



APPROVED DOCUMENT

ACCEPTABLE SOLUTIONS

Issued by Commissioner of Building Control
under
Regulation 27 of the Building Control Regulations

Ver 4.0
Jul 2011

History of amendments

S/N	Brief description of changes	Revision date
1	Ver 1.0 – first issue	01 Jan 2004
2	Ver 1.01 – first revision a) Re-numbering of paragraphs in all sections to make it easier for referencing purposes. b) First two paragraphs of each section amended to be consistent with the Fifth Schedule of the Building Control Regulations. c) Paragraph A.2.1 – removal of abbreviations and symbols not used in the Document. d) Paragraph B.3 – title of codes and specifications amended to reflect the current names. e) Exemption scope expanded for the following specifications in section E – i. width of staircase; ii. risers and treads; iii. landing; iv. handrails; and v. protection from falling f) Paragraph E.3.8.1 – new note added to make it clearer. g) Note 2 of paragraph F.3.2.1 – amended to it clearer. h) Amendments to description of acceptable solution for section G - Ventilation to make it clearer. i) Paragraphs I.3.2 and I.3.3 – new note added to make it clearer.	11 Feb 2004
3	Ver 2.0 – Addition of a new Section M on Safety of Windows	01 Oct 2004
4	Ver 2.01- SS CP 24 referred to in Section I has been amended to SS CP 530 to reflect the change.	27 Feb 2007
5	Ver 2.02 – Revision to Section H on Safety from Falling: a) Paragraph H.3.2 – i. changes to the minimum height; and ii. additional note added b) Paragraph H.3.4 – i. scope of application expanded to include all buildings; ii. new provision added and iii. re-numbering of clauses.	01 Apr 2007
6	Ver 2.03 – Revision to section B on Structural design and Construction: a) Paragraph B.3.3.1 amended to include design for glass panel barrier	24 Oct 2007
7	Ver 2.04 – Revision to Section I on Energy Efficiency a) Paragraph I.3.2 - i. New Paragraphs I.3.2.1 to I.3.2.3 added, to include requirement for RETV ii. Amendment to Paragraph I.3.2.4 to make it clearer iii. Re-numbering of clauses b) All references to "Guidelines on Envelope Thermal Transfer Value for Buildings" amended to "Code on Envelope Thermal Performance for Buildings"	15 Apr 2008
8	Ver 3.0 – Revision to Section B on Structural design and Construction and Section H on Safety from Falling. <u>Section B :</u> a) Paragraph B.3.2.1 (c) – incorporates current practice on wind loads	04 May 2009

	<ul style="list-style-type: none"> b) Paragraph B.3.3.1 (a) - Facilitate use of concrete with strength greater than 60 N/mm² c) Paragraph B.3.3.1 (c) - Facilitate use of wider choice of structural steel material. d) Paragraph B.3.3.1 (g) - Facilitate use of glued laminated timber structures and non-tropical timber. e) Paragraph B.3.3.1 (l) - Incorporate design code for agricultural/farm structures. f) Paragraph B.3.3.1 (m) - Incorporate design guides for FRP system. g) Paragraph B.3.3.1 (n) - Incorporate design codes for maritime structures. h) Paragraph B.3.7.1 (a) - Title of code for BS 4248 has been changed. SS EN 197 will co-exist with current SS 26 until SS 26 is withdrawn in Jan 2011. i) Paragraph B.3.7.1 (b) - Incorporate design guides for ground granulated blast furnace slag. j) Paragraph B.3.7.1 (c) - SS EN 12620 will co-exist with current SS 31 until SS 31 is withdrawn in Jan 2011. k) Paragraph B.3.7.1 (d) - Current code has been replaced by BS EN 1008. l) Paragraph B.3.7.1 (e) - Title of code has been changed. m) Paragraph B.3.7.1 (h) - Incorporate SS EN 206, Introduce control on alkali content in concrete, Incorporate design code for repair of concrete structures. n) Paragraph B.3.7.1 (i) - Current codes have been replaced by BS EN 934-2. o) Paragraph B.3.7.1 (j) - Current codes have been replaced by BS EN 10025, Incorporate design code for stainless steels. p) Paragraph B.3.7.1 (k) - Current code has been replaced by BS EN 12020. q) Paragraph B.3.7.1 (m) - Facilitate use of glued laminated timber structures and non-tropical timber. r) Paragraph B.3.8.1 (a) - SS 26, SS 477 and SS476 have been deleted as they are covered in current SS 397, Incorporate SS EN 196 s) Paragraph B.3.8.1 (b) - SS 73 has been replaced by SS 31, BS EN 12620 will co-exist with SS 31 until SS 31 is withdrawn by Jan 2011 t) Paragraph B.3.8.1 (c) - Incorporate BS EN 12350, BS EN 12390, BS EN 12504, BS EN 13971, Incorporate BS EN 13971 u) Paragraph B.3.8.1 (e) - Incorporate BS EN 480 v) Paragraph B.3.8.1 (f) - Title of code has been changed. w) Paragraph B.3.8.1 (g) - Current code has been replaced by BS EN 10025 x) Paragraph B.3.8.1 (k) - Incorporate codes for testing of timber <p><u>Section H :</u></p> <ul style="list-style-type: none"> a) Paragraph 3.3 – Heading has been changed to include design of glass panel barrier b) Paragraph 3.3.2 - This item is moved from B.3.3 on Structural Design so as to group all requirements pertaining to safety barrier under section H on Safety from Falling. 	
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9	<p>Ver 3.01 – Revision to section H on Safety from Falling:</p> <ul style="list-style-type: none"> a) Paragraph H.3.4.4 - Editorial changes to improve clarity on the opening or gap in a barrier. b) Note 1 of Paragraph H.3.4 - This is re-phrased and re-numbered to become new paragraph H.3.4.6 to include promenades and boardwalks at ground level along the waterfront. c) Note 2 of Paragraph H.3.4 - This is re-numbered to become new paragraph H.3.4.7 	16 Jul 2009
10	<p>Ver 3.02- SS CP 2 referred to in Section K has been amended to SS 550 to reflect the change.</p>	16 Jul 2010
11	<p>Ver 3.03 –</p> <ul style="list-style-type: none"> a) SS CP 38 referred to in Section F has been amended to SS 531 to reflect the change. b) SS CP 13 referred to in Section G has been amended to SS 553 to reflect the change. 	31 Dec 2010
12	<p>Ver 4.0 – Revisions are:</p> <ul style="list-style-type: none"> a) SS CP 11 referred to in Section B has been amended to SS 557: 2010 to reflect the change. b) Addition of a new Section N on Use Of Glass At Height c) Addition of new paragraph H.3.5 on Glass Barrier to Section H on Safety from Falling d) SS CP 33 referred to in Section L has been amended to SS 555 to reflect the change. 	01 Jul 2011

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A GENERAL

A.1 INTRODUCTION

A.1.1 The framework for performance-based building code is set out in the Building Control Regulations 2003 (referred to in this Document as the Regulations). The Fifth Schedule of the Regulations sets out the objectives and performance requirements that must be complied with in the design and construction of building works (referred to in this Document as “prescribed objectives and performance requirements”). The objectives set out community expectations of a safe, disabled-friendly and energy efficient building. The performance requirements outline the level of performance, which must be met in order for a building to meet the objectives.

A.1.2 This Approved Document provides a set of ‘acceptable solutions’ that meet the prescribed objectives and performance requirements. The prescribed objectives and performance requirements are deemed to be satisfied if the design and construction of a building comply with the acceptable solutions.

A.1.3 Alternatively, a person may utilise alternative solutions in respect of the design and construction of any building if these solutions satisfy the prescribed objectives and performance requirements. Alternative solutions are solutions that entail the use of any design, material or construction method that differs completely or partially from those in the acceptable solutions.

A.2 ABBREVIATIONS AND SYMBOLS

A.2.1 The following abbreviations and symbols are used in this Document –

<u>Abbreviation or Symbol</u>	<u>Definition</u>
BS	British Standard
CP	Code of Practice
°K	degree Kelvin
kW	kiloWatt
kg	kilogram
m	metre
m ²	square metre
mm	millimetre
SS	Singapore Standard

B STRUCTURAL DESIGN AND CONSTRUCTION

B.1 OBJECTIVE

B.1.1 The objectives of paragraphs B.2.1 to B.2.4 are to –

- (a) protect people from injury caused by structural failure;
- (b) protect people from loss of amenity caused by structural failure; and
- (c) protect other property from physical damage caused by structural failure.

B.2 PERFORMANCE REQUIREMENT

B.2.1 A building, including its foundation, shall be designed and constructed so that the combined dead, imposed, wind and other intended loads can be sustained and transmitted by it to the ground –

- (a) safely; and
- (b) without causing such deflection or deformation of any part of that building, or such movement of the ground, as will impair the stability of any part of another building or property.

B.2.2 The building shall be constructed with materials that are appropriate for the circumstances in which they are used.

B.2.3 Tests that are appropriate to the materials and building works concerned shall be performed on those materials and building works.

B.2.4 If a building or any part thereof is to be demolished, the demolition works shall be carried out safely and without impairing the stability of any other part of that building or another property.

B.3 ACCEPTABLE SOLUTION

B.3.1 The requirements in paragraphs B.2.1 to B.2.4 are deemed to be satisfied if the design and construction of a building comply with the specifications set out in paragraphs B.3.2 to B.3.7.

B.3.2 Loads

B.3.2.1 The building shall be able to resist loads determined in accordance with the following Standards –

- (a) Dead loads –
 - (i) Schedule of Weights of Building Materials – BS 648; and
 - (ii) Loading for Buildings. Code of Practice for Dead and Imposed Loads – BS 6399:Part 1.
- (b) Imposed floor and ceiling loads, dynamic loads due to crowd movement, loads on parapets and balustrades, loads on vehicular barrier for car parks, accidental loads –
 - (i) Loading for Buildings. Code of Practice for Dead and Imposed Loads – BS 6399:Part 1.
- (c) Wind loads –
 - (i) Code of Basic Data for the Design of Buildings. Loading. Wind Loads – CP 3 Chapter V Part 2, using 33 m/s as the basic wind speed (3 second gust speed); and
 - (ii) Loading for buildings. Code of Practice for Wind Loads – BS 6399:Part 2, using 22 m/s as the basic wind speed (hourly mean speed).
- (d) Imposed roof loads –
 - (i) Loading for Buildings. Code of Practice for Imposed Roof Loads – BS 6399:Part 3.
- (e) Single crane gantry loads –
 - (i) Rules for the Design of Cranes. Specification for Classification, Stress Calculations and Design Criteria for Structures – BS 2573:Part 1.

- (f) Vehicular bridge live loads –
 - (i) Land Transport Authority (LTA)'s design criteria for vehicular bridge.

B.3.3 **Structural Design**

B.3.3.1 The design of the building structures shall comply with the following Standards –

- (a) Reinforced and prestressed concrete structures –
 - (i) Code of Practice for Structural Use of Concrete – SS CP 65; and
 - (ii) Design Guide of High Strength Concrete to Singapore Standard CP 65 – BC 2.
- (b) Bridges –
 - (i) Steel, Concrete and Composite Bridges – BS 5400.
- (c) Steel structures –
 - (i) Structural Use of Steelwork in Building – BS 5950; and
 - (ii) Design Guide on Use of Alternative Steel Materials to BS 5950 – BC 1.
- (d) Precast concrete structures –
 - (i) Code of Practice for Precast Concrete Slab and Wall Panel – SS CP 81.
- (e) Foundations –
 - (i) Code of Practice for Foundations – SS CP 4.
- (f) Aluminium structures –
 - (i) Structural Use of Aluminium – BS 8118.
- (g) Timber structures –
 - (i) Code of Practice for Structural Use of Timber – SS CP 7; and
 - (ii) Structure use of timber – BS 5268-2 – For use of Glued Laminated Timber structures and non-tropical timber.

- (h) Aqueous retaining concrete structures –
 - (i) Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids – SS CP 73.
- (i) Retaining structures –
 - (i) Code of Practice for Earth Retaining Structures – BS 8002.
- (j) Assessment of concrete –
 - (i) Testing Concrete – BS 1881; and
 - (ii) Guide to Assessment of Concrete Strength in Existing Structures – BS 6089.
- (k) Cranes –
 - (i) Rules for Design of Cranes. Specification for Classification, Stress Calculations and Design Criteria for Structures – BS 2573:Part 1.
- (l) Buildings and structures for Agriculture –
 - (i) Buildings and structures for agriculture. Code of practice for design, construction and loading - BS 5502-22.
- (m) Externally Bonded Fibre-Reinforced Polymer (FRP) Systems –
 - (i) Design guidance for strengthening concrete structures using fibre composite materials – Concrete Society Technical Report 55; and
 - (ii) Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures – ACI 440.2R-02.
- (n) Maritime structures (including floating platforms) –
 - (i) Maritime structures – BS 6349.

B.3.4 **Site Investigation and Instrumentation**

B.3.4.1 Site investigation and instrumentation shall be carried out in accordance with the following Standards –

- (a) Code of Practice for Site Investigations – BS 5930; and
- (b) Method of Test for Soils for Civil Engineering Purposes – BS1377.

B.3.5 Site Formation

B.3.5.1 Site formation works shall conform to Code of Practice for Earthworks – SS CP 18.

B.3.6 Demolition Works

B.3.6.1 The demolition works shall conform to the Code of Practice for Demolition – SS 557: 2010.

B.3.7 Construction Materials

B.3.7.1 Construction materials shall comply with the following Standards –

- (a) Cement –
 - (i) Ordinary Portland Cement – SS 26;
 - (ii) Specification for Sulphate-resisting Portland Cement – BS 4027;
 - (iii) Supersulfated cement – BS 4248;
 - (iv) Portland Blastfurnace Cement – SS 477; and
 - (v) High Slag Blastfurnace Cement – SS 476; and
 - (vi) Cement – SS EN 197.
- (b) Ground granulated blast furnace slag -
 - (i) Ground granulated blast furnace slag for use in concrete, mortar and grout – SS EN 15167.
- (c) Aggregates –
 - (i) Aggregates from Natural Sources for Concrete – SS 31 ; and
 - (ii) Aggregates for concrete – SS EN 12620.
- (d) Water –
 - (i) Mixing water for concrete – BS EN 1008.
- (e) Steel reinforcement –
 - (i) Steel for the Reinforcement of Concrete – SS 2;
 - (ii) Cold-reduced Steel Wire for the Reinforcement of Concrete and the Manufacture of Welded Fabric – SS 18;

- (iii) Welded Steel Fabric for the Reinforcement of Concrete – SS 32; and
 - (iv) Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification – BS 4449.
- (f) Prestressing tendon –
- (i) Code of Practice for Structural Use of Concrete – SS CP 65; and
 - (ii) Steel, Concrete and Composite Bridges. Specification for Materials and Workmanship, Concrete, Reinforcement and Prestressing Tendons – BS 5400:Part 7.
- (g) Prestressing steel –
- (i) Steel for the Prestressing of Concrete – SS 475.
- (h) Concrete –
- (i) Concrete – Guide to Specifying Concrete & Methods for Specifying Concrete Mixes – SS 289;
 - (ii) Concrete - Specification, performance, production and conformity – SS EN 206-1;
 - (iii) Concrete - Complementary Singapore Standard to SS EN 206-1 – SS 544;
 - (iv) Control on alkali content in accordance with BRE Digest 330 'Alkali-silica reaction in concrete' (2004) by
 - using low alkali cement¹ with equivalent Na₂O of not more than 0.6% ; or
 - limiting the total alkali content of concrete to 2.5kg equivalent Na₂O /m³; and
 - (v) Repair of concrete structures - Products and systems for the protection and repair of concrete structures - BS EN 1504.
- (i) Admixture –
- (i) Concrete Admixtures – SS 320;
 - (ii) Admixtures for concrete, mortar and grout – BS EN 934-2.

¹ To be used with aggregates with marginal reactivity having expansion not greater than 0.2% when evaluated using ASTM C1260.

- (j) Structural steel –
 - (i) Specification for Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steels – BS 7668;
 - (ii) Hot rolled products of structural steels – BS EN 10025;
 - (iii) Hot Finished Structural Hollow Sections of Non-alloy and Fine Grain Structural Steels – SS 470; and
 - (iv) Cold Formed Welded Structural Sections of Non-alloy and Fine Grain Steel – BS EN 10219; and
 - (v) Stainless steels - BS EN 10088.
- (k) Aluminium and aluminium alloys –
 - (i) Sheet, Strip and Plate – BS EN 485;
 - (ii) Wrought Product: Temper Designation – BS EN 515;
 - (iii) Chemical Composition and Form of Wrought Product – BS EN 573;
 - (iv) Extruded Rod/Bar, Tube and Profiles – BS EN 755:Part 1; and
 - (v) Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 – BS EN 12020.
- (l) Fixings of claddings –
 - (i) Mechanical Properties of Corrosion-resistant Stainless Steel Fasteners – BS EN ISO 3506.
- (m) Timber structures –
 - (i) Code of Practice for Structural Use of Timber – SS CP 7; and
 - (ii) Structure use of timber – BS 5268-2 – For use of Glued Laminated Timber structures and non-tropical timber.

B.3.8 Construction Tests

- B.3.8.1 Construction tests for the materials and the structural members or elements of a building shall comply with the following Standards –

- (a) Cement –
 - (i) Methods of Testing Cement – SS 397; and
 - (ii) Methods of testing cement – BS EN 196.

- (b) Aggregate –
 - (i) Aggregates from Natural Sources for Concrete – SS 31; and
 - (ii) Aggregates for concrete – SS EN 12620.

- (c) Water –
 - (i) Mixing water for concrete – BS EN 1008.

- (d) Concrete –
 - (i) Testing Concrete – BS 1881;
 - (ii) Testing fresh concrete – BS EN 12350;
 - (iii) Testing hardened concrete – BS EN 12390;
 - (iv) Testing concrete in structures - BS EN 12504;
 - (v) Assessment of Concrete Strength in Existing Structures – BS 6089; and
 - (vi) Assessment of in-situ compressive strength in structures and precast concrete components – BS EN 13791.

- (e) Admixture –
 - (i) Admixtures for concrete, mortar and grout – Test methods – BS EN 480.

- (f) Steel reinforcement –
 - (i) Steel for the Reinforcement of Concrete – SS 2;
 - (ii) Cold-reduced Steel Wire for the Reinforcement of Concrete and the Manufacture of Welded Fabric – SS 18;
 - (iii) Welded Steel Fabric for the Reinforcement of Concrete – SS 32; and
 - (iv) Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification – BS 4449.

- (g) Structural steel –
 - (i) Hot rolled products of structural steels - BS EN 10025.

- (h) Prestressing wires, strands or bars –
 - (i) Specification for High Tensile Steel Wire and Strand for the Prestressing of Concrete – BS 5896; and
 - (ii) Specification for Hot Rolled and Processed High Tensile Alloy Steel Bars for the Prestressing of Concrete – BS 4486.

- (i) Weld quality –
 - (i) Non-destructive Examination of Welds. Magnetic Particle Examination of Welds - BS EN 1290;
 - (ii) Non-destructive Examination of Welds. Magnetic Particle Testing of Welds. Acceptance Levels - BS EN 1291;
 - (iii) Non-destructive Testing. Penetrant Testing – BS EN 571;
 - (iv) Non-destructive Examination of Welded Joints. Ultrasonic Examination of Welded Joints – BS EN 1714;
 - (v) Methods for Ultrasonic Examination of Welds – BS 3923 Part 2; and
 - (vi) Non-destructive Examination of Welds. Radiographic Examination of Welded Joints – BS EN 1435.

- (j) Pile load test –
 - (i) Code of Practice for Foundations – SS CP 4.

- (k) Timber -
 - (i) Code of Practice for Structural Use of Timber – SS CP 7; and
 - (ii) Structure use of timber – BS 5268-2 – For use of Glued Laminated Timber structures and non-tropical timber.

C HEADROOM AND CEILING HEIGHT

C.1 OBJECTIVE

C.1.1 The objectives of paragraph C.2.1 isare to safeguardprotect people from –

- (a) injury caused by inadequate headroom; and
- (b) injury or loss of amenity caused by inadequate height of room or space.

C.2 PERFORMANCE REQUIREMENT

C.2.1 All rooms and spaces in a building shall be provided with adequate headroom and height for their intended uses.

C.2.2 The requirement in paragraph C.2.1 shall not apply to the following rooms and spaces –

- (a) an attic room;
- (b) equipment and plant rooms;
- (c) the underside of a staircase or escalator if such staircase or escalator is not located along an access route or circulation space;
- (d) toilets, bathrooms or lavatories; and
- (e) store rooms, utility rooms, wash area and the like.

C.3 ACCEPTABLE SOLUTION

C.3.1 The requirement in paragraph C.2.1 is deemed to be satisfied if the specifications set out in paragraphs C.3.2 and C.3.3 are complied with.

C.3.2 Headroom

C.3.2.1 The headroom of every room, access route and circulation space shall not be less than 2.0 m.

- Note:*
- 1 *The term “access route” shall include a covered walkway or footway of a building.*
 - 2 *The headroom is measured from the finished floor level to the underside of any beam, duct, service pipe, fixture, fitting or other obstruction or projection; and in the case of a doorway, it shall be measured up to the underside of the transom.*
 3. *Windows, which open into any access route or circulation space, , consideration should be given such that they do not poseshall not result in any inadequacy in headroom in the access route or circulation space.*

C.3.3 Ceiling height

C.3.3.1 The ceiling height of rooms and spaces shall not be less than 2.4 m.

- Note:*
- 1 *The requirement in paragraph C.3.3.1 does not apply to the following –*
 - (a) *corridors and lobbies; and*
 - (b) *localised areas within a room or space where there is a drop in ceiling height due to physical constraints such as structural beams or building services.*
 - 2 *The ceiling height is measured from the finished floor level to the underside of any slab, false ceiling or suspended ceiling.*

D BARRIER-FREE ACCESSIBILITY

D.1 OBJECTIVE

D.1.1 The objective of paragraphs D.2.1 to D.2.4 is to ensure that persons with disabilities are able to enter and carry out their activities and functions within a building.

D.2 PERFORMANCE REQUIREMENT

D.2.1 At least one access route shall have barrier-free features to enable persons with disabilities to –

- (a) approach the building or the vehicle park; and
- (b) have access to those spaces where they may be expected to work or visit.

D.2.2 Sanitary facilities that are appropriate for use by persons with disabilities shall be adequately provided for use by such persons.

D.2.3 Barrier-free facilities that are appropriate for the intended type of building or occupancy shall be adequately provided.

D.2.4 Signages shall be adequately provided to guide persons with disabilities to spaces or facilities where or which they may be expected to work, visit or use.

D.3 ACCEPTABLE SOLUTION

D.3.1 The requirements in paragraphs D.2.1 to D.2.4 are deemed to be satisfied if the provisions and facilities for persons with disabilities comply with the Code on Barrier-Free Accessibility in Buildings issued by the Commissioner of Building Control.

E STAIRCASES**E.1 OBJECTIVE**

E.1.1 The objective of paragraphs E.2.1, E.2.2 and E.2.3 is to safeguard protect people from injury and to facilitate access during movement from one level to another in a building.

E.2 PERFORMANCE REQUIREMENT

E.2.1 A staircase (including a flight of 2 steps or more) shall provide a safe and suitable passage for movement of people.

E.2.2 A staircase shall have –

- (a) handrails or guides to assist movement;
- (b) landings to break a fall and provide a place for rest;
- (c) sufficient headroom to avoid injury; and
- (d) barriers against falling from 1.0 m or more from an open side.

E.2.3 Paragraphs E.2.1 and E.2.2 shall apply only to staircases that provide access to levels having rooms or spaces meant for human occupation.

E.3 ACCEPTABLE SOLUTION

E.3.1 The requirements in paragraphs E.2.1 and E.2.2 are deemed to be satisfied if a staircase is designed and constructed in accordance with the specifications set out in paragraphs E.3.2 to E.3.8.

E.3.2 Projection

E.3.2.1 No projection, other than handrails, is allowed in a staircase within a height of 2.0 m from the landing or pitch line.

E.3.3 Width of staircase

E.3.3.1 The width of every staircase shall not be less than 900 mm.

Note: 1 The width is measured from the inner side of the wall, balustrade or handrail.

2 The requirement in paragraph E.3.3.1 does not apply to the following –

(a) plants and equipment rooms;

(b) the production area of an industrial building;

(c) attic rooms in residential buildings; and

(d) houses built by the owners for their own use.

E.3.4 Risers and treads

E.3.4.1 The height of a riser shall not be more than 175 mm.

E.3.4.2 The width of a tread shall not be less than 250 mm except that in a residential unit, the width of a tread may not be less than 225 mm.

E.3.4.3 The width of a tapered tread or winder in a spiral, circular or geometric staircase measured at a distance of 500 mm from the narrower end shall not be less than 225 mm in the case of residential buildings and 250 mm in the case of other buildings.

E.3.4.4 The risers and treads within each flight of stairs shall be of uniform height and size.

Note: 1 A tolerance of +/- 5 mm in any flight of stairs is acceptable.

2 The requirements in paragraphs E.3.4.1 to E.3.4.3 do not apply to the following –

(a) plants and equipment rooms;

(b) the production area of an industrial building;

(c) attic rooms in residential buildings; and

(d) *houses built by the owners for their own use.*

E.3.5 Landing

E.3.5.1 A landing shall be provided at every floor level and door opening.

E.3.5.2 Except for spiral, circular or geometric staircases, an intermediate landing shall be provided in between floor levels at intervals of not more than 18 risers.

E.3.5.3 The length of any intermediate landing, measured in the direction of travel, shall not be less than 900 mm.

E.3.5.4 A landing shall not have any step or drop except that in the case of a residential unit, one winder is allowed in every 90° turn.

Note: The requirements in paragraphs E.3.5.1 to E.3.5.4 do not apply to the following –

(a) *plants and equipment rooms;*

(b) *the production area of an industrial building;*

(c) *attic rooms in residential buildings; and*

(d) *houses built by the owners for their own use.*

E.3.6 Headroom

E.3.6.1 The headroom of any staircase shall not be less than 2.0 m.

Note: The headroom is measured vertically between the pitch line and any point directly above that limits the headroom.

E.3.7 Handrails

E.3.7.1 A handrail shall be provided on at least one side of the flight of staircase.

E.3.7.2 The height of the handrail shall be between 750 mm and 900 mm above the pitch line.

- Note:*
- 1 *A handrail need not be provided for a flight of not more than 5 steps.*
 - 2 *A handrail may terminate at the landing and the ends of the handrail should be properly formed or rounded off so that they do not pose a danger to the user.*
 - 3 *The requirements in paragraphs E.3.7.1 and E.3.7.2 do not apply to the following –*
 - (a) plants and equipment rooms;*
 - (b) the production area of an industrial building; and*
 - (c) houses built by the owners for their own use.*

E.3.8 Protection from falling

E.3.8.1 The open sides of a staircase shall be protected by barriers in accordance with Section H – ‘Safety from Falling’ of this document.

- Note:*
- 1 *For the purpose of paragraph E.3.8.1, the open sides shall include any gap or opening along the entire flight of steps.*
 - 2 *The requirement in paragraph E.3.8.1 does not apply to the following –*
 - (a) plants and equipment rooms;*
 - (b) the production area of an industrial building; and*
 - (c) houses built by the owners for their own use.*

F LIGHTING**F.1 OBJECTIVE**

F.1.1 The objective of paragraphs F.2.1 and F.2.2 is to protect people from injury or loss of amenity due to isolation from natural lighting and lack of artificial lighting.

F.2 PERFORMANCE REQUIREMENT

F.2.1 Lighting shall be adequately provided in a building for its intended purpose.

F.2.2 Residential buildings, other than houses built by the owners for their own use, shall be provided with natural lighting for the purpose of paragraph F.2.1.

F.3 ACCEPTABLE SOLUTION

F.3.1 The requirement in paragraph F.2.1 is deemed to be satisfied if –

- (a) natural lighting that complies with paragraph F.3.2.1; or
- (b) artificial lighting that complies with the recommended illuminance given in SS 531 - Code of Practice for Lighting of Work Places

is provided.

F.3.2 Natural lighting

F.3.2.1 Natural lighting shall be provided by means of one or more windows or other openings with an aggregate light transmitting area of not less than 10% of the floor area of the room or space required to be lighted.

Note: 1 *The light transmitting area for a window and other similar devices may be measured over the framing members and glazing bars.*

- 2 *In lieu of natural lighting, artificial lighting may be provided to the following rooms or spaces within residential units –*
 - (a) *bathroom, toilet or lavatory;*
 - (b) *store room;*
 - (c) *basement; or*
 - (d) *civil defence shelter.*

- 3 *For the purpose of promoting energy efficiency in buildings, the use of artificial lighting as the sole means of lighting is to be discouraged.*

G VENTILATION**G.1 OBJECTIVE**

G.1.1 The objective of paragraphs G.2.1 and G.2.2 is to protect people from loss of amenity due to lack of fresh air.

G.2 PERFORMANCE REQUIREMENT

G.2.1 Ventilation shall be adequately provided in a building for its intended occupancy.

G.2.2 Residential buildings, other than houses built by the owners for their own use, shall be provided with natural ventilation for the purpose of paragraph G.2.1.

G.3 ACCEPTABLE SOLUTION

G.3.1 The requirement in paragraph G.2.1 is deemed to be satisfied if –

- (a) natural ventilation that complies with paragraphs G.3.2.1 and G.3.2.2; or
- (b) mechanical ventilation or air-conditioning system that complies with the ventilation rates given in SS 553 - Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings

is provided.

Note: The requirement in paragraph G.3.1 does not apply to the following rooms or spaces –

- (a) *utility rooms and store rooms not exceeding 6.0 m² in floor area; and*
- (b) *corridors or passageways not exceeding 13 m in length.*

G.3.2 Natural ventilation

G.3.2.1 Natural ventilation shall be provided by means of one or more openable windows or other openings with an aggregate area of not less than –

- (a) 5% of the floor area of the room or space required to be ventilated; and
- (b) in the case of an aboveground car park, 15% of the floor area of the car parking area required to be ventilated.

G.3.2.2 The windows or other openings shall be –

- (a) located such that they open to the exterior of the building or an adjoining open space; and
- (b) in the case of an aboveground car park, permanently located on each level and evenly distributed along the external walls to facilitate cross-ventilation throughout the car park.

Note: *In lieu of natural ventilation, mechanical ventilation may be provided to the following rooms or spaces within residential units –*

- (a) bathroom, toilet or lavatory;*
- (b) basement; and*
- (c) civil defence shelter.*

H SAFETY FROM FALLING

H.1 OBJECTIVE

H.1.1 The objective of paragraph H.2.1 is to protect people from injury caused by falling.

H.2 PERFORMANCE REQUIREMENT

H.2.1 Where there is a vertical drop in level of 1.0 m or more, appropriate measures shall be taken to prevent people from falling from a height.

H.2.2 The requirement in paragraph H.2.1 shall not apply to –

- (a) roofs or other areas generally not intended for human occupation; and
- (b) special service or usage areas such as loading or unloading bays, stages for performance or entertainment.

H.3 ACCEPTABLE SOLUTION

H.3.1 The requirement in paragraph H.2.1 is deemed to be satisfied if a barrier is provided in accordance with the specifications set out in paragraphs H.3.2 to H.3.5.

H.3.2 Height of barrier

H.3.2.1 The height of a barrier shall not be less than -

- (a) 1.0 m at all locations except for locations indicated in (b);
- (b) 900 mm at the lower edge of the window, stairs, ramps and gallery or balcony with fixed seating in areas such as theatres, cinemas and assembling halls.

Note: 1 The height of a barrier is measured vertically from the finished floor level to the top of the barrier.

2 The height of a barrier at the flight of stairs is measured vertically from the pitch line to the top of the barrier.

3. *The requirements in paragraphs H.3.2.1 do not apply to houses built by the owners for their own use.*

H.3.3 **Horizontal loading and design of glass panel barriers**

H.3.3.1 A barrier shall be designed to withstand a horizontal loading as prescribed in BS 6399:Part 1 – Loading for Buildings. Code of Practice for Dead and Imposed Loads.

H.3.3.2 Glass panel barriers shall be designed and installed in accordance with Section 8 of BS 6180 – Barriers in and about Buildings – Code of Practice.

H.3.4 **Size of opening**

H.3.4.1 The lowest 75mm of the barrier at the external wall shall be built solid.

H.3.4.2 The lowest 75 mm of the bay window shall not be operable.

H.3.4.3 In all buildings, except for industrial buildings

(a) the size of any opening or gap in a barrier shall not be large enough as to permit the passage of a sphere of a diameter of 100 mm; and

(b) The barrier at a location where there is a vertical drop in level of 3.0 m or more shall have no toeholds between the height of 150mm and 750mm above the finished floor level. The use of perforated sheet or mesh rigidly fixed over the full barrier height is acceptable provided the openings have a maximum dimension (other than the perimeter) of 50mm.

H.3.4.4 In industrial buildings, the size of any opening or gap in a barrier shall not be large enough as to permit the passage of a sphere of a diameter of 150 mm.

H.3.4.5 For a flight of staircase, any triangular opening or void formed around a tread, riser and the bottom edge of the barrier, the size of any opening or gap shall not be large enough as to permit the passage of a sphere of a diameter of 150 mm.

H.3.4.6 The requirements under paragraph H.3.4 do not apply to promenades and boardwalks at ground level along the waterfront; or houses built by the owners for their own use.

H.3.4.7 The requirements in paragraph H.3.4.3 (b) do not apply to bay windows in a residential unit.

H.3.5 **Glass Barrier**

H.3.5.1 Where glass is used as a part or whole of a barrier, laminated glass shall be used.

H.3.5.2 All glass used must comply with SS 341: Specification for Safety Glazing Materials for Use in Buildings.

I ENERGY EFFICIENCY

I.1 OBJECTIVE

I.1.1 The objective of paragraphs I.2.1 and I.2.2 is to facilitate efficient use of energy.

I.2 PERFORMANCE REQUIREMENT

I.2.1 A building shall be designed and constructed with energy conservation measures to reduce –

- (a) solar heat gain through the roof;
- (b) solar heat gain through the building envelope;
- (c) air leakage through doors, windows and other openings on the building envelope;
- (d) energy consumption of lighting, air-conditioning and mechanical ventilation systems; and
- (e) energy wastage through adequate provisions of switching means.

I.2.2 Commercial buildings with a gross area of more than 500 m² shall be installed or equipped with means to facilitate the collection of energy consumption data.

I.3 ACCEPTABLE SOLUTION

I.3.1 The requirements in paragraphs I.2.1 and I.2.2 are deemed to be satisfied if the design and construction of a building comply with the specifications set out in paragraphs I.3.2 to I.3.8.

I.3.2 Air-conditioned building

I.3.2.1 For all residential buildings with a gross floor area of 2000m² or more, the Residential Envelope Transmittance Value (RETV) of the building, as determined in accordance with the formula set out in the “Code on Envelope Thermal Performance for

Buildings” issued by the Commissioner of Building Control, shall not exceed 25 W/m².

- I.3.2.2 The requirements in paragraphs I.3.2.1 are deemed to be satisfied if a residential building with external walls consisting of masonry construction, satisfies the criteria below:

$$WWR_{\text{Bldg}} < 0.3 \text{ and } SC_{\text{facade}} < 0.7$$

Or

$$WWR_{\text{Bldg}} < 0.4 \text{ and } SC_{\text{facade}} < 0.5$$

Or

$$WWR_{\text{Bldg}} < 0.5 \text{ and } SC_{\text{facade}} < 0.43$$

Where:

WWR: Window to wall ratio

SC: Shading coefficient of fenestration = $SC_{\text{glass}} \times SC_{\text{shading device}}$

- I.3.2.3 For all non-residential buildings with an aggregate air-conditioned area of more than 500m², the Envelope Thermal Transfer Value (ETTV) of the building, as determined in accordance with the formula set out in the “Code on Envelope Thermal Performance for Buildings” issued by the Commissioner of Building Control, shall not exceed 50 W/m².
- I.3.2.4 In respect of roofs with skylight, the roof thermal transfer value (RTTV) as determined in accordance with the formula set out in the “Code on Envelope Thermal Performance for Buildings” issued by the Commissioner of Building Control, shall not exceed 50 W/m².
- I.3.2.5 In respect of roofs without skylight, the average thermal transmittance (U-value) for the gross area of the roof shall not exceed the limit prescribed in Table I1 for the corresponding weight group.

TABLE I1

Maximum thermal transmittance for roof of air-conditioned building

Weight group	Weight range (kg/m ²)	Maximum thermal transmittance (W/m ² °K)
Light	Under 50	0.5
Medium	50 to 230	0.8
Heavy	Over 230	1.2

- Note:*
- 1 *The requirements in paragraphs I.3.2.3 to I.3.2.5 apply to buildings with a gross floor area exceeding 500 m².*
 - 2 *In the case of semi-detached, terraced and linked houses, each unit of the semi-detached, terraced or linked houses is construed as a building for the purpose of the above note (1).*

I.3.3 **Non air-conditioned building**

- I.3.3.1 The thermal transmittance (U-value) of the roof, as determined in accordance with the formula set out in the “Code on Envelope Thermal Performance for Buildings” issued by the Commissioner of Building Control, shall not exceed the limit specified in Table I2 for the corresponding weight group.

TABLE I2

Maximum thermal transmittance for roof of non air-conditioned building

Weight group	Weight range (kg/m ²)	Maximum thermal transmittance (W/m ² ·K)
Light	Under 50	0.8
Medium	50 to 230	1.1
Heavy	Over 230	1.5

- Note:*
- 1 *The requirement in paragraph I.3.3.1 does not apply to the following –*
 - (a) *buildings with a gross floor area not exceeding 500 m²;*
 - (b) *open-sided sheds;*
 - (c) *linkways;*
 - (d) *covered walkways;*
 - (e) *store rooms and utility rooms; and*
 - (f) *plants and equipment rooms.*

- 2 *Where a building is partially air-conditioned and the aggregate air-conditioned area is less than 500 m², the requirement in paragraph 1.3.3.1 shall apply if the total gross floor area of the building exceeds 500 m².*

1.3.4 Air tightness and leakage

1.3.4.1 All windows on the building envelope shall not exceed the air leakage rates specified in SS 212 – Specification for Aluminium Alloy Windows.

1.3.4.2 Where the door opening of any commercial unit is located along the perimeter of the building envelope, that unit shall –

- (a) be completely separated from the other parts of the building; and
- (b) has its air-conditioning system separated from and independent of the central system.

Note: 1 *The requirements in paragraphs 1.3.4.1 and 1.3.4.2 do not apply to non air-conditioned buildings.*

- 2 *The requirement in paragraph 1.3.4.2 also applies to commercial units, the doors of which open into an exterior open space, external corridor, passageway or pedestrian walkway.*

1.3.5 Air-conditioning system

1.3.5.1 Where the cooling capacity of any air-conditioning system exceeds 30 kW, the equipment shall comply with the relevant provisions of SS 530 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment.

1.3.6 Artificial lighting

1.3.6.1 The maximum lighting power budget in a building shall comply with SS 530 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment.

I.3.7 **Switching control**

I.3.7.1 Air-conditioning system shall be equipped with manual switches, timers or automatic controllers for shutting off part of the air-conditioning system during periods of non-use or reduced heat load.

I.3.7.2 Lighting control for artificial lighting shall be provided in accordance with SS 530 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment.

I.3.7.3 In any hotel building, a control device acceptable to the Commissioner of Building Control, shall be installed in every guestroom for the purpose of automatically switching off the lighting and reducing the air-conditioning when a guestroom is not occupied.

I.3.8 **Energy auditing**

I.3.8.1 For buildings used as offices, shops, hotels or a combination thereof, suitable means for the monitoring of energy consumption shall be provided to all incoming power supply to a building and the sub-circuits serving –

- (a) a central air-conditioning system;
- (b) a major mechanical ventilation system;
- (c) a vertical transportation system;
- (d) a water pumping system;
- (e) the general power supply to tenancy areas;
- (f) the general lighting supply to tenancy areas;
- (g) the general power supply to owner's premises; and
- (h) the general lighting supply to owner's premises.

J ROOF

J.1 OBJECTIVE

J.1.1 The objective of paragraph J.2.1 is to protect the roof of semi-detached houses, terraced houses and linked houses from physical damage when repairs, alterations or additions to the roof of an adjoining house are being carried out.

J.2 PERFORMANCE REQUIREMENT

J.2.1 The roof shall be designed and constructed such that the roof of every house is separate and independent of each other.

J.3 ACCEPTABLE SOLUTION

J.3.1 The requirement in paragraph J.2.1 is deemed to be satisfied if the party wall is extended above the level of the roof so that each roof is separate and independent of the roof of the adjoining house.

K LIFTS AND ESCALATORS

K.1 OBJECTIVE

K.1.1 The objective of paragraphs K.2.1 and K.2.2 is to provide a convenient means of vertical transportation and to protect people from injury while using the lifts or escalators.

K.2 PERFORMANCE REQUIREMENT

K.2.1 Lifts and escalators shall –

- (a) move people safely; and
- (b) not produce excessive acceleration or deceleration.

K.2.2 A building comprising 5 or more storeys (including the ground level) shall be provided with one or more passenger lifts.

K.3 ACCEPTABLE SOLUTION

K.3.1 The requirements in paragraphs K.2.1 and K.2.2 are deemed to be satisfied if –

- (a) the lifts are designed and installed in accordance with the requirements of SS 550 - Code of Practice for Installation, Operation and Maintenance of Electric Passenger and Goods Lifts; and
- (b) the escalators are designed and installed in accordance with SS CP 15 - Code of Practice for Installation, Operation and Maintenance of Escalators and Passenger Conveyors.

L LIGHTNING PROTECTION

L.1 OBJECTIVE

L.1.1 The objective of paragraph L.2.1 is to protect a building from the direct effects of lightning strike and to protect its occupants from the risk of lightning current being discharged through the building.

L.2 PERFORMANCE REQUIREMENT

L.2.1 A lightning protection system shall be capable of protecting the building and its occupants from the effects of lightning strike.

L.3 ACCEPTABLE SOLUTION

L.3.1 The requirement in paragraph L.2.1 is deemed to be satisfied if the lightning protection system is designed and installed in accordance with SS 555 - Code of Practice for Protection Against Lightning.

M SAFETY OF WINDOWS

M.1 OBJECTIVE

M.1.1 The objective of paragraphs M.2.1 and M.2.2 is to protect people from injury caused by falling windows.

M.2 PERFORMANCE REQUIREMENT

M.2.1 A window system shall be adequately designed and constructed with appropriate materials for its intended use.

M.2.2 A casement window system shall have –

- (a) fasteners, fixings, hinges and stays of adequate number, size and strength to safely support the weight of the window system and other loads imposed on it;
- (b) a structural frame profile that is of adequate size and strength and adequately reinforced at locations where screws or rivets are to be affixed; and
- (c) appropriate design and materials used to minimise occurrence of localised corrosion.

M.3 ACCEPTABLE SOLUTION

M.3.1 In the case of aluminium alloy window, the requirements in paragraphs M.2.1 and M.2.2 are deemed to be satisfied if such window is designed and constructed in accordance with SS 212 – Specification for Aluminium Alloy Windows.

N USE OF GLASS AT HEIGHT

N.1 OBJECTIVE

N.1.1 The objective of paragraph N2 is to protect persons from injury cause by spontaneous breakage of glass elements at height and by falling glass panels resulting from bond failure of structural sealant.

N.2 PERFORMANCE REQUIREMENT

N.2.1 Where glass is used as a part or whole of the facade, roof, canopy or other type of overhead glazing of a building located at height of 2.4 metres or more, appropriate measures shall be taken to minimise the risk of injury to people in the event of spontaneous breakage of such glass elements.

N.2.2 Where structural sealant glazing is used in a glass curtain wall or other glass installation located at a height of 2.4 metres or more, whether situated within the interior or forming the exterior of a building, appropriate measures shall be taken to minimise the risk of injury to people in the event of falling glass panels resulting from bond failure of the structural sealant.

N.3 ACCEPTABLE SOLUTION

N.3.1 The requirement in paragraphs N.2.1 is deemed to be satisfied if the specifications set out in paragraphs N.3.2 to N.3.4 are complied with.

N.3.2 Float (or annealed) glass, heat strengthened glass, laminated glass or other type of glass that is not prone to spontaneous breakage shall be used as the glass material at height.

N.3.3 Where monolithic tempered glass, heat-soaked tempered glass or other types of glass that are prone to spontaneous breakage is used in the facade, roof, canopy or other type of overhead glazing located at a height of 2.4 metres or more, the design of the facade, roof, canopy or overhead glazing shall provide for suitable protection such as installation of screens or shields to protect

people from any injury in the event of breakage of such glass elements at height.

N.3.4 Where the glass is used as a part or whole of the facade, roof, canopy or other type of overhead glazing, the glass used shall comply with SS 341: Specification for Safety Glazing Materials for Use in Buildings.

N.3.5 The requirement in paragraph N.2.2 is deemed to be satisfied if the specifications set out in paragraphs N.3.6 to N.3.8 are complied with.

N.3.6 The structural sealant glazing (SSG) shall be constructed to be of

- (a) two-sided SSG type; or
- (b) four-sided SSG type with retaining devices

Note: 1 *The requirement in paragraph N.3.6(b) is illustrated in Figure N1*

2 *Retaining devices are to be designed and constructed to prevent any fall of facade panels in the event of bond failure of the structural sealant.*

N.3.7 Mechanical self-weight supports shall be provided for all glass panels of the SSG.

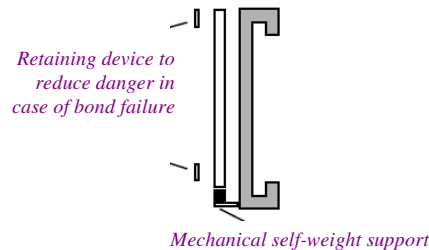


Figure N1

Four-sided SSGS with mechanical self-weight and retaining devices

N.3.8 The SSG shall be designed and constructed in accordance with the following Standards –

- (a) ASTM C1184: Standard Specification for Structural Silicone Sealants and ASTM C1401: Standard Guide for Structural Sealant Glazing; or

- (b) BS EN 13022-2: 2006: Glass in Building - Structural Sealant Glazing and BS EN 15434: 2006: Glass in Building – Product Standard for Structural and/or Ultra-violet Resistant Sealant.