural design*

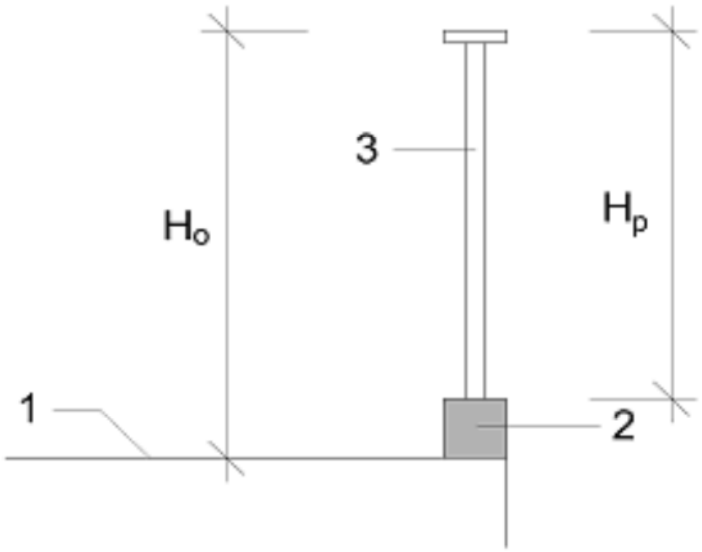
EN 10204*, Metallic products — Types of inspection documents*

EN 12767, *Passive safety of support structures for road equipment — Requirements, classification and test methods*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1317-1:2010 and the following apply.



Key

1 pedestrian walking surface

2 plinth (concrete, steel, or other material)

3 manufactured pedestrian parapet covered by this Technical Report (manufactured product in steel, aluminium, wood, or other material which is capable of meeting the requirements of this Technical Report)

Figure 1 — Pedestrian parapet

Note 1 to entry: See informative Annex E for examples of parapets, Figure E.1 and E.2.

3.1.1
base-plate
plate attached to the base of a pedestrian parapet post, which is used to fix the pedestrian parapet to the structure

3.1.2
design working life
period of time in which the product or component is required to maintain the declared performance characteristics and will not require repair or withdrawal from service under normal maintenance and intended use conditions

3.1.3
handrail
rigid rail attached to or part of a pedestrian parapet to assist and guide pedestrians

Note 1 to entry: The top rail may also function as the handrail.

3.1.4
infilling
material that is fixed to posts and/or rails of a pedestrian parapet in order to reduce the size of openings (voids)

3.1.5
kicking plate
continuous upstand which can be attached to the bottom of the pedestrian parapet

3.1.6
overall working height
H_O
total working height (regulatory height) of the pedestrian parapet above the pedestrian walking surface

Note 1 to entry: See Figure 1.

3.1.7
panel
section of a pedestrian parapet bounded by two posts

Note 1 to entry: The panel includes any surrounding posts and rails.

3.1.8
pedestrian parapet
pedestrian or other users restraint system along or on top of a bridge, retaining wall or similar structure which is not intended to act as a road vehicle restraint system

3.1.9
pedestrian restraint system
product designed to meet the requirements of this Technical Report

3.1.10
plinth
continuous upstand which supports the posts of the pedestrian parapet and which is part of the main structure to which it is attached

3.1.11
post
vertical or inclined member of a pedestrian parapet which withstands both horizontal and vertical forces and transmits these forces to the supporting structure

3.1.12
product height
H_p
overall height of the manufactured product including base-plate if provided

Note 1 to entry: See Figure 1.

3.1.13
rail
member of a pedestrian parapet that transmits vertical and horizontal forces to the posts

Note 1 to entry. Top and other rails are included.

3.1.14
spaces, gaps and voids
space formed by the surrounding infilling of posts and rails

3.1.15
traffic loads
non-vehicular loads caused by pedestrians and other highway users e.g. cyclists and equestrians

3.2 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply:

3.2.1 Latin upper case letters

A_d	Design value of an accidental action
C_d	Limiting design value of the relevant serviceability criterion
D_s	Declared dimension(s) of spaces and voids
D_b	Diameter of spherical object which defines the dimensions of the spaces and voids
E	Energy
E_d	Design value of effect of actions
F_d	Design value of an action (load)
F_{dc}	Design value of connection to main structure
F_{hk}	Characteristic horizontal point load caused by traffic
F_{pdn}	Design load perpendicular on the infill
F_T	Test load
$F_{T,S}$	Test load at serviceability level
$F_{T,U}$	Test load at ultimate level
F_w	Resultant Wind force
G_k	Characteristic value of a permanent action
H_O	Overall height in metres of the pedestrian parapet above the pedestrian walking surface
H_P	The vertical height of the manufactured pedestrian parapet
Q_{hk}	Characteristic value of the concentrated horizontal traffic loads
Q_{vk}	Characteristic value of the concentrated vertical traffic loads
R_d	Design resistance
R_k	Characteristic resistance
R_T	Resistance derived from testing
S	Slope of load/deformation curve
$S_{n,dyn}$	Load from snow removal machinery
S_n	Snow load
SLS	Serviceability Limit State
ULS	Ultimate Limit State

3.2.2 Latin lower case letters

b	Width of footway
q_{hk}	Characteristic value of the uniformly distributed horizontal traffic loads (line load or patch load)-top rail
q_{hki}	Characteristic value of the uniformly distributed horizontal traffic loads (line load or patch load)-other rails
q_{vk}	Characteristic value of the uniformly distributed vertical traffic loads (line load or patch load)

3.2.3 Greek lower case letters

α	Test resistance reduction factor (and bag angle B.4.4)
γ	Partial factor
γ_A	Partial factor for accidental actions
γ_{Gs}	Partial factor for permanent actions (e.g. self weight permanent actions)
γ_M	Partial factor for a material property
γ_Q	Partial factor for variable actions (traffic loads, wind loads, snow loads)
δ_h	Horizontal deformation or deflection
ψ	Combination factor
ψ_0	Factor for the combination value of a variable action
ψ_1	Factor for the frequent value of a variable action

4 Requirements

4.1 General

Pedestrian parapets should be designed and/or tested and should conform to the requirements of this Technical Report.

NOTE 1 Where a vehicle restraint system is required to also function as a pedestrian parapet, the requirements of EN 1317-5 should be met.

Figures in Annex E illustrate the constituent parts of a pedestrian parapet.

NOTE 2 Manufacturers may provide other design types which are not shown in Annex E provided they comply with the requirements of this Technical Report.

4.2 Construction

4.2.1 Assembly

Design, drawing, installation and maintenance instructions should be provided describing the measures that have to be taken in order to achieve the following performances where they form part of the pedestrian parapet:

a) a continuous flowing alignment;

b) smooth surfaces;

c) the absence of sharp edges that could cause injury to users;

d) the provision for expansion, contraction and movement of the main structure (e.g. under traffic loads and temperature effects) so that these do not endanger the performance or flowing alignment;

e) the avoidance of corrosion pockets;

f) the provision for adequate drainage in hollow sections and channels;

g) the compatibility between component parts so that there is avoidance of electrolytic action;

h) that fixings and fittings cannot be loosened without using tools;

i) to demonstrate the ease of assembly at site location, the ease of maintenance and repair including the replacement of parts;

j) finish and surface protection;

k) any special provisions for end posts/panels.

NOTE A method for ensuring a smooth finish is described in Annex G.

4.2.2 Optional facilities

The following optional facilities may be declared:

a) safety provisions for maintenance personnel;

b) provision for the fixing of a safety harnesses to support the weight of maintenance personnel to be fixed to the posts;

c) special provisions for the safe passage of cyclists;

d) the manufactured height of a kicking plate;

e) the manufactured height of solid infill where horses and cattle are expected to use the bridge or structure, the position of the infill is to be specified;

f) measures to prevent snow, debris and other hazards from falling on to traffic below the bridge or structure;

g) the provision of a plinth, which shall have a minimum height of 50 mm;

h) specification for the provision of a steel cable inside the handrail;

i) avoidance of footholds to discourage climbing;

j) provision for intervisibility;

k) meeting the requirements of EN 12767.

4.3 Geometrical requirements

4.3.1 Height of manufactured product

The height H_p of the manufactured pedestrian parapet should be declared. Where the pedestrian parapet is to be installed at an angle, the vertical height H_p should be declaredm see Figure 1.

NOTE The overall height HO of the pedestrian parapet is related to Hp but depends on the location of the fixing. See Figure 1 for examples. Where the post height exceeds the height of the top horizontal rail the declared height should be to the top of the top rail.

Table 1 — Minimum heights

Height (H_p)	**Height** m
A	1
B	1,1
C	1,2
D	1,4
E	1,6
F	1,5
G	1,8

Height should be measured with equipment that accords EN ISO 9001.

4.3.2 Spaces and voids

The spaces and voids should not allow the passage of a spherical object with a diameter D_b. The maximum value of D_b should be declared as D_s. Various values for D_s should be declared in relation to height, see Figure 2.

Determination of D_s should take account of manufacturing tolerances and measured from a sample (using callipers) and/or an analysis of the manufacturing drawings.

Table 2 — Maximum spaces & voids

Void D_s	Diameter mm
0	D_S = 0
15	D_S = 15
30	D_S = 30
50	D_S = 50
60	D_S = 60
100	D_S = 100
110	D_S = 110
120	D_S = 120
130	D_S = 130
150	D_S = 150
300	D_S = 300
500	D_S = 500

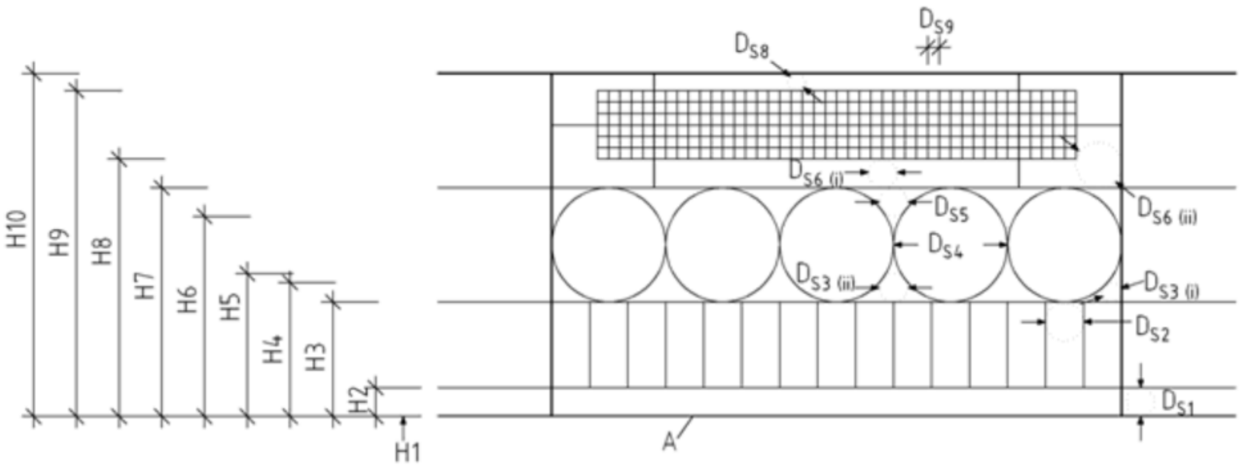
NOTE The selection of void size(s) may have implications for

i) the avoidance of footholds which could make provision for persons to climb the pedestrian parapet (e.g. minimum height 1,1 m and no horizontal ledges on traffic face greater than 15 mm);

ii) visibility (transparency/intervisibility) for drivers particularly at road junctions where there is a need for side visibility (e.g. percentage of clear view area through parapet when viewed at a specified angle);

iii) the avoidance of objects being thrown through the pedestrian parapet onto traffic below (e.g. limiting a void/space size to 5 mm).

The above implications are mainly related to the site location of the pedestrian parapet which is not an issue for this Technical Report and further guidance on the selection of sizes may be found in guideline requirements prepared by Member States.



Key

A fixing level

D_S diameter in mm

H height level in mm

Report each D_S value for each H level measured from fixing level, e.g.

D_{S1}	from H1 to H2
D_{S2}	from H2 to H3
$D_{S3(i)}$ and $D_{S3(ii)}$	from H3 to H4
D_{S4}	from H3 to H4
etc.	

Figure 2 — Spaces and voids

4.4 Design requirements

4.4.1 General

The design working life under given use and maintenance conditions should be declared.

NOTE A minimum design working life of 25 years is normally required, excluding the possibility of accidental action (see EN 1990:2002, 2.3).

Pedestrian parapets should be designed in accordance with the general requirements in EN 1990:2002 and EN 1991 and the material resistance requirements in EN 1992, EN 1993, EN 1994, EN 1995, EN 1996 and EN 1999 (see subclauses below) for the following limit states:

a) Ultimate Limit State (*ULS*) (see 4.5.2);

b) Serviceability Limit State (*SLS*) (see 4.5.3).

Partial factors and combinations of actions that are in accordance with EN 1990:2002, A.2 are given in Annex A of this Technical Report.

The manufacturing tolerances should be taken into account in the design of the parapet including method(s) used to deal with the deformation resulting from traffic loads and temperature effects in the main structure.

4.4.2 Connections to the main structure

The connections to the parapet base should be designed so that at the *ULS,* the pedestrian parapet connections should cause no damage to any part of the structure.

The design resistance of the connection to the main structure should be at least 1,25 times the ultimate resistance of the member of the pedestrian parapet being connected.

EXAMPLE Frangible bolts may be used provided that the pedestrian parapet anchorages have a design resistance at least 1,25 times that of the ultimate resistance of the frangible bolts.

The design resistance value of the connection to the main structure, F_{dc} (in kN), should be declared.

4.4.3 Traffic loads

4.4.3.1 General

For the design of pedestrian parapets, traffic loads are defined as loads in horizontal and vertical directions and can be applied as distributed or as point loads.

The loads should be applied as given in Annex A.

Rails are not loaded simultaneously.

4.4.3.2 Horizontal uniformly distributed traffic loads

4.4.3.2.1 General

The horizontal uniformly distributed traffic load q_{hk} should be declared for the top rail, and where a different value is declared for other rails, it should be declared as q_{hki}.

4.4.3.2.2 Method 1

The characteristic value of the horizontal uniformly distributed traffic load q_{hk} on the top rail and other horizontal rails can be specified from the loads given in Table 3.

Table 3 — Minimum loads — Method 1

Load	q_{hk} kN/m
A	0,4
B	0,8
C	1,0
D	1,2
E	1,6
F	2,0
G	2,4
H	2,8
J	3,0

NOTE Minimum class C (qhk = 1,0 kN/m, for forces transferred by the pedestrian parapet) and class B (qhk = 0,8 kN/m, for service side path) are recommended by EN 1991-1-2:2002, 4.8, Note 2, for the structural design of bridge decks.

4.4.3.2.3 Method 2

The characteristic value of the horizontal uniformly distributed traffic load q_{hk} to be applied to the top rail, can be determined in the range between 1,0 kN/m (1,0 kN/m for footways used by maintenance personnel only) and 2,8 kN/m according to the following Formula:

$$q_{hk} = 0,5\ (1,0 + b)\ \text{kN/m},\ 1,0\ \text{kN/m} \leq q_{hk} \leq 2,8\ \text{kN/m} \quad (1)$$

where

b is the width of the elevated footway or footpath subject to pedestrian traffic.

Other horizontal rails should withstand a minimum characteristic horizontal uniformly distributed load q_{hki} equal to 1,0 kN/m.

NOTE 1 Based on the selected UDL in Method 1, the width b of Method 2 may be calculated.

NOTE 2 Minimum class C (qhk = 1,0 kN/m, for forces transferred by the pedestrian parapet) and class B (qhk = 0,8 kN/m, for service side path) are recommended by EN 1991-1-2:2002, 4.8, Note 2, for the structural design of bridge decks.

4.4.3.3 Concentrated horizontal traffic point load

A pedestrian parapet rail should withstand a concentrated horizontal point load Q_{hk} applied to any point of the rail.

The concentrated horizontal traffic point load Q_{hk} should be declared.

The minimum value for Q_{hk} can be 1,0 kN.

4.4.3.4 Vertical uniformly distributed traffic loads

All horizontal and inclined elements up to 60° of a pedestrian parapet should withstand a vertical uniformly distributed traffic load q_{vk}.

The vertical uniformly distributed traffic load q_{vk} should be declared.

The minimum value for q_{vk} can be 1,0 kN.

4.4.3.5 Concentrated vertical point traffic load

A concentrated vertical point load Q_{vk} should be applied to any point of the horizontal and inclined elements of a pedestrian parapet.

The concentrated vertical point traffic load Q_{vk} should be declared.

The minimum value for Q_{vk} can be 1,0 kN.

4.4.4 Load(s) on infill

Where the design of a pedestrian parapet includes infill then the load(s) on infill F_{pdn} should be applied perpendicular to the plane of the infill.

The load(s) on infill F_{pdn} should be declared.

The loads can be static or dynamic as described in Table 4.

When there is no infill, the value for F_{pdn} should be declared as nil.

NOTE Different infill types may have different loads, all of which should be declared.

Table 4 — Minimum loads on infill, F_{pdn}

Load	F_{pdn}	Application	Note
1	1,0 kN	For infill including mesh and solid infill, it should withstand a distributed load of 1 kN applied on an area of 125 mm × 125 mm on a 700 mm × 700 mm grid at any position perpendicular to the infill without any deformation.	This can be verified by calculation and/or static test
2	1,0 kN	For vertical infill members it should withstand a line load of 1,0 kN applied on a length of 125 mm on a 700 mm centres in any direction on single infill members perpendicular to the member without any deformation.	This can be verified by calculation and/or static test
3	1,5 kN	As for load 1 but the 1,0 kN is replaced by 1,5 kN	This can be verified by calculation and/or static test
4	1,5 kN	As for load 2 but the 1,0 kN is replaced by 1,5 kN	This can be verified by calculation and/or static test
5	600 J soft body	600 J at any part of the infill and meets the requirements of Table 6	This can be verified by Annexes B and D.
6	30 J hard body	30 J on any part of the infill and meets the requirements of Table 6	This can be verified by Annexes B and D and may be suitable for testing frangible materials
7	3,75 J hard body	3,75 J on any part of the infill and meets the requirements of Table 6	This can be verified by Annexes B and D and may be suitable for testing frangible materials
NOTE Loads 1 to 4 are static loads and 5 to 7 are dynamic loads.			

4.4.5 Wind actions

The pedestrian parapet should be designed to withstand a wind action F_w.

The wind action force F_w should be declared.

The declared force F_w can be determined in accordance with EN 1991-1-4:2005, Clause 8 which may use an informative value of 0,8 kN/m².

The minimum value for F_w can be 0,8 kN/m².

For pedestrian parapets with H_o not exceeding 1,2 m and structural properties that do not make them susceptible to dynamic excitation, the simplified method of analysis according to EN 1991-1-4:2005, 8.3.2 may be used. Where the height H_o (Figure 1) exceeds 1,2 m the general method in accordance with EN 1991-1-4:2005, 8.3.1 may be used.

For secondary structural elements, wind actions may be ignored.

4.4.6 Snow load(s)

Where the design of a pedestrian parapet allows for snow load(s) S_n, the value of S_n should be declared.

The declared snow load(s) S_n can be determined in accordance with EN 1991-1-3.

The minimum value for S_n can be 1,0 kN/m².

When no snow load is declared, the value(s) for S_n should be declared as nil.

4.4.7 Accidental action(s)

Where the design of a pedestrian parapet allows for an accidental action(s) which could include an accidental load, caused by machinery clearing snow, litter etc., the value should be declared as accidental action load A_d *or* $S_{n,dyn}$ if it is a snow clearing action and the parts of the pedestrian parapet that can withstand this load should be identified on the drawings and in the specification for the product.

The minimum value for A_d or $S_{n,dyn}$ can be 1,0 kN/m² or 3,75 kN/m² which value can be proportioned to the area of solid infill.

When no accidental action(s) is declared, the value(s) for A_d / $S_{n,dyn}$ should be declared as nil.

4.5 Structural safety and serviceability

4.5.1 General

For verification of the pedestrian parapet in limit state, the material properties and structural behaviour should be obtained, according to the material, from EN 1992, EN 1993, EN 1994, EN 1995, EN 1996 or EN 1999.

NOTE See also 5.2.

4.5.2 Ultimate limit state

The structural safety of the pedestrian parapet should be verified under *ULS*. Conditions considering the combinations of actions are given in Annex A.

The design resistance R_d of each member of the pedestrian parapet at *ULS* should be equal to or greater than the design value of effects of the relevant combination of actions E_d.

$$R_d \geq E_d \tag{2}$$

where

$$R_d = R_k/\gamma_M.$$

Where the design of the pedestrian parapet allows for loads 5, 6, 7 in Table 4, these dynamic impact loads are combined with permanent actions by means of the testing procedure and need not be considered further.

Combinations of actions and the recommended partial factors for serviceability and ultimate limit states should be as in Annex A.

4.5.3 Serviceability limit state

The serviceability of the pedestrian parapet should be verified under *SLS* conditions for the following situations considering the combinations of actions given in Annex A.

The design criterion C_d of the pedestrian parapet at *SLS* should be equal to or greater than the design value of the effects of the relevant combination of actions E_d.

$$C_d \geq E_d \tag{3}$$

The deformation at *SLS* should not exceed the values specified below. No plastic deformation is allowed. The deformation at *SLS* should not exceed the values specified in the following situations:

a) Traffic and wind

The horizontal deformation δ_h caused by $F_{d,\,SLS}$ should not exceed the value listed below:

$\delta_h \leq 0{,}01$ of the vertical distance to the walking face at any point.

The deformation may be either calculated or measured by testing.

The horizontal deformation δ_h should be declared.

b) Snow load(s) and accidental action(s)

Where the design of the pedestrian parapet allows for snow load(s) and/or accidental action(s), the design performance should be declared. Otherwise, a nil performance should be declared.

4.6 Durability

The material used and systems applied for protection of the pedestrian parapet should be declared. The maintenance regime(s) to be used for the pedestrian parapet, including any special precautions, should be also declared. An assessment of the materials durability rating (according to appropriate material standards and experience) should be provided. A durability statement, including the following, should be declared.

a) Description of the system:

1) product descriptions (e.g. materials, coating types, coating(s) thickness);

2) composition;

3) procedures (e.g. preparation, application regime, drying time, treatment of corner and edge effects).

b) Maintenance manual:

1) recommended inspection intervals;

2) recommended inspection methods;

3) how to evaluate the inspection results (e.g. degree of degradation);

4) procedures for small repair work (including products and procedures);

5) procedures (including preparation, application regime, drying time, treatment of corners and edges, environmental control, special requirements);

6) special environmental precautions.

NOTE Further information on FPC, protection systems and matters influencing durability are given in Annex F.

5 Performance verification methods

5.1 General

Performance verification should be done either by calculation; a combination of calculation and static testing; a combination of calculation, static testing and dynamic testing or by a combination of static and dynamic testing. The surface finish should be verified as demonstrated in Annex G.

All testing should be carried out as described in Annexes B and C.

The resistance of infill and panels to dynamic impact loads (5, 6 and 7 loads in Table 4) may only be verified by testing. The testing methods specified in Annex B should be used and the test results should be reported as given in Annex D.

5.2 Verification by combination of calculations and acceptance criteria

The pedestrian parapet should be designed in accordance with EN 1992, EN 1993, EN 1994, EN 1995, EN 1996 or EN 1999 for the materials used to fabricate the pedestrian parapet and the combinations of actions defined in Annex A.

Materials for which no European Technical Specification or ISO standard exists, design assisted testing should be carried out in accordance with EN 1990:2002.

Additional calculations and/or tests should be provided to demonstrate the adequacy of

a) joints i.e. welds, screws, nuts, bolts, glues,

b) anchorages and/or holding down bolts.

5.3 Verification by testing and acceptance criteria

5.3.1 Static load tests

5.3.1.1 Location and execution

Annex C gives the procedures that should be used for the static load testing.

5.3.1.2 Acceptance criteria

The acceptance criteria that should be used for static load tests are given in Table 5.

Table 5 — Static load test acceptance criteria

Test procedure	Property	Acceptance criteria
C.6	Deflection	Should not exceed values given in 4.5.3 by a maximum of 20 %
	Strength	No cracks, visible with the naked eye, corrected for normal vision from a maximum distance of 1 m and no overall buckling
	Local strength	No local buckling and no part of the specimen should become loose or detached.
C.7	Strength	No softening behaviour (C.7.2), or buckling
	Local strength	No visible cracks, local buckling or distortion
	Material behaviour	No hardening or brittle behaviour

For all loads in Table 4, the sphere diameter D_b should not pass through the test panel.

5.3.2 Dynamic energy load tests

5.3.2.1 Location and execution

The resistance of infill to dynamic impact loads (loads 5, 6 and 7 in Table 4) should be verified by testing. The testing methods specified in Annex B should be used.

More than one test may be required as required by the test house. At least one test should be carried out at a point of first contact located at 25 % of the length and 50 % of the height of the infill.

5.3.2.2 Acceptance criteria

The pedestrian parapet, when subjected to the dynamic impact loads (loads 5, 6 and 7 in Table 4), should comply with the acceptance criteria set out in Table 6.

Table 6 — Dynamic load test acceptance criteria (loads 5, 6 and 7 in Table 4)

Infill load test Table 4	Energy absorption level	Acceptance criteria
Soft body load 5	E = 600 J	a) No part of the infill should be detached or dislodged. b) An object larger than the declared value(s) D_s should not be able to pass through the tested infill. c) The infill should not be separated from the structure of the parapet. d) No infill member or its connection should fracture.
Hard body load 6	E = 30,0 J	e) The hard body should not pass through the infill. f) The infill or its connections should not fail in a manner, which would present a danger to pedestrians, e.g. present sharp edges. g) No full depth cracks should occur. [a] h) No infill member or its connection should fracture. [a]
Hard body load 7	E = 3,75 J	i) The hard body should not pass through the infill. j) The infill or its connections should not fail in a manner, which would present a danger to pedestrians, e.g. present sharp edges.
[a] Applicable to ductile materials only.		

6 Manufacturing assembly and tolerances

6.1 Storage, handling and transportation

NOTE Information on manufacturing assembly and tolerances should be given on the pedestrian parapet drawings and/or the installation manual as described below.

Procedures with methods for the handling and transportation of the product should be provided. In addition, suitable storage areas preventing damage or deterioration of the product should also be provided.

6.2 Instructions for assembly

An installation manual including sub-assembly drawings and setting out how the pedestrian parapet should be safely installed to replicate the declared product's performance. The statement should make reference to items such as:

a) description of the installation works, including special equipment;

b) procedures for installation (erection, assembly, foundations, etc.);

c) description of suitable support conditions for the system;

d) provisions for repair and maintenance;

e) any other information relevant (e.g. recycling information, details of toxic or dangerous materials present in the works);

f) bolt torque;

g) weld procedures;

h) arrangements and special requirements for gluing;

i) gap setting at the bridge / structure expansion / contraction movement joints;

j) protection of dissimilar materials and their fixings;

k) fixing bolt arrangements including anchorages;

l) arrangements for temporary fixings and supports prior to completing the installation.

Layout drawings and anchorage requirements should be provided.

6.3 Installation of pedestrian parapet

Details of storage, transportation, handling, installation, maintenance and inspection requirements should be described in the installation manual.

6.4 Tolerances

Drawings should show all tolerances that should accord with recognised European tolerances associated with the material used. The performance of the product should not be affected by these tolerances.

7 Characteristic aspects of pedestrian parapets

7.1 Safety in use for pedestrians and other highway users (excluding motor vehicles)

The characteristic aspects for safety in use pedestrians and other highway users (excluding motor vehicles) are set out in 4.2 including the requirement setting out the measures taken for achieving the declared performances.

7.2 Safety considerations of pedestrians using road bridges and footbridges and similar structures

The characteristic aspects for the safety considerations of pedestrians using road bridges and footbridges and similar structures are set out in 4.3 including the requirement setting out the measures taken for achieving the declared performance.

7.3 Analysis and test methods

The characteristic aspects for analysis and test methods are set out in 4.4, 4.5 and Clause 5.

7.4 Durability

The characteristic aspects for durability are set out in 4.6**.**

8 Labelling and marking

8.1 Identification of pedestrian parapets

Each panel of a pedestrian parapet should be labelled with a durable plate fixed to the top rail identifying the following:

a) CEN/TR 1317-6 and year of manufacture;

b) manufacturer's trade mark / name and address;

c) items identified below in 8.2:

    1) H … m;

    2) V … mm;

    3) DL … yrs;

    4) HL … kN/m;

    5) HLi … kN/m;

    6) F … kN or F … J.

Where the pedestrian parapet is a continuous system (no panels), the plate should be fixed at each end and at the centre of the installed system.

8.2 Information to be made available by the manufacturer

The pedestrian parapet specification should include the following information:

a) assembly – design drawings (4.2.1);

b) optional facilities (4.2.2);

c) height H_p (to top rail *'H') (4.3.1);

d) spaces and voids D_s (maximum void / space *'V') (4.3.2);

e) design working life *‘DL’ (4.4.1);

f) design resistance of connection to main structure (4.4.2);

g) horizontal uniformly distributed traffic loads traffic loads (4.4.3.2):

1) *udl top rail q_{hk} (*’HL’),

2) *udl other rails q_{hki} (*’HLi’);

h) concentrated horizontal traffic point load Q_{hk} (4.4.3.3);

i) vertical uniformly distributed traffic load q_{vk} (4.4.3.4);

j) concentrated vertical point traffic load Q_{vk} (4.4.3.5);

k) loads on infill F_{pdn} (*‘F’) (4.4.4);

l) wind action F_w (4.4.5);

m) snow loads S_n (4.4.6);

n) accidental actions A_d / $S_{n,dyn}$ (4.4.7);

o) horizontal deformation δ_h (4.5.3);

p) durability (4.6);

q) the validation procedures used (Clause 5): performance verification can be validated by:

1) calculation,

2) a combination of calculation and static testing,

3) a combination of calculation, static testing and dynamic testing,

4) a combination of static and dynamic testing.

The surface finish should be verified as demonstrated in Annex G.

Calculations and test reports should be submitted to checking by an independent party.

r) installation manual, 6.3.

Annex A
(informative)

Partial factors (γ), action combinations and combination factors (ψ)

A.1 Introduction

This Annex sets out partial factors γ, action combinations and combination factors ψ that should be used in limit state design. These factors should be taken from EN 1990:2002, A.2 (National Annex), or the values of this Annex A should be used, as they have been derived on the same basis of safety format.

A.2 Partial factors for actions

The recommended partial factors for actions are given in Table A.1.

Table A.1 — Partial factors for actions, γ

Action	Permanent/Transient situation		Accidental situation		Remark
	Unfavourable	Favourable	Unfavourable	Favourable [a]	
Permanent	γ_{Gs} = 1,35	γ_{Gs} = 1,00	γ_{Gs} = 1,00	γ_{Gs} = 0	Self weight, permanent action
Traffic	γ_Q = 1,35	γ_Q = 0	γ_Q = 1,00	γ_Q = 0	Pedestrians
Other variable actions	γ_Q = 1,50	γ_Q = 0	γ_Q = 1,00	γ_Q = 0	Wind, snow, temperature, maintenance etc.
Accidental actions	–	–	γ_A = 1,00	–	E.g. impact from service vehicles, snow clearance etc.

[a] Accidental actions in combinations may not be considered to act in a favourable way.

A.3 Combinations of actions for *ULS*

In the general method, the self-weight and wind actions are combined with individual horizontal and vertical traffic loads in combinations A.3.1.1.1, A.3.1.1.2, A.3.1.1.3 and A.3.1.1.4 given below. Alternatively, less accurate, but in a more simple “envelope” method, the self weight and wind actions may be combined with all traffic loads in combination A.3.1.2, given below.

A.3.1 Permanent action, traffic and wind

A.3.1.1 General approach

A.3.1.1.1 Self weight, horizontally distributed traffic load and wind

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times q_{hk} + \psi_{0,W} \times \gamma_Q \times F_W \quad \text{(A.1)}$$
$$\gamma_{Gs} \times G_k + \gamma_Q \times q_{hki} + \psi_{0,W} \times \gamma_Q \times F_W$$

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \psi_{0,Q} \times \gamma_Q \times q_{hk} + \gamma_Q \times F_W \quad \text{(A.2)}$$
$$\gamma_{Gs} \times G_k + \psi_{0,Q} \times \gamma_Q \times q_{hki} + \gamma_Q \times F_W$$

A.3.1.1.2 Self weight, concentrated horizontal traffic load and wind action

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times Q_{hk} + \psi_{0,W} \times \gamma_Q \times F_W \quad \text{(A.3)}$$

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \psi_{0,Q} \times \gamma_Q \times Q_{hk} + \gamma_Q \times F_W \quad \text{(A.4)}$$

A.3.1.1.3 Self weight, vertically distributed traffic load and wind action

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times q_{vk} + \psi_{0,W} \times \gamma_Q \times F_W \quad \text{(A.5)}$$

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \psi_{0,Q} \times \gamma_Q \times q_{vk} + \gamma_Q \times F_W \quad \text{(A.6)}$$

A.3.1.1.4 Self weight, concentrated vertical traffic load and wind action

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times Q_{vk} + \psi_{0,W} \times \gamma_Q \times F_W \quad \text{(A.7)}$$

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \psi_{0,Q} \times \gamma_Q \times Q_{vk} + \gamma_Q \times F_W \quad \text{(A.8)}$$

A.3.1.2 Simplified envelope approach

Self weight, horizontally distributed traffic load, vertically distributed traffic load, concentrated horizontal traffic load, concentrated vertical traffic load and wind action.

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times q_{hk} + \gamma_Q \times Q_{hk} + \gamma_Q \times q_{vk} + \gamma_Q \times Q_{vk} + \gamma_Q \times F_W \quad \text{(A.9)}$$
$$\gamma_{Gs} \times G_k + \gamma_Q \times q_{hki} + \gamma_Q \times Q_{hk} + \gamma_Q \times q_{hki} + \gamma_Q \times Q_{vk} + \gamma_Q \times F_W$$

In Formulas (A.1) to (A.9), the following abbreviations apply for actions:

G_k = characteristic value of a permanent action;

Q_{hk} = characteristic value of the concentrated horizontal traffic loads (4.4.3.3);

q_{hk} = characteristic value of the uniformly distributed horizontal traffic loads top rail (4.4.3.2);

q_{hki} = characteristic value of the uniformly distributed horizontal traffic loads not top rail (4.4.3.2);

Q_{vk} = characteristic value of the concentrated vertical traffic loads (4.4.3.5);

q_{vk} = characteristic value of uniformly distributed vertical traffic loads (4.4.3.4);

F_W = wind action, (4.4.5).

The recommended values for combination factors ψ_0 are in compliance with EN 1990:2002, A.2:

— $\psi_{0,W}$ = 0,3 for wind actions;

— $\psi_{0,Q}$ = 0,4 for traffic loads.

A.3.2 Permanent action and snow

$$F_{d,ULS} = \gamma_{Gs} \times G_k + \gamma_Q \times S_n \quad \text{(A.10)}$$

In Formula (A.10), the following abbreviations apply for actions:

G_k = characteristic value of a permanent actions;

S_n = snow loads (4.4.6).

A.3.3 Loads on infill

$$F_{d,ULS} = \gamma_Q \times F_{pdn} \quad \text{(A.11)}$$

In Formula (A.11), the following abbreviation applies for actions:

F_{pdn} = design load perpendicular load on the infill load in accordance with 4.4.4.

A.3.4 Accidental situation, permanent actions, horizontal traffic, loads and accidental action

$$F_{d,ULS} = G_k + \psi_{1,Q} \times Q_{hk} + A_d \quad \text{(A.12)}$$

$$F_{d,ULS} = G_k + \psi_{1,Q} \times q_{hk} + A_d \quad \text{(A.13)}$$
$$F_{d,ULS} = G_k + \psi_{1,Q} \times q_{hki} + A_d$$

The recommended value for the combination factor ψ_1 for actions complies with EN 1990:2002, A.2:

— $\psi_{1,Q}$ = 0,4 for traffic loads.

In Formula (A.12) and Formula (A.13), the following abbreviations apply for actions:

G_k = characteristic value of permanent action;

Q_{hk} = characteristic value of the concentrated horizontal traffic loads (4.4.3.3);

q_{hk} = characteristic value of the uniformly distributed horizontal loads (4.4.3.2);

A_d = accidental design actions.

A.4 Combinations of actions for *SLS*

A.4.1 General

The serviceability of the pedestrian parapet should be verified under *SLS* conditions.

The following combinations should be considered.

A.4.2 Traffic and wind

$$F_{d,SLS} = q_{hk} + \psi_{0,W} \times F_W \qquad (A.14)$$

$$F_{d,SLS} = \psi_{0,Q} \times q_{hk} + F_W \qquad (A.15)$$

$$F_{d,SLS} = Q_{hk} + \psi_{0,W} \times F_W \qquad (A.16)$$

$$F_{d,SLS} = \psi_{0,Q} \times Q_{hk} + F_W \qquad (A.17)$$

The recommended values of combination factors ψ_0 are in compliance with EN 1990:2002, A.2:

— $\psi_{0,W}$ = 0,3 for wind actions;

— $\psi_{0,Q}$ = 0,4 for traffic loads.

In Formulas (A.14) to (A.17), the following abbreviations apply for actions:

Q_{hk} = characteristic value of the concentrated horizontal traffic loads (4.4.3.3);

F_W = wind action (4.4.5).

Annex B
(informative)

Dynamic impact tests

B.1 Introduction

Subclause 4.4.4 sets out the requirements for loads on infill. Subclause 5.3.2 sets out the verification requirements.

B.2 Scope

Annex B specifies a method to assess by testing the ability of the infill of a pedestrian parapet to accommodate dynamic impacts which simulate the action of a human body or hard bodies or similar.

The test is carried out in the laboratory on a sample of a pedestrian parapet with a representative length of at least 1 m subject to agreement with the testing laboratory.

B.3 Normative references

See Clause 2.

B.4 Terms and definitions

For the needs of Annex B, no specific terms and definitions are used.

B.5 Test methods

B.5.1 Principles

The types of impact to be considered should be as follows:

B.5.1.1 Impacts of soft body of large dimensions, being mainly impacts of human bodies with large impact area (e.g. a blow from a shoulder).

B.5.1.2 Impacts from hard bodies such as a stone or piece of rock but not impacts such as bullets fired from guns.

B.5.2 Apparatus and materials

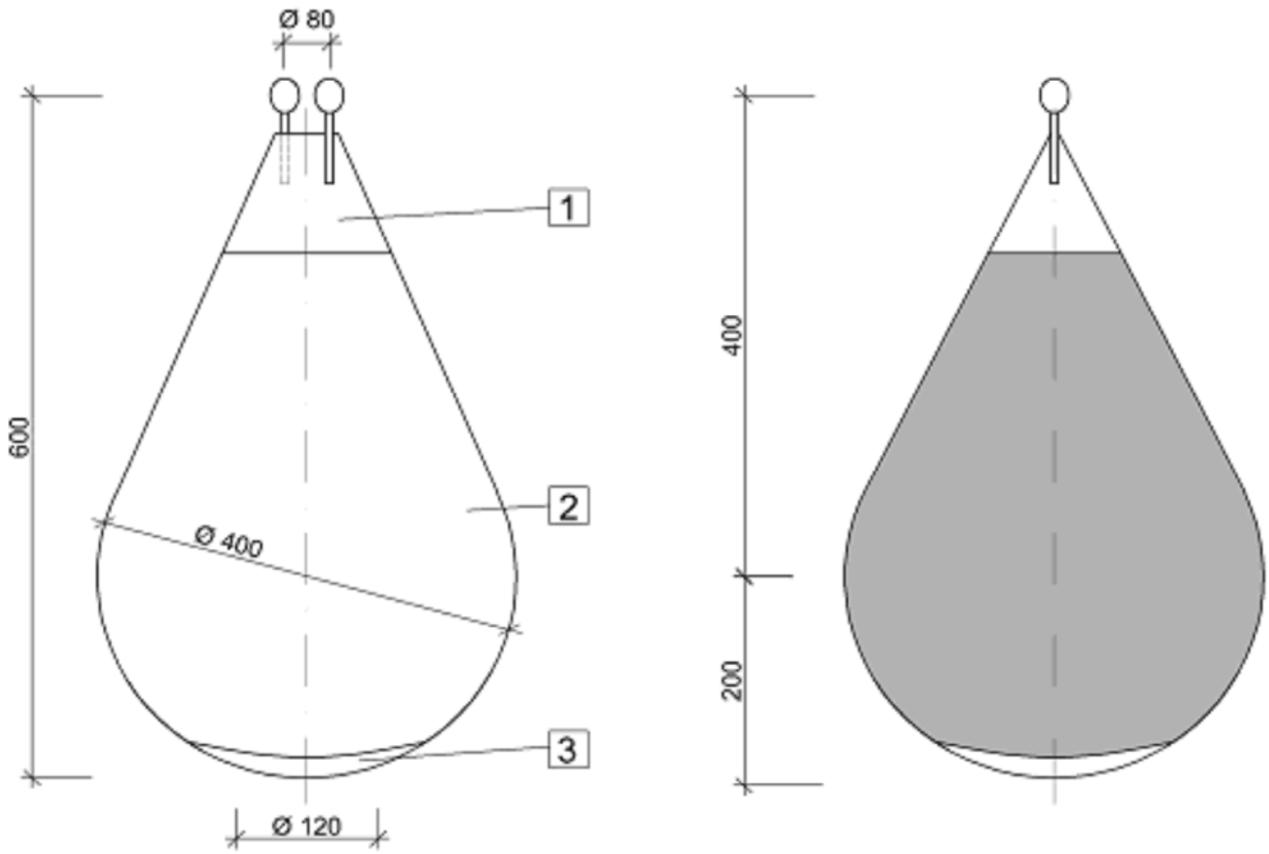
B.5.2.1 Soft body

The soft body impact should be represented by a spheroconical bag of 50 kg mass (see Figure B.1) made up of eight tarpaulin panels sewn together using saddle stitch to form a 400 mm diameter sphere within a cone having a vertex 400 mm vertically above the centre of the sphere. The bottom of the bag should be reinforced with a domed shaped piece of leather 120 mm long sewn onto the bag. The top of the bag should be suitably truncated to form an 80 mm diameter opening. The opening should be reinforced with stitched on leather edging into which equidistant rings gathered together into one suspension ring should be attached. The bag should be filled with 3 mm diameter glass balls so that the total mass is 50 kg ± 0,5 kg.

The glass balls should be those that are normally used for milling paint.

NOTE It is advisable that the bag be lined with a bladder (polyethylene bag), which should avoid the bag bursting and releasing the glass balls.

Dimensions in mm



a) Bag closed and full **b) Bag open and empty**

Key

1 leather edge

2 tarpaulin panels

3 leather bottom

Figure B.1 — Spheroconical 50 kg bag

B.5.2.2 Hard body

The impact from a hard body should be represented by a solid steel ball, which may have a ringbolt fixture. The total mass should be 3 000 g (- 0 g / + 50 g).

B.5.2.3 Small hard body

The impact from a small hard body should be represented by a solid steel ball 63,5 mm diameter, which may have a ringbolt fixture. The total mass should be 1 000 g (- 0 g / + 10 g).

B.5.3 Preparation of test specimens

B.5.3.1 Dimensions

The pedestrian parapet sample to be tested represents the product as realistically as possible. The exact length of the sample is fixed by agreement between the manufacturer and the test laboratory according to the type of product in order to avoid cuts modifying the operating mode.

The minimum length of the test specimen should be 1,0 m.

NOTE It is recommended that the test specimen have a length corresponding to the nominal length of a standard manufactured element.

B.5.3.2 Control of samples

As a minimum, the following information should be available for to the testing laboratory prior to the test in order that a description of the system performance for one class of product can be assessed:

a) product description;

b) installation manual;

c) installation description (for the test);

d) system layout drawings.

The panels to be tested should be clearly identified and marked.

B.5.3.3 Installation of samples on the test frame

B.5.3.3.1 General points

The impacting body should be allowed to swing freely onto the centre of the test panel. The test rig should be firmly fixed, not deform in any way during the test and it should not absorb or modify the energy from the impacting body.

B.5.3.3.2 For soft body test

The panel to be tested should be supported identically to the installed panel. It should be positioned so that it is at a plane tangential to the point of impact being at right angles to the vertical plane described by the swing of the bag.

The test rig apparatus is shown in Figure B.2 and the pulleys and winches are all within the plane described by the fall of the bag:

— the bag is suspended by its ring from the cable C1 passing over a pulley to winch T1,

— before the test, the suspended bag at rest is tangential to the test panel,

— the horizontal positioning of the bag at right angles to the point of impact is obtained either by the positioning of the winches T1 and T2 or adjusting the position of the test panel,

— the vertical positioning of the bag is obtained by adjusting cable C2 on winch T2,

— the angle α should not exceed 65°.

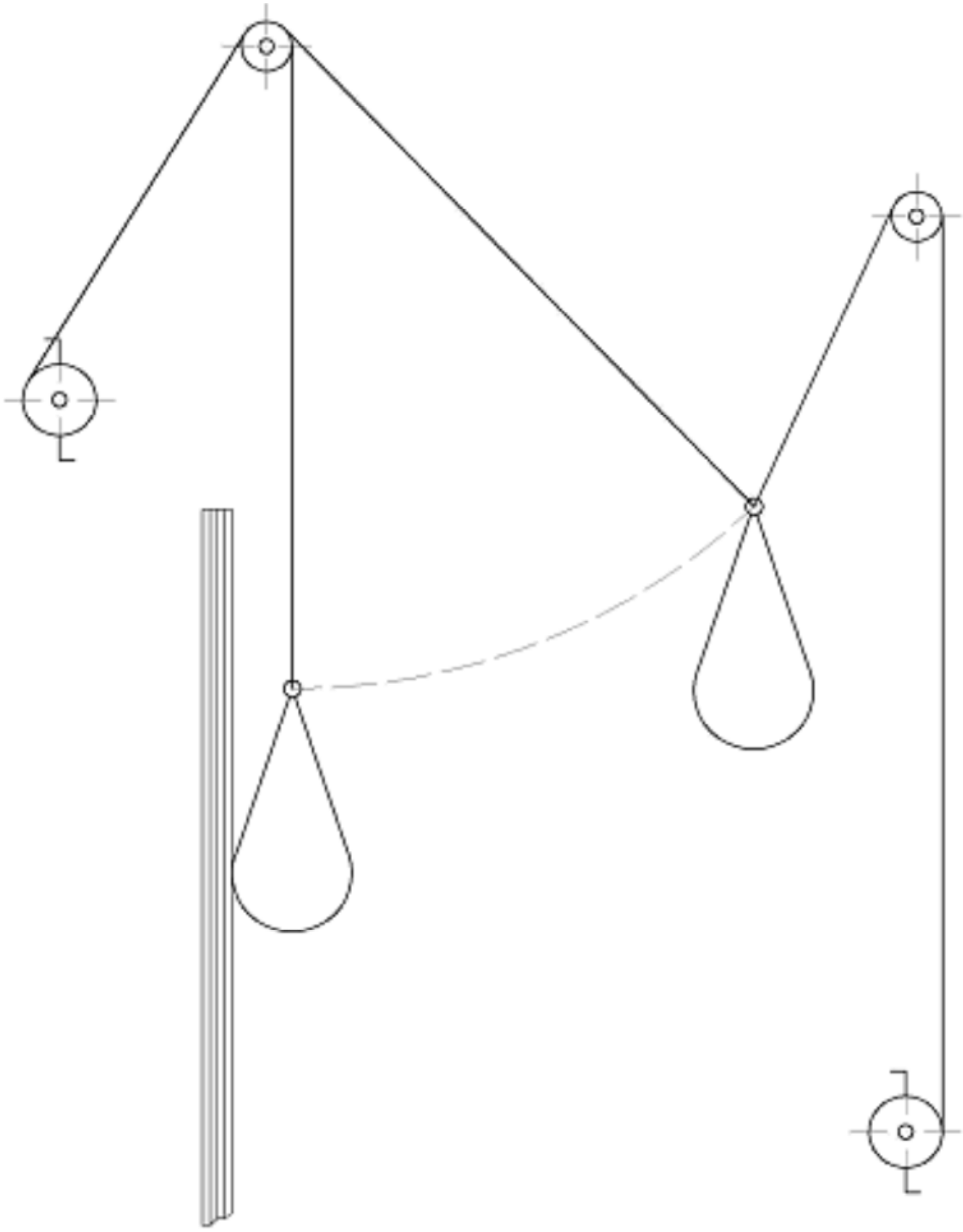


Figure B.2 — Impact test rig for large diameter soft body

B.5.3.3.3 Hard body test rig

The hard body impact testing rig apparatus is shown in Figure B.3. The rig should be firmly fixed and not become distorted during the test. The ball is suspended by its ring from cable C1 that is attached to a fixed point on the rig so that

— the ball, when at rest, is tangential to the test panel and to the intended point of impact,

— the length of cable C1 between the ring of the ball and its point of attachment is not less than 1,75 times the anticipated height of fall.

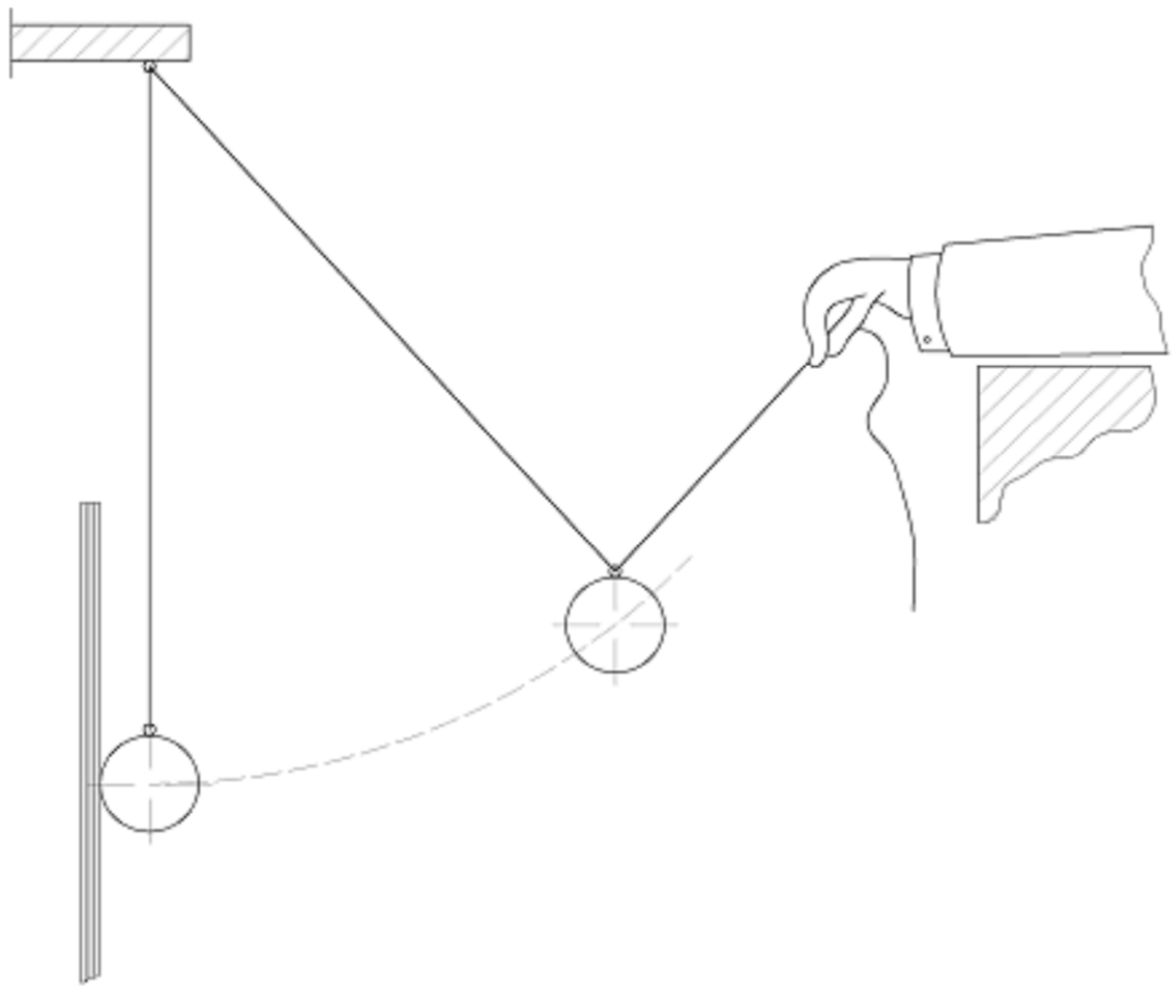


Figure B.3 — Impact test rig for hard body

NOTE The hard body may fall freely from a vertical position.

B.5.4 Test procedures

B.5.4.1 Testing conditions

The test is carried out under the following test temperature conditions. The ambient temperature during the tests should lie between +5 °C and +35 °C.

The following test conditions should also be met:

a) the movements of the soft body and the attached cable are not be blocked by any obstacle other than the infill;

b) the heights of the pulleys carrying the ropes/wires (see Figures B.2 and B.3) are determined taking into account the position of the centre of gravity of the impacting body;

c) if the impacting body rebounds after initial impact then it should be prevented from re-striking the panel.

B.5.4.2 Test procedures for soft body

The test is executed by placing the bag in the starting position and then winding it by cable T2 (that passes over pulley P2 to winch T2) attached to the ring on the bag by means of a snap hook, which is released to activate the test. The height of fall is to be measured prior to the test.

NOTE The snap hook may take the form of a fuse, which can be broken by remote ignition.

B.5.4.3 Test procedures for hard body

The test is executed by using cable C2 to swing the ball to its starting position ensuring that the cables C1 and C2 remain at right angles to the point of impact on the test panel and that the angle made by cable C2 with the perpendicular is not less than 30° or more than 45°. Prior to the test, the height of fall should be measured.

Alternatively, this test may be carried out by free vertical fall. The ball should be released without any initial velocity from a height measured between the lowest part of the ball and anticipated point of impact.

B.6 Expression of results

Expression of results should be in the form of the requirements set out in Table 6.

B.7 Test report

A test report should be prepared in accordance with Annex D.

Annex C
(informative)

Static tests

C.1 Introduction

This Annex describes the tests, which may be carried out instead of or in combination with design calculations. The tests are carried out over a range of applied loads which represent the conditions of the Serviceability Limit State (SLS) and the Ultimate Limit State (ULS).

C.2 Technical description for testing

As a minimum, the following information should be available to the testing laboratory so that a description of the system performance for one class of product can be assessed:

a) product description;

b) installation manual;

c) installation description (for the test);

d) system layout drawings.

C.3 Test specimens

The testing laboratory should agree the figuration to be tested which should include a minimum of 4 panels with posts (including end panels), or a minimum length of 8,0 m.

A smaller test specimen is allowed, if it can be demonstrated that the boundary conditions have been correctly reproduced.

Test specimens, which have passed the test at serviceability level, may be used for tests at ultimate level.

C.4 Position of the test specimen

The test specimen should be mounted so that the post fixing arrangements are the same as the real structure i.e. posts may be vertical / inclined and the handrail horizontal.

C.5 Loading

C.5.1 General

The loading should be in accordance with 4.4.3.2, 4.4.3.3, 4.4.3.4, 4.4.3.5, 4.4.4, 4.4.5, 4.4.6 and 4.4.7.

The loading combinations should be in accordance with Annex A.

C.5.2 Determination of the test loads F_T

1) Determine the design load $F_{d,ULS}$ in accordance with A.3.

2) Determine the design load $F_{d,SLS}$ in accordance with A.4.

The test load F_T is derived from the design load F_d by:

$$F_T = 1{,}25 \times F_d \quad \text{(C.1)}$$

$$F_{T,S} = 1{,}25 \times F_{d,SLS} \quad \text{(C.2)}$$

$$F_{T,U} = 1{,}25 \times F_{d,ULS} \quad \text{(C.3)}$$

The factor 1,25 should apply to point, patch and uniformly distributed loads acting in any direction.

NOTE The factor 1,25 accounts for uncertainties in the material and workmanship.

C.6 Static test at serviceability level

C.6.1 Test procedure

1) Apply the test load $F_{T,S}$ derived in accordance with C.5.2 in five equal steps: 20 %, 40 %, 60 %, 80 %, 100 %.

2) Maintain the 100 % load for 60 min; maintain all other loads for 10 min.

3) Measure and record the loads and the deflections at each loading stage for both loading and unloading.

4) Measure and record the load and deflections at ten-minute intervals during the 100 % loading stage.

5) Record test conditions and make photographic records.

6) Release load slowly in stages of 20 %.

C.6.2 Acceptance criteria

Acceptance criteria are given in 5.3.1.2, Table 5.

C.7 Static test at ultimate state level

C.7.1 Test procedure

1) Apply the test load $F_{T,U}$, derived in accordance with C.5.2 in seven steps:

Table C.1 — Loading steps and stages

Load step	Load stage of $F_{T,U}$	Comment
1	20 %	
2	40 %	
3	60 %	
4	70 %	Measure deflections
5	80 %	Measure deflections
6	90 %	Measure deflections
7	100 %	Measure deflections and maintain the load for 60 min and then re-measure deflections

2) Record test conditions and make photographic records.

3) Release load slowly in the seven equal steps (as for loading).

4) For load steps 4, 5, 6 and 7 draw up a load ($F_{T,U}$) / deformation (d) curve:

$$S = \frac{\Delta F_{T,U}}{\Delta d} \qquad \text{(C.4)}$$

where

$\Delta F_{T,U}$ = rate of change of the test load.

Δ_d = rate of change of the deformation.

C.7.2 Acceptance criteria

Acceptance criteria are as given in 5.3.1.2, Table 5.

At ultimate level the structure should not show any softening behaviour over the last four loading increments indicated by the slope of the load / deflection curve 'S' should always be positive (see C.7.1).

C.8 Test requirements

C.8.1 Number of tests

The number of tests relates to the design strength that is derived from the testing procedure in accordance with EN 1990:2002, Annex D, based on the information of statistical data.

C.8.2 Load application

a) The load should be applied at a controlled rate.

b) Point loads should be equally distributed over a length of 200 mm.

c) Line loads should be applied as five equal loads each equally distributed over a 200 mm length.

d) Equally distributed loads should be applied as point loads over a plate area of 200 mm × 200 mm which can be considered as loading an area of 300 mm × 300 mm.

e) Rubber or other similar synthetic material should be used between the load actuator(s), which apply the load(s), and the test specimen(s).

C.8.3 Test rig frame

The test frame used to apply the test loads should be strong and rigid enough to withstand all test loads without bending or distortion exceeding 1 % of the test results of the specimen. Should it bend or distort at any time whilst the test is underway the test should be abandoned and repeated with an appropriate test frame.

C.8.4 Test records

The manufacturer should keep ***full records*** of the test undertaken including photographic records and details of the test rig for a period not less than 10 years after production has ceased for the pedestrian restraint system represented in the test.

C.8.5 Interpretation of test results

The characteristic value of the resistance of the structure and its parts is derived from the tests by a method in accordance with EN 1990:2002, Annex D.

Alternatively, if no statistical data are available the characteristic value of the resistance R_k should be derived by applying the test resistance reduction factor α from Table C.2 to the test resistance R_T such that:

$$R_k = \alpha \times R_T \quad \text{(C.5)}$$

Table C2 — Test resistance reduction factor α

Number of tests	Test resistance reduction factor α
1	0,5
3	0,8
5	0,9
7	0,95

NOTE 1 The variety of materials (brittleness, ductility etc.) and structures make it impossible to include a simple relationship between numbers of tests and derived design resistance.

NOTE 2 The test load FT,S or FT,U according to C.5.2 can be insufficient to derive a resistance from testing with sufficient reliability, when a small number of tests are carried out.

C.8.6 Test report

The test report should be in accordance with Annex D.

Annex D
(informative)

Test report

The test reports for both the dynamic and static tests should include the following information.

a) The reference number and date of publication of this Technical Report CEN/TS 1317-6 and the characteristics tested.

b) The name of the organisation which prepared the samples and calculations/drawings (of the whole pedestrian parapet or parts) together with the names of the organisation which witnessed the preparation and assembly and the place of sampling.

c) The identification of the sample(s) tested e.g. name of manufacturer, number or quantity of samples, description of pedestrian parapet product including type and source of materials and the manufacturer's code number.

d) A description of the whole installation system including length, fastenings, welds and corrosion protection system (6.2).

e) A description of the test rig including arrangements of pulleys and winches including angles and hydraulic jacks.

f) The dates when the sample(s) were made and the dates when the test or repeat tests were undertaken including the assembly of the test rig.

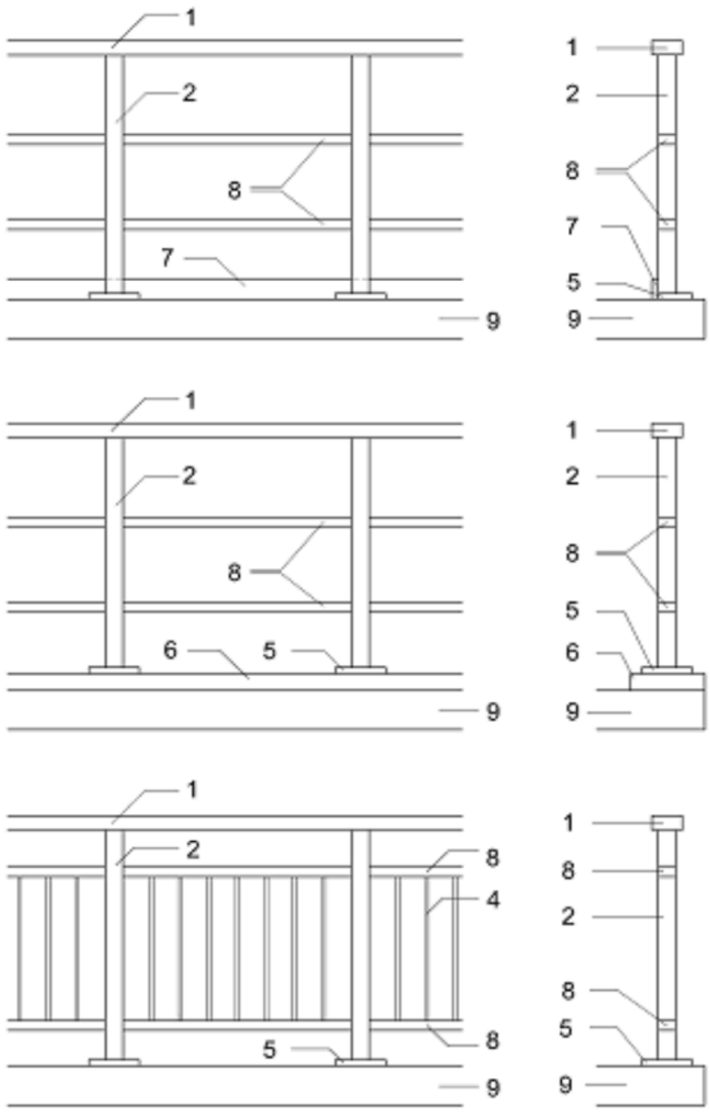
g) A full test report including graphs showing application of load stages, deflections and deformations measured.

h) The registration number of the laboratory.

i) The name and signature of the person carrying out the test and person responsible for the test.

Annex E
(informative)

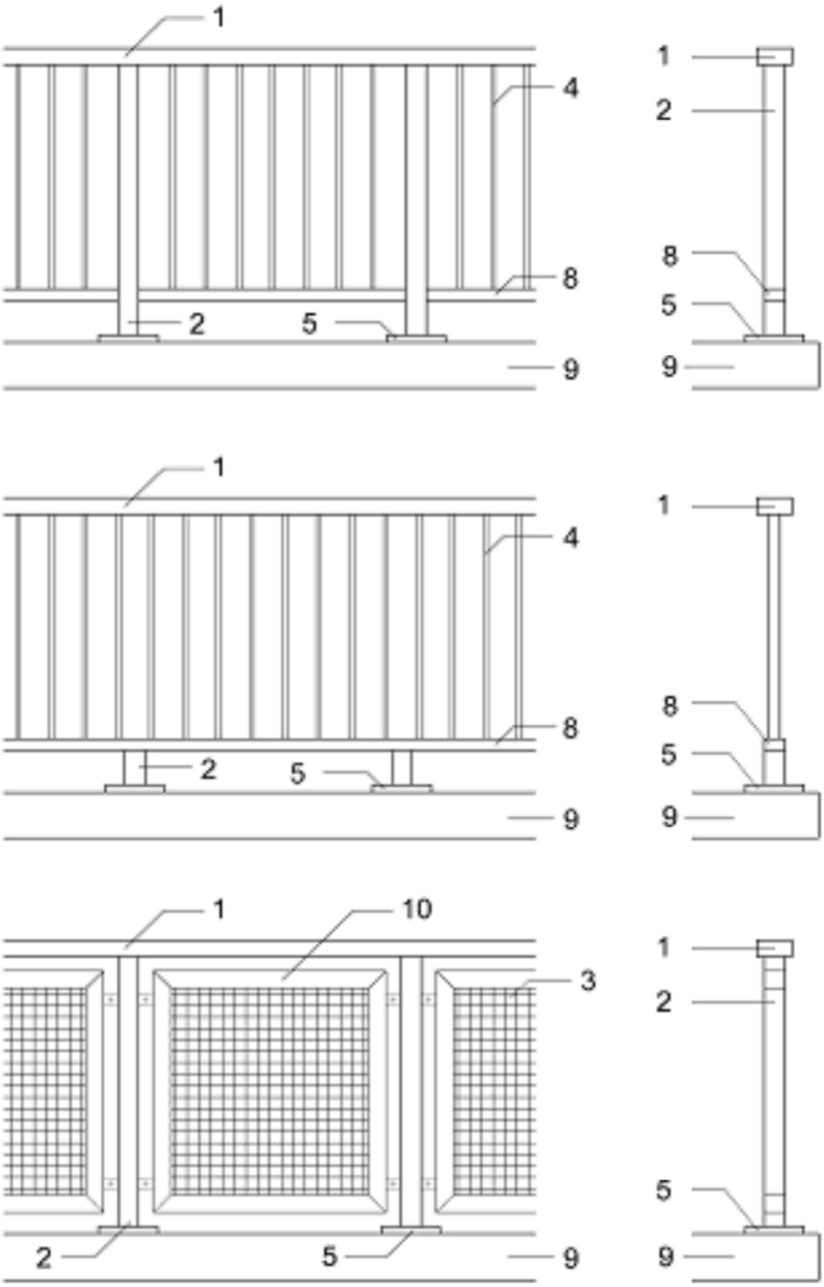
Diagrams of constituent parts of a pedestrian parapet



Key

1 top rail
2 post
3 mesh infill
4 infill with verticals
5 base plate
6 plinth
7 kicking plate
8 rail
9 footpath

Figure E.1 — Elevation and cross-section 1



Key

1 top rail
2 post
3 mesh infill
4 infill with verticals
5 base plate
6 plinth
7 kicking plate
8 rail
9 footpath
10 panel

Figure E.2 — Elevation and cross-section 2

Annex F
(informative)

Testing under the factory production control

This Annex describes aspects, which are needed for the control of manufacturing pedestrian parapet products, (see Table F.1). The extent and frequency of control during the manufacturing and completion processes should include reference to the control items shown and should be described in the manufacturer's documented FPC system.

Further information may be found in EN 1090-1, EN 1090-2 and EN 1090-3.

Table F.1 — Testing under the factory production control

Subject of control	Control in accordance with	Method of control	Minimum frequency
Materials	Specification of type test Relevant EU standards	EN 10204, Certificate 3.1	Every batch
Mechanical fasteners	Relevant EU standards	EN 10204, Certificate 3.1	Each charge
Dimensions	Manufacturer's drawings	Measurement	Each panel
Welded connections	Manufacturer's procedure (WPS & WPQ)	Visual inspection Critical Welds – NDT	Each weld
Glued connections	Procedure of bonding products manufacturer	Visual inspection of connections and inspection of procedures	Each connection
Bolt torque	Manufacturer's procedure	Measurement by calibrated instrument	Each bolt
Tolerances	Manufacturer's drawings	Measurement	Each panel
Finish	4.6	Visual inspection	Each panel
Corrosion protection	Manufacturer's procedure	Visual inspection Measurement of layer thicknesses	Each component
Marking	8.3.2.8	Visual inspection	Each panel or end panels only
Marking and labelling	Clause 8	Visual inspection	Each panel or end panels only

Key

NDT = Non Destructive Testing

WPS = Welding Procedure Statement (Sets out the procedures and compliance requirements for each weld process).

WPQ = Welding Procedure Qualification (Examines the welds produced by individual welders for compliance with the Welding Procedure Statement and sets NDT parameters by which the welder will be judged to be maintaining the correct techniques to ensure that the WPS requirements continue to be met).

Annex G
(informative)

Method for ensuring a smooth finish

G.1 Introduction

This procedure has been drafted for the test procedure for the Kingswells KW-18 sharp edge tester for sharp edge testing to UL 1439 and similar test procedures.

G.2 Equipment details

The sharp edge tester was designed and developed to provide an objective means for judging the sharpness on an edge. Made by Kingswells Test Equipment, it was initially designed for testing to UL 1439 but has subsequently been used to test in accordance with this procedure.

It is required to be calibrated annually or before use.

Figure G.1 — Example of sharp edge tester

G.3 Test procedure

G.3.1 Remove all the parts which can be removed without tools (a coin is not regarded as a tool). Remove also parts which are instructed to be removed in manual.

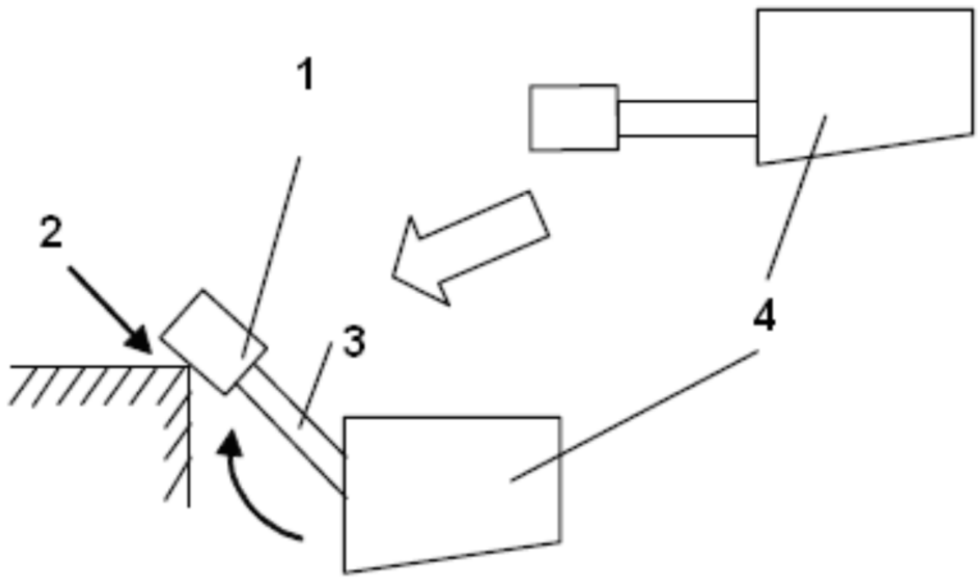
G.3.2 Apply a new sensing tape onto sharp edge tester. Tapes are according to UL 1439 (part number KW-18TC from Kingswells Test Equipment) and incorporate 3 layers of tape:

— bottom layer: 1/16 thk Black foam;

— centre layer: 1/32 thk White foam;

— outer layer: 3 mil Teflon tape Slide the tape cap assembly all the way on to the ‘pressure head’ of the tester with the centre guideline and the uncovered portion of the red plastic cap facing up.

G.3.3 Place the top part of the sharp edge tester onto the sharp edge which can be touched / accessed by the end user as seen in Figure G.2 and Figure G.3.



Key

1 sensing tape

2 sharp edge

3 lever

4 sharp edge

Figure G.2 — Test set-up

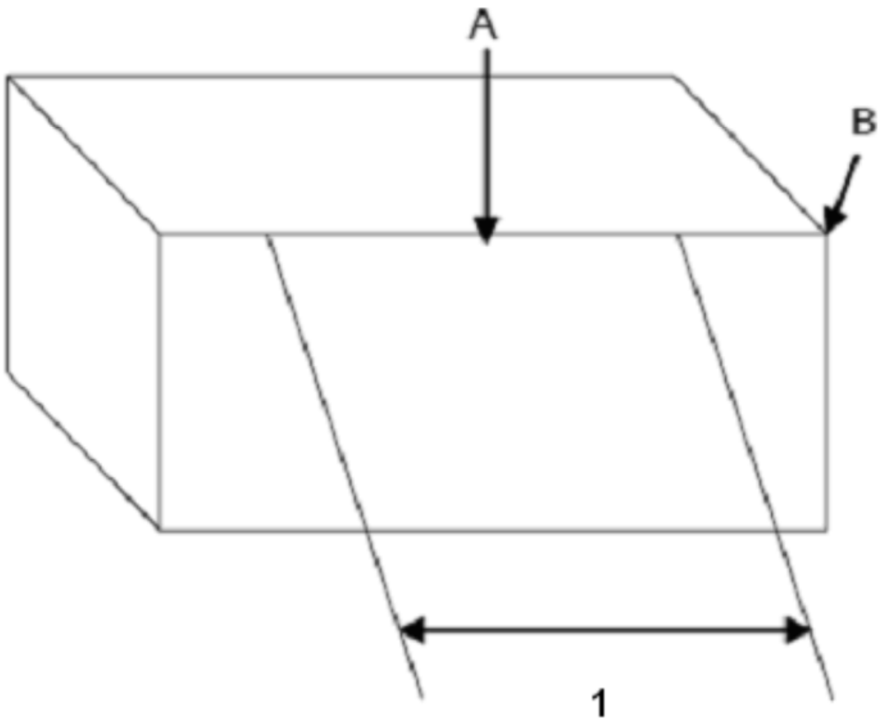
Figure G.3 — Sharp edge tester pressed down onto sharp edge until lever stops

G.3.4 Apply sensing tape of sharp edge tester onto the sharp edge.

G.3.5 Move the lever up/down and stop just before the lever stops as limited by the plastic moulding (this is to prevent additional pressure from the tester).

G.3.6 For Section A in Figure G.4, whilst applying pressure as in Step 5) above, slide the sensing tape back and forth (once for each direction) with a maximum length of 6 cm.

G.3.7 For edges such as point B shown in Figure G.3, apply pressure as in Step 5) for 1 min.



Key

1 6 cm max. 1 lap (from side to side)

Figure G.4 — Area (with sensing tape applied) to slide sharp edge tester

G.3.8 Test all sharp edges found on test piece.

G.3.9 Pass criteria – After test:

— the tape of sharp edge tester should not be cut, and no holes should be on tape;

— the sharp edge tester should be applied to all sharp edges and at multiple angles to ensure that it is not sharp;

— screw heads are regarded as dangerous edges and it should not be at any surface or area in which a user can come in easy contact.

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