

OVERVIEW OF LEGAL REQUIREMENTS FOR PERMANENT AND TEMPORARY EDGE PROTECTION



REGULATIONS

There are many standards relating to both temporary and permanent edge protection around the globe. These standards include:-

CP 3:Chapter V-2:1972 Code of basic data for the design of buildings. Loading. Wind loads (Replaced BS 6399 Part 2)
HSE Specialist Inspectors Report No 15 1987
Workplace Health Safety & Welfare Regulations 1992
BS 6399 Part 1 Loading for Building 1996
BS 6399 Part 2 Code of Practice for Wind Loading 1997
Construction Health, Safety and Welfare Regulations 1996
BS 6180 Protective Barriers In and About Buildings 1999
The Work at Height Regulations 2005
EN 14122-3 Safety of machinery. Permanent means of access to machinery, stairways, stepladders and guardrails 2010
BS EN 1991-1-4:2005+A1:2010 Eurocode 1.
HSE Health & Safety in Roofwork 2012
The Building Regulations Part K 2013
BS EN 13374 2012 Temporary edge protection systems - product specification - Test methods
BS 13700:2021 Permanent counterweighted guardrail systems
EN 13374 Temporary Edge Protection Systems – Product Specification, Test Methods 2018
BS 13700 2021 Permanent counterweighted guardrail systems
OSHA Reg 29 CFR 1910.23 (E) (1); (E) (3) (IV).
OSHA Reg 29 CFR 1926.502 (B) (1) – (B) (14).
OSHA Reg 29 CFR 1926.501 (b) (1); (b) (2) (ii)
Canadian National Building Code 4.1.10.1(1)(e), 4.1.10.1(2), 4.1.10.1(4)
Ontario Building Code Section 4.1.10.1(1)(b), 4.1.10.1(2), 4.1.10.1(4)
Z259.18:19 Counterweighted guardrail systems

The above standards often cause confusion when individuals are trying to specify a guardrail product as many require different load and testing criteria. In addition, until recently, there were no specific standards that deal with cantilevered guardrails which are used as both temporary and/or permanent product solutions, hence further confusion. Thankfully we now have specific Standards for permanent counter balanced systems in the UK and Canada.

The UK **Building Regulations Part K** requires a guardrail to consist of a minimum two horizontal rails with a minimum height of 1100mm.

The loading criteria is taken from **BS 6399 part 1 1996** and requires the guardrail to withstand a uniformly distributed load of 0.74kN per metre and a point load of 0.5kN.

Part K2 has a specific heading "Guarding of areas used for maintenance" Clause 3.4b states "If access will be required less frequently than once a month: it may be appropriate to use temporary guarding..."
"The Construction (Design and Management) Regulations 2015 (CDM) and the **Work at Height Regulations 2005** give provisions for such measures."

Hence this is a relaxation of the suggested loadings contained within Part K where the frequency of access is low and controlled.

The referral to the CDM Regulations 2015 requires a risk assessment to be made to ensure that the guardrail is suitable and sufficient to prevent both persons and objects from falling.

The European Directive 89/391/EEC - OSH "Framework Directive" was introduced to allow member states to introduce legislation in relation to Health & Safety when working at height. The UK **Work at Height Regulations 2005** was introduced under this Directive and requires all those that have a duty of care to ensure that work at height is carried out safely. Solutions need to be suitable and sufficient to ensure prevention of both persons and objects from falling.

These Regulations revoked Regulation 13 of the Workplace Health Safety & Welfare Regulations 1992 and Regulations 6-8 of the Construction Health, Safety and Welfare Regulations 1996.

In relation to Schedule 2 of the Regulations, "Construction Work" (Temporary provisions of protection) states that the top guardrail or other similar means of protection must be at least 950mm high. Toe boards should be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work. The intermediate guardrail or similar means of protection must be positioned so that any gap between it and other means of protection does not exceed 470mm.

In the UK permanent protection barriers need to be suitable and sufficient and must comply with the Building Regulations Part K criteria in relation to height. As a result, the 470mm gap stipulation would not be possible to achieve. If however the "existing place of work" becomes "Construction Work" then the Work at Height Regulations would prevail and one would need to adopt perhaps toe boards and further intermediate guardrails in order to comply with the 470mm gap.

In Europe **EN 13374** provides for the design of temporary edge protection systems and requires a system to withstand loads applied perpendicular, horizontal and vertical to the system. This standard was initially introduced in 1997 and replaced the UK **HSE Specialist Inspectors Report No 15 1987 and other European Standards**. EN 13374 has recently been revised by Technical Committee 53, Working Group 10 (TC53/WG10). During the Working group meetings there was discussion of changing the title of this European Norm to accommodate permanent counter balanced systems. Unfortunately the change never occurred, however, in the UK National Standard there is clear reference to include such permanent counter balanced system, although this is now being revised to reflect the publication of **BS 13700:2021 Permanent counterweighted guardrail systems**.

Extract from EN 13374:2018

"This standard can also be applied where the protection of only a few persons, in a controlled environment, not subject to panic, crowd control or access by the general public, can be demonstrated (e.g maintenance of plant and equipment on roofs"

The European Norm establishes three classes of edge protection system.

Class A	0-10 degree roof pitch
Class B	10-30 degree roof pitch
Class C	30-45 degree roof pitch

All classes have a static load requirement and class B & C also have a dynamic load applied representing someone rolling down the roof slope and making contact with the edge protection system.

Under Clause 7.3 friction, all counterbalanced systems should be tested at the maximum inclination, according to the manufacturers Operation & Maintenance manual. The performance will vary according to the roof pitch, base material (wet or dry) and whether or not there is an upstand or parapet wall present. The manufacturer needs to demonstrate compliance to this standard through testing the permutations they claim are suitable for their product to be installed on.

Due to the above confusion and uncertainty, companies have commissioned independent assessment and testing by institutions, such as, "The British Board of Agrément." In situations, where there are no specific standards relating to a product, it is essential to establish the product is "fit for the intended use."

In the absence of an appropriate standard, in Europe, some European authorities have applied inappropriate standards such as **EN 14122-3 Safety of machinery. Permanent means of access to machinery, stairways, stepladders and guardrails 2010.**

This standard provides a UDL and a deflection criteria. However it fails to mention roof pitch, roof membrane, wet or dry conditions, upstand/parapet wall details, or toe-board requirements. Clearly this standard is intended for guardrails around plant and machinery, nevertheless it is often specified inappropriately and the French version adds a dynamic load in accordance with NF E85-003.

In addition to these requirements the edge protection system, when installed permanently, should also comply with appropriate wind loading criteria. In the UK & Europe this is **BS EN 1991-1-4:2005+A1:2010 Eurocode 1. Actions on structures. General actions. Wind actions.**

Although EN 13374 includes a degree of testing for wind loading, it has become clear that wind loading is a far more onerous force than that of a person falling against a guardrail.

Therefore any professional manufacturer should provide a wind design for each and every installation dependent upon the topography, height of building and location in the World.

As counterweighted edge protection systems are "Safety Critical" products, BSI B514 Committee, has now published **BS 13700:2021 Permanent counterweighted guardrail systems.** This Standard has adopted similar test loadings to BS EN 13374 including "working wind" load. The Standard has introduced more onerous criteria requiring a requirement for a site specific wind load calculation for every installation to ensure the product is fit for purpose.

Further this Standard has introduced the requirement of producing a "Technical File" for the complete installation and the requirement for an annual inspection based on the manufacturer's examination scheme.

To pick-up "legacy issues in the field" this Standard recommends a retrospective wind speed calculation to be completed, as part of the annual inspection, of all edge protection systems. The Standard requires a guardrail to be installed at 1100mm high and products conforming to this Standard cannot be reliant on upstands or parapets as these may not of been constructed when the guardrail was initially installed or even part of the construction design.

All testing is to be conducted on a five-degree sloping test rig covered with single ply roofing membrane (most unfavourable) material tested in both wet and dry conditions. The test program consists of nine tests in total, testing both the guardrail components and toe-board, in a parallel, horizontal outwards and vertically up and downwards plane.

Toe-boards may be required to be installed to permanent counterweighted guardrail systems only when "Construction operations" are taking place. The addition of toe-boards must be wind calculated to ensure the system is fit for use whilst temporary construction works are taking place. Toe-boards can be included to remain permanently attached and this element will increase the wind loading on the system and is required to be calculated accordingly.

BS 13700 provides annotated drawings and load tables for each required tests and also detailed informative annexes regarding the data required to design a system and an example of what should be included in a wind loading report. There are also worked examples, to assist the reader, to calculate the correct test load to be applied during the test program to represent the "working wind".

In other parts of the World there are other standards that require other criteria in relation to height and loadings. The OSHA regulations require the height of the edge protection system to be 42" (1050mm) with the load applied to the top rail of 200lbs (890N or 90.7kg) in an outwards or downward direction without the guardrail deflecting to a height less than 39" (1000mm). Midrails, screens, mesh, intermediate vertical members, solid panels and equivalent structural members shall be capable of withstanding a force of at least 150lbs (667N or 68kg) applied in any downward or outward direction at any point along the midrail or other member.

With regards to wind loading please refer to ASCE7 - The American Society of Civil Engineers design standard: "Minimum Design Loads for Buildings and Other Structures.

The Ontario Building code requires a guardrail system to resist a horizontal load of 50lb/ft (0.75kN/m) or a concentrated load of 1.0kN (225lb) applied at any point along the top rail. The system also needs to be designed to resist a 1.5kN/m (100lb/ft) load applied vertically downwards. Mid-rails, screens, mesh, intermediate vertical members, solid panels and equivalent structural members shall be capable of withstanding a force of at least 0.5kN (112lb) or 51kg applied to an area not to exceed 1 foot square in any downward or outward direction at any point along the mid-rail or other member.

In 2019 CSA Z259.18 published their Standard for those designing permanent (class 1) and temporary (class 2) counterweighted guardrails.

This Standard requires a guardrail to be installed between 990 – 1143mm high and products conforming to this Standard cannot be reliant on upstands or parapets as these may not of been constructed when the guardrail was initially installed or even part of the construction design.

All testing is to be conducted on a five-degree sloping test rig covered with membrane (most unfavourable) material tested in both wet and dry conditions. The test program consists of both static and dynamic tests and there are four tests in total applied at a number of points along the guardrails length, testing horizontal outwards, vertically up and downwards, plus the dynamic test. Tests are applied horizontally outwards to the principal (top) guardrail 1.0kN (225lb) and to the intermediate rail 0.67kN (151lb). Tests are applied vertically downwards to the principal (top) guardrail 1.0kN (225lb) and to the intermediate guardrail 0.67kN (151lb). To ensure all components are physically connected, as opposed to relying on gravity to stay in position, there is an upwards test applied to the principal (top) guardrail 0.45kN (101lb).

The dynamic test is particularly onerous and involves a 100KG (220lb) weight falling vertically 1000mm and striking the principal (top) guardrail at various points.

Clause 9.2 – Instructions, details the requirements that manufacturers have to adhere to include annual inspection of type 1 systems and compliance with the normative annex including wind speed calculations and full installation details and as installed drawings.

Summary

It is clear that there is a need of interpreting the Standards to establish if a product is fit for use. Many manufacturers will claim compliance to certain standards but what does this mean?

It's extremely important the manufacturer provides test reports both internal and in some cases third party verified, providing analysis to demonstrate the given system is suitable for the intended use including the roof pitch, membrane, both wet and dry, performance and whether or not the system was tested with or without an upstand or parapet. In addition wind speed calculations should be provided to ensure the product will remain on the facility.

When we use guardrails in a permanent application (UK & Europe 1100mm high) it may be appropriate to adopt the loading criteria of BS 13700 in relation to the frequency of access and controls in place. The Building Regulations - Part K2 has a specific heading "Guarding of areas used for maintenance" Clause 3.4b states "If access will be required less frequently than once a month: it may be appropriate to use temporary guarding..." although one can now adopt BS 13700 permanent counterweighted guardrail systems. "**The Construction (Design and Management) Regulations 2015 (CDM)** and the **Work at Height Regulations 2005** give provisions for such measures."

A suitably and sufficient design risk assessment needs to be completed before considering any solution, in order to determine the products suitability and is fit for the intended use. Best practice, BS 13700, recommends this to be applied retrospectively during any annual inspection and includes completing a wind speed calculation for the system.

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