Draft for Public Comment

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Introduction

Your comments on this draft are invited and will assist in the preparation of the consequent standard.

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Guide to the design of balconies and terraces

Contents

Foreword

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As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any 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.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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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.

Introduction

The UK has seen an increase in medium and high-rise residential development in cities. The need to provide outdoor amenity space for occupants in apartments gives rise to the proliferation of balconies and roof terraces. Industry is frequently divided in opinion about the design of balconies. The need for a guide has therefore been identified to address this problem.

Better guidance is needed for harmonizing the drivers of safety, longevity, inclusive access and weathering.

This British Standard aims to set a benchmark for quality and functionality in the design of balconies and terraces.

1 Scope

This British Standard gives guidance on the design of balconies and terraces and their component parts.

Balconies and terraces covered within this British Standard can be at any height above lowest ground level, unless stated in the text.

Juliet balconies are defined and relevant scope covers guarding only.

This British Standard is not applicable to walkways, roofs, decks and balconies intended for access only for maintenance.

This British Standard is not specifically intended to cover internal balconies, such as within a building atrium, but relevant guidance herein can be used in the absence of guidance specific to such balconies.

Asset protection other than service life is not included within the scope of this British Standard.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document[1]. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standard publications

BS 6229, *Flat roofs with continuously supported coverings – Code of practice*

BS 6180, *Barriers in and about buildings – Code of practice*

BS 7976, *Pendulum testers*

BS 8610, *Personal fall protection equipment – Anchor systems – Specification*

BS 9991, *Fire safety in the design, management and use of residential buildings – Code of practice*

BS EN 1990, *Eurocode – Basis of structural design*

BS EN 1991 (all parts), *Eurocode 1 – Actions on structures*

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

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

BS EN 1994 (all parts), *Eurocode 4 – Design of composite steel and concrete structures*

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

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

BS EN 1090 (all parts), *Execution of steel and aluminium structures*

BS EN 12056-3, *Gravity drainage systems inside buildings – Part 3: Roof drainage, layout and calculation*

BS EN 13501-1:2018, *Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests*

BS EN 13501-5:2016: *Fire classification of construction products and building elements – Part 5: Classification using data from external fire exposure to roofs tests*

[1] Documents that are referred to solely in an informative manner are listed in the Bibliography.

BS EN ISO 13789, *Thermal performance of buildings – Transmission heat loss coefficient – Calculation method*

NA to BS EN 1991-1-1:2002, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-4: General actions – Wind actions*

PD 6688-1-1:2011, *Recommendations for the design of structures to BS EN 1991-1-1*

Other publications

[N1] IStructE. Structural use of glass in buildings, 2014. Available from https://www.istructe.org/resources/guidance/structural-use-glass-buildings/

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 balcony
accessible external amenity platform above ground level exterior to and with direct access from a building

NOTE A balcony is formed above an external space that is not a habitable room.

3.1.1 enclosed balcony
balcony that is protected from rain ingress by a roof or balcony above and/or to the side and a weather screen

NOTE 1 The envelope is deemed rain resistant, but not part of the thermal, acoustic, fire or air tightness envelope of the building, and therefore an enclosed balcony is not considered in this document a habitable room. An enclosed balcony is sometimes referred to as a 'winter garden'.

NOTE 2 BS 9991 gives guidance on open and enclosed balconies that helps give a more precise definition in terms of fire. It does not cover weather protection and therefore the definition of enclosure may be different.

3.1.2 free standing balcony
balcony supported independently of the adjacent building structure

3.1.3 inset balcony
balcony that is recessed inwards from the external wall line of a building but not above a habitable internal space

3.1.4 juliet balcony
balcony formed by adding an external guarding to full-height openable doors without an associated external floor

NOTE Also known as balconet or balconette.

3.1.5 open balcony
balcony that has guarding but no other form of vertical enclosure and does not provide protection to the occupants from weather

NOTE BS 9991 gives guidance on open and enclosed balconies that helps give a more precise definition in terms of fire.

3.1.6 projecting balcony
balcony that cantilevers outwards from the external wall line of a building

3.2 deck
pedestrian surface finish of a balcony or terrace

NOTE 1 This definition might differ from that of the same term in other standards.

NOTE 2 Raised timber structures on support posts built into the ground and serving ground floor accommodation is considered raised decking and outside the scope of this standard'

3.3 drip
projecting profile at the base of a vertical or sloping surface that prevents water from tracking onto the fascia or soffit below

3.4 drainage

3.4.1 controlled drainage
drainage from a balcony that prevents water ingress to the interior and staining of the exterior of a building and nuisance to persons under or around the balcony

3.4.2 edge drainage
drainage of a water collecting surface via the edge of a balcony

3.4.3 edge overflow
point in a vertical upstand to a horizontal waterproof surface where the uppermost level is reduced to allow overspill to a non-critical point on the edge

3.4.4 freeboard
difference between the *spillover level* (**3.4.12**) and the *ingress level* (**3.4.8**)

3.4.5 non-piped drainage
any means of conveying rainwater from a horizontal surface other than *piped drainage*

3.4.6 piped drainage
drainage of a water collecting surface via outlet(s) and downpipe(s)

NOTE Sometimes referred to as 'positive drainage'.

3.4.7 principal water collecting surface
surface on which water is primarily collected for dispersal to an outlet, edge or overflow

3.4.8 ingress level
lowest level around the perimeter of a balcony or terrace at which water may leak into the building if an outlet route is blocked or surcharged

NOTE This is usually the lowest level of the impervious membrane upstands against the bounding walls. It usually occurs at a door threshold between a balcony/terrace and the interior of the building.

3.4.9 outlet
primary conveyance for transferring water from a balcony or terrace to *piped drainage*

NOTE An outlet may be vertical or side draining.

3.4.10 outlet overflow
outlet above a waterproof horizontal surface set below the *spillover level* to allow overspill into a pipe

3.4.11 overflow
secondary conveyance for the discharge of water where an outlet has become blocked

NOTE An overflow could also be a means to warn of drainage problems/blockage. An overflow may take the form of an edge overflow or an outlet overflow.

3.4.12 spillover level
level at which water discharges via an overflow if an outlet is blocked or surcharged

3.4.13 spout
rainwater outlet or overflow that projects laterally from a balcony

3.4.14 warning pipe
pipe set at a level and location solely to warn of rising water levels

NOTE A warning pipe cannot be an overflow due to insufficient capacity.

3.5 guarding
physical barrier that restricts access to a significant hazard e.g. falling from height

3.6 REI
fire resistance

NOTE *R = load bearing, E = integrity, I = thermal insulation.*

3.7 terrace
external accessible space positioned above internal space above ground level exterior to and with direct access from a building

NOTE *Certain spaces might incorporate features of both a balcony and terrace.*

3.8 thermal envelope
envelope of a building that controls the unwanted transfer of heat and air in and out of the building

NOTE *This might be different from the weather screen.*

3.9 walkway
exterior passage affording access to an apartment above ground level

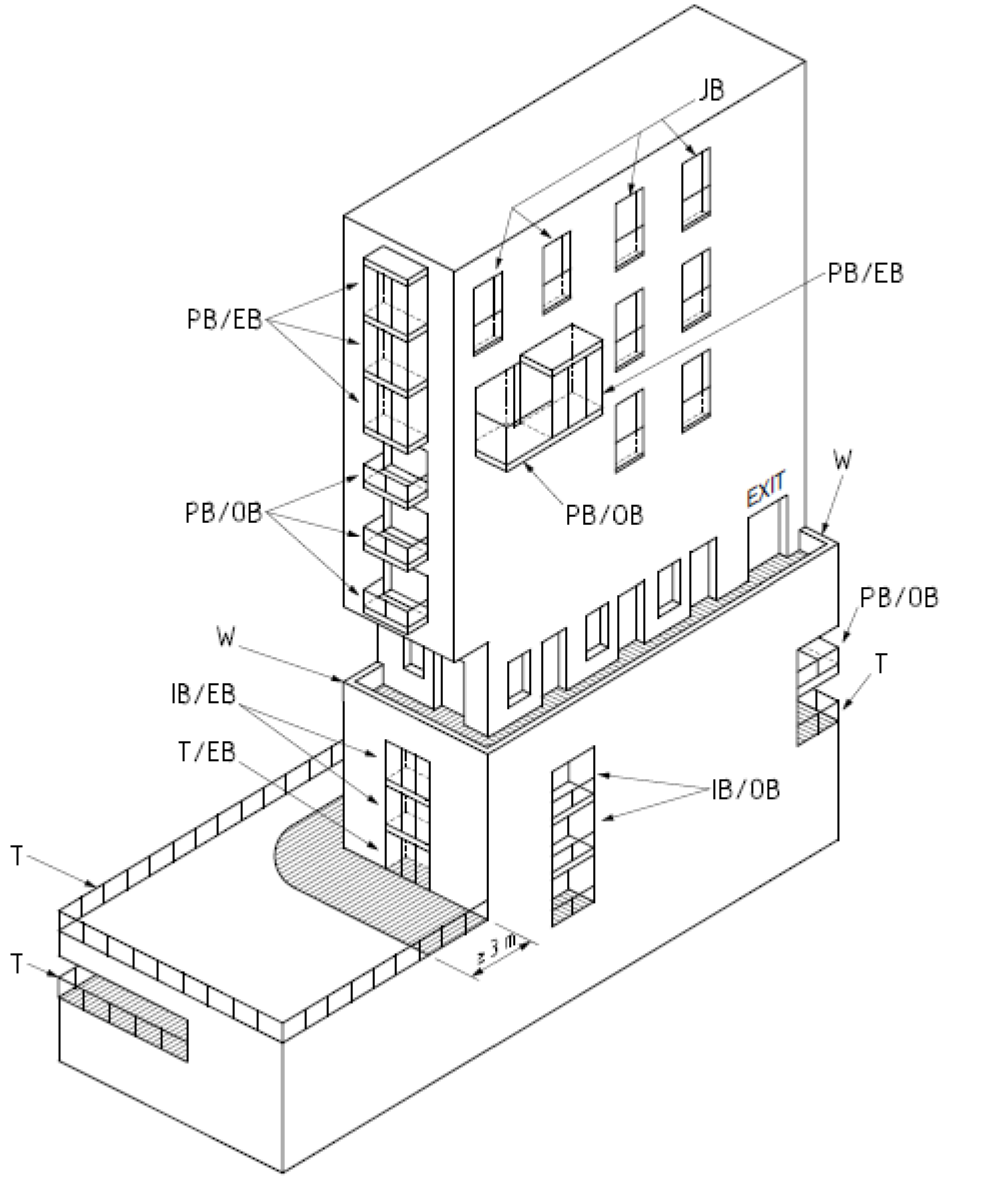
NOTE *This can sometimes be referred to as an access deck.*

3.10 weather screen
vertical screen that, in combination with a roof or balcony above, prevents rain ingress into an enclosed balcony

NOTE *This might be different from the thermal envelope.*

Figure 1 illustrates some of the terms and definitions given in Clause **3**.

Figure 1 – Balconies and terraces



Key

PB	Projecting balcony	EB	Enclosed balcony
IB	Inset balcony	JB	Juliet balcony
OB	Open balcony	T	Terrace
[hatched]	Terrace surface, B_{ROOF} (t4) performance		

NOTE National regulatory codes might cover roof performance in relation to relevant boundaries.

4 General principles

4.1 General

Balconies and terraces should be designed to provide amenity for the building users and should be sized appropriately for the intended use. Balconies form a significant feature on the façade of many buildings, very often forming the character of the building. High quality design is therefore important to maintain the quality of cities and building stock. Design can be separated into two aspects: aesthetic and functional.

NOTE This British Standard does not attempt to cover the former as the drivers are numerous and codification of subjective content is left to other documents.

Good functionality is vital to the long term and safe enjoyment of a balcony. The design should aim to leave a

legacy of quality and functionality without nuisance to building occupants or the public.

4.2 Relationship to building – balconies

A balcony can be one of several types, or even a combination. A balcony can project beyond the walls of a building; it can be formed within a recess of a building, or it can be a hybrid of both. It can be formed upon a single wall or at a corner between walls on different planes.

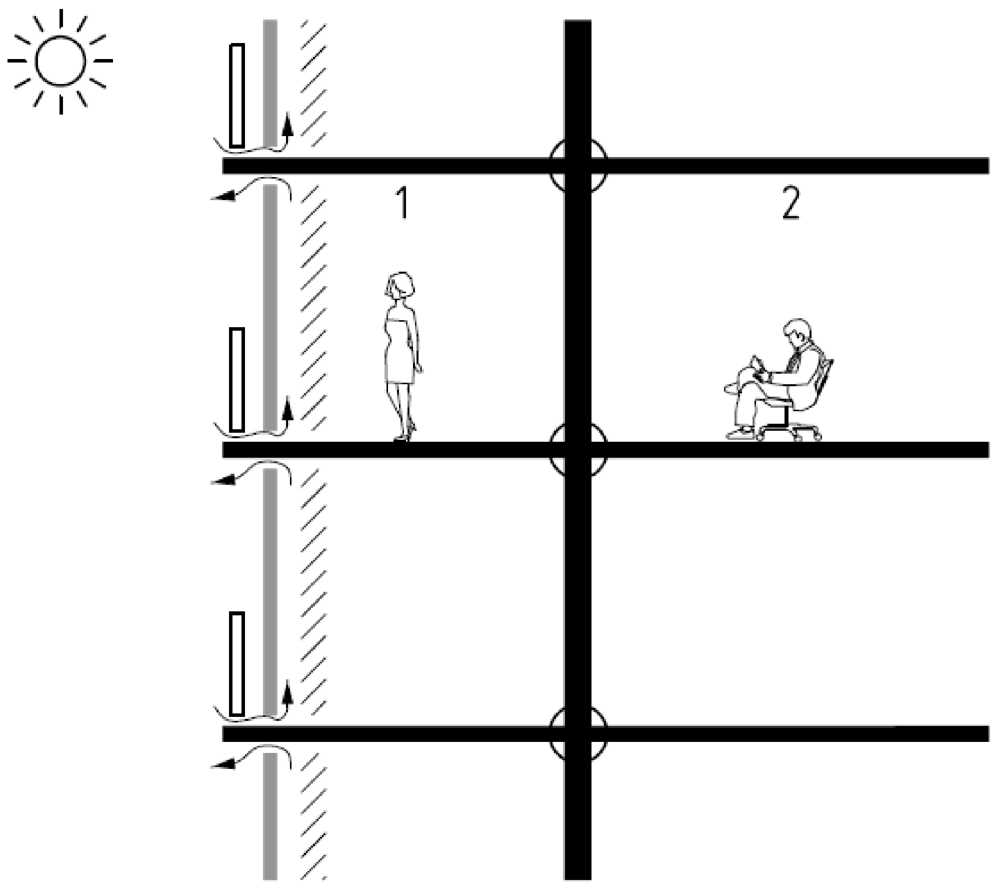
5 Enclosure of balconies

5.1 General

A balcony can be open, wholly or partly covered by another balcony or roof above, or it can be enclosed by a weather screen on one or more sides and a roof or balcony above, thus creating an enclosed balcony.

Figure 2 illustrates the typical features of an enclosed balcony. Mechanical ventilation should be ducted past the balcony from the interior to outside of the weather screen.

Figure 2 – Basic principles of an enclosed balcony



Key

Horizontal structure with REI fire performance as required by national regulations

Thermal and weather envelope (openable)

Thermally broken and fire stopped balcony connection

Weather screen (openable)

Guarding

Blinds or other solar control (optional depending on overheating risk, orientation, etc.) Fully openable

Permanent gaps for airflow

Where a weather screen is required to form an enclosed balcony, it can be formed from full or part height components which are either fixed, sliding, louvred or hinged to form openings. Opening components can be formed in a weather screen above, in front or behind the fixed guarding

Factors to be considered in the design include:

a) the effects of wind on any opening components;

b) the potential for water penetrating the balcony with the screen open;

c) the effects of enclosure on fire and smoke on the safety of occupants and the spread of flame (see Clause **12**);

d) the effects of enclosure on acoustics into and between apartments

e) cleaning and maintenance.

5.2 Daylight, thermal, ventilation and acoustic considerations

In a temperate climate such as the UK, balconies in proximity to windows have environmental effects upon the interior of the building. These include:

a) providing beneficial shading on certain façade orientations from detrimental high and medium angle sunlight in summer, thus offering an aid to passive cooling of the interior spaces;

b) providing too much shading on certain façade orientations that would benefit from low angle solar gain in winter;

c) providing too much shading from beneficial daylight to the interior spaces; and

d) providing beneficial acoustic buffering to the internal spaces (see Clause **17**).

Enclosure of balconies can result in the following additional environmental effects for the interior of the building:

1) detrimental overheating in the internal occupied space connected to an enclosed balcony on certain façade orientations due to the restriction of ventilation to the adjacent interior space and entrapment of incident heat;

2) beneficial passive insulation of adjacent interior space by the thermal buffering effect of the enclosed balcony space in cold weather; and
3) detrimental condensation forming on the inside of a single glazed outer weather screen.

The design of the facade, windows, balconies and weather screens should take these factors into account in reaching an optimum balance for interior comfort and energy efficiency.

A well-designed enclosure to a balcony can facilitate its use by occupants for a greater period of time during the year than an unenclosed balcony, due to the weather protection it affords.

An enclosed balcony should not be designed as an internal room for occupation, which is not the role of a balcony. Therefore, targets for air tightness and thermal transfer performance for the outer weather screen should not be set. Targets for acoustic separation from adjacent balconies through the party wall may be set. Targets for acoustic reduction from exterior to the balcony through the weather screen may be set, but should not be as stringent as those for internal living areas. The buffering effect of the outer weather screen may be taken into account in both thermal and acoustic calculations for the thermal envelope of the building.

Where a balcony is enclosed, the outer weather screen should incorporate both controllable openings for purge type ventilation (such as openable windows) and uncontrollable fixed openings for background type ventilation. The controllable openings in the outer weather screen for purge type ventilation should have effective free area calculated based upon the requisite percentage of the combined areas of the balcony deck and the inner rooms being ventilated.

The fixed openings in the outer weather screen for permanent background type ventilation of enclosed balconies should have effective free area to external air of at least 8 000 mm^2. This would ideally be distributed evenly along the external perimeter at the base and top of the weather screen by continual gaps of minimum 2 mm. Other arrangements for fixed ventilation can be adopted but might require greater free area.

NOTE 1 *This ensures that an enclosed balcony remains a sheltered exterior amenity space, not to be confused with habitable space. If the space occupied by the balcony is to be sealed from exterior air, it is not classed as a balcony and therefore does not fall within the scope of this British Standard.*

NOTE 2 An enclosed balcony is not to be confused with a conservatory, which can be fully closed from outside. Conservatories are generally associated with low rise/low density buildings, which are prone to greater heat loss and less overheating than high-rise/high density buildings where enclosed balconies are used.

Where an adjacent interior room relies upon trickle ventilators for background ventilation via the enclosed balcony, the fixed openings in the outer weather screen providing permanent background type ventilation should provide at least 5% more effective free area than the trickle ventilators serving the room.

In addition to self-shading and ventilation, overheating can be controlled by coatings on the glass. Alternatively, either fixed or moveable shading devices, such as blinds, louvres or shutters can be used. Detrimental solar gain can be controlled by moveable shading devices, with little effect on beneficial daylight, if well designed and operated. The use of shading devices on the inside near the glazed weather screen creates a layer of hot air which, if fixed ventilation openings are provided at the base and top of the glazing, can create a convection current that expels hot air at the upper opening and draws fresh cool air in to replace it at the lower opening. This is the basic principle of a double skin facade. Glass coatings and fixed blinds are less adaptable than moveable shading and care should be taken to ensure a balanced solution for ensuring interior thermal comfort in all seasons.

5.3 Drainage considerations

An enclosed balcony requires a drainage strategy, as it is likely to be left open during hot weather. An assessment should be carried out to consider risk and amount of rain ingress and effect when windows in the weather screen are open. If in doubt, drainage should be provided with equal design characteristics to an unenclosed balcony.

5.4 Fire considerations

The enclosure of balconies triggers additional risks relating to fire, smoke and means of escape. Where balconies are enclosed on buildings containing dwellings, residential blocks or specialised housing, the guidance in BS 9991 should be followed. See also guidance related to fire in Clause **12**.

5.5 Finishes and equipment

No active heating, cooling or mechanical ventilation, including MVHR (mechanical ventilations with heat recovery) should be connected to the volume of an enclosed balcony which, as a sheltered exterior space, should rely on natural ventilation only. Electrical fittings should be suitable for use in exterior locations. Surface finishes to an enclosed balcony should be exterior-grade materials that do not discolour or degrade in moist external air.

6 Arrangement of balconies

6.1 Proximity and organization of multiple balconies and effect on design

The arrangement of balconies on a façade can take one of several forms:

a) stacked – arrayed vertically one above the other;

b) staggered – arrayed vertically, but alternately; or

c) random – at different locations across a façade.

The vertical organization of balconies can affect drainage pipes, rainwater run-off, influence balconies below, and cleaning and maintenance strategies.

6.2 Level above ground and effect on design

The design should take account of the elevation of a balcony above ground. Persons occupying a balcony which is significantly above ground level might experience vertigo. This might be more pronounced on projecting balconies than recessed ones or terraces. Designers should consider ways of mitigating this to make occupants feel safe while using balconies. See Clause **7**.

6.3 Privacy

Designers should consider overlooking and the effect this would have on amenity. This can influence the transparency and degree of enclosure selected. Where balconies are horizontally adjacent, dividing screens should be used to enhance privacy.

7 Wind effects

7.1 General

Wind can have a significant effect on a balcony, its occupants of and objects placed thereon. The design of the balcony, its guarding and/or weather screens should mitigate nuisance effects of wind to its occupants and the occupants of other balconies and areas of the building.

Wind is more likely to create uncomfortable or unsafe conditions for occupants if the balcony is:

a) at a higher elevation than the roof height of the neighbouring buildings;

b) exposed to the prevailing wind direction;

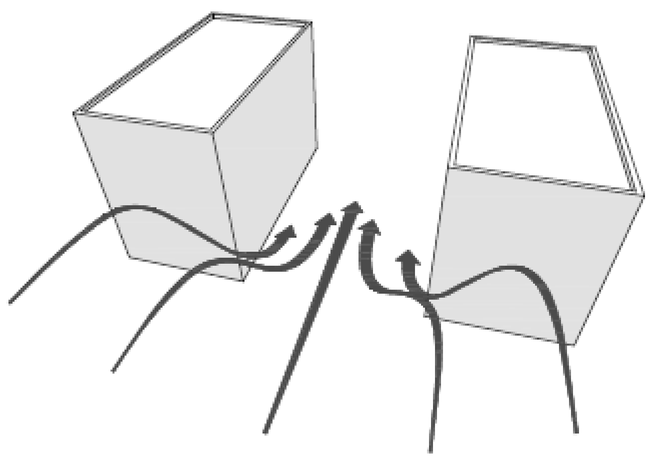
c) located close to a building corner; and/or

d) in close proximity to other buildings, such that the wind might accelerate as it flows between them.

Corner balconies are especially susceptible to adverse wind conditions, due to the way in which the wind accelerates around the corners of a building. Where possible, balconies should be located away from building corners to avoid these effects. Designers should consider conducting a detailed wind microclimate assessment to develop appropriate wind mitigation measures.

The interaction of buildings in close proximity to each other can result in complex aerodynamic effects, some of which could be beneficial (such as by providing increased shelter to occupied areas), while others adverse (such as by causing the wind to accelerate as it is “funnelled” between buildings, as shown in Figure 3). These effects can only be quantified in a detailed wind assessment, using either wind tunnel or computational methods. Adverse proximity effects such as funnelling tend to be compounded by exposure to the prevailing wind direction.

Figure 3 – Wind accelerating as it is funnelled between adjacent buildings



Objects can be dislodged from balconies if they are exposed to high wind speeds. Guidance on protection against objects falling is included in Clause **11**. During storms or other extreme wind events, there is potential for larger items such as patio furniture to be dislodged. In general, a balcony that is safe and comfortable for occupant use is unlikely to be exposed to such extreme wind speeds. For balconies that are susceptible to high wind speeds, such as those identified in a) to d), the same assessment techniques used for establishing occupant comfort and safety could also be used to identify the potential for extreme wind events with regard to blown objects and debris. Consideration should be given to providing tie-down points.

A balcony incorporates a doorway or other means of access from the interior of the building which it is serving. Doors to projecting balconies at high levels should be inward opening or sliding where possible. Outward opening doors should be fitted with suitable door restraints to avoid the potential for damage to the door, balcony or guarding if caught by wind gusts.

7.2 Wind mitigation measures

Design guidance for calculating wind pressures on guarding is given below for building heights up to 50 m above ground. For taller buildings, or buildings with complex or unconventional layouts not covered by the general guidance, wind tunnel testing should be conducted to determine the design wind pressures.

For balconies subjected to uncomfortable or unsafe wind conditions, the design of the guarding may be used to mitigate these adverse wind effects. Beneficial wind mitigation measures could include:

a) Increasing the height of the imperforate guarding to at least 1.5 m around the exposed perimeter of the balcony;

b) Full height guarding (or additional screening elements above the guarding) to the sides of the balcony of a minimum of 1.8 m; and/or

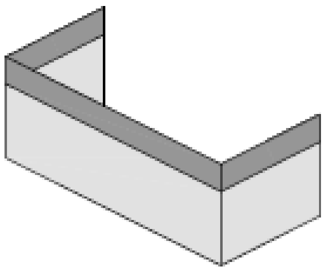
c) (for larger balconies) the addition of vertical partitions within the balcony (see Figure 4).

NOTE *Points a) to c) could trigger consequential design for fire as required in BS 9991.*

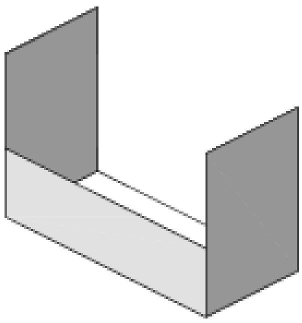
The design should consider conducting a detailed wind microclimate assessment (using wind tunnel testing or computational fluid dynamics) to develop appropriate wind mitigation measures.

Care should be taken to ensure the increased wind loading on higher screens are catered for in the design.

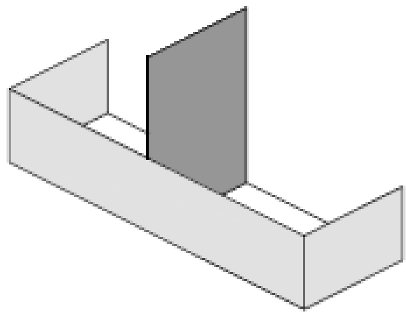
Figure 4 – Examples of wind mitigation measures



a) Increased guarding height



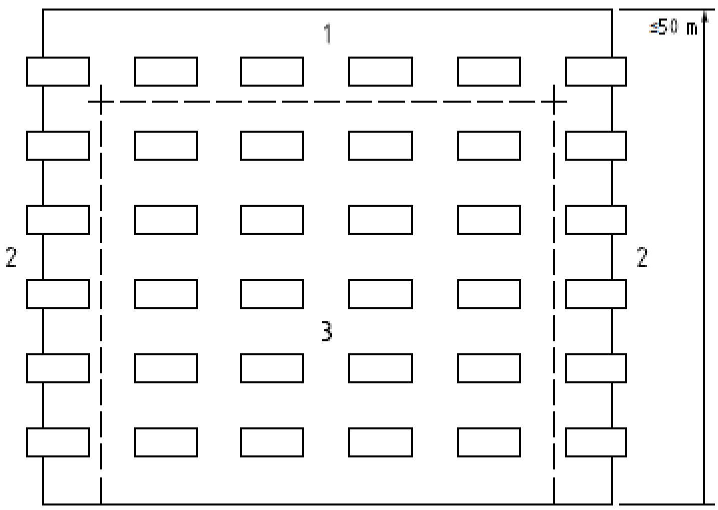
b) Full height side-screens



c) Vertical partition

The net wind pressures on balcony guarding depend on that balcony's location on the building face, with balconies on the top level or located at the building corners likely to have the highest net wind pressure. For rectangular buildings up to 50 m height, the upper bound pressure coefficients are shown in Figure 5. Note that these coefficients are referenced to the gust velocity pressure at eaves height of the building.

Figure 5 – Upper bound pressure coefficients for rectangular buildings up to 50 m height



Key

1 Top floor balconies

2 Corner balconies

3 Mid-wall balconies

Mid-wall balconies: $C_{p,n}$ = 1.5

Corner and top floor balconies: $C_{p,n}$ = 1.8

Details of how to implement the above net wind pressures can be found in the Australia and New Zealand Standard AS/NZS 1170.2 "Wind Actions" and associated commentary, which represents the current best available code-based guidance for wind actions on balcony guardings in the absence of wind tunnel test data.

For buildings taller than 50 m, or with unconventional (e.g. non-rectangular) layouts, or in close proximity to other tall buildings, net wind pressures on guardings should be determined through detailed scale-model wind tunnel tests in accordance with Eurocode BS EN 1991-1-4, the UK National Annex to BS EN 1991-1-4 and PD 6688-1-4.

8 Service life of balconies with a floor level greater than 2.4 m above ground level

Components transferring load from parts of the balcony to the main structure of the building should have equal service life to that of the primary structure of the building with the exception of decking and balustrade infill, which is more easily inspected and replaced and which should have a minimum service life of 30 years.

All components that cannot be easily inspected or replaced, or that are disproportionately expensive to replace, should have a service life as primary components.

All other balcony components should be designated as secondary components. Secondary components should be able to be easily inspected. A safe method of replacing each secondary component should be demonstrated in the design. Guidance on safe working at height is given in BS 8560. When considering an acceptable service life for a secondary component the service life of components in the wall should be considered as a guide line to harmonise repair and replacement cycles.

Any components that are less than the design life of the primary structure of the building should have a maintenance inspection strategy as part of the design.

Where laminated glass is used/permitted in construction, a capping or similar should be provided to the top edge to minimize the risk of water ingress into the laminate and protect against impact damage.

See BS 7543 for further information on service life.

9 Inclusive design

*COMMENTARY ON CLAUSE **9***

General guidance on inclusive design can be found in BS 8300-2. BS 8300-2 does not apply to individual domestic buildings and flats though it does apply to the common parts of blocks of flats, and specific guidance on balconies to accessible bedrooms e.g. in hotels and student accommodation is provided. Additional guidance on balconies in residential buildings is provided in BS 9266 and provides alternative means of designing for inclusivity.

9.1 Thresholds

Balconies and terraces should be designed to provide equal utility and enjoyment for all users. The threshold should be designed to provide the minimum restriction or trip hazard to as wide as possible a range of occupants likely to be using the balcony.

At least one door serving a balcony or terrace should be designed such that it permits equal ease of access to users with or without mobility impairments. The threshold of this door should be level from the internal finished surface to the external deck finishes. This might not be possible given increasing requirements for rain exclusion, air tightness, acoustic damping, clearance for the door opening leaf to function and accommodation of building movements and construction tolerances. In which case, the design of the threshold and any transition surfaces immediately each side of it should meet the following criteria.

a) Any external transition up to the threshold from the deck and any internal transition to the threshold from the finished floor level (including carpeting) should form a slope as short and low as possible, with maximum slope of 15° and maximum length 150 mm.

b) Any threshold upstand, if needed for a hinged door, should not project more than 15 mm above the immediately adjacent surfaces. Any trough in the threshold of a sliding door should be minimized as far as reasonably practical.

NOTE 1 At the time of writing, the window and door industry is generally unable to eliminate un-chamfered or rounded steps and shoulders over 5 mm in thresholds and still achieve air and water tightness standards. Further product development is needed to eliminate such steps to facilitate better inclusive access to balconies and terraces.

NOTE 2 Alternative solutions can be found in 'Accessible thresholds in new housing – Guidance for house builders and developers' [1].

Where a threshold is not completely flat, the balcony, terrace or interior design should allow sufficient space for a wheelchair user and attendant to approach the threshold straight on, without needing to negotiate obstacles or approach obliquely.

NOTE FOR COMMENTERS

Guidance on achieving balance in the design of thresholds suitable for inclusive access whilst achieving some degree of technical performance, buildability and functionality generally derives from a DETR publication, 'Accessible thresholds in new housing - Guidance for house builders and designers'. Contemporary balconies in Britain are not generally a feature of houses and current performance targets for building envelopes of high-rise buildings are considerably higher than in 1999, when the document was published. The result is that manufacturers of balcony doors are generally failing to meet the exact dimensional limitations of the guidance, in order to achieve overall functionality. The problem is generally caused by difficulty in forming a compression seal between the door leaf and the threshold.

9.2 Door design for inclusivity

The design of the door to a balcony or terrace should consider functional requirements of the door including weather and air tightness, safety in use and security in conjunction with user operability. Account should be taken of high negative and positive wind pressures, sudden gusts and their effect on a balcony door while open, closed and during operation by all users including physically impaired.

Opening forces should be measured under still air conditions. See BS 6375 (all parts) for further information on opening forces. Doors to balconies in high-rise constructions should not open outwards unless specific provisions are made to achieve the above (see Clause **7**).

The effective clear width of a door (including sliding and folding doors) or one leaf of a pair of doors should be at least 850 mm. The clear width should be increased where the approach is restricted.

NOTE Where a door is a main entrance to a dwelling from a terrace, national regulatory standards need to be applied to the clear opening width.

A minimum 300 mm nib and maximum 200mm recess should be provided to the pull side of the leading edge of the door to achieve the functional requirements above.

9.3 Balcony and terrace surfaces for inclusivity

Where the deck design is of a drain-through type, the surface finish should be such that the risk of entrapment of e.g. the wheel of a wheelchair or wheeled support appliance, or the ferrule of a walking stick or crutch, is removed.

Slots in gratings should be not more than 8 mm wide and should be set at right angles to the dominant line of travel. Circular holes in gratings should have a diameter not more than 12 mm. See BS 8300-1.

9.4 Sight lines via balconies

Where the design of a room is intended to offer an exterior view to the occupant through a fully glazed window or door, the balcony should not prevent a seated person from enjoying the intended view. Therefore the design of the guarding should not significantly impede the view through at least 50% of the area of the guarding. Balusters or glazing may be used to facilitate transparency.

9.5 Balcony and terrace dimensions for inclusivity

Where a balcony or terrace is accessed by the public or employees of a building, balconies should be sufficiently deep to accommodate a wheelchair with a minimum turning circle of 1500 mm diameter.

The guidance in BS 9266 or BS 8300-2 can be followed for the design of the balcony and access door, depending on the building type.

10 Structural and mechanical stability and integrity

A balcony can project from the structure of a building as a cantilever from a wall or floor. This is normally achieved by:

a) continuation of a floor slab; or

b) by attaching a secondary structure using one of the following:

   1) brackets or point fixings to the edge of the primary structure;

   2) hanging;

   3) strut and tie systems; or

   4) other proprietary engineered systems.

A balcony can also be free standing where loads are taken directly to ground (which is more suitable for low rise buildings).

When precast, pre-stressed, prefabricated, modular or other off-site balcony structural solutions are used, there should be close cooperation between the designer of the solution and the designer of any supporting structure. The designer of the supporting structure should make adequate provision for loads from the balcony and its supporting connections.

Balcony connection points should incorporate a suitable thermal break where necessary to reduce heat loss and avoid condensation risk (see Clause **13** for more detail) and when used, their suitability with regards the interface between the balcony and primary structure should be considered in terms of fixing tolerances and camber of any precast, pre-stressed or prefabricated elements.

NOTE 1 There are thermal breaks specifically designed to be used with cast in-situ slabs and as such, their design might prohibit their use within some forms of off-site manufactured systems.

When designing a roof terrace above a heated internal space it is important to ensure that adequate provision is made for insulation to maintain continuity of the building's thermal envelope. This might require the slab to be stepped down to accommodate the necessary layers. Designers should take this into account when setting floor to floor heights at early stages of the building design in order to prevent the need for changes at later stages in the design.

Balconies should be designed to meet the following standards and their relevant UK National Annexes:

- BS 6180, *Barriers in and about buildings*
- BS EN 1990, *Eurocode – Basis of structural design*

- BS EN 1991 (all parts), *Eurocode 1 – Actions on structures*
- BS EN 1992 (all parts), *Eurocode 2 – Design of concrete structures*
- BS EN 1993 (all parts), *Eurocode 3 – Design of steel structures*
- BS EN 1994 (all parts), *Eurocode 4 – Design of composite steel and concrete structures*
- BS EN 1995 (all parts), *Eurocode 5 – Design of timber structures*
- BS EN 1999 (all parts), *Eurocode 9 – Design of aluminium structures*
- BS EN 1090 (all parts), *Execution of steel and aluminium structures*
- IStructE, Structural use of glass in buildings [N1]
- PD 6688-1-1, *Recommendations for the design of structures to BS EN 1991-1-1*

NOTE 2 The UK NA to BS EN 1991-1-1 has a minimum uniformly distributed load for balconies in single family dwelling units and communal areas in blocks of flats with limited use of 2.5 kN/m.sq or an alternative point load of 2 kN which is greater than that stated in superseded national standards. Other values are given for other balcony uses.

To avoid alarming users, no accessible portion of the balcony deck should deflect more than 5 mm under a 2 kN vertical point load spread over a square with a width of 50 mm. More stringent requirements might be set by the client.

Balconies and their connections to the structure should be designed to restrict movement under the characteristic static uniformly distributed loads and concentrated loads as defined by BS EN 1991-1-1.

Balconies should be designed to have a minimum vertical frequency of 5 Hz.

NOTE 3 The value of 5 Hz has been considered due to wind fluctuations.

For balconies with a minimum vertical frequency of less than 5 Hz, an analysis for wind loading using the structural factor $c_s c_d$ as defined in BS EN 1991-1-4 should be conducted.

Loads arising from replacement of façade glazing or cladding adjacent to the balcony should be considered. If the replacement strategy of glazing requires elements to be temporarily loaded onto a balcony to facilitate replacement, the load of such panels, glass carrier and glazing operatives should be taken into account in the design capacity of the structure of the balcony.

Barriers should be designed in accordance with BS 6180. Where an infill consists of multiple balusters, each baluster should be designed to resist half the concentrated load to the infill given in BS EN 1991-1-1, applied at mid height.

For cantilever glass balustrades made with laminated glass the following design criteria are should be used, in addition to those given in BS 6180:

a) assume that an accident occurs and 1 ply breaks;

b) ignore the serviceability criteria; and

c) design for strength using standard barrier loading; assume 1 ply contributes to resistance.

11 Safety

11.1 Safety for persons occupying the balcony

11.1.1 General

Balconies and terraces should be designed to accommodate the maximum anticipated occupancy. Aspects to consider relating to safety for persons occupying the balcony include:

a) loading of structure;

b) loading of envelope and/or guardings;

c) prevention of falls; and

d) prevention of slip.

11.1.2 Loading

The decking and all supporting layers (including insulation used on terraces incorporating inverted roof membranes) should not be easily dislodged by wind action, flotation or persons walking on it. Inverted roof insulation should be ballasted by material of sufficient weight to prevent its dislodgement. Lightweight decking might not provide enough mass to prevent this from happening. The design should therefore incorporate additional ballast in the form of paving or pebbles below lightweight decking.

In the interest of safety, projecting and partially projecting balconies can incorporate a durable sign or label indicating the total safe imposed load (expressed in kg or an equivalent number of persons) for which the balcony is designed to warn against unsuitable use, for example, against the placement of heavy objects, such as paddling pools, hot tubs, large planters, etc. To be effective, such a sign or label should be placed in a position permanently visible to the users of the balcony and include guidance that it not be removed. The sign or label and its associated fixings should be designed for a service life equivalent to that of the balcony.

The designer should consider functional requirements of the door including weather and air tightness, safety in use and security in conjunction with door operability. Consideration should be given to high negative and positive wind pressures, sudden gusts and their effect on a balcony door while open, closed and in operation by all users including physically impaired (see Clause **7**). Opening forces should be measured under still air conditions.

11.1.3 Prevention of falls

Occupants of balconies or terraces frequently use the space to store household objects. Such objects can be climbed by unsupervised young children, exposing them to risk of fall. In order to minimize this risk, the designer's risk assessment should consider if guidance could be passed over to the occupants warning of such hazards and advising against placement of such items where children have access to a balcony or terrace. One way of mitigating this risk in the design could be to place a key lock or restrictor on any access doors or windows. The selection of such door equipment should consider any conflicts between security, safety, inclusivity and means of escape.

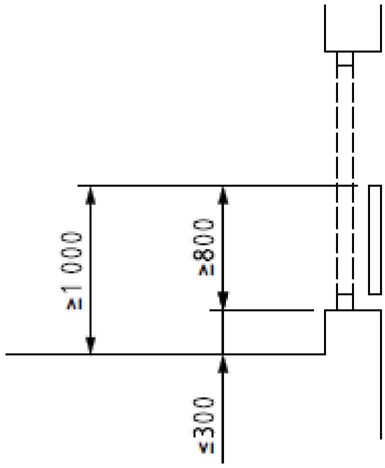
Guarding is required to prevent persons and objects falling easily from a balcony. Guarding should be designed so as to prevent people climbing over, or climbing from one balcony to another. Where private balconies are adjoined, the separating screen and adjacent guardings should not enable passage over or around them.

Guardings for balconies, Juliet balconies and terraces should be designed to a height that provides safe prevention of falls. This can be achieved if the guarding is 1 100 mm or higher above the balcony deck or finished floor level. Steps, shelves, parapets or plinths directly adjacent to the guarding should be avoided. See Figure 6. If this is not possible, the following guidance should be used:

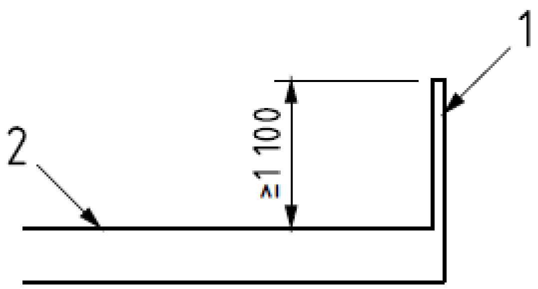
a) For Juliet balconies - where a step or toehold is up to 300 mm above finished floor level, the guarding height including the step should be 1 100 mm or more.

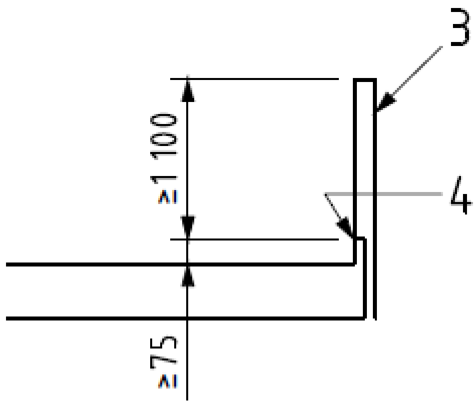
b) For other balconies and terraces - where a step or toehold is up to 600mm above the deck, the 1 100 mm guarding should be measured from the top of the step or toehold. For steps greater than 700 mm, planters, fixed furniture and other conditions, a risk assessment should be conducted in the design and hazards eliminated or minimised.

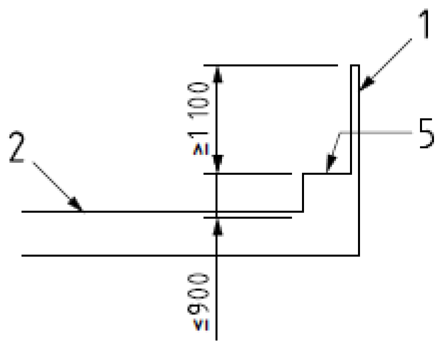
Figure 6 – Guardings to balconies and terraces



a) Juliet balconies







b) Other balconies and terraces

Key

1 Any guarding

2 Deck

3 Open balustrade guarding

4 Toe board or upstand

5 Toe hold, platform, planter, fixed furniture or step

The guarding should provide protection from wind where possible (see Clause **7**) and should also provide a sense of enclosure for occupants, particularly those who experience vertigo. Means of mitigating these risks include raising the height of the guarding above that required for safety from falls and providing a handrail.

Post-failure behaviour should be considered as part of the design of a glass balustrade. Post failure, the barrier should still provide containment; this is not the case for any monolithic glass. The designer should therefore take into account the support arrangements for the glass, including whether the glass is bolted, bonded, or in a rebate, and the number of edges supported with a view to optimizing post-failure performance.

NOTE Toughened glass can fail other than on impact.

11.1.4 Prevention of slip

Care should be taken to select materials and surface textures of appropriate slip resistance. Good slip resistance is usually afforded by a combination of effective surface drainage, selection of appropriate surfacing materials, and routine maintenance/cleaning regime, plus macro and micro roughness. Micro roughness (Rz value) should be at least 20 microns to ensure low slip potential.

Slip resistance should be appropriate for the intended usage of the surface. The pedestrian surface should have slip resistance when tested to BS 7976 (all parts) of pendulum test value (PTV) at least 36 (wet and dry) using slider 96 rubber for balconies and terraces where users' feet are expected to be shod. For terrace areas where users might be barefoot, the test should use 55 rubber.

To contain the risk of users tripping, abrupt steps in horizontal pedestrian surfaces (other than at a threshold) should not be greater than 3 mm.

Micro ribs in the surface of metal plank decking can be incorporated to improve the slip resistance. Likewise, timber and composite decking should incorporate small grooves.

Concrete and natural stone paving surfaces might have an inherently higher slip resistance than metals, timber and composites, but this depends on product specific properties and finishes.

Pedestrian surfaces can become progressively more slippery due to factors such as prolonged exposure to heavy wear, buffing, polishing or lack of cleaning. This is especially pertinent to timber. Accordingly, the design of the balcony or terrace should allow for ease of cleaning and avoid surface materials with high slip potential. Users should be alerted as to the need to maintain decking to ensure the surface does not deteriorate.

11.2 Safety for persons below the balcony

Aspects to consider relating to safety for persons below the balcony include:

a) prevention of objects falling;

b) prevention of liquid spills to below; and

c) prevention of falling fire brands.

Handrails should be designed to avoid incorporation of level surfaces which might be used as a rest for drinks and other objects that might fall onto persons below, unless they are located on the inside of a continuous unbroken guarding. When a rail is placed on top of a guarding it should therefore be slanted in towards the balcony with an angle of at least 15°.

Edges of balconies and terraces should incorporate some means to prevent objects rolling off. This can take the form of a toe board or upstand of at least 75 mm high, which should not impede drainage.

If brittle materials are used for balcony decking, the design should ensure that when broken, fragments cannot fall from the balcony and injure persons below.

Balconies should be fitted with a soffit, tray or impervious layer designed to prevent liquids or solids from falling onto the occupants of balconies below, or onto public areas (see **12.2** and **15.2**).

Open deck balconies without such protection might allow sharp objects, hot liquids, chemicals or fire brands to fall onto and injure persons below. Designers should assess potential hazards and mitigate against injury.

Each part including soffits and fascia cladding should have physical fixings to prevent any item becoming dislodged, e.g. by wind or maintenance work.

11.3 Safety for persons constructing, cleaning, maintaining and dismantling

Where balconies are being installed using lifting equipment, they should be designed to avoid persons working under suspended load and reduce the need for persons working at height where possible.

Component sizes for replaceable items should be designed for safe transport to and from the balcony. Designers should consider the route components might take from the delivery vehicle to the point of installation.

Suitable risk assessments and method statements should be provided, detailing a safe replacement strategy for items which could be damaged, or have an expected service life of less than that of the balcony structure.

Where possible, such strategy should enable work to be carried out from the balcony concerned, without access being required from other balconies or beyond the guarding.

Component parts of a balcony usually require cleaning and some form of inspection and/or maintenance during its service life. The designer should consider cleaning and maintenance needs when specifying form, organization and materials for balconies and the skills needed to undertake this. The design should propose safe and viable means of access to component parts and surfaces for operations such as cleaning and maintenance. Certain operations, such as cleaning of windows and surfaces facing into the balcony or terrace, might be done by an occupant. However, surfaces outside the guarding might need specialist access requiring working at height. BS 8560 contains guidance for this aspect of the design. Other items that might require attention, and therefore consideration within the design, include cleansing of the water collecting layer below a deck level, inspecting the support structure for corrosion, painting of a soffit or replacement of a cavity barrier after its claimed service life.

Access to drainage gullies, rodding eyes and outlets where installed, should be considered in the locating and detailing of such features.

The location of lighting to balconies should also be considered. Where possible, fittings should be positioned within easy reach of the balcony deck level to avoid the requirement for additional methods of reaching.

Where cleaning is to be carried out by rope access, suitable checks should be made on the balustrade design to ensure it is adequate to resist any expected loads applied by operatives and working ropes without damage.

Where rope access is used for the cleaning of windows on tall buildings, the presence of balconies above windows may hinder access to those windows. Provision should be made in the soffits of such balconies to aid safe access. The imposed loads of such systems should be considered within the balcony design.

Deviation and rope access connection points should be designed and installed in accordance with cleaning strategy requirements.

Where abseil connection points are required, these should be designed in accordance with the connection details and loads outlined in BS 8610.

Access for specialists to carry out work might be needed via the interior space served by the balcony or terrace. This can involve legal complexities which should be considered in the early stages of a project and communicated along the project information and responsibility chain.

12 Performance in fire

12.1 General

A balcony or terrace should not give rise to additional fire risk to a building or adjacent building by virtue of its existence. It is therefore vital to consider balcony organization, details and materials to reduce fire risk to a minimum.

The design of balconies, walkways and terraces for buildings which include residential use should meet the recommendations of BS 9991. The design of balconies, walkways and terraces for non-residential use should meet the recommendations of BS 9999. Particular attention should be given where approaches and escape routes are concerned.

NOTE 1 *Terms and definitions in this British Standard might not be the same in BS 9991.*

NOTE 2 *BS 9991 provisions for private balconies include degree of enclosure, fire compartmentation, smoke clearance, restriction of storage and fire warning and escape. Guidance for communal roof gardens, terraces and other balconies includes separation, travel distances, enclosure, fire warning and means of escape.*

Balconies, terraces and walkways, when exposed to fire, including from below, e.g. from a window or other openings, should not:

a) enhance fire spread on the face of the building;

b) propagate fire downwards, e.g. should not produce falling brands or flaming/molten droplets or debris capable of initiating fire below;

c) become detached from the face of the building and present a hazard to persons below, e.g. firefighters or the public; or

d) prejudice the stability of the building when undergoing large deformations resulting from fire exposure.

The stability of balconies above an opening, e.g. a window, garage, or bin store, when exposed to direct flame impingement from below can be determined by fire engineering using information on the external fire scenario given in BS EN 1991-1-2:2002, Annex B and BS 7974, PD 7974-1, PD 7974-2 and PD 7974-3.

For balconies in buildings containing dwellings, the following applies.

1) The horizontal component separating one enclosed balcony from another in a separate fire compartment or from any other fire compartment is classed as a floor which requires fire resistance (REI) from underside.
2) The vertical component separating one enclosed balcony from an adjacent one in another fire compartment is classed as a fire compartment wall and requires fire resistance (REI) from both sides. In the case of an inset balcony adjacent to the wall of another fire compartment or dwelling, the wall is also classed as a fire compartment wall. The fire resistant separation between apartments/residences should extend to the extremities of the demise, i.e. should be provided between the terraces/balconies of neighbouring dwellings, where these elements are continuous.
3) A terrace that does not provide a means of access from one part of a building to another or act as an escape route is classed as a roof and therefore does not require fire resistance (REI). Certain areas of roofs should have limited reaction to fire. See **12.13**.
4) A terrace or walkway that does provide a means of access from one part of a building to another or act as an escape route is classed as a floor and therefore requires fire resistance (REI) from underside.
5) The wall cavity at the line of connection of an unenclosed balcony to the building should be closed by a cavity barrier.
6) The wall cavity at the line of connection of an enclosed balcony wall or floor to the building should be closed by fire stopping.

Minimum periods of fire resistance and measurement of escape distances for balconies and terraces are given in other standards and national regulation.

12.2 Materials and components for balconies in respect to fire

Components of balconies on buildings with an occupied floor over 18 m above the lowest ground level and all buildings with stacked balconies should be constructed from materials achieving class A1 or $A2_{fl}$ for deck materials, and A1, or A2-s1, d0 for all other materials, in accordance with BS EN 13501-1:2018. All other buildings and other balcony arrangements should have risk of fire spread assessed and mitigated in the design. Certain components such as seals, gaskets, fixings, membranes, laminated glass and thermal breaks necessary to ensure all aspects of performance and life safety are achieved, are exempt from the above restriction.

NOTE Attention is drawn to national regulations regarding the use of certain components within balconies.

NOTE FOR COMMENTERS

Laminated glass is included due to its life safety properties in post breakage scenarios; the lack of evidence of its significant contribution to the spread of fire across facades via balconies and the lack of alternative materials capable of mitigating wind while allowing daylight transmission and views. Industry research is planned with a view to shedding more light on this. The text might be changed depending upon public comments received.

Balconies comprising an open structure and open deck should be fitted with a non-combustible imperforate tray or soffit to reduce the risk of fire spreading to balconies below via firebrands or burning droplets and to protect the balcony from the risk of fire spread from below. A tray can act as a water collecting surface and/or a visual soffit to the balcony.

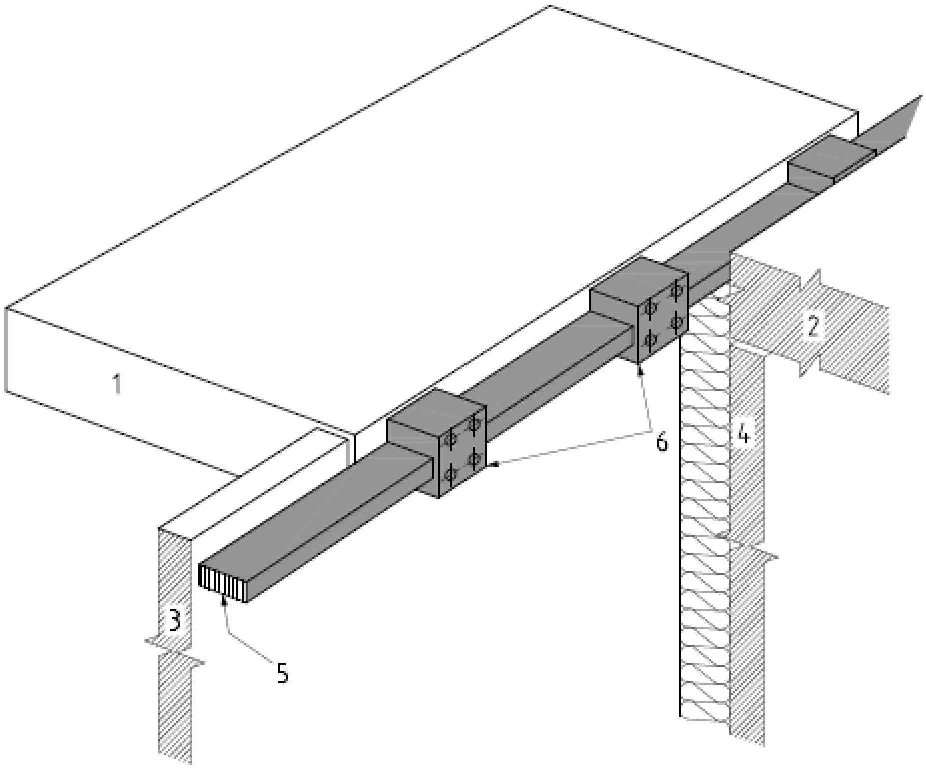
The area where a balcony abuts a wall has numerous components and most likely complex detailing. Most balconies are supported by brackets fixed back to the structure of the building, which can pass through the wall cavity. The design should ensure that fire separation is continuous and that no routes for the passage of smoke, flame or hot gases are created within this zone even when adjacent elements distort. Loadbearing and other components of a balcony should not compromise continuity of any cavity barriers or fire stopping.

Where slab depths allow, the fire stopping or cavity barrier may be designed to pass over or under the brackets. Where this is not possible, the brackets should incorporate means to ensure the continuity of fire separation by the fire stopping or cavity barrier if interrupted by the bracket. The bracket may incorporate a thermal wrapping which also performs as fire stopping or cavity barrier, thus allowing continuity of fire spread prevention where space is not available to run it past the brackets. See Figure 7.

Mechanical fixtures for cavity barriers and fire stopping should be used in accordance with their product test certificates.

The floor of an enclosed balcony should provide fire separation from a balcony below in accordance with BS 9991. Where such a floor is penetrated by a drainage outlet, provision should be made to ensure continuity of the fire separation. Proprietary tested components to achieve this might include compression collars and fire-rated pipes.

Figure 7 – Projecting balconies and protection from fire



Key

1	Zone of balcony structure	4	Zone of inner leaf or backing wall
2	Zone of building structure or separating element	5	Zone of cavity barrier or fire stopping (see **12.1** on which is applicable)
3	Zone of outer leaf or cladding	6	Zone of load transferring bracket acting as cavity barrier or fire stopping (see **12.1** on which is applicable)

12.3 Materials and components for terraces in respect to fire

Any terrace or walkway build-up within 3 m of an extensive vertical facade above should be limited to classification B_{ROOF} (t4) in accordance with BS EN 13501-5:2016. See Figure 1.

NOTE *The reason for this advice is to prevent the spread of fire from a terrace to an adjacent facade above and therefore internal spaces of the same building.*

13 Thermal considerations

13.1 General

The design of balconies and terraces should recognize the significance of heat losses and gains upon energy consumption, condensation risk and the general comfort of building users. It is generally necessary for the heat losses via the building envelope, including any balconies and terraces, to meet the requirements of a whole-building energy performance model.

All aspects of heat transfer should be assessed in the design by calculation. It is insufficient to use one-dimensional heat flow calculations only and lateral heat flow should be calculated using two and/or three-dimensional models.

Where a terrace forms a small part of a building with substantial roof area over a habitable internal space, its contribution to the overall thermal performance of the building might be limited. Therefore, to help maintain step-free access to a terrace, consideration can be given to reducing the target thermal performance of the terrace as this can reduce the overall construction build up, while not having a significant impact on the overall building performance. Additional insulation might be required elsewhere in the building envelope to maintain the target for the area weighted average *U*-value.

Similarly, a local reduction in the thickness of the thermal insulation at the perimeter of a terrace can help to set the principal water collecting surface to the required level below the water ingress level into the building, while not significantly affecting the thermal performance. See **13.3**.

13.2 *U*-, *ψ*- and *χ*-values

Thermal transmittance through the surface of a terrace or balcony can be calculated in accordance with BS EN ISO 6946 or, where repeating thermal bridges are present, BS EN ISO 10211.

NOTE *BR 443, Conventions for U-value calculations, [2] also contains useful guidance on calculation methods.*

Where a balcony or terrace structure is formed as a contiguous part of the building structure, the interface between the balcony structure and the adjacent floor structure is most likely to be a geometric linear thermal bridge, likewise the junction where a terrace deck meets adjoining wall constructions. The linear transmittance *ψ*-values can be determined in accordance with BS EN ISO 10211 or BS EN ISO 14683.

NOTE *BS EN ISO 10211 is a more detailed method of calculation and gives more precise results than BS EN ISO 14683.*

If a balcony is connected to the building structure via discrete points (bracketry or point fixings) which penetrate the thermal envelope of the building, these should be treated as point thermal bridges requiring detailed three-dimensional analysis techniques. Both linear and point thermal bridges along the entire interface should be assessed. The *ψ*- and *χ*-value(s) can be determined in accordance with BS EN ISO 10211.

13.3 Coupling and transmission heat loss coefficients

A terrace will be subject to some degree of direct transmission heat loss from the building, and a coupling coefficient, L_D should be determined. This is made up of heat loss through the main area of the terrace, expressed in terms of a *U*-value, plus heat losses associated with thermal bridges at the perimeter of the terrace, made up of (mostly) linear thermal bridge *ψ*-values and (possibly) point thermal bridge *χ*-values.

A terrace or balcony over an unheated space will be subject to a generally lesser degree of indirect heat loss from the building if any of the other enclosing surfaces of the unheated space act as the envelope to a heated part of the building. In such cases, a transmission heat loss coefficient through unheated spaces, H_U should be determined. This also requires *U*-, *ψ*- and *χ* -values to be calculated for the terrace or balcony and its interfaces with the remainder of the building.

The balcony will not be subject to direct transmission heat loss, but there will be additional heat losses through the wall associated with thermal bridging at the points of connection of the balcony to the primary structure of the building. In such cases, *ψ*-values and *χ*-values for the interface should be calculated.

The calculation of L_D and H_U should be made in accordance with BS EN ISO 13789.

13.4 Condensation risk

Condensation risk should be assessed regardless of the form of balcony or terrace. The specifier should identify suitable values for the indoor and outdoor temperature and relative humidity. Guidance on this is given in BS 5250, BS EN ISO 13788 and BS EN 15026.

Dynamic modelling of condensation risk requires the use of Test Reference Year data, which is covered in BS EN 15026.

Caution should be taken where drainage pipes or ventilation ducts penetrate the thermal layer into a heated space. These can create a high risk of condensation around the pipe or duct and therefore, the length of the pipe from the point of penetration should be enclosed with insulation which should include a vapour control layer on the outer surface. Any penetration through a fire separating element should incorporate fire stopping.

14 Ventilation outlets near balconies

In certain cases, ventilation outlets or inlets may be positioned adjacent to open balconies. Designers should give consideration to the effects of exhaust air on the occupants of a balcony. Where outlets and inlets are positioned adjacent to a balcony, they should serve the same dwelling. Outlets and inlets should not terminate in the volume of enclosed balconies and should be taken beyond the weather screen (see Clause **5**).

15 Weathering and hydraulic design

15.1 General

An understanding of how rainwater affects a balcony and its surrounds is essential for good design. The following considerations should be taken into account:

a) incident rain: influence of balconies above, flanking walls, imperforate guardings, uplift and eddy borne rain;

b) rainwater outlet design;

c) overflow design, location, discharge, clearance and prevention of residual dripping;

d) cumulative flow and down pipe design;

e) warning pipe design; and

f) threshold design, freeboard and prevention of water ingress at openings.

15.2 Drainage of balconies and small terraces

The design of balconies should incorporate some form of controlled drainage in order to prevent risk of water ingress into the building, unsightly detrimental staining of the building and/or nuisance to people below.

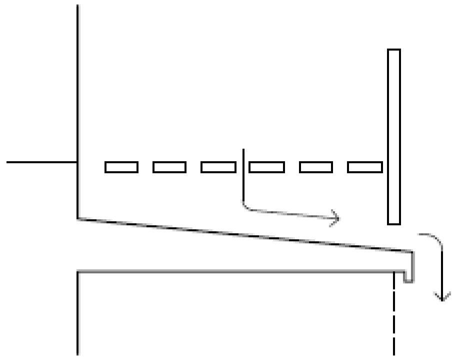
There are two generic methods of draining a balcony or a small terrace in a controlled way:

a) edge drainage – incident water is collected on a surface and directed to an edge where it is thrown clear of the building; or

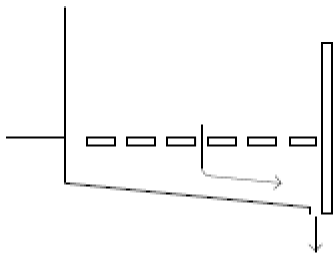
b) piped drainage – incident water is collected on a surface and directed via gutters and/or outlets to pipes in the building drainage system.

Drainage can be taken either directly over the deck surface or through open-jointed decking to a collecting surface below. See Figure 8.

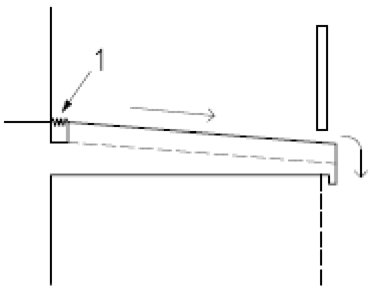
Figure 8 – Deck and drainage surface options



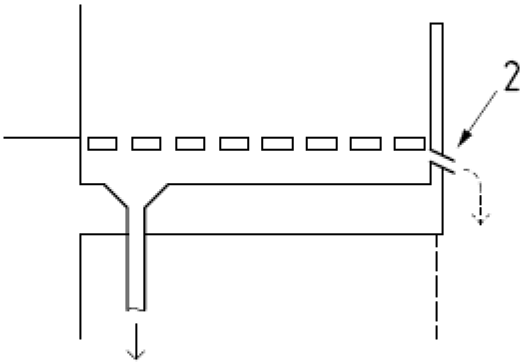
a) Flat porous deck edge drained – should have collecting surface to falls



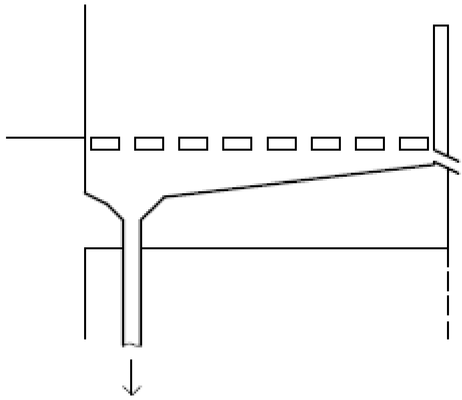
b) Flat porous deck edge drained - alternative drip line adjacent to back of guarding



c) Sloping non-porous deck edge drained – should have collecting surface to falls



d) Flat porous deck pipe drained – may have collecting surface flat, but no back-falls



e) Flat porous deck pipe drained – alternative incorporating collecting surface to falls

Key

1 Drainage channel to allow level access

2 Overflow

The pedestrian deck should provide a surface sufficiently free of standing water to allow safe access by occupants, and should not give rise to water ingress into the interior of the building via the accessible threshold. As-built gaps between planks or slabs should be between 5 mm to 8 mm in order to achieve effective drainage whilst minimizing the risk of discomfort to wheelchair users. As-built gaps of 10 mm to 12 mm should be maintained around the perimeter of the decking in order to facilitate good drainage.

Balconies should not have perforated decking draining directly onto balconies below without a water collecting surface.

For terraces and balconies with upstands on all sides, the water collecting surface can be designed to falls or nominally flat with no back falls or ponding. For balconies, the collecting surface can be edge drained. Where water is to be drained via an edge, the principle of **15.6** should be followed.

The design of the structure supporting the collecting surface should take into account long and short-term deflections and tolerances so that the collecting surface is always sloping in the designed falls and direction. This is to ensure that the collecting surface is self-cleansing and the negative effects from ponding water.

If designed as nominally flat, no part should be capable of collecting ponding water when built. The design of nominally flat surfaces should therefore include a remedial screed, layer or filler to correct as-built levels and ensure that ponding cannot take place. A full structural analysis should be carried out to predict the degree of settlement, long term deflection, and direction of falls from which a design and method statement should be produced to show how effective drainage is to be provided.

The material used for the waterproof layer should be certified by a third party as suitable for the finished falls intended. This is particularly important for any waterproof layer with a finished fall less than 1:80.

Where balconies or terraces are to be tiled, guidance is available in BS 5385-3.

15.3 Drainage of large terraces

A large terrace requires piped drainage and reference should be made to BS 6229. Terraces with width, measured from the face of the building, of no more than 2.5 m, may be edge drained if they can be shown to comply with **15.6**.

15.4 Principles of prevention of water ingress to the building

The basic principles of ingress prevention for any terrace or balcony that is bounded by and continuously connected to all sides by walls, parapets or upstands are illustrated in Figure 9 as follows:

a) The highest point of the principal water collecting surface should be set at least 75 mm below the ingress level. This could be the membrane surface of a warm roof or the water flow reducing layer of an inverted roof on a terrace. Where ballast is placed above the water flow reducing layer of an inverted roof, the ballast should be sufficiently open to allow free flow of water to the water collecting surface.

b) Freeboard: the spillover level should be set at least 25 mm below the ingress level as built. This is to ensure that water cannot enter the building in the event of a blockage of the outlet.

c) The as-built highest point of the principal water collecting surface should be set (25 ±10) mm below the spillover level. This is to allow water to drain away in the event of a blockage of the outlet, whilst preventing:

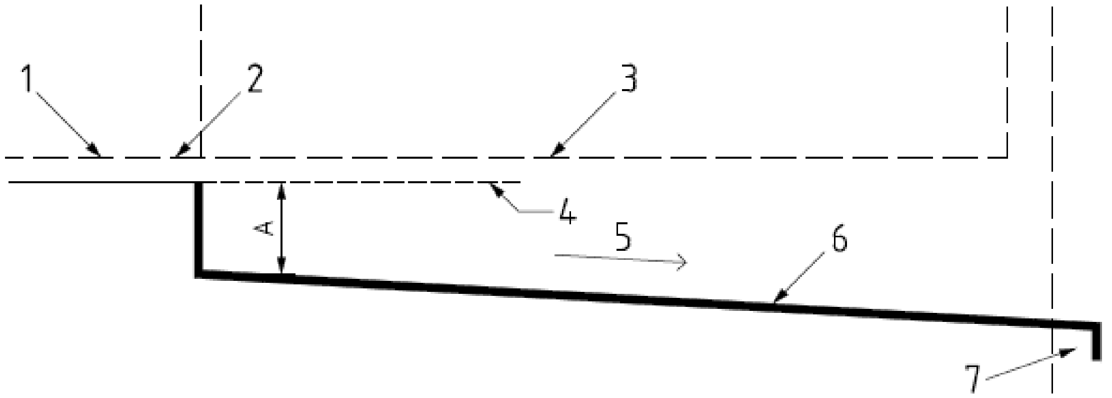
   1) water draining or dripping unnecessarily from the spillover/overflow level when the outlet is operational, and

   2) an excess of water building up in the event of the outlet being blocked causing potential structural problems.

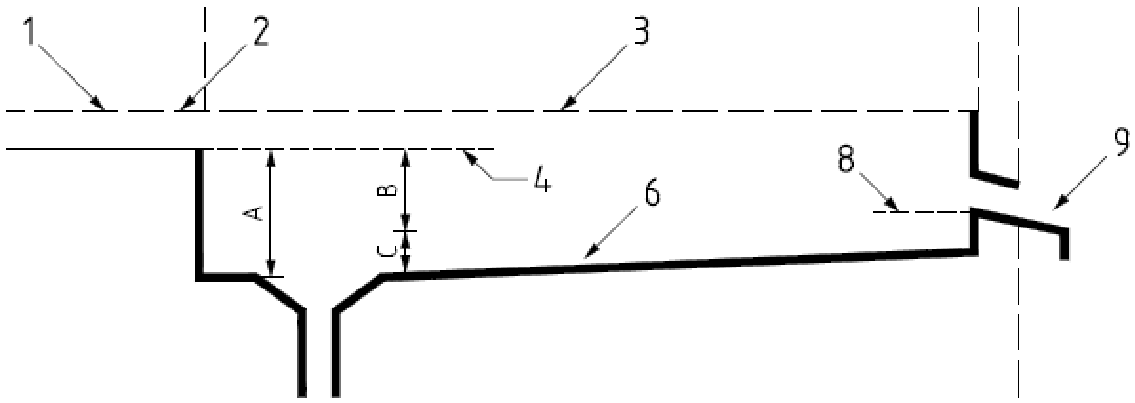
d) The waterproof membrane should terminate a minimum of 150 mm above the principal water collecting surface where possible. The membrane may be taken up behind the cladding in order to prevent ingress of any water that has penetrated into the cavity behind the cladding.

In certain cases, the required level for inverted roof insulation to meet thermal targets might conflict with the need to meet the principles above. It might be necessary to reduce the insulation level locally to the perimeter and create a drainage channel/trough which connects any thresholds, outlets and overflows to facilitate good drainage. In such a case, water management should be demonstrated by calculation to BS EN 12056 and the insulation should be secured by ballast at all levels in order to prevent dislodgement.

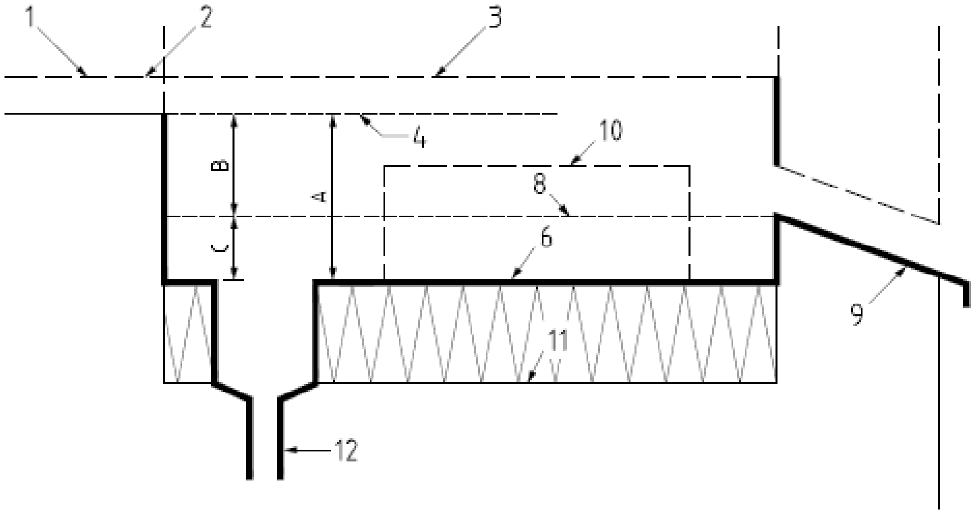
Figure 9 - Basic strategy for prevention of water ingress into a building



a) Balcony: edge drained



b) Balcony: outlet plus edge overflow



c) Terrace (illustrated as an inverted roof)

Key

1	Interior finished floor level	7	Edge drainage
2	Threshold	8	Spillover level
3	Deck level	9	Overflow
4	Ingress level	10	Other drained surface [A)]
5	Fall	11	Waterproof membrane level if inverted roof
6	Principal collecting surface	12	Piped outlet

A ≥ 75 mm

B ≥ 25 mm

C = (25 ± 10) mm

[A)] *This may result from the need for additional insulation to meet thermal requirements.*

NOTE Where the principal collecting surface is set to falls, B + C might not equal A.

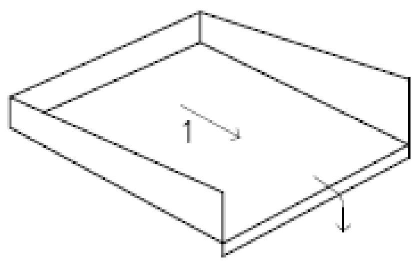
15.5 Managing water drainage

Arrangements for piped drainage, edge drainage, overflow and warning are illustrated in Figure 10. Drainage may be taken over the edge of a balcony via a properly formed edge drainage or into a pipe via an outlet. If the outlet becomes blocked, water should be prevented from entering the building by provision of an overflow(s) which is designed with an equal or greater flow rate than that of the outlet(s) and set at the spillover level. The overflow(s) may be in the form of an edge spout or an elevated outlet. Edge outlet spouts and weirs perform best when designed with a wide orifice.

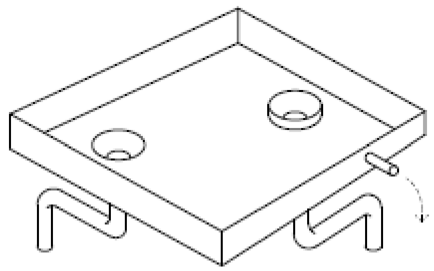
A warning pipe should also be provided where the flow from an overflow is not visible. Warning pipes are only designed to warn of a blockage and should not be relied upon to prevent ingress. The warning pipe should not operate when the outlet is operating normally. See Figure 10.

The level of the warning pipe should be set between the level of the outlet and the overflow.

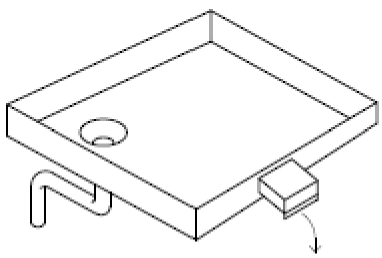
Figure 10 – Alternative strategies for drainage of balconies and terraces



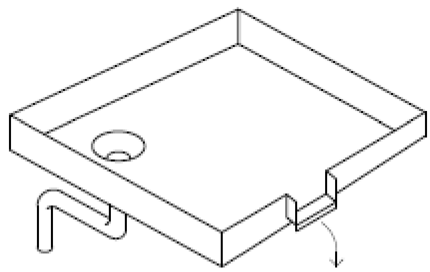
a) Edge drainage



b) Outlet and baffled overflow and visible warning pipe A)



c) Outlet and edge overflow



d) Outlet and edge overflow B)

Key

1 Fall

A) If the outlet and overflow are visually obscured by decking, a warning pipe will be required to indicate blockage before ingress occurs.

B) Overflow may be full width for a projecting balcony.

Where a balcony abuts a wall, the rainwater collecting surface might be in contact with the wall or there might be a small gap allowing the facade to run past the balcony. Where the collecting surface contacts the wall, the design should ensure that the water collecting surface membrane is taken up the wall to a level equal to or higher than the ingress level.

Where a terrace abuts a wall, the rainwater collecting surface will be in contact with the wall and the design should ensure that water from within the cavity or from the terrace does not ingress to the building. Care should be taken with cavity trays.

Soffits should be ventilated to avoid water vapour and dampness building up in the void behind if it could have an adverse effect on the construction.

Where the soffit acts as the water collecting surface, care should be taken to ensure that it is set to falls to ensure self-cleansing. See **15.2** and **15.6**.

15.6 Edge drainage of balconies

Edge drainage is a form of non-piped drainage and needs particular care in design. In order to prevent nuisance to persons and prevent the risk of staining of surfaces below, edge drainage, if used, should only be used where appropriate and should be carefully designed using the following principles.

a) Water collecting surfaces should always be designed to falls. Prefabricated balconies might be expected to be installed to good tolerances, therefore the water collecting surface should be designed to falls of 1:80 in order to induce good flow and prevent residual dripping after rain. If the balcony is designed to be built on site rather than prefabricated, tolerances might be more flexible and falls should be designed to 1:60 or 1:40, depending on the nature of the construction intended. Falls should follow the same direction as the cantilever of the balcony in order to prevent back drainage or ponding as loads are applied.

b) The water collecting surface should project and turn down to form a drip of at least 30 mm beyond the adjacent vertical surface. See Figure 11.

c) Balconies should be drained via the edge that is furthest from the adjacent wall. Alternatively, where drainage is from edges near to the adjacent wall, such as the sides of projecting balconies, no part of the weir should be within 400 mm of an adjacent wall. See Figure 12.

d) Concentrations of edge flow should be avoided, and water should be dispersed as evenly as practicable.

e) Balconies that are extensive or are divided for multiple dwellings may be edge drained, provided that the plan depth of the collecting surface is never more than 2 500 mm as indicated in Figure 13.

f) The design of the landscape below balconies should take cognizance of the effects of edge drainage. Surfaces should be designed to reduce splashing and resist erosion. This approach should not be adopted over private gardens or over building entrances (unless a suitable canopy or alternate protection is provided).

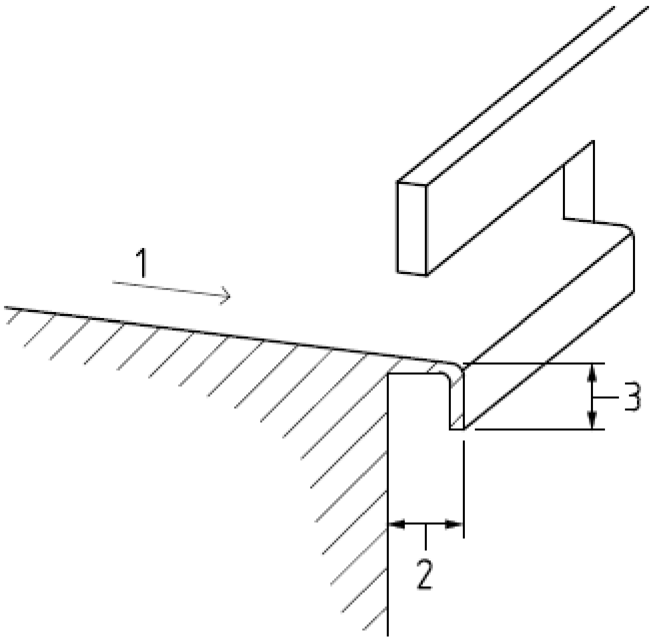
g) The draining edge should project to within at least 25 mm of the guarding of any balconies or terraces below in order to prevent nuisance to their occupants.

h) The collecting surface that is edge drained should have no other surfaces relying upon it for drainage other than adjacent window sills. No other roofs or balconies should be designed to deliberately drain onto an edge drained balcony.

NOTE 1 BS EN 12056-3:2000, NC.5 states that gutter and rainwater pipes may be omitted from a roof at any height providing it has an area not exceeding 6 m^2 and no other area drains onto it. This has given rise to the practice of dividing extensive balconies into sections of less than 6 m^2 to achieve the same effect. Item (e) places a limit on width of the collecting area relative to its edge drained length in order to distribute outflow from edge drained areas evenly.

NOTE 2 BS EN 12056-3:2000, NC.6 states that gutters and rainwater pipes may be omitted from tall structures where runoff would be dispersed before reaching the ground. Such runoff should be directed so as to avoid undesirable pattern staining and splashing of windows and the building.

Figure 11 – Edge drainage characteristics for effective discharge



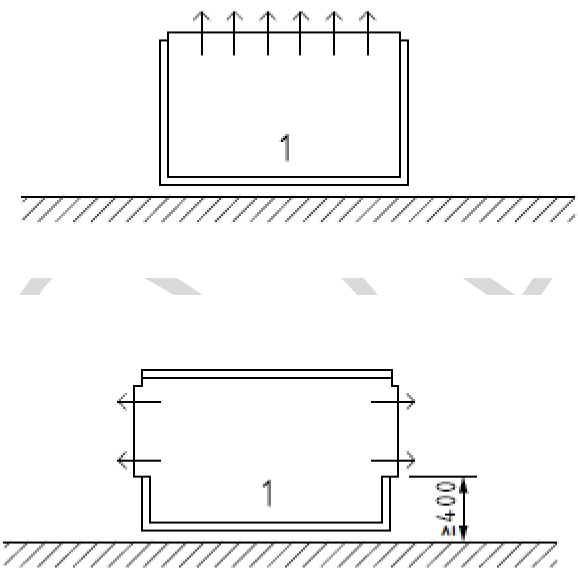
Key

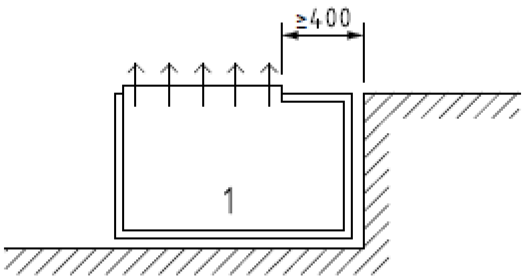
1 Falls

2 Projection ≥ 30 mm

3 Drip sufficient to shed water clear of the surface below

Figure 12 – Proximity of edge drainage to vertical surfaces

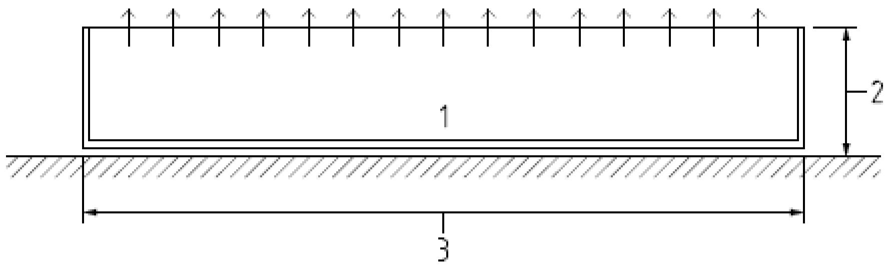




Key

1 Balcony

Figure 13 – Limitation of projection for edge drainage of long projecting balconies



Key

1 Long balcony

2 Drainage projection ≤ 2 500 mm

3 Length unrestricted for edge drainage

15.7 Assessing the volume of rainfall on balconies

The design for drainage of balconies and terraces should take account of the prevailing wind direction and windborne rain. For normal UK design purposes, when assessing the additional catchment effect of surfaces adjacent to a roof, it is assumed that wind driven rain falls at an angle of 26° to the vertical (i.e. 2 in 1). Air flow patterns around buildings can affect the local angle of descent of rain and consideration should be given to the implications of tall buildings and buildings in exposed positions (see Clause **7**).

BS EN 12056-3:2000 gives guidance on the effects of rainfall on flat roofs, sloping roofs and vertical surfaces. The effect of wind driven rainfall is covered by National Annex NC, which specifies:

a) 50% of the area of all vertical surfaces (up to a maximum height of 10 m) should be added to any plan area of catchments. Note each balcony is its own discrete catchment area and thus the 10 m factor is unlikely to apply even on tall buildings.

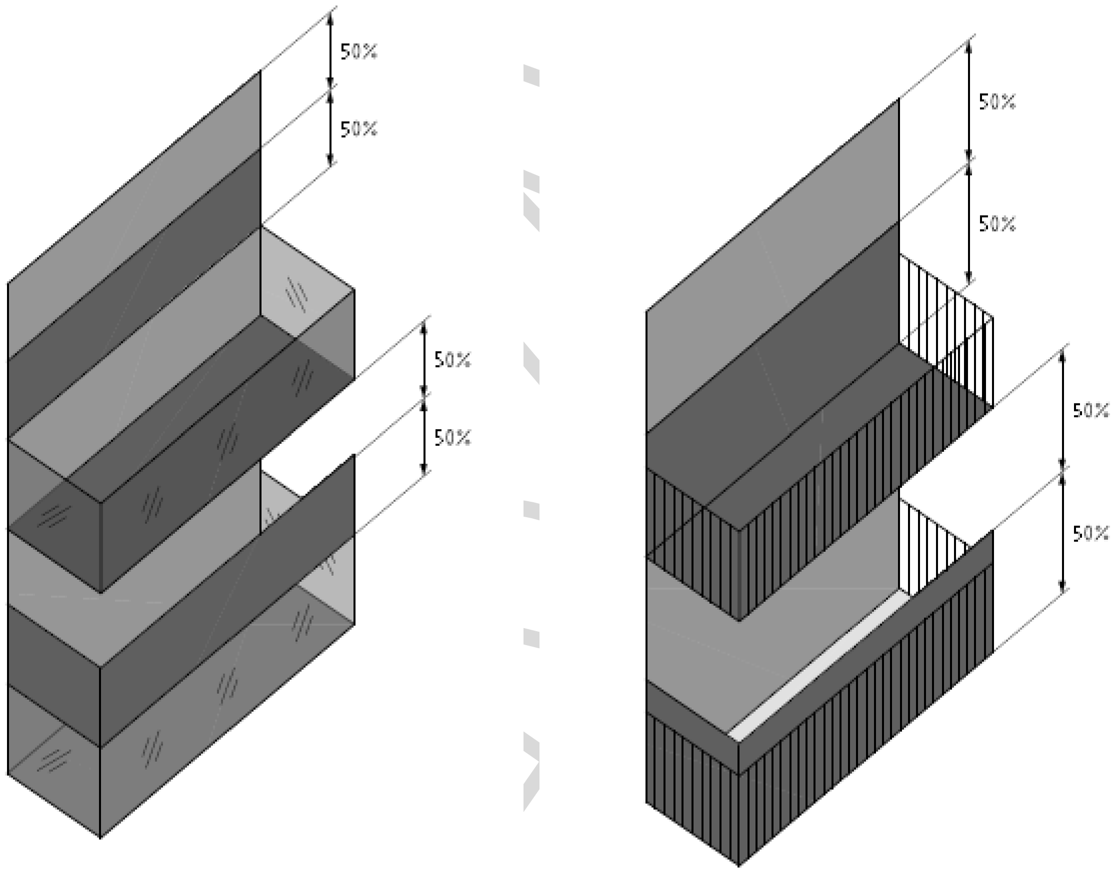
b) Where there is more than one perpendicular vertical surface, the combined effect of the greater two of these surfaces should be taken into account.

Balconies and building facades usually incorporate elements that offer some sheltering effect to incident rainwater. An approach to calculating effective catchment area for rainfall on a balcony is given below.

1) For a top level or non-stacked balcony, the area can be found from the summation of:
    i) the plan area of the balcony; and
    ii) 50% of the adjacent exposed wall area above any solid guarding.
2) For a lower level balcony (i.e. covered or sheltered by other stacked balconies) the area can be found from the summation of:
    i) 50% of the unenclosed vertical wall above any solid guarding on the front edge; and
    ii) 50% of the unenclosed vertical wall above any solid guarding on one of the two projecting edges.

Figure 14 illustrates the catchment areas for rainfall of balconies and terraces offered by various arrangements of adjacent elements.

Figure 14 – Catchment areas



Key

Solid guarding

Non-solid guarding

Catchment area

Other surfaces

15.8 Pipe and outlet design

Drainage pipes and outlets (including edge mounted guttering) should be designed in accordance with BS EN 12056-3. Pipes may be stacked above outlets in stacked balconies without a trap or the pipe from each individual outlet may be connected to a common vertical stack pipe.

Where pipes are stacked vertically from balcony to balcony, the pipe should extend without offset and fully down to the outlet below so as not to cause splashing at the receiving outlet.

Outlets should always be accessible and should incorporate a removable grating to prevent items blocking the system. See BS EN 1253-2 for further guidance on drains and floor gullies without a trap.

The design of the outlet and surface into which it is set should allow for it to be recessed slightly below the adjacent surface to ensure good drainage without ponding. If an outlet flange is mounted directly onto the supporting surface, the thickness of the flange can act as a barrier to water draining into it, thus giving rise to ponding. The remediating layer referred to in **15.2** can be used as a way of correcting levels to ensure smooth drainage and elimination of ponding.

Where a pipe penetrates a balcony floor, the effects of acoustic, fire and smoke transfer should be considered in the design, especially if the balcony is enclosed.

See BS EN 12056-3 for additional guidance on outlets and overflows.

15.9 Prevention of surface staining to the building

In addition to the recommendations in **15.8**, vertical components abutting the horizontal surfaces of balconies and terraces should be designed so as to avoid staining from rainwater splashing onto them. Non-absorbent materials such as glass and metal might not easily stain, but absorbent ones such as brick might need to be considered differently, together with the effect of sheltering elements, openings in the horizontal surface and absorbency of the vertical surface. A DPC and cavity tray should be incorporated into any masonry wall at least 150 mm above any adjacent water collecting surface.

In addition, the design should consider the risk of staining from splashing of incident rainfall from horizontal surfaces to the adjacent wall.

NOTE Timber cladding can be susceptible to discolouration if terminated in close proximity to a surface prone to rainwater splashing. Advice on design is available from the Timber Research and Development Association (TRADA).

16 Security

The provision of balconies and terraces could offer unintended means of access to buildings. The design should take into account expectations for security against unwanted entry and respond accordingly. The design of the building and its cladding should not provide means for persons to gain purchase to climb from ground levels to a balcony or from one balcony to another. Enclosed balconies can offer an extra layer of protection in this respect.

In all cases, the door to the balcony or terrace should be lockable from the interior.

17 Acoustic design

17.1 General

In areas at risk of exceptional external noise, consideration should be given to the acoustic effects engendered by the inclusion of balconies.

Balconies can be used as an effective method of increasing the acoustic performance of a façade, however if not properly considered, can be detrimental to noise ingress as well.

Good acoustic performance can be achieved by removing or decreasing the line of sight to the noise source while also minimizing unwanted acoustic reflections from adjacent façade elements. While the design of the balcony elements is important, it is equally as important to carefully position ventilation openings in relation to the balcony, in order to benefit from potential acoustic screening.

The acoustic performance of a balcony is predominantly determined by the following factors:

a) The position and type of the dominant external noise source

The angle of noise propagation at the façade has an impact on how a balcony will mitigate external noise levels.

Screening elements below a ventilation opening are beneficial in attenuating road and rail noise in high-rise developments, while screening elements above ventilation openings mitigate external noise from airborne sources.

b) Reduction of line of sight from the façade to the sound source

Significant noise reduction at the façade can only be achieved by decreasing the line of sight between noise source and the receiver or ventilation opening. As such, the geometry of the balcony should be considered to minimize this as much as possible. Requirements for wind protection can provide additional acoustic benefits and so the two should be considered together (see Clause **7** on wind effects).

c) The material and uniformity of the balcony construction

Constructions that include gaps or holes within a balcony floor, screen or balustrade significantly limit the acoustic performance that can be achieved. Solid constructions should be used where possible, and gaps between elements should be minimized.

d) The acoustic absorption properties of the balcony materials

The presence of acoustically absorptive materials to the underside of balconies can reduce the impact of unwanted reflections that might potentially decrease the performance of the façade.

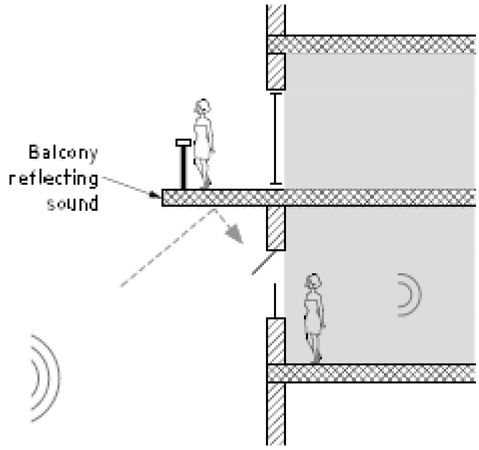
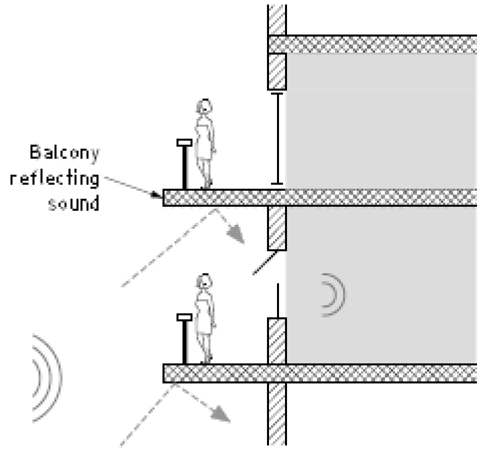
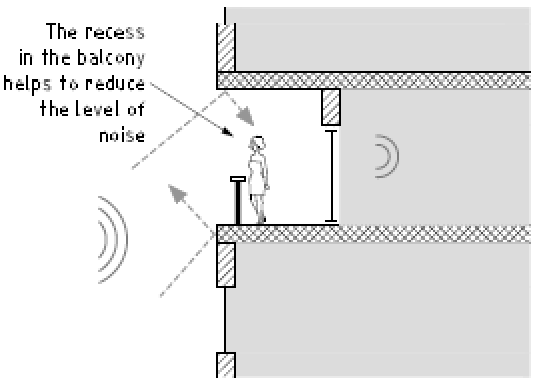
BS 12354-3 provides further guidance and acoustic performance data for various balcony designs.

17.2 Balcony position on a façade

Whilst the inclusion of a balcony can provide an increased acoustic performance, any ventilation opening that is located below a balcony (not on the balcony itself), can be negatively affected from reflections from the underside of the balcony above. This can be mitigated by applying an absorptive finish (with the appropriate fire rating) to the underside of the balcony.

As such, the placement and uniformity of balcony placement within a façade could have a significant acoustic impact. Vertically stacked balconies perform better than staggered balconies (see **6.1**). Table 1 gives the possible acoustic impact of different façade types.

Table 1 – Acoustic impact of different façade types

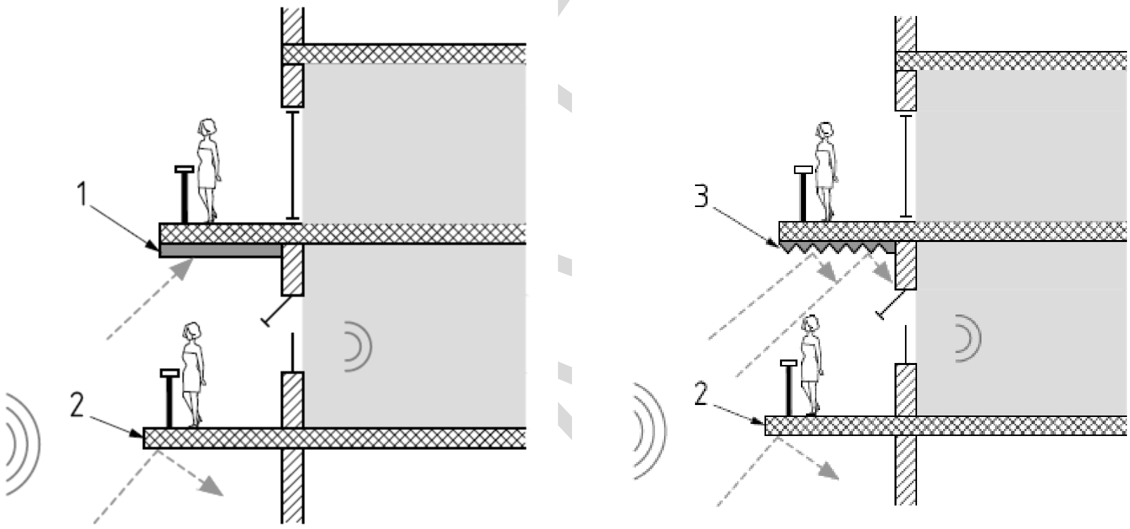
Façade type	Description	Acoustic impact
	Balcony positioned above ventilation opening	Can have a negligible or detrimental impact upon noise ingress
	Balcony adjacent to and above ventilation opening	Can have a positive and/or detrimental impact upon noise ingress
	Recessed balcony adjacent to and above ventilation opening	Can have a positive impact upon noise ingress

17.3 Enhancement with acoustic absorption or diffusion

Unwanted sound reflections off balcony soffits or walls can be mitigated though the use of either absorption or diffusive finishes. When used in conjunction with any screening elements from the balcony, this can be an effective method of decreasing noise ingress to a building.

A Class A absorptive finish in accordance with BS EN ISO 11654 is typically the most effective method of mitigating reflections off surfaces; however such finishes might not always be appropriate with a façade, and the inclusion of a diffusive element might be more appropriate. Examples of absorptive or diffusive elements within a balcony are shown in Figure 15 and Figure 16.

Figure 15 – Improving acoustic performance through either (a) absorption, or (b) diffusion



a) Absorption

b) Diffusion

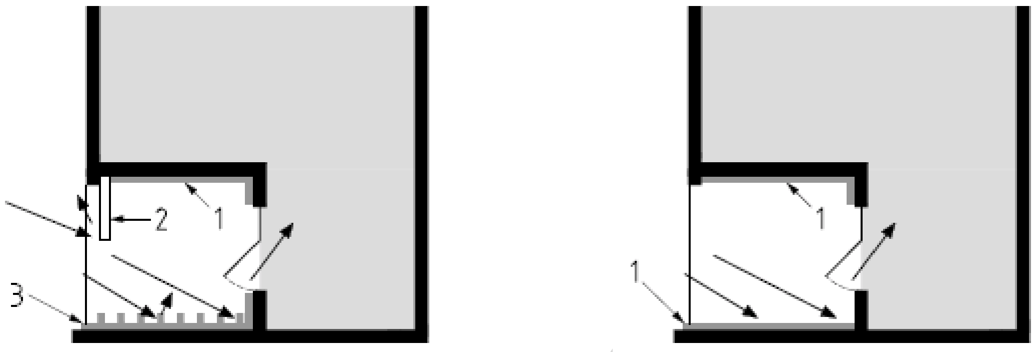
Key

1 Absorptive surface

2 Balcony

3 Diffusive surface

Figure 16 – Plan view – improving acoustic performance through either (a) absorption, or (b) diffusion



a) Absorption b) Diffusion

Key

1 Absorptive surface

2 Acoustic screen

3 Diffusive surface

Examples of absorptive materials suitable for external use include the following:

a) mineral wool with perforated covering (up to Class A);

b) perforated board with 200 mm cavity (up to Class C); or

c) fair-faced acoustic block (up to Class D).

The design of absorptive finishes within balconies should ensure that any material chosen is in line with the fire performance recommendations given in Clause **12**.

The effectiveness of a diffusive finish is determined by the width and depth of the variations within the surface. Diffusion can be achieved in external elements such as stepped or textured brickwork patterns or angled timber/metal cladding. Diffusion of low frequency noise is achieved through larger variations and as such is more difficult to achieve through the depth changes achieved within such brickwork.

17.4 Location of ventilation opening within balcony design

Noise ingress within a building can be improved by considering the location of a ventilation opening in relation to the building and balcony design, through using the building envelope as additional screening.

Positioning a ventilation opening perpendicular to a balcony opening can provide significant increase in performance, particularly when considered with the orientation of the opening window pane. This can be achieved easily with recessed or enclosed balconies.

The performance can be enhanced further through the use of adjacent absorptive materials, as well as through using architectural elements as additional screening, as illustrated in **17.5**.

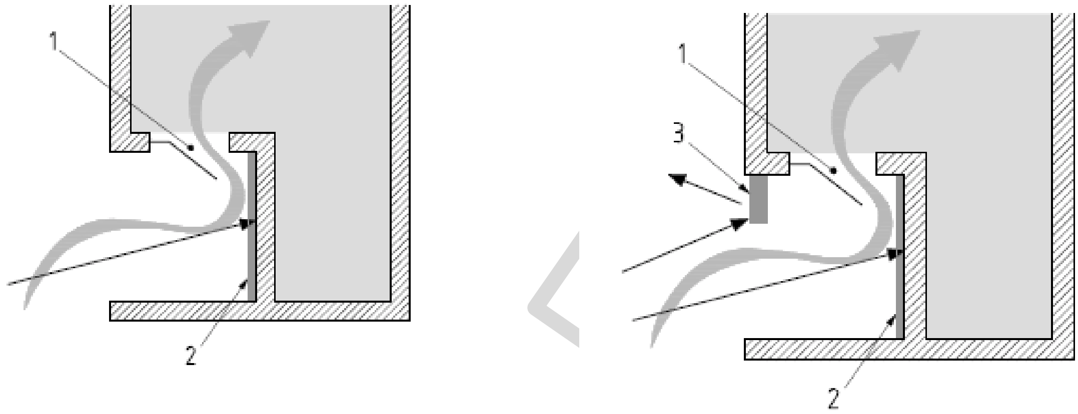
See Clause **14** for more guidance on ventilation outlets.

17.5 Enclosed balcony design for acoustics

Enclosed balconies create effective acoustic buffer zones that can provide significant increase to the noise reduction across a façade.

Acoustic performance can be further improved through the addition of absorptive elements to the inner surfaces of the balcony enclosure, as this reduces noise build-up within the balcony. See Figure 17.

Figure 17 – Improving acoustic performance through positioning of ventilation opening and acoustic absorption



a) b)

Key

1 Opening is perpendicular to the balcony

2 Absorptive surface

3 Acoustic screen

Further improvement can be achieved by creating an indirect airpath through the enclosed balcony. This is done by staggering the external ventilation opening and the interior room opening on to the balcony.

Flanking transmission between adjacent balconies should be considered in the design. Continuing the dividing floors and walls beyond the weather screen aids both acoustic and fire separation performance.

Enclosed balconies should incorporate fixed continuous background type ventilation (see Clause **5**). This should be achieved through continuous gaps at the base and top of the weather screen of at least 2 mm width. However, this will compromise the acoustic performance of the weather screen in regards to high frequency noise ingress. A single glazed weather screen with a 10 mm continuous gap is likely to provide a sound reduction of around 20 dB. If a higher performance is required, acoustic trickle vents can be used to provide further attenuation.

17.6 Integration within acoustics, ventilation and overheating design

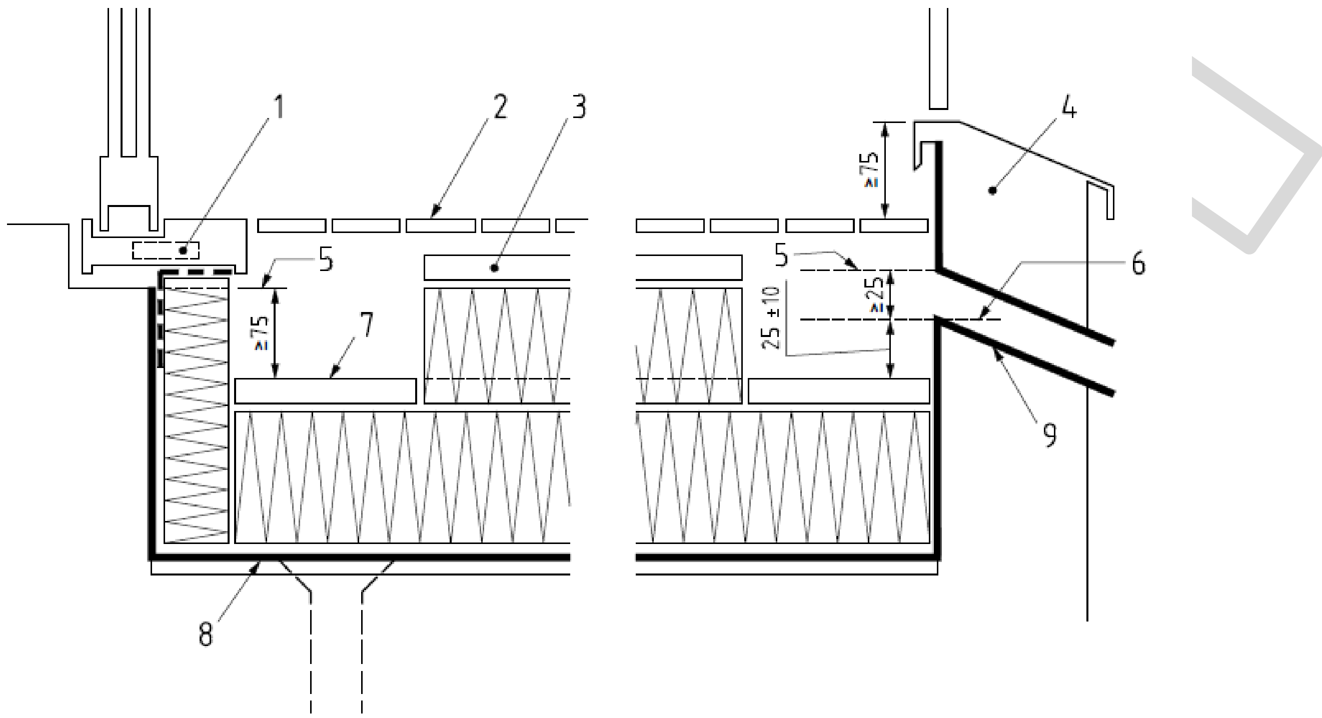
As both the acoustic and ventilation performance of a façade is reliant on the total area of the ventilation opening, the two design considerations are inherently interlinked. By reducing solar gains, and thus the ventilation requirements to remove these extra gains in the summer, the total open area required can therefore be decreased. This will therefore have a beneficial impact on the acoustic performance.

As such, any shading provided through additional balconies will have an indirect impact upon the acoustic performance. Therefore, both ventilation and acoustic design should be approached in an integrated manner to ensure the most efficient design can be achieved.

Annex A (informative)
Example arrangement of components of a balcony

Figure A.1 gives an example of a typical waterproofing arrangement for a balcony.

Figure A.1 – Terrace waterproofing example arrangement



Key

1 Thermal break in window overlaps with insulation below

2 Deck

3 Ballast

4 Build-up of wall/parapet not indicated as not within scope of this standard

5 Ingress level

6 Spillover level

7 Principal collecting surface

8 Bonded screed or other means to ensure no as-built back falls if zero pitch strategy is chosen. Not required if membrane is laid to falls

9 Overflow

—— Roofing membrane

---- Connecting membrane

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BS 6375 (all parts), *Performance of windows and doors*

BS 7543, *Guide to durability of buildings and building elements, products and components*

BS 7974, *Application of fire safety engineering principles to the design of buildings – Code of practice*

BS 12354-3, *Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound*

BS 6229, Flat roofs with continuously supported coverings – Code of practice

BS 6262-4, *Glazing for buildings – Code of practice for safety related to human impact*

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

BS 5250, *Code of practice for control of condensation in buildings*

BS 5385-3, *Wall and floor tiling – Part 3: Design and installation of internal and external ceramic and mosaic floor tiling in normal conditions – Code of practice*

BS 8300-1, *Design of an accessible and inclusive built environment – Part 1: External environment – Code of practice*

BS 8300-2, *Design of an accessible and inclusive built environment – Part 2: Buildings – Code of practice*

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BS EN 1253-2, *Gullies for buildings – Part 2: Roof drains and floor gullies without trap*

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BS EN ISO 6946, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation methods*

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PD 7974-1, *Application of fire safety engineering principles to the design of buildings – Part 1: Initiation and development of fire within the enclosure of origin (Sub-system 1)*

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PD 7974-3, *Application of fire safety engineering principles to the design of buildings – Part 3: Structural response to fire and fire spread beyond the enclosure of origin (Sub-system 3)*

Other publications

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Further reading

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