Building and Construction Authority

APPROVED DOCUMENT

ACCEPTABLE SOLUTIONS

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

Version 7.07
March 2025

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 make 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 reference 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>	04 May 2009

S/N	Brief description of changes	Revision date
	a) Paragraph B.3.2.1 (c) – Incorporates current practice on wind loads. b) Paragraph B.3.3.1 (a) – Facilitate use of concrete with strength greater than 60 N/mm^2. 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 (i) – 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 with 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 BD 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 (l) – 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 SS 476 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. <u>Section H:</u> 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.	
9	Ver 3.01 – Revision to Section H on Safety from Falling:	16 Jul 2009

S/N	Brief description of changes	Revision date
	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 renumbered to become new paragraph H.3.4.7.	
10	Ver 3.02 – SS CP 2 referred to in Section K has been amended to SS 550 to reflect the change.	16 Jul 2010
11	Ver 3.03 – 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	Ver 4.0 – The revisions are as follows: 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
13	Ver 5.0 – Revisions to Section B on Structural Design and Construction and Section H on Safety from Falling. <u>Section B:</u> a) Paragraph B.3 – Addition of new paragraphs B.3.1a, B.3.1b and B.3.1c to incorporate the Eurocodes as part of the acceptable solutions. b) Paragraph B.3.2.1 – Addition of table showing the standards to be used with the adoption of the Eurocodes. c) Paragraph B.3.2.1 (b) – Incorporate BS 4592. d) Paragraph B.3.2.1 (e) – Revised for clarity. e) Paragraph B.3.2.1 (g) – Addition of new paragraph on Seismic Loads. f) Paragraph B.3.3.1 – Addition of table showing the standards to be used with the adoption of the Eurocodes. g) Paragraph B.3.3.1 (d) – Precast concrete structures omitted and the remaining paragraphs are renumbered. h) Paragraph B.3.3.1 (k) – Paragraph on Cranes omitted for clarity and the remaining paragraphs are renumbered. i) Paragraph B.3.3.1 (k) – ACI 440.2R-02 amended to ACI 440.2R. j) Paragraph B.3.3.1 (m) – Addition of new paragraph on Glass. k) Paragraph B.3.3.1 (n) – Addition of new paragraph on Seismic Loads l) Paragraph B.3.4.1 – Incorporate SS EN 1997-2 for use with the adoption of the Eurocodes. m) Paragraph B.3.5.1 – Incorporate BS 6031 for use with the adoption of the Eurocodes. n) Paragraph B.3.6.1 – SS 557:2010 amended to SS 557. o) Paragraph B.3.7.1 – Addition of table showing the standards to be used with the adoption of the Eurocodes. p) Paragraph B.3.7.1 (a) – Incorporate BS EN 15743	01 Apr 2013

S/N	Brief description of changes	Revision date
	q) Paragraph B.3.7.1 (b) – Incorporate BS 6699 for this transition period to the Eurocodes. r) Paragraph B.3.7.1 (e) – Incorporate BS 4483, SS 560 and SS 561. s) Paragraph B.3.7.1 (f) and (g) – Combined and revised as a new paragraph B.3.7.1 (f) on Prestressing wires. t) Paragraph B.3.7.1 (h) – BS EN 934-2 is replaced by SS EN 934. u) Paragraph B.3.7.1 (i) – SS 470 is replaced by BS EN 10210. v) Paragraph B.3.7.1 (i) – Incorporate BC 1. w) Paragraph B.3.7.1 (l) – Incorporate BS EN 14080 and BS EN 14081. x) Paragraph B.3.8.1 – Addition of table showing the standards to be used with the adoption of the Eurocodes. y) Paragraph B.3.8.1 (c) – Incorporate BS 3148 in for this transition period to the Eurocodes. z) Paragraph B.3.8.1 (d) – Incorporate SS 78 in for this transition period to the Eurocodes. aa) Paragraph B.3.8.1 (e) – Incorporate SS 320 in for this transition period to the Eurocodes. bb) Paragraph B.3.8.1 (g) – Incorporate BS EN 10210, BS EN 10219, BS EN 10088 and BC 1. cc) Paragraph B.3.8.1 (i) – BS EN 1290, BS EN 1291, BS EN 1714 and BS 3923 are replaced by BS EN ISO 17638, BS EN 23278 and BS EN ISO 17640. dd) Paragraph B.3.8.1 (k) – Incorporate BS EN 14080 and BS EN 14081. <u>Section H:</u> Paragraph H.3.3.1 – Addition of table showing the standards to be used with the adoption of the Eurocodes. <u>New Annexes:</u> a) Addition of Annex A – Structural design standards based on the Eurocodes and the corresponding Singapore National Annexes. b) Addition of Annex B – Comparative list of Singapore/British standards and their equivalent Singapore/European Standards.	
14	Ver 6.0 – <u>Section M:</u> Paragraph M.2.2 – Revised to amend performance requirements to cover all window types and not just for casement windows.	28 Oct 2013
15	Ver 6.01 – <u>Section C:</u> a) Paragraph C.2.2 – Revised to limit the exemption to attic rooms, toilets, bathrooms, lavatory and store room: i. attic rooms of area 10m^2 or less, built by the owners for their own use; ii. toilets, bathrooms or lavatories within houses built by the owners for their own use; iii. store room of area 6m^2 or less. b) Addition of new Paragraph C.3.2.2 on headroom requirement within a sheltered carpark. c) Addition of new Paragraph C.3.2.2 Note 4 to clarify on the manner in which headroom is measured on staircases.	1 Apr 2014

S/N	Brief description of changes	Revision date
	d) Paragraph C.3.3.1.Note 1 – Addition of new paragraph to exempt ceiling height requirement for toilets, bathrooms, lavatories or powder rooms. e) Paragraph C.3.3.1.Note 2 – Revised for clarity. <u>Section D:</u> a) Renamed to "Accessibility in Built Environment". b) Paragraph D.1.1 – Revised to incorporate new requirements that will benefit the young and parents or caregivers with infants. c) Paragraph D.2.2 – Revised to incorporate new requirements that will benefit the young. d) Paragraph D.2.3 – Revised to incorporate new requirements that will benefit parents or caregivers with infants. e) Paragraph D.2.4 – Revised to incorporate new requirements on audible and tactile information providing directions or instructions. f) Paragraph D.3.1 – i. Revised to include the young and parents or caregivers with infants. ii. Renamed Code document to "Code on Accessibility in the Built Environment". <u>Section E:</u> a) Paragraph E.1.1 – Amended the typographical error and updated omission of Paragraph E.2.3. b) Paragraph E.2.3 – Omitted. c) Paragraph E.3.1 – Updated omission of Paragraphs E.3.6 and E.3.8. d) Paragraph E.3.3.1 – Revised to clarify the width requirement refers to a clear width. e) Paragraph E.3.3.1.Note 2(c) – Revised to limit the exemption to attic rooms of area 10m^2 or less. f) Paragraph E.3.4.2 – Revised to require minimum tread width of 275mm in all buildings except in industrial buildings and residential units. g) Addition of Paragraph E.3.4.2A – Tread requirement in residential units. h) Addition of Paragraph E.3.4.2B – Tread requirement in industrial buildings. i) Paragraph E.3.4.3 – Revised for clarity. j) Paragraph E.3.4.Note 1 – Revised for clarity. k) Paragraph E.3.4.Note 2(c) – Revised to limit the exemption to attic rooms of area 10m^2 or less. l) Paragraph E.3.5.2 – Revised to omit circular and geometric staircase. m) Paragraph E.3.5.3 – Revised to take into consideration chamfered landing. n) Paragraph E.3.5.4 – Revised to Paragraph E.3.5.4 and new Paragraph E.3.5.5 for clarity. o) Paragraph E.3.5 Note – i. Note (c) – Revised to limit the exemption to attic rooms of area 10m^2 or less. p) Paragraph E.3.6 – Moved to requirements under Section C, and the remaining paragraphs are renumbered. q) Paragraph E.3.6 (renumbered from Paragraph E.3.7) – i. Paragraph E.3.6.2 – Revised to change the max. height of handrail to 1000mm. ii. Addition of new Paragraphs E.3.6.3 and E.3.6.4.	

S/N	Brief description of changes	Revision date
	iii. Paragraph E.3.6 Note.1 – Omitted and the remaining paragraphs are renumbered. iv. Paragraph E.3.6 Note.2 – Amended to require handrail to be continuous throughout the entire length of stairs. r) Paragraph E.3.8 – Moved to requirements under Section H. <u>Section G:</u> a) Addition of new Paragraph G.3.1A to exempt store room of area not exceeding 6m^2 and private lift lobby of area not exceeding 6m^2. b) Paragraph G.3.1.Note – Omitted. c) Paragraph G.3.2.1 – Revised ventilation requirement for above ground car park. d) Addition of new Paragraph G.3.2.1.Note for clarity on the calculation of effective open area for natural ventilation for various types of openings. e) Paragraph G.3.2.2 – Amendments for clarity for acceptable sources for natural ventilation f) Paragraph G.3.2. Note – Paragraph is moved to new Paragraph G.3.2.1A and revised to allow fitness room and clubhouse within residential developments to be mechanically ventilated. g) Addition of new Paragraph G.3.2.3 to set a maximum distance (12.0m) for effective natural ventilation. <u>Section H:</u> a) Paragraph H.1.1 – Revised for clarity and to include new Paragraphs H.2.1A and H.2.1B. b) Paragraph H.2.1 – Addition of new Paragraphs H.2.1A and H.2.1B. c) Paragraph H.2.2.(a) – Revised to improve the safety of occupants in buildings. d) Paragraph H.2.2.(b) – Revised to clarify the scope of “special service or usage areas” in the original paragraph. e) Paragraph H.3.1 – Revised to include new paragraphs H.2.1A and H.2.1B f) Paragraph H.3.2.1.(b) – Revised to standardize the minimum safety barrier height requirement at stairs and ramps to 1.0m. g) Paragraph H.3.2.1. Note – Addition of new paragraph H.3.2.1. Note 3 to clarify the measurement of safety barrier height where a foothold is provided next to the safety barrier. h) Paragraph H.3.4.1 – Revised to standardize the application of the requirement to all safety barriers and clarify the intent of the requirement. i) Paragraph H.3.4.3.(b) – Paragraph is moved to new Paragraph H.3.4A and revised to provide greater clarity on the climbability requirements. j) Addition of new Paragraph H.3.4.4A to relax the requirement on gap size for safety barriers in maintenance areas. k) Paragraph H.3.4.5 – Revised and addition of new paragraphs (b) and (c) to prevent little children from slipping through gaps in-between steps. l) Paragraph H.3.4.7 – Paragraph is move to new Paragraph H.3.4A. m) Addition of new Paragraph H.3.4A. <u>Section N:</u> Paragraph N.2.1 – Revised to amend performance requirement to provide greater clarity.	

S/N	Brief description of changes	Revision date
	<u>Section O:</u> Addition of a new Section O on Protection from Injury by Vehicles in Buildings.	
16	Ver 6.1 – Revision to Section B on Structural Design and Construction and Section K on Lifts and Escalators <u>Section B:</u> a) Paragraph B.3.7.1 (i) – Incorporate BS EN 10340, BS EN 1559-1 and 2. b) Paragraph B.3.7.1 (m) – New paragraph on the selection and installation of post-installed anchors using BS 8539. c) Paragraph B.3.8.1 (g) – Incorporate BS EN 10340, BS EN 1559-1 and 2, BS EN 1369, BS EN 12680-1 and 2, and BS EN 12681. <u>Section K:</u> Addition of new Paragraph K.3.2 to incorporate the acceptable solutions for the design, installation and operation of vertical platform lifts and stair lifts.	01 Oct 2014
17	Ver 6.2 – Addition of a new Section P on Daylight Reflectance	27 Jun 2016
18	Ver 6.3 – Deletion of the words “or air-conditioning system” from paragraph G.3.1(b) and addition of new paragraph G.3.1(c) on new requirements for air-conditioning system for all types of building works.	01 Apr 2017
19	Ver 6.4 – Amendments to section K on Lifts and Escalators a) Addition of new requirements for lifts and escalators in Paragraph K.3.1(a)(ii), (iii) & (iv) and (b)(ii) & (iii). b) Paragraph K.3.1.(b)(i) – SS626 to replace CP15 as the acceptable solution for escalators. c) Paragraph K.3.1 – Addition of definition for light curtain. d) Paragraph K.3.2 – Addition of definition for stairlifts and vertical platform lifts. e) Addition of new Paragraph K.3.3 to incorporate the acceptable solutions and definition for home lifts.	01 Mar 2018
20	Ver 7.0 – The revisions are as follows: a) Addition of new performance requirements requirement in paragraph B.2.1A for a floating structure on a body of water. b) Paragraphs B.2.2 and B.2.4 – Addition of “or structure” after the word “building”. c) Paragraphs C.2.1 and C.2.2 deleted and replaced by new paragraphs C.2.1, C.2.2 and C.2.3. d) Note (1) after paragraph C.3.3.1 removed *(relocated to paragraph C.2.3)*. e) Revision made to paragraph E.2.2 and addition of paragraphs E.2.3 and E.2.4. f) The “Note” after paragraph E.3.5.5 and the “Note (2)” after paragraphs E.3.3.1, E.3.4.4 and E.3.6.4 are removed *(relocated to paragraphs E.2.3 and E.2.4)*. g) Revision made to paragraph F.1.1. h) Addition of paragraph F.2.3. i) Note (2) after paragraph F.3.2.1 removed *(relocated to paragraph F.2.3)*.	25 May 2018

S/N	Brief description of changes	Revision date
	j) Addition of paragraphs G.2.3 and G.2.4. k) Paragraph G.3.1A is removed *(relocated to paragraph G.2.3)*. l) Paragraph G.3.2.1A is removed *(relocated to paragraph G.2.4)*. m) Revision made to paragraph H.2.1A. n) Addition of paragraphs H.2.3, H.2.4 and H.2.5. o) Note (4) after paragraph H.3.2.1 is removed *(relocated to paragraph H.2.3)*. p) Paragraph H.3.4.6 s removed *(relocated to paragraph H.2.4)*. q) Paragraph H.3.4A is removed *(relocated to paragraph H.2.5)*. r) Addition of paragraph I.2.3. s) Note (1) after paragraph I.3.3.1 is removed *(relocated to paragraph I.2.3)*. t) Addition of paragraphs K.2.3, K.2.4 and K.2.3.5.	
20	Ver 7.01 – Corrected error in paragraph C.2.3. The paragraph should read "The requirement in paragraph C.2.1(b) does not apply…" and not "The requirement in paragraph C.2.1(a) does not apply…".	20 Jun 2018
21	Ver 7.02 – The revisions are as follows: a) Paragraph A.1.1 – editorial change: delete "a safe disabled-friendly and energy efficient building" and replace with "a safe, accessible and energy efficient building". b) Paragraph B.3.3.1 – A. add to the third column for "(c) Steel structures; composite steel and concrete structures" the following: "(iv) Design Guide for Concrete Filled Tubular Members with High Strength Materials – BC4". B. replace "(i) Design of timber structures – BS EN 1995" in the third column for "(f) Timber structures" with the following: "(i) Design of timber structures – SS EN 1995-1-1, SS EN 1995-1-2". C. add to the third column for "(i) Assessment of concrete" the following: "(ii) Complementary guidance to that given in SS EN 13791 – SS 592". c) Paragraph B.3.7.1 – add to the third column for "(i) Structural steel" the following: "(ix) Open die steel forgings for general engineering purposes – BS EN 10250-1 and BS EN 10250-2". d) Paragraph C.3.2.1 – editorial change: replace "less than 2.0m" with "less than 2.0 metres". e) Paragraph C.3.2.2 – A. editorial change: replace "less than 2.2m" with "less than 2.2 metres". B. delete Notes 2, 3 and 4 and replace with the following: *"2 The headroom is measured from the finished floor level to –* *a) in the case of a doorway, the underside of the transom;* *b) in the case where a window opens into an access route or circulation space, the underside of the opened window, or* *c) in all other cases, the underside of any beam, duct, service pipe, fixture, fitting or other obstruction or projection.* *3 The headroom along a flight of staircase is measured vertically between the pitch line and any point directly above*	05 Jul 2019

S/N	Brief description of changes	Revision date
	that limits the headroom. See Figure C.3.2.1(a) for illustration of headroom measurement at staircases. *4 The pitch line is the notional line joining the leading edge or nosings (if any) of successive stair treads within a flight of a stairway."* f) Paragraph E.3.1 – editorial change: replace "set out in paragraphs E.3.2 to E.3.6" to set out in paragraphs E.3.2 to E.3.7". g) Paragraph E.3.2.1 – A. editorial change: delete all and replace with the following: "No projection, other than handrails, is allowed into the space of a staircase that is within a height of 2.0 m from the landing or pitch line". B. add the following: "Note: The pitch line is the notional line joining the leading edge or nosings (if any) of successive stair treads within a flight of a stairway." h) Paragraph E.3.3 – editorial change: replace "clearance of the with" with "clear width". i) Paragraph E.3.4.1 – add "(see Figure E.3.4.2(a) for measurement of "riser")". j) Paragraphs E.3.4.2, E.3.4.2A and E.3.4.2B – editorial change: delete all and replace with the following: "*E.3.4.2 The width of a tread of a staircase (see Figure E.3.4.2(a) for measurement of "tread") shall not be less than:* *a) 225 mm, if the staircase is in a residential unit within a residential building;* *b) 250 mm, if the staircase is in an industrial building, or* *c) 275 mm, if the staircase is in any other type of building, including common staircases in a residential building."* k) Paragraphs E.3.4.3 – editorial change: replace "shall be taken as that when measured" with "shall be measured". l) Paragraphs E.3.5.3 – editorial change: delete "See Figure E.3.5.3(a)" and replace with "See Figure E.3.5.3(a) and (b) on how to measure landing width". m) Figure E.3.5.3(a) – delete and replace with new "Figure E.3.5.3(a)" and new "Figure E.3.5.3(b)". n) Paragraphs E.3.5.4 and E.3.5.5 – delete both and replace with the following: "*E.3.5.4 A landing shall not have any step or drop, except that in a dwelling unit, one winder is allowed in every 90 degrees turn in the staircase. Note: A 'winder' means a tread within a straight flight that is used to change the direction of the stair. A winder will not halt a person's fall and therefore will be counted as a riser in a flight of stairs.*" o) Paragraph E.3.6 – editorial change: replace "flight of staircase" with "flight of any staircase with more than 5 steps". p) Paragraph E.3.6.3(a) – replace "circular section of 32 mm" with "circular section from 32 mm". q) Paragraph E.3.6.3(b) – editorial change: replace "wall surface" with "wall surfaces". r) Paragraph E.3.6.3(b)(ii) – editorial change: replace "at least 30 mm" with" not less than 60 mm". s) After Figure E.3.6.4(a) – rename "Note: 1" to "E.3.6.5". t) New paragraph E.3.7 – add new paragraphs E.3.7.1, E.3.7.2, E.3.7.3 and E.3.7.4" and new Figure E.3.7.1(a) on Stair Nosings.	

<table>
<tr><th>S/N</th><th>Brief description of changes</th><th>Revision date</th></tr>
<tr><td></td><td>
u) Paragraph F.3.2.1 – remove Note 2.
v) Paragraph G.3.2.1 – add to Note, after “unobstructed”, the following: “and for the purposes of paragraph G.3.2.1, the effective open area may be taken as the entire area of the opening.
w) Paragraph G.3.2.2 – editorial change: delete G.3.2.2 and replace with the following: “G.3.2.2 All windows and openings intended for natural ventilation shall be located such that they open to –
a) the exterior of the building;
b) an airwell with a minimum width of 3.0m and a minimum area open to the sky complying with Table G.3.2.2(a); or
c) a recess, exceeding 3.0m from the external building wall, and of minimum width 3.0m. See Figure G.3.2.2(b) for illustration.”
x) Table G.3.2.2(a) Dimension of airwells – remove Table and replace with revised table as follows:
<table>
<tr><td>Height of airwell</td><td>Minimum airwell size (m^2)</td></tr>
<tr><td>Not more than 30 m</td><td>10</td></tr>
<tr><td>For each additional 3m height, or part of, beyond 30 m</td><td>Add 1 to the minimum size of 10</td></tr>
</table>
y) Figure G.3.2.2(b) Recessed Void Dimension – replace the figure with a new figure for better clarity.
z) Paragraph G.3.2.3 – editorial change: replace “shall be more than 12.0m from any window/opening ventilating the space” with “shall be located more than 12 metres from any window or opening that is used to ventilate the room or space”.
aa) Paragraph H.2.1A(b) – editorial change: replace “must no have” with “must not have”.
bb) Paragraph H.2.2 – editorial change: replace “The requirement in paragraphs H.2.1, H.2.1A and H.2.1B shall not apply” with “The requirement in paragraphs H.2.1, H.2.1A and H.2.1B do not apply”.
cc) Paragraph H.2.5(b) – editorial change: replace “any promenade and boardwalk” with “any promenade or boardwalk”.
dd) Paragraph H.3.2 –
A. paragraph H.3.2.1(a) - editorial change: replace “1.0 m at all locations except for locations indicated in (b);” with “1.0 metre or”
B. Note 3 – editorial change: replace “dimensions more than 150mm by 150mm is provided” with “dimensions more than 150 mm width by 150 mm length is provided”.
ee) Paragraph H.3.3.1 – delete the entire paragraph and table and replace with the following: “A barrier shall be designed to withstand a horizontal loading determined in accordance with SS EN 1991 Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings and the associated Singapore National Annex.”
ff) Paragraph H.3.4 –
A. paragraph H.3.4.1 - editorial change: delete entire paragraph and replace with “There must not be any gap, from the finished floor level to a height no less than 75 mm, at the lowest part of a barrier.
</td><td></td></tr>
</table>

S/N	Brief description of changes	Revision date
	Note: This is to prevent objects from slipping through the base of the barrier and falling off into the space below". B. paragraph H.3.4.2 - editorial change: replace "*The lowest 75mm of the bay window*" with "*The lowest 75 mm section of a bay window*". C. paragraph H.3.4.3, H.3.4.4 and H.3.4.4A - editorial change: delete all three paragraphs and replace with "*H.3.4.3 The size of any opening or gap in a barrier must not be large enough as to permit the passage of –* *(i) in the case of non-industrial buildings, a 100 mm diameter sphere;* *(ii) in the case of industrial buildings, a 150 mm diameter sphere, or* *(iii) in the case of maintenance areas, including plants, equipment rooms, catwalks or maintenance platforms that are accessible only by authorised personnel, a 500 mm diameter sphere.*" D. paragraph H.3.4.5 - editorial change: delete the entire paragraph and sub-paragraphs and replace with *"H.3.4.4 For any flight of staircase –* *(i) the gap size between any two consecutive steps in a flight of staircases shall not be large enough as to permit the passage of –* *(i) in the case of industrial buildings, a 150 mm diameter sphere, or* *(ii) in the case of all other buildings, a 100 mm diameter sphere.* *(ii) the size of any triangular opening, gap or void formed around a tread, riser and bottom edge of the barrier at a staircase in any building other than an industrial building shall not be large enough as to permit the passage of a 150 mm diameter sphere*". gg) Paragraph H.3.4A – A. paragraph H.3.4A.1 - editorial change: delete entire paragraph and replace with "*A barrier must have a height no less than –* *(i) the height specified in paragraph H.3.2.1, or* *(ii) 850 mm when measured from the last climbable toehold;* *whichever is higher. See Figure H.3.4A.1(a) for illustration".* B. paragraph H.3.4A.2 – editorial change: delete entire paragraph and replace with the following: "*Note 1: A toehold means –* *(i) any opening in a perforated sheet or mesh having a horizontal dimension of more than 50 mm and a vertical dimension of more than 30 mm; or* *(ii) any kerb or protrusion having a width of more than 50mm and has a chamfer gentler than 45˚relative to the horizontal plane*. *See Figures H.3.4A.1(b), H.3.4A.1(c) and H.3.4A.1(d) for examples on toehold dimensions*". C. Figure H.3.4A.2(a) – delete and replace with new drawing that is renumbered Figure H.3.4A.1(b). D. Figure H.3.4A.2(b) – delete and replace with new drawing that is renumbered Figure H.3.4A.1(c). E. Figure H.3.4A.2(c) – renumber the figure as "Figure H.3.4A.1(d).	

S/N	Brief description of changes	Revision date
	F. paragraph H.3.4A.3 – editorial change: delete entire paragraph and replace with "*Note 2: A toehold is considered to be climbable if it is located within 600 mm vertically from –* *(i) the finished floor level;* *(ii) a step; or* *(iii) another climbable toehold*". hh) Paragraph K.1.1 – editorial change: replace "*The objective of paragraphs K.2.1 and K.2.2 is to*" with "*The objectives of paragraphs K.2.1, K.2.2, K.2.3 and K.2.4 are to*". ii) Paragraph K.3.4 – add as a new paragraph on mechanical fasteners. jj) Paragraph M.3.1 – editorial change: replace "*In the case of aluminium alloy"* with "In *the case of an aluminium alloy*". kk) Paragraph N.3.2 – replace "*Float (or annealed) glass*" with "*Except as provided in N.3.3, float (or annealed) glass*". ll) Paragraph N.3.6(b) – editorial change: delete entire sub- paragraph and replace with the following: "*four-sided SSG type with retaining devices that are to be designed and constructed to prevent any fall of façade panels in the event of bond failure of the structural sealant*", and delete Note 2 that comes after the paragraph. mm) Figure N1 – rename to "*Four-sided SSG with mechanical self-weight and retaining devices*". nn) Paragraph N.3.8(b) – replace "BS EN 13022-2: 2006" with "BS EN 13022-2" and "BS EN 15434: 2006" with "BS EN 15424". oo) Paragraph O.3.2 – editorial change: delete entire paragraph and replace with "*The vehicular barrier should be capable of resisting forces set out in SS EN 1991*". pp) Add new paragraph O.3.3 – "*Notwithstanding paragraph O.3.2, in the case of a vehicular barrier in a project where the first structural plans have been submitted for approval by the Commissioner of Building Control before 1 April 2015, the vehicular barrier may be designed to be capable of resisting forces set out in BS 6399-Part 1: Loading for Buildings. Code of Practice for Dead and Imposed Loads*". qq) Paragraph P.3.2 – editorial changes: A. sub-paragraph P.3.2(a): replace "*The glass for*" with "*the glass for*". B. sub-paragraph P.3.2(b): delete the entire sub- paragraph and replace with the following: *"any material, other than glass, for the building work on –* *(i) the façade of the building has a specular reflectance not exceeding 10%* *(ii) the roof of the building, inclined at an angle not exceeding 20 degrees from the horizontal plane, has a specular reflectance not exceeding 10%* *(iii) the roof of the building, inclined at an angle more than 20 degrees from the horizontal plane, has a daylight reflectance not exceeding 20% and a specular reflectance not exceeding 10%* C. sub-paragraph P.3.2(c): delete the entire sub- paragraph and replace with the following: "*emulsion paint on plastered or concrete surfaces has a specular reflectance not exceeding 10%.*" rr) Annex A – Structural design standards based on the Eurocodes and the corresponding Singapore National Annexes – *relevant standards are updated*.	

S/N	Brief description of changes	Revision date
	ss) Annex B – Comparative list of Singapore/British standards and their equivalent Singapore/European Standards - *relevant standards are updated.*	
23	Ver 7.02A – The note on "winder" just after E.3.5.4 is removed.	04 Sep 2019
24	Ver 7.03 – The revisions are as follows: a) Paragraph B.3.1.1 – editorial changes A. Replace *"(iv) Design Guide for Concrete Filled Tubular Members with High Strength Materials – BC4"* in the third column for "(c) Steel structures; composite steel and concrete structures" with the following: *"(iv) Design Guide for Steel-Concrete Composite Columns with High Strength Materials – BC4"*. B. Add to the third column for "(c) Steel structures; composite steel and concrete structures" with the following: "*(v) Design Guide for Semi-rigid Composite Joints and Beams*". C. Add new sub-paragraph B.3.3.1(o) *"Fastenings for use in concrete".* D. Add to the third column for "(o) Fastenings for use in concrete" the following: *"(i) Design of concrete structures – Design of fastenings for use in concrete – SS EN 1992-4."* E. Add new sub-paragraph B.3.3.1(p) *"Fibre concrete structures"* F. Add to the third column for "(p) Fibre concrete structures" the following: *"(i) Fibre concrete – Design of fibre concrete structures – SS 674."* b) Paragraph B.3.7.1 – editorial changes A. Replace *"(m) Post-installed anchors"* with the following *"(m) Post-installed anchors and fastenings for use in concrete".* B. Add to the third column for "(m) Post-installed anchors and fastenings for use in concrete" the following: *"(ii) Design of concrete structures – Design of fastenings for use in concrete – SS EN 1992-4."* c) Paragraph E.3.3.1 – editorial changes: A. Replace *"The clearance of the width of every staircase shall not be less than 900 mm"* with the following: *"The clearance of the width of every staircase shall not be less than 1000 mm."* B. Replace Note "*The width is measured from the inner side of the wall, balustrade or handrail.*" with the following: "*If the projection of the handrail into the clear width does not exceed 80 mm on each side of the staircase, the width is measured from (a) the finished surfaces of the walls, if the staircase is enclosed on both sides by walls only, or (b) the finished surface of the wall and the inner side of the balustrade, if the staircase has a wall on one side and a balustrade on the other side, or (c) the inner sides of the balustrades if the staircase has balustrades on both sides. If the projection of the handrail into the clear width exceeds 80 mm on one or more side of the staircase, the clear width of the staircase shall be measured from (a) the finished surface of the wall and the inner side of the handrail, if the staircase has a wall on one side and a handrail on the other side, or (b) the inner sides of the handrails if the staircase has handrails on both sides.*" C. Add new Figure E.3.3.1(a) "*Figure E.3.3.1(a) – Measurement of Clear Width with 80mm or less balustrade / handrail projection*"	01 Dec 2022

S/N	Brief description of changes	Revision date
	D. Add new Figure E.3.3.1(b) "*Figure E.3.3.1(b) – Measurement of Clear Width more than 80mm balustrade or handrail projection*" d) Paragraph E.3.5.3 – editorial changes: A. Replace *"The clear width of any landing, measured from the handrail or kerb (whichever protrudes further into the landing) to the wall or external railing of the landing, shall not be less than 900 mm. See Figure E.3.5.3(a) and (b) on how to measure landing width."* with the following: *"The clearance width of any landing shall not be less than 1000 mm. See Figure E.3.5.3(a) and (b) on how to measure landing width."* B. Figure E.3.5.3(a) – delete and replace with new "Figure E.3.5.3(a)". C. Figure E.3.5.3(b) – delete and replace with new "Figure E.3.5.3(b)". e) Paragraph E.3.6.3 - editorial changes: A. sub-paragraph E.3.6.3(a): replace *"having a circular section from 32 mm to 50 mm in diameter or an equivalent gripping surface; and"* with the following *"have a circular section from 32 mm to 50 mm in diameter or an equivalent gripping surface as shown in Code on Accessibility in the Built Environment, Clause 4.7.3.1(b); and".* f) Paragraph E.3.7 – editorial changes: A. Add New Note *"The requirements on stair nosing in Section E.3.7 do not apply to dwelling units including landed houses. For the avoidance of doubt, the requirements in Section E.3.7 apply to common property such as corridors, lift lobbies etc. within residential developments.".* g) Paragraph G.2.4 – editorial changes: A. sub-paragraph G.2.4(i): replace *"any fitness room"* with the following: *"any fitness room forming part of the communal area or common property;"*. h) Paragraph K.3.1 – editorial changes: A. sub-paragraph K.3.1(a)(ii): replace *"with light curtain installed at the lift door as a door protective device that shall automatically initiate re-opening of the door(s) in the event of a person crossing the entrance during the closing movement, and that the light curtain:"* with the following: *"with light curtain installed at the lift door as a door protective device that shall automatically initiate re-opening of the door(s) in the event of a person crossing the entrance during the closing movement, and that the light curtain shall have its nudging mode de-activated if nudging mode is provided; and"*. B. sub-paragraph K.3.1(a)(ii) – delete sub-paragraph (a), (b), (c) and (d). C. sub-paragraph K.3.1(a)(iii) – delete entire sub-paragraph. D. sub-paragraph K.3.1(a)(iv) – rename to "K.3.1(a)(iv)" to "K.3.1(a)(iii)" E. sub-paragraph K.3.1(a)(iii) – replace *"with a video recorder that has the following minimum specifications –"* with the following *"provided with a video recorder that has the following minimum specifications - ".* F. sub-paragraph K.3.1(a)(iii)(b) - replace *"Capture footage of the entire lift car including in-car floor indicator;"* with the following: *"Capture footage of the entire lift car including in-car floor indicator, lift car door(s) and landing area outside the lift car in front of the lift doors;"*.	

S/N	Brief description of changes	Revision date
	G. sub-paragraph K.3.1(a)(iii)(e) – replace *"Storage of video footage of at least 30 days;"* with the following: *"Storage of video footage for at least 30 days;"*. H. sub-paragraph K.3.1(b)(iii) – replace *"with a video recorder that has the following minimum specifications –"* with the following *"provided with a video recorder that has the following minimum specifications - "*. I. sub-paragraph K.3.1(b)(iii)(b) – replace *"Capture the entire length of the escalator;"* with the following: *"Capture footage of the entire length of escalator including landing floor plates on both the upper and lower landing areas of the escalator;"*. J. sub-paragraph K.3.1(b)(iii)(e) – replace *"Storage of video footage of at least 30 days;"* with the following: *"Storage of video footage for at least 30 days"*. i) Paragraph K.3.2 – editorial changes: replace *"The requirements in paragraphs K2.1 are deemed to be satisfied if vertical platform lifts and stairlifts which are primarily designed for persons with impaired mobility are designed, installed and operated in accordance with the requirements of –*" with the following: *"The requirements in paragraphs K2.1 are deemed to be satisfied if vertical platforms lifts and stairlifts which are primarily design for persons with impaired mobility are designed and installed in accordance with the requirements of -"*. j) Paragraph K.3.2 – editorial changes: A. sub-paragraph K.3.2(c) – replace *"AMSE 18.1 – Safety standard for platform lifts and stairway chairlifts; or"* with the following: *"AMSE A18.1 – Safety standard for platform lifts and stairway chairlifts; or"*. B. sub-paragraph K.3.2(d) – replace *"Other relevant standards which are acceptable to the Commissioner of Building Control."* with the following: *"Other relevant standards which are acceptable to the Commissioner of Building Control; and".* C. Add new sub-paragraph K.3.2(e) *"except for stairlifts and chairlifts, with a telephone, intercom system or any other communication device that enables notification or direct communication with personnel who can initiate an emergency response; and"*. D. Add new sub-paragraph K.3.2(f) *"for vertical platform lifts that are not installed in private homes solely for the use of the occupants, in addition to the above standards, they are provided with a video recorder that has the following minimum specifications –* *i. Capacity to record 24 hours a day, 7 days a week;* *ii. Capture footage of the entire lift platform and platform entrance, from floor to ceiling (if any), and landing area outside the lift platform in front of the landing doors;* *iii. Frame rate of at least 6 frames per second;* *iv. Video resolution of at least 352 x 240 pixels or CIF CCTV resolution; and* *v. Storage of video footage for at least 30 days."* k) Paragraph K.3.3 – editorial changes: replace *"The requirements in paragraph K2.1 are deemed to be satisfied if home lifts are designed, installed and operated in accordance with the requirements of –"* with the following: *"The requirements in paragraph K2.1 are deemed to be*	

S/N	Brief description of changes	Revision date
	satisfied if home lifts are designed, and installed in accordance with the requirements of –". l) Paragraph K.3.3 – editorial changes: A. sub-paragraph K.3.3(b) – replace *"other relevant standards which are acceptable to the Commissioner of Building Control."* With the following: *"other relevant standards which are acceptable to the Commissioner of Building Control; and"*. B. Add new sub-paragraph K.3.3(c) *"with a telephone, intercom system or any other communication device that enables notification or direct communication with personnel who can initiate an emergency response."* C. definition for home lifts – replace *""homelift" means a lift, not being common property, installed in a private home solely for the use of its occupants."* with the following: *""home lift" means a lift, excluding a stairlift or a vertical platform lift, not being common property, installed in a private home solely for the use of its occupants."*. m) Paragraph P.3.2 – editorial changes: A. sub-paragraph P.3.2(b) - replace *"Any material, other than glass, for the building on –"* with the following: *"Any material, other than glass and paint on plastered and concrete surfaces, for the building on –"*. n) Annex A – Structural design standards based on the Eurocodes and the corresponding Singapore National Annexes – editorial changes: A. Add to "Eurocode 2 Design of concrete structures" the following: *"SS EN 1992-4 Design of concrete structures. Design of fastenings for use in concrete."* B. Add to the second column for *"SS EN 1992-4 Design of concrete structures. Design of fastenings for use in concrete."* the following: *"NA to SS EN 1992-4"*	
25	Ver 7.04 – The revisions are as follows: a) Paragraph H.3.1– editorial changes A. Add new sub-paragraph H.3.1A The requirements in paragraphs H.2.1, H.2.1A and H.2.1B are deemed to be satisfied for a safety barrier integrated with window at existing residential buildings, if such safety barrier is in accordance with the standardised design. *Note: For purposes of Regulation 2 of the Building Control Regulations 2003 and paragraph H3.1A, "standardised design" means the standardised design set out in Annex C in this Approved Document.* <u>New Annexes:</u> a) Addition of Annex C – Standardised Designs for replacement and reinstatement of safety barriers integrated with windows in existing residential buildings	01 Mar 2023
26	Ver 7.05 – The revisions are as follows: a) Paragraph C.2 – editorial changes: A. sub-paragraph C.2.2(d) - replace "*any toilet, bathroom or lavatory*" with "*any toilet or bathroom*" B. sub-paragraph C.2.3(b) - replace "*any toilet, bathroom, lavatory or powder room*;" with "*any toilet, bathroom or powder room;"* b) Paragraph C.3.2 – editorial changes: Figure C.3.2.1(a) – delete and replace with new "Figure C.3.2.1(a)".	01 Mar 2024

S/N	Brief description of changes	Revision date
	c) Paragraph E.2.2(a) – editorial change: Add on to "*handrails or guides to assist movement*" with the following: "*(in accordance with paragraph E.3.6.1*);" d) Paragraph E.3.4.4 – editorial changes: Add New Note *"2. Uniformity of risers and treads is applicable to all rooms or spaces under paragraph E.2.4 (except houses built for owner's own use)."* e) Paragraph E.3.5 – A. paragraph E.3.5.3 – editorial change: "*Figure E.3.5.3(b)"* relocated to above paragraph E.3.5.4. B. paragraph E.3.5.4 – editorial change: delete entire paragraph and replace with *"A landing shall not have any step or drop. A winder does not constitute a landing and is only allowed in a dwelling residential unit, where one winder is allowed in every 90 degrees turn in the staircase with a minimum of one tread in between. See Fig. E.3.5.4 on acceptable winder layout."* C. Add new Figure E.3.5.4(a) "*Figure E.3.5.4(a) – Winders as part of total riser count*" f) Paragraph E.3.6.2 – Replace "*The height of the handrail shall be between 750 mm and 1000 mm above the pitch line*." with the following: "*The height of the handrail shall be between 800 mm and 1000 mm above the pitch line*." g) Paragraph E.3.7 – A. Figure E.3.7.1(a) – delete and replace with new "Figure E.3.7.1(a) Stair nosing" B. Paragraph E.3.7.3 – Replace "*All steps must be fitted with nosing strips between 50 mm and 65 mm in width.*" with the following: "*All steps must be fitted with nosing strips between 50 mm and 75 mm in width.*" C. *"Note:"* after Paragraph E.3.7.4 – editorial changes: replace the term *"dwelling"* with *"residential".* h) Paragraph F.2.3 – editorial changes: sub-paragraph F.2.3(a) - replace "*any toilet, bathroom or lavatory;*" with "*any toilet or bathroom;*" i) Paragraph G.2.3 – delete all and replace with the following: "*The requirement in paragraph G.2.1 does not apply to any of the following rooms or spaces not exceeding an area of 6 square metres –* *(a) any store room;* *(b) any private lift lobby;* *(c) any walk-in wardrobe;"* j) Paragraph G.2.4 – editorial changes: sub-paragraph G.2.4(iv) – replace "*any toilet, bathroom or lavatory;*" with "*any toilet or bathroom;*" k) Paragraph H.2.2 – editorial changes: sub-paragraph H.2.2(a) - replace "*any roof which is accessible for maintenance purposes only and not easily accessible to the public;*" with "*any roof or maintenance area which is not easily accessible;"* *l)* Paragraph H.3.2 – editorial changes: A. delete and replace "*Note: 3."* with the following: "*3. A kerb, protrusion or flat surface with dimensions more than*	

S/N	Brief description of changes	Revision date
	150 mm width by 150 mm length must be not less than 1000 mm away from the top of the barrier. B. Add New Note *"4. Where a kerb, protrusion or flat surface with dimensions more than 150 mm width by 150 mm length is provided next to a barrier, the height of the barrier shall be measured from the top of the kerb, protrusion or flat surface."*	
27	Ver 7.06 – The revisions are as follows: Paragraph K3.2 – Add new sub-paragraph K.3.2(d) *"Code of Practice for installation, operation and maintenance of vertical platform lift with enclosed platform and automatic sliding doors; or"*	03 Jun 2024
28	Ver 7.07 – The revisions are as follow: a) Contents page have been amended with the deletion of Annex B and Annex C has been labelled as Annex B. b) Section B - References to the old, superseded Singapore/British standards have been removed. c) Paragraph B.3.3.1 – Complementary guidance to SS EN 13791 – SS592 has been removed. d) Paragraph B.3.3.2 -Add requirements for design of earth retaining or stabilizing structures. e) Paragraph E.3.6.3 – Editorial Changes: Delete "Clause 4.7.3.12(b)" f) Paragraph G.3.2.1- Editorial Changes to add "effective open area" and amend the existing Note (c) to include formula for effective open area. g) Paragraph H.3.3.1A deleted. h) Section I deleted i) Paragraph K.2.2 - Editorial Changes to add "and any basement level". j) Paragraph O.3.3 deleted. k) Deleted Annex B – Comparative list of Singapore / British standards and their equivalent Singapore / European Standards'. l) Annex C – deleted.	01 Mar 2025

* * *

CONTENTS

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, accessible 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 –

Abbreviation or Symbol	Definition
BS	British Standard
CP	Code of Practice
^{o}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 cause 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.2.1A A floating structure on a body of water, including the foundation of the structure, must be designed and constructed so that the combined dead, imposed, wind and other intended loads can be sustained and transmitted by the floating structure to the body of water supporting the structure –

B.2.2 The building or structure 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 structure 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 structure 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.3.1a Structural design standards shall be based on the Eurocode design standards. Mixing the Eurocode design standards with the old superseded Singapore/British design standards within the same building design is not acceptable.

B.3.1b Any reference to the Eurocodes must be taken to include reference to the relevant Singapore National Annex listed in Annex A. However, in the absence of Singapore National Annex, reference shall be made to the relevant UK National Annex.

B.3.1c Similar to the design standards, the use of the Eurocodes will require the product and execution standards to be based on the equivalent Singapore/European standards.

B.3.2 **Loads**

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

Type of loads	Standards
(a) Dead loads	(i) Actions on structures – General actions - Densities, self-weight and imposed loads for buildings - SS EN 1991- 1-1.
(b) Imposed floor and ceiling loads, dynamic loads due to crowd movement, loads on balustrades, loads on vehicular barrier for car parks, accidental loads on parapets and balustrades, loads on vehicular barrier for car parks, accidental loads	(i) Actions on structures – General actions - SS EN 1991; and (ii) Industrial type flooring and stair treads - BS 4592.
(c) Wind loads	(i) Actions on structures – General actions - Wind actions - SS EN 1991-1-4.
(d) Imposed roof loads	(i) Actions on structures – General actions - Densities, self-weight and imposed loads for buildings - SS EN 1991 - 1-1.

Type of loads	Standards
(e) Crane loads	(i) Actions on structures – Actions induced by cranes and machinery - SS EN 1991-3.
(f) Vehicular bridge live loads	(i) Actions on structures – Traffic loads on bridges – SS EN 1991- 2.
(g) Seismic loads	(i) Design of structures for earthquake resistance – General rules, seismic actions and rules for buildings - SS EN 1998-1.

B.3.3 **Structural Design**

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

Type of structures	Standards
(a) Reinforced and prestressed concrete structures	(i) Design of concrete structures – SS EN 1992.
(b) Bridges	(i) Design of concrete structures – Concrete bridges – Design and detailing rules – SS EN 1992-2; (ii) Design of steel structures – Steel bridges – SS EN 1993- 2; and (iii) Design of composite steel and concrete structures – General rules and rules for bridges – SS EN 1994- 2.
(c) Steel structures; composite steel and concrete structures	(i) Design of steel structures - SS EN 1993; (ii) Design of composite steel and concrete structures - SS EN 1994; (iii) Design Guide on Use of Alternative Structural Steel Materials to Eurocode 3 – BC 1; (iv) Design Guide for Steel-Concrete Composite Columns with High Strength Materials – BC4; and (v) Design Guide for Semi-rigid Composite Joints and Beams.
(d) Foundations	(i) Geotechnical design – General rules - SS EN 1997-1.

Type of structures	Standards
(e) Aluminium structures	(i) Design of aluminium structures - BS EN 1999.
(f) Timber structures	(i) Design of timber structures – SS EN 1995-1-1, SS EN 1995- 1-2.
(g) Aqueous retaining concrete structures	(i) Design of concrete structures – Liquid retaining and containment structures – SS EN 1992-3.
(h) Retaining structures, earth retaining or stabilizing structure (ERSS)	(i) Geotechnical design – General rules - SS EN 1997-1. (ii) Guidance listed in B.3.3.2 below
(i) Assessment of concrete	(i) Assessment of in-situ compressive strength in structures and precast concrete components – SS EN 13791.
(j) Buildings and structures for agriculture	(i) Buildings and structures for agriculture. Code of practice for design, construction and loading - BS 5502-22.
(k) 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.
(l) Maritime structures (including floating platforms)	(i) Maritime works and structures – BS 6349.
(m) Glass	(i) Glass in buildings – Selection and installation – AS 1288; (ii) Standard practice for determining load resistance of glass in buildings – ASTM E1300; and (iii) Structural use of glass in buildings – The Institution of Engineers of Structural Engineers, United Kingdom.
(n) Seismic Loads	(i) Design of structures for earthquake resistance – General rules, seismic actions and rules for buildings - SS EN 1998-1.

Type of structures	Standards
(o) Fastenings for use in concrete	(i) Design of concrete structures – Design of fastenings for use in concrete – SS EN 1992-4.
(p) Fibre concrete structures	(i) Fibre concrete – Design of fibre concrete structures – SS 674

B.3.3.2 The Design Qualified Person preparing plan shall design earth retaining or stabilizing structures in accordance with requirements listed below:

a) The structural elements of ERSS shall be designed with an adequate safety factor that is not less than that of permanent structural works carried out in the same project.

b) The allowable maximum wall deflection limits shall be limited to 0.5%H for Zone 1; 0.7%H for Zone 2; 0.7%H (Ground Type A) and 1.0%H (Ground Type B) for Zone 3, where –

(i) H is the excavation depth;

(ii) Zone 1 is denoted as where there are existing structures within a distance of H from the edge of the excavation;

(iii) Zone 2 is denoted as where there are existing structures within a zone of between H and 2H from the edge of the excavation.

(iv) Zone 3 is denoted as where existing structures are more than 2H from the edge of the excavation. Ground Type A refers to over-consolidated stiff clays and silts, residual soils, and medium to dense sands; and Ground Type B refers to soft clays (including treated soft clays), silts or organic soils extending to or below formation level (e.g. Kallang Formation) and loose fills.

c) The allowable wall deflection limits shall also address the prevention of damage to neighbouring buildings or structures arising from ground deformations.

d) In any case, the QP shall adopt the more stringent value determined in b) and c) above and specify in the ERSS plan the allowable wall deflection as work suspension level (WSL) for inclinometer and 70% of WSL as the Alert Level. When the work suspension level is reached, work must be stopped, and immediate measures shall be implemented to remove any danger that is likely to cause a risk of injury or damage to adjoining properties.

e) To ensure the structural stability of the excavation system or to ensure the structural stability of the deep excavation system, the use of ground

improvement measures such as jet grout piles (JGP), or grout mixed piles (GMP) or deep cement mixing (DCM) shall be restricted to ground strengthening or soil improvement works. It shall not be used as part of the support system or compressive strutting system or as embedded retaining walls. Movement during the installation of the ground improvement block or layer shall be monitored with appropriate allowable limits. If ground improvement layer is used to fulfil part of the stability requirement, the wall embedment shall be extended to such a depth that the minimum factor of safety (FOS) against basal heave of the ERSS alone (without consideration of ground improvement layer) shall be not less than 1.1.

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 –

Type of works	Standards
(a) Site investigation and instrumentation	(i) Geotechnical design – Ground investigation and testing - SS EN 1997- 2. (ii) 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 the Code of practice for earthworks – BS 6031.

B.3.6 Demolition Works

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

B.3.7 **Construction Materials**

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

Type of materials	Standards
(a) Cement	(i) Cement – SS EN 197; and (ii) Supersulfated cement – BS EN 15743.
(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 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. Weldable reinforcing steel. Bar, coil and decoiled product. Specification – BS 4449. (ii) Steel fabric for the reinforcement of concrete. Specification – BS 4483; (iii) Steel for reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product - SS 560; and (iv) Steel fabric for the reinforcement of concrete - SS 561.
(f) 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.
(g) Concrete	(i) Concrete - Specification, performance, production and conformity – SS EN 206-1; (ii) Concrete - Complementary Singapore Standard to SS EN 206-1 – SS 544; (iii) Control on alkali content in accordance with BRE Digest 330 ‘Alkali-silica reaction in concrete’ (2004) by - using low alkali cement[1] with equivalent Na2O of not more than 0.6% ; or - limiting the total alkali content of concrete to 2.5kg equivalent Na2O /m^3; and

Type of materials	Standards
	(iv) Repair of concrete structures - Products and systems for the protection and repair of concrete structures - BS EN 1504.
(h) Admixture	(i) Admixtures for concrete, mortar and grout – SS EN 934.
(i) 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 steels – BS EN 10210; (iv) Cold formed welded structural hollow sections of non-alloy and fine grain steels – BS EN 10219; (v) Stainless steels – BS EN 10088; (vi) Design Guide on Use of Alternative Structural Steel Materials to Eurocode 3 – BC 1; (vii) Steel castings for structural uses – BS EN 10340; (viii) Founding – Technical conditions of delivery – BS EN 1559-1 and 2; and (ix) Open die steel forgings for general engineering purposes – BS EN 10250-1 and BS EN 10250-2.
(j) Aluminium and aluminium alloys	(i) Sheet, strip and plate – BS EN 485; (ii) Wrought products: Temper designations – BS EN 515; (iii) Chemical composition and form of wrought product – BS EN 573; (iv) Extruded rod/bar, tube and profiles – BS EN 755; (v) Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 – BS EN 12020; and (vi) Design of aluminium structures - BS EN 1999.
(k) Fixings of claddings	(i) Mechanical properties of corrosion-resistant stainless steel fasteners – BS EN ISO 3506.
(l) Timber structures	(i) Timber structures - Glued laminated timber – Requirements – BS EN 14080; and

Type of materials	Standards
	(ii) Timber structures - Strength graded structural timber with rectangular cross section – BS EN 14081.
(m) Post-installed anchors and fastenings for use in concrete	(i) Code of practice for the selection and installation of post- installed anchors in concrete and masonry – BS 8539. (ii) Design of concrete structures – Design of fastenings for use in concrete – SS EN 1992-4.

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 –

Material of element	Standards
(a) Cement	(i) Methods of testing cement – BS EN 196.
(b) Aggregate	(i) Aggregates for concrete – SS EN 12620.
(c) Water	(i) Mixing water for concrete – BS EN 1008.
(d) Concrete	(i) Testing concrete – BS 1881 (parts of the standard which have been withdrawn will not be applicable); (ii) Testing fresh concrete – BS EN 12350; (iii) Testing hardened concrete – BS EN 12390; (iv) Testing concrete in structures - BS EN 12504; and (v) Assessment of in-situ compressive strength in structures and precast concrete components – SS EN 13791.
(e) Admixture	(i) Admixtures for concrete, mortar and grout – SS EN 934.
(f) Steel reinforcement	(i) Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification – BS 4449; (ii) Steel fabric for the reinforcement of concrete. Specification – BS 4483;

Material of element	Standards
	(iii) Steel for reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product - SS 560; and (iv) Steel fabric for the reinforcement of concrete - SS 561.
(g) Structural steel	(i) Hot rolled products of structural steels – BS EN 10025; (ii) Hot finished structural hollow sections of non-alloy and fine grain steels – BS EN 10210; (iii) Cold formed welded structural hollow sections of non-alloy and fine grain steels – BS EN 10219; (iv) Stainless steels – BS EN 10088; (v) Design Guide on Use of Alternative Structural Steel Materials Eurocode 3 – BC 1; (vi) Steel castings for structural uses – BS EN 10340; (vii) Founding – Technical conditions of delivery – BS EN 1559-1 and 2; (viii) Founding – Magnetic particle testing – BS EN 1369; (ix) Founding – Ultrasonic examination – BS EN 12680-1 and 2; and (x) Founding – Radiographic examination – BS EN 12681.
(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 testing of welds. Magnetic particle testing - BS EN ISO 17638; (ii) Non-destructive testing of welds. Magnetic particle testing. Acceptance levels - BS EN ISO 23278; (iii) Non-destructive testing. Penetrant testing – BS EN 571; (iv) Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels and assessment – BS EN ISO 17640; and

Material of element	Standards
	(v) Non-destructive examination of welds. Radiographic examination of welded joints – BS EN 1435.
(j) Pile load test	(i) Geotechnical design – General rules - SS EN 1997-1.
(k) Timber	(i) Timber structures – Glued laminated timber – Requirements - BS EN 14080; and (ii) Timber structures – Strength graded structural timber with rectangular cross section – BS EN 14081.

C HEADROOM AND CEILING HEIGHT

C.1 OBJECTIVE

C.1.1 The objectives of paragraphs C.2.1 are –

(a) to protect people from injury caused by inadequate headroom; and

(b) to prevent loss of amenity caused by inadequate height of room or space.

C.2 PERFORMANCE REQUIREMENT

C.2.1 Any room or space in a building must be provided with –

(a) adequate headroom; and

(b) adequate height,

for the intended uses of the room or space.

C.2.2 The requirements in paragraph C.2.1(a) and (b) do not apply to any of the following rooms or spaces:

(a) any attic that –

(ii) does not exceed an area of 10 square metres; and

(iii) is in a house that is built for the owner's own use;

(b) any equipment or plant room;

(c) the underside of any staircase or escalator if the staircase or escalator is not located along an access route or circulation space;

(d) any toilet or bathroom in any house built for the owner's own use;

(e) any store room not exceeding an area of 6 square metres.

C.2.3 The requirement in paragraph C.2.1(b) does not apply to any of the following rooms or spaces:

(a) any corridor or lobby;

(b) any toilet, bathroom or powder room;

(c) any localised area within a room or space where there is a drop in ceiling height due to physical constraints such as structural beams or building services.

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 metres.

C.3.2.2 For sheltered car parks, the headroom at parking lots and driveway shall not be less than 2.2 metres.

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 –
a) in the case of a doorway, the underside of the transom;
b) in the case where a window opens into an access route or circulation space, the underside of the opened window, or
c) in all other cases, the underside of any beam, duct, service pipe, fixture, fitting or other obstruction or projection.

3 The headroom along a flight of staircase is measured vertically between the pitch line and any point directly above that limits the headroom. See Figure C.3.2.1(a) for illustration of headroom measurement at staircases.

4 The pitch line is the notional line joining the leading edge or nosings (if any) of successive stair treads within a flight of a stairway.

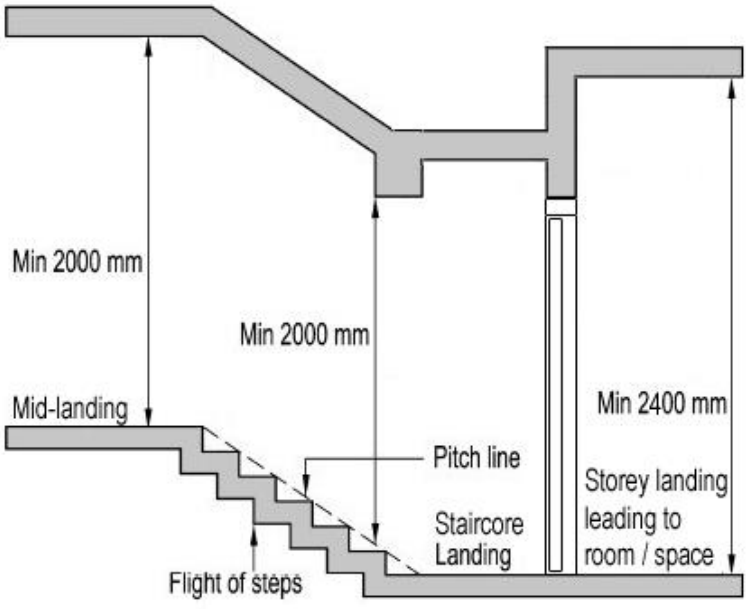


Figure C.3.2.1(a) – Measurement of Headroom

C.3.3 **Ceiling height**

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

Note: The ceiling height is measured from the finished floor level to the underside of any slab, false ceiling or suspended ceiling, whichever is lower.

D ACCESSIBILITY IN BUILT ENVIRONMENT

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 easily gain access to and exit from the whole or part of a building, and that persons with disabilities, children between 90cm and 120cm in height, caregivers of infants, and nursing women are able to carry out their activities within the building with reasonable ease.

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 and sanitary facilities that are appropriate for use by children between 90cm and 120cm in height shall be adequately provided for use by such persons.

D.2.3 Appropriate facilities for lactation and changing of diapers shall be adequately provided and be accessible for use by nursing women and caregivers of infants.

D.2.4 Appropriate wayfinding guides such as signages or audible or tactile information providing directions or instructions shall be adequately provided within a building 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, children between 90cm and 120cm in height, caregivers of infants, and nursing women comply with the Code on Accessibility in the Built Environment issued by the Commissioner of Building Control.

E STAIRCASES

E.1 OBJECTIVE

E.1.1 The objective of paragraphs E.2.1and E.2.2 is to 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 must have –

(a) handrails or guides to assist movement (in accordance with paragraph E.3.6.1);

(b) landings to break a fall and provide a place for rest;

(c) sufficient width, tread and riser to avoid injury;

(d) sufficient headroom to avoid injury; and

(e) barriers to prevent people from falling off the edge of any open side that has a drop of 1,000 mm or more.

E.2.3 The requirement in paragraph E.2.2(a) does not apply to a staircase located in any of the following rooms or spaces:

(a) any equipment or plant room;

(b) any production area of an industrial building; and

(c) any house built for the owner's own use.

E.2.4 The requirements in paragraph E.2.2(b) and (c) do not apply to a staircase located in any of the following rooms or spaces:

(a) any equipment or plant room;

(b) any production area of an industrial building;

(c) any attic that –

(ii) does not exceed an area of 10 square metres; and

(iii) is in a residential building;

(d) any house built for the owner's own use.

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.3.7.

E.3.2 **Projection**

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

Note:
The pitch line is the notional line joining the leading edge or nosings (if any) of successive stair treads within a flight of a stairway.

E.3.3 **Width of staircase**

E.3.3.1 The clear width of every staircase shall not be less than 1000 mm.

Note: *If the projection of the handrail into the clear width does not exceed 80 mm on each side of the staircase, the width is measured from:*

(a) *The finished surfaces of the walls, if the staircase is enclosed on both sides by walls only; or*

(b) *The finished surface of the wall and the inner side of the balustrade, if the staircase has a wall on one side and a balustrade on the other side; or*

(c) *The inner sides of the balustrades if the staircase has balustrades on both sides.*

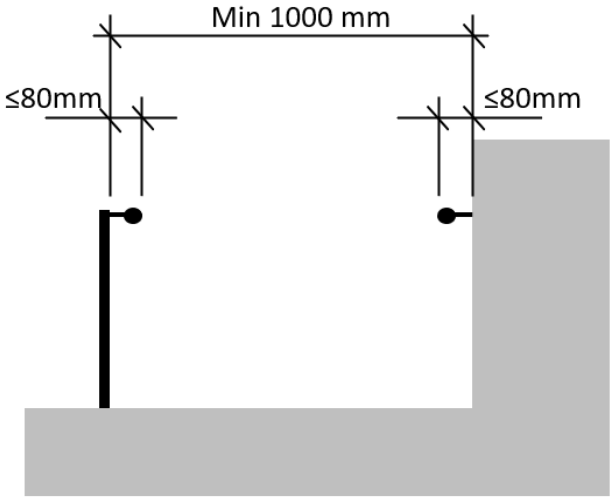


Figure E.3.3.1(a) – Measurement of Clear Width with 80mm or less handrail projection

If the projection of the handrail into the clear width exceeds 80 mm on one or more side of the staircase, the clear width of the staircase shall be measured from:

(a) *The finished surface of the wall and the inner side of the handrail, if the staircase has a wall on one side and a handrail on the other side; or*

(b) *The inner sides of the handrails if the staircase has handrails on both sides.*

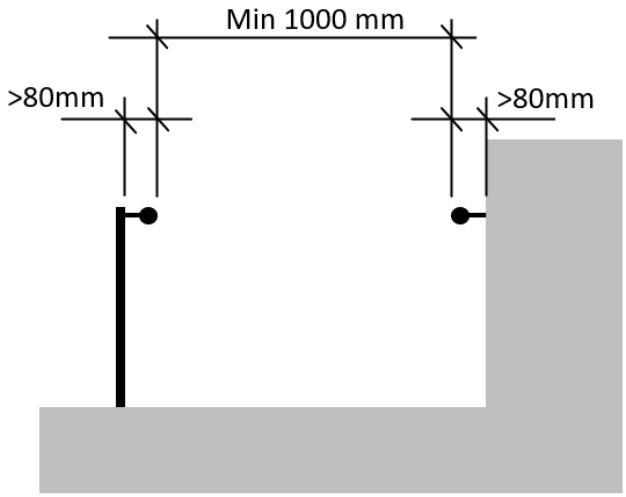


Figure E.3.3.1(b) – Measurement of Clear Width more than 80mm handrail projection

E.3.4 Risers and treads

E.3.4.1 The height of a riser shall not be more than 175 mm. (see Figure E.3.4.2(a) for measurement of "riser")

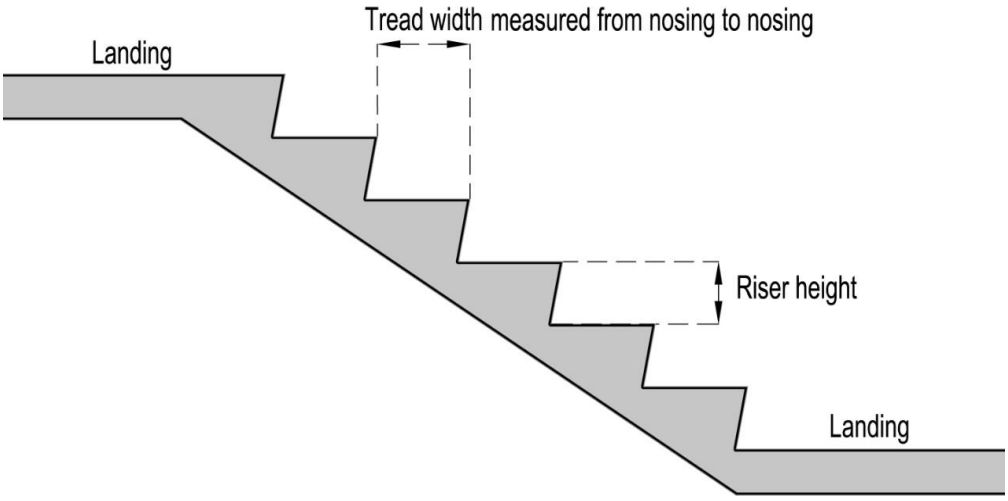


Figure E.3.4.2(a) – Measurement of Tread and Riser

E.3.4.2 The width of a tread of a staircase (see Figure E.3.4.2(a) for measurement of "tread") shall not be less than:

a) 225 mm, if the staircase is in a residential unit within a residential building;

b) 250 mm, if the staircase is in an industrial building; or

c) 275 mm, if the staircase is in any other type of building, including common staircases in a residential building.

E.3.4.3 The width of the tread of any tapered step shall be measured at a distance of 500 mm from the narrower end.

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 5mm between two consecutive steps in any flight of staircase is acceptable.*

2. *Uniformity of risers and treads is applicable to all rooms or spaces under paragraph E.2.4 (except houses built for owner's 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 staircases, an intermediate landing shall be provided in between floor levels at intervals of not more than 18 risers.

E.3.5.3 The clear width of any landing shall not be less than 1000 mm. See Figure E.3.5.3(a) and (b) on how to measure landing width.

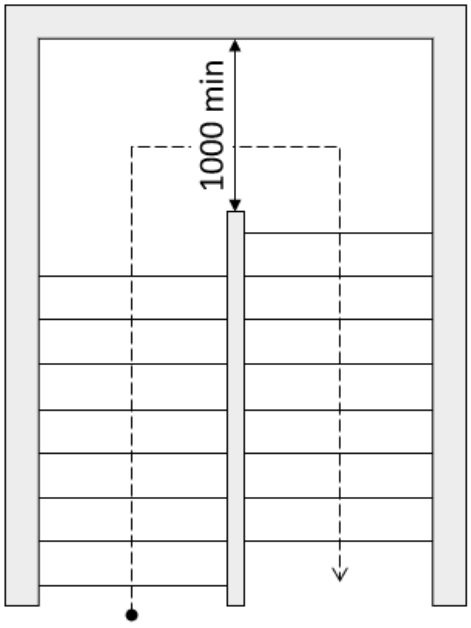


Figure E.3.5.3(a) – Measurement of landing width

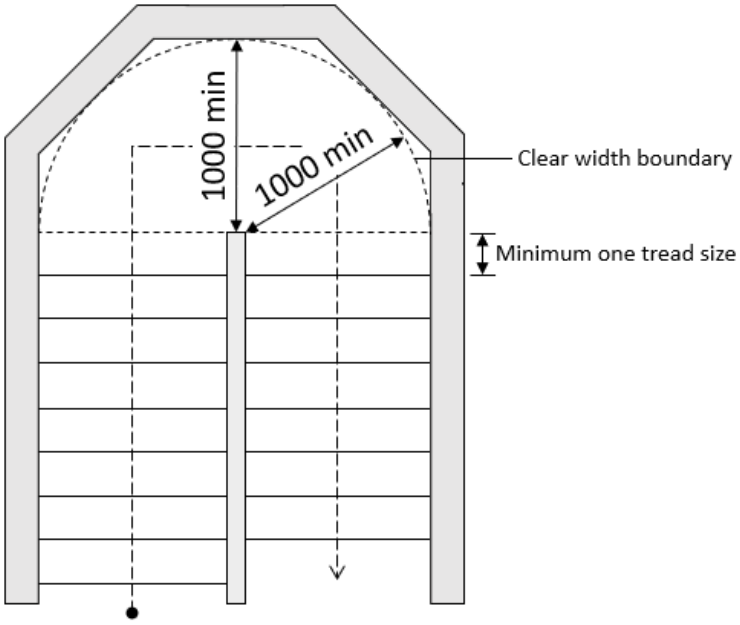


Figure E.3.5.3(b) – Measurement of the width of an irregular landing

E.3.5.4 A landing shall not have any step or drop. A winder does not constitute a landing and is only allowed in a residential unit, where one winder is allowed in every 90 degrees turn in the staircase with a minimum of one tread in between. See Fig. E.3.5.4 on acceptable winder layout.

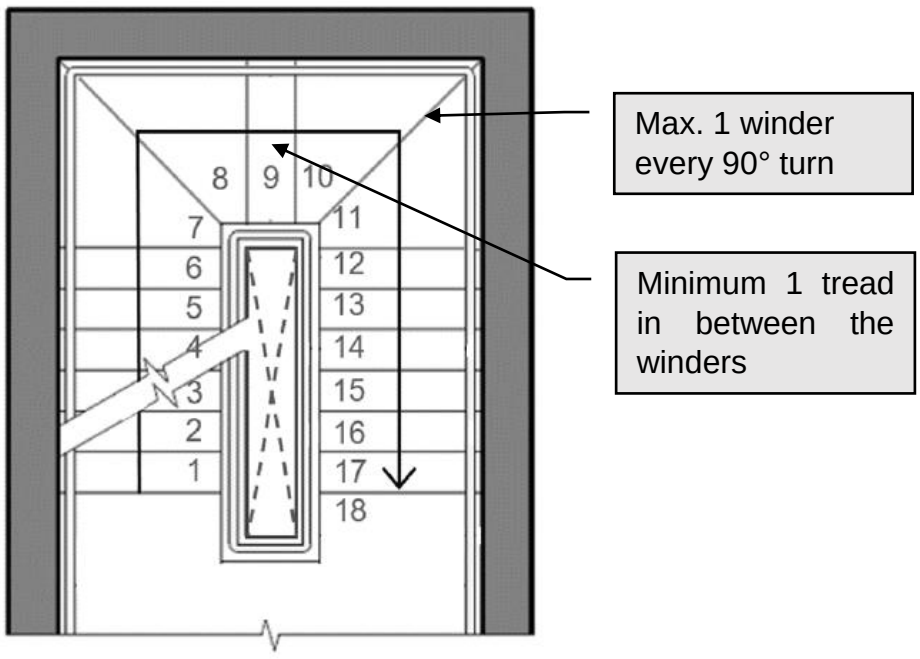


Figure E.3.5.4(a) – Winders as part of total riser count

E.3.6 **Handrails**

E.3.6.1 A handrail shall be provided on at least one side of the flight of any staircase with more than 5 steps.

E.3.6.2 The height of the handrail shall be between 800 mm and 1000 mm above the pitch line.

E.3.6.3 Handrails shall:

a) have a circular section from 32 mm to 50 mm in diameter or an equivalent gripping surface as shown in Code on Accessibility in the Built Environment ; and

b) have a clear space between the handrail and all wall surfaces as shown in Figure E.3.6.3(a) of –

(ii) not less than 40 mm; or

(iii) not less than 60 mm where the wall has a rough surface.

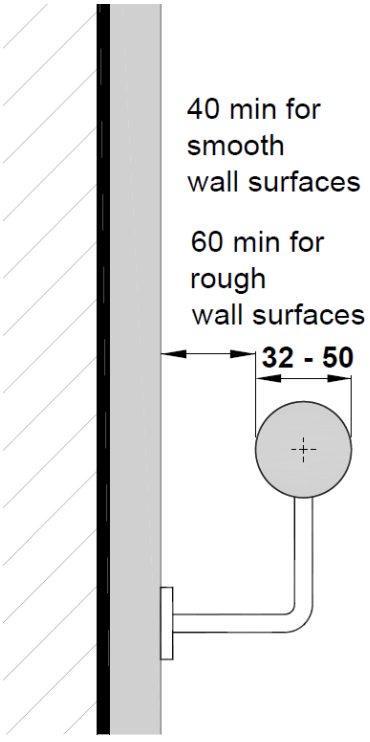


Figure E.3.6.3(a) – Handrails Clearance from Wall

E.3.6.4 A recess containing a handrail shall extend at least 450mm above the top of the rail as shown in Figure E.3.6.4(a).

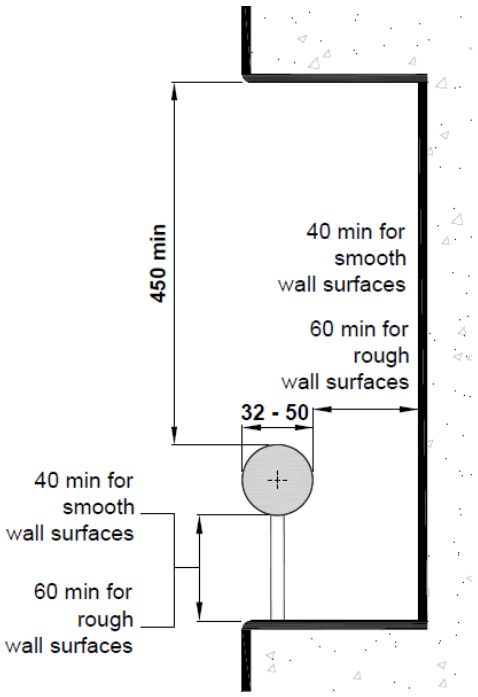


Figure E.3.6.4(a) –Handrail in Recess

E.3.6.5 A handrail shall be continuous throughout the entire length of stairs and the ends of the handrail should be properly formed or rounded off so that they do not pose a danger to the user.

E.3.7 **Stair Nosing**

E.3.7.1 Stair nosing must not project beyond the face of the riser and the riser may be vertical or have a splay backwards up to a maximum 25 mm, as shown in Fig E.3.7.1(a).

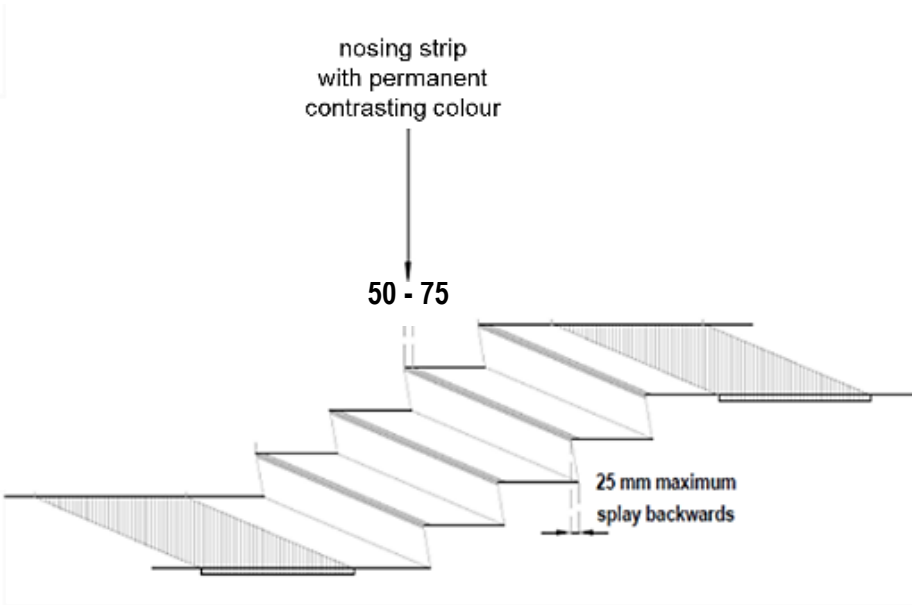


Figure E.3.7.1(a) – Stair nosing

E.3.7.2 All steps must be fitted with nosing strips between 50 mm and 75 mm in width.

E.3.7.3 Nosing strips must be of a colour that contrasts with the steps to make the drop edge of each step clearly visible.

E.3.7.4 Painting of a nosing strip to achieve the colour contrast mentioned in sub-paragraph E.3.7.3 is not acceptable.

Note: *The requirements on stair nosing in Section E.3.7 do not apply to residential units including landed houses. For the avoidance of doubt, the requirements in Section E.3.7 apply to common property such as corridors, lift lobbies etc. within residential developments.*

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 lack of lighting, whether natural or artificial.

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.2.3 Despite paragraph F.2.2, artificial lighting may be provided to any of the following rooms or spaces in a residential unit, instead of natural lighting –

(a) any toilet or bathroom;

(b) any store room;

(c) any basement;

(d) any civil defence shelter.

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

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.2.3 The requirement in paragraph G.2.1 does not apply to any of the following rooms or spaces not exceeding an area of 6 square metres –

(a) any store room;

(b) any private lift lobby;

(c) any walk-in wardrobe;

G.2.4 Despite paragraph G.2.2, mechanical ventilation may be provided to any of the following rooms or spaces in any residential development:

(i) any fitness room forming part of the communal area or common property;

(ii) any clubhouse;

(iii) any civil defence shelter;

(iv) any toilet or bathroom;

(v) any basement.

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 that complies with the ventilation rates given in SS 553 - Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings; or

(c) air-conditioning system that complies with –

(for new erections of non-residential buildings)

(i) the ventilation rates given in SS 553 – Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings; and

(ii) the Minimum Efficiency Reporting Value (MERV) for cleaning the air given in SS 553 – Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings

(for all other types of building works)

the ventilation rates given in SS 553 – Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings,

is provided.

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 effective open 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, comply with relevant clause in SS553 – Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings.

Note: *Except otherwise stated in the following, any openable window or opening may be considered to be unobstructed and for the purposes of paragraph G.3.2.1, the effective open area may be taken as the entire area of the opening.*

(a) The effective open area of a sliding window is the unobstructed area when the sliding window is opened fully.

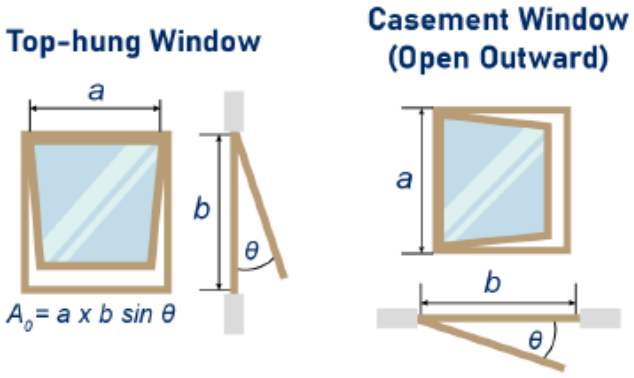
(b) The effective open area of any opening installed with fixed louvers shall be assumed to be 50% of the area of the opening.

(c) For windows other than sliding types (e.g. top hung windows, casement windows) that are installed with a fixed restrictor which does not allow the opening of the window beyond a certain angle, the effective open area shall be determined in accordance with the following formula.

Effective open area = internal clear width x internal clear height x sin θ

Where:
θ *(theta) is the maximum angle formed between the open edge of the window and the frame when the window is fully opened.*
Internal clear width is the unobstructed width of the window opening.
Internal clear height is the unobstructed height of the window opening.

Illustrations:



A_0 = *Effective open area (sqm)*
$A_0 = a \times b \times \sin\theta$

G.3.2.2 All windows and openings intended for natural ventilation shall be located such that they open to –

(a) the exterior of the building;

(b) an airwell with a minimum width of 3.0m and a minimum area open to the sky complying with Table G.3.2.2(a); or

(c) a recess, exceeding 3.0m from the external building wall, and of minimum width 3.0m. See Figure G.3.2.2(b) for illustration.

Height of airwell	Minimum airwell size (m^2)
Not more than 30 m	10
For each additional 3m height, or part of, beyond 30 m	Add 1 to the minimum size of 10

Table G.3.2.2(a) – Dimension of airwells

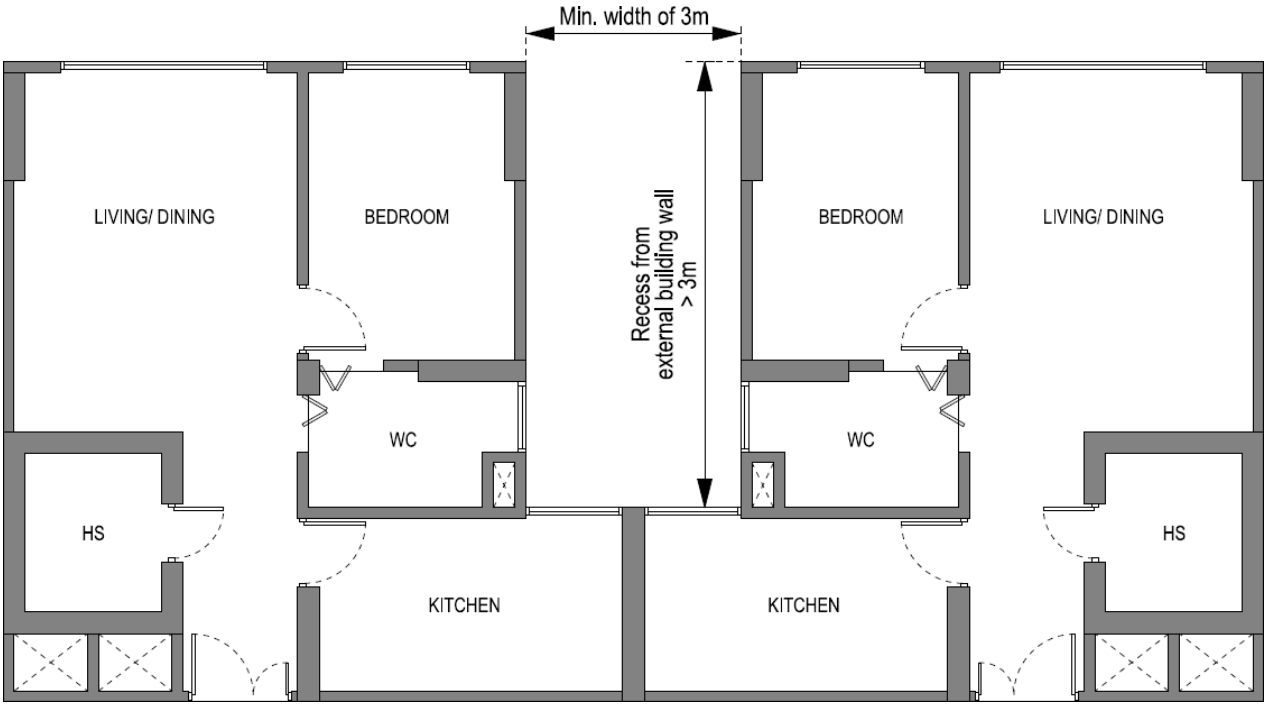


Figure G.3.2.2(b) – Recessed Void Dimension

G.3.2.3 No part of any room or space (other than a room in a warehouse) that is designed for natural ventilation shall be located more than 12 metres from any window or opening that is used to ventilate the room or space.

H SAFETY FROM FALLING

H.1 OBJECTIVE

H.1.1 The objective of paragraphs H.2.1, H.2.1A and H.2.1B is to protect people from injury caused by falling from a height.

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.2.1A Where a barrier is installed to prevent a person from falling from a height, the barrier –

(a) must be sufficiently high to prevent a person from falling over the top of the barrier;

(b) must not have any opening or gap that will allow a person to slip through the barrier; and

(c) must not have any feature that facilitates a person in climbing over the barrier.

H.2.1B Where glass is used as a part or whole of a barrier, the glass used shall be able to withstand the loading for which it is designed and shall not be susceptible to spontaneous breakage or to shattering.

H.2.2 The requirement in paragraphs H.2.1, H.2.1A and H.2.1B do not apply to –

(a) any roof or maintenance area which is not easily accessible; and

(b) any area where the provision of a barrier would prevent it from being used as intended, such as a loading dock or pier, platform for the loading or unloading of goods, or for boarding or alighting of passengers, stage for performance or entertainment, golf driving range, equipment pit and the like.

H.2.3 The requirement in paragraph H.2.1A(a) does not apply to a barrier installed in any house built for the owner's own use.

H.2.4 The requirement in paragraph H.2.1A(b) does not apply to a barrier installed in any of the following places:

(a) any promenade or boardwalk at ground level along a waterfront;

(b) any houses built for the owner's own use.

H.2.5 The requirements under paragraph H.2.1A(c) does not apply to –

(a) any industrial building;

(b) any promenade or boardwalk at ground level along a waterfront;

(c) any bay window in a residential unit;

(d) any house built for the owner's own use.

H.3 ACCEPTABLE SOLUTION

H.3.1 The requirement in paragraphs H.2.1, H.2.1A and H.2.1B 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.3.1A The requirements in paragraphs H.2.1, H.2.1A and H.2.1B are deemed to be satisfied for a safety barrier integrated with window at existing residential buildings, if such safety barrier is in accordance with the standardised design.

Note: For purposes of Regulation 2 of the Building Control Regulations 2003 and paragraph H3.1A, "standardised design" means the standardised design set out in Annex C in this Approved Document.

H.3.2 Height of barrier

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

(a) 1.0 metre; or

(b) 900 mm at the lower edge of the window 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. A kerb, protrusion or flat surface with dimensions more than 150 mm width by 150 mm length must be not less than 1000 mm away from the top of the barrier.

4. Where a kerb, protrusion or flat surface with dimensions more than 150 mm width by 150 mm length is provided next to a barrier, the height of the barrier shall be measured from the top of the kerb, protrusion or flat surface.

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 determined in accordance with SS EN 1991 Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings and the associated Singapore National Annex.

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 There must not be any gap, from the finished floor level to a height no less than 75 mm, at the lowest part of a barrier.

Note: *This is to prevent objects from slipping through the base of the barrier and falling off into the space below.*

H.3.4.2 The lowest 75 mm section of a bay window shall not be openable.

H.3.4.3 The size of any opening or gap in a barrier must not be large enough as to permit the passage of –

(a) in the case of non-industrial buildings, a 100 mm diameter sphere;

(b) in the case of industrial buildings, a 150 mm diameter sphere, or

(c) in the case of maintenance areas, including plants, equipment rooms, catwalks or maintenance platforms that are accessible only by authorised personnel, a 500 mm diameter sphere.

H.3.4.4 For any flight of staircase –

(a) the gap size between any two consecutive steps in a flight of staircases shall not be large enough as to permit the passage of –

(i) in the case of industrial buildings, a 150 mm diameter sphere, or

(ii) in the case of all other buildings, a 100 mm diameter sphere

(b) the size of any triangular opening, gap or void formed around a tread, riser and bottom edge of the barrier at a staircase in any building other than an industrial building shall not be large enough as to permit the passage of a 150 mm diameter sphere.

H.3.4A **Requirements to prevent climbing**

H.3.4A.1 A barrier must have a height no less than –

(a) the height specified in paragraph H.3.2.1, or

(b) 850 mm when measured from the last climbable toehold;

whichever is higher.

See Figure H.3.4A.1(a) for illustration.

Note 1: A toehold means –

(a) any opening in a perforated sheet or mesh having a horizontal dimension of more than 50 mm and a vertical dimension of more than 30 mm; or

(b) any kerb or protrusion having a width of more than 50mm and has a chamfer gentler than 45˚relative to the horizontal plane.

See Figures H.3.4A.1(b), H.3.4A.1(c) and H.3.4A.1(d) for examples on toehold dimensions.

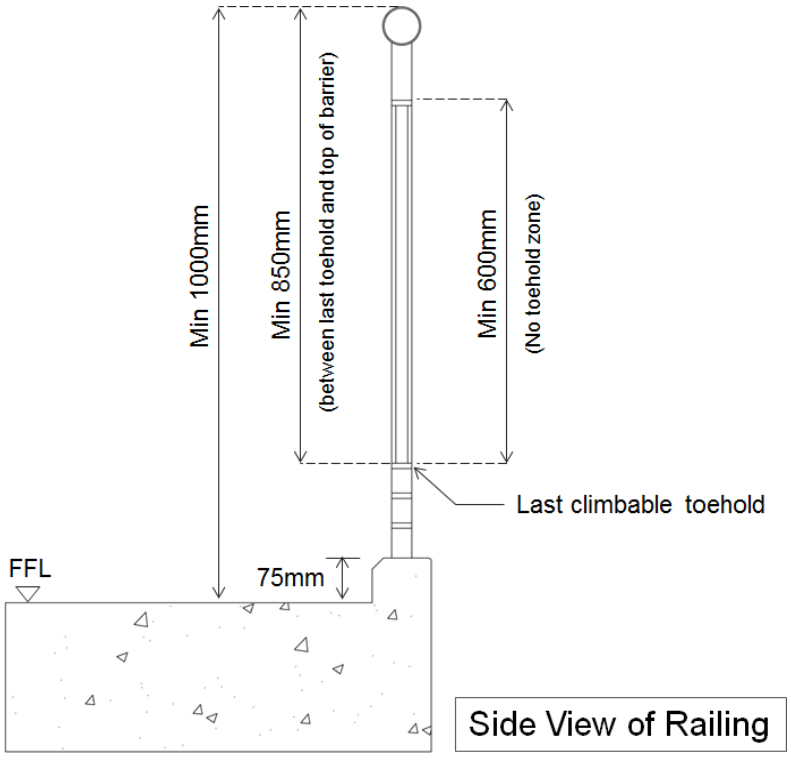


Figure H.3.4A.1(a) – Requirements to Prevent Climbing

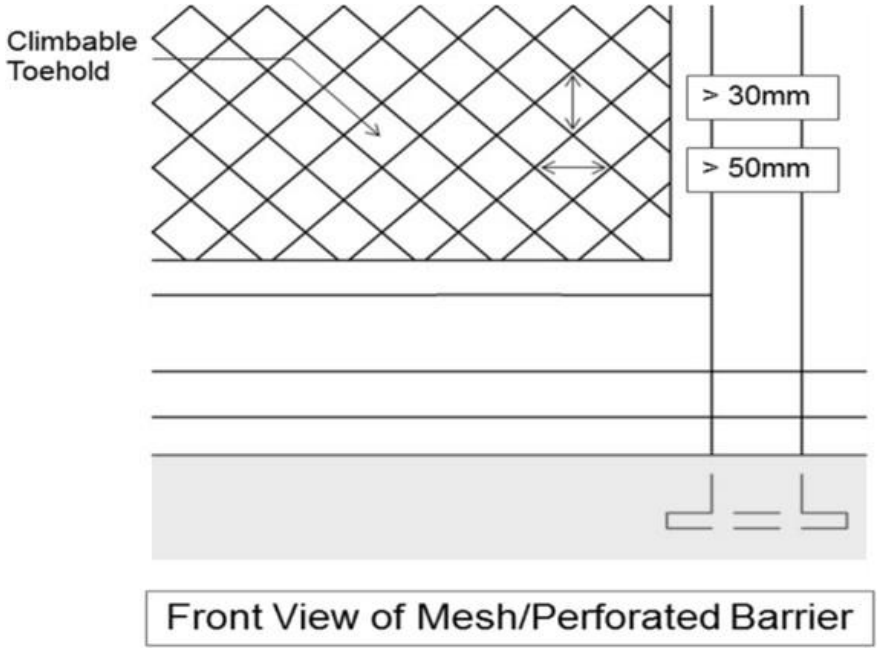


Figure H.3.4A.1(b) - Toehold Dimensions at Mesh/ Perforated Barrier

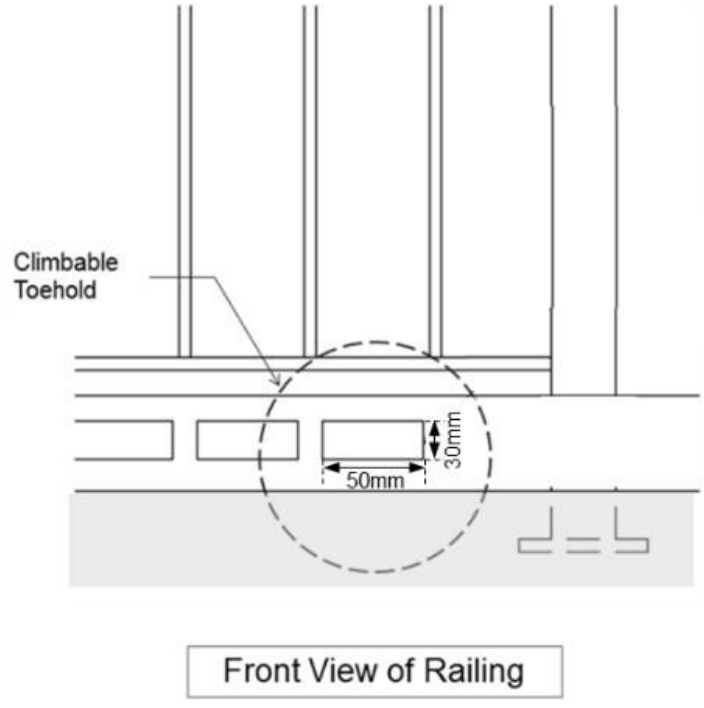


Figure H.3.4A.1(c) - Toehold Dimensions at Railing

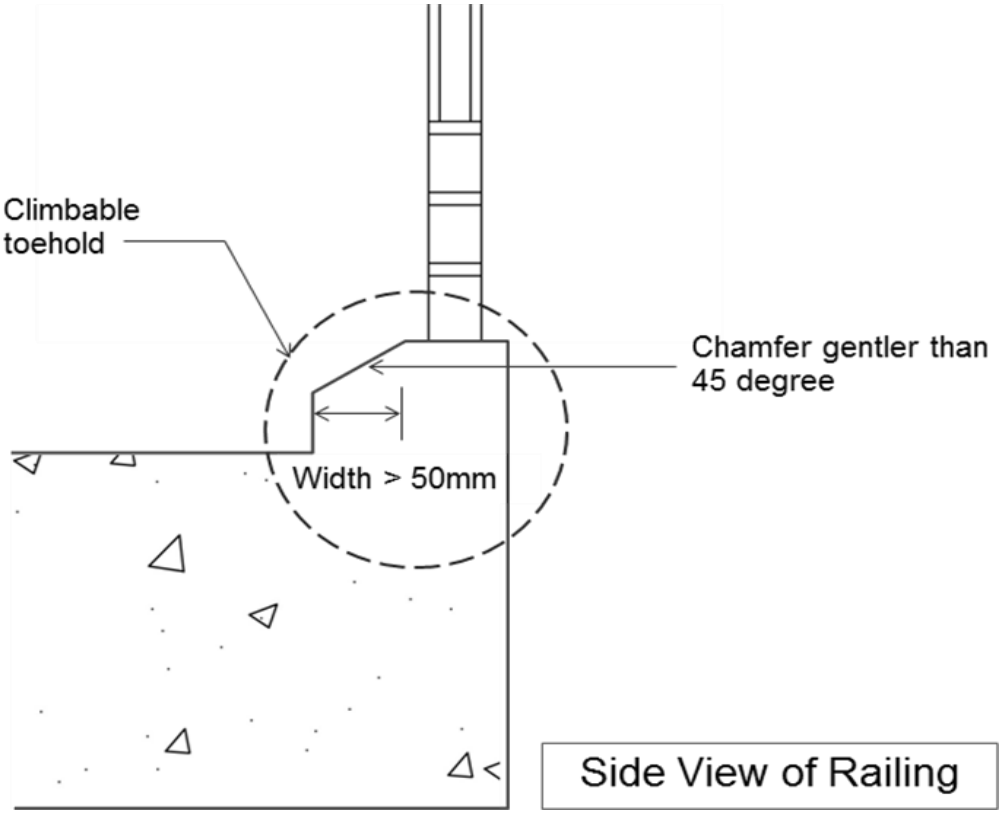


Figure H.3.4A.1(d) – Toehold Dimensions at Kerb/Protrusion

Note 2: *A toehold is considered to be climbable if it is located within 600 mm vertically from –*

(a) *the finished floor level;*

(b) a step; or

another climbable toehold.

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 SECTION I

Section deleted and streamlined under the Building Control (Environmental Sustainability) Regulations 2008 ("BC (ES) Regulations").

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 objectives of paragraphs K.2.1, K.2.2, K.2.3 and K.2.4 are 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 and any basement level) shall be provided with one or more passenger lifts.

K.2.3 All lift interior fittings and fixtures must be securely fastened by appropriate mechanical fasteners.

K.2.4 The requirement in paragraph K.2.1 does not apply to any stairlift or vertical platform lift that –

(a) has a maximum vertical displacement of less than 1,000 mm when the lift is in operation;

(b) has a maximum obstruction force of less than 150 Newtons when the lift is in operation; and

(c) serves a single residential unit.

K.2.5 In paragraph K.2.4, “stairlift” and “vertical platform lift” have the same meanings given to them in regulation 2(1) of the Building Maintenance and Strata Management (Lift, Escalator and Building Maintenance) Regulations 2016 (G.N. No. S 348/2016).

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:

(i) in accordance with the requirements of SS 550 - Code of Practice for Installation, Operation and Maintenance of Electric Passenger and Goods Lifts;

(ii) with light curtain installed at the lift door as a door protective device that shall automatically initiate re-opening of the door(s) in the event of a person crossing the entrance during the closing movement, and that the light curtain shall have its nudging mode de-activated if nudging mode is provided; and

(iii) provided with a video recorder that has the following minimum specifications –

a. Capacity to record 24 hours a day, 7 days a week;

b. Capture footage of the entire lift car including in-car floor indicator, lift car door(s) and landing area outside the lift car in front of the lift doors;

c. Frame rate of at least 6 frames per second;

d. Video resolution of at least 352 x 240 pixels or CIF CCTV resolution; and

e. Storage of video footage for at least 30 days;

and

(b) the escalators are designed and installed:

(i) in accordance with SS 626 - Code of Practice for Design, Installation and Maintenance of Escalators and Moving Walks;

(ii) with means to limit or detect the riser end of the step being displaced upward by more than 5mm at the upper and lower transition curves at or prior to the point of tangency of the horizontal and curved track. When the upward displacement exceeds 5mm, the means shall cut off the power to the driving machine and brake and stop the escalator before the detected step reaches the comb plate with any load up to brake rated load with escalator running; and

(iii) provided with a video recorder that has the following minimum specifications –

a. Capacity to record 24 hours a day, 7 days a week;

b. Capture footage of the entire length of escalator, including landing floor plates on both the upper and lower landing areas of the escalator;

c. Frame rate of at least 6 frames per second;

d. Video resolution of at least 352 x 240 pixels; or CIF CCTV resolution; and

e. Storage of video footage for at least 30 days.

For the purposes of this part:

"light curtain" means an opto-electronic device that is usually mounted at the lift doors to detect the presence of objects in the path of its light rays.

K.3.2 The requirements in paragraphs K2.1 are deemed to be satisfied if vertical platform lifts and stairlifts which are primarily designed for persons with impaired mobility are designed and installed in accordance with the requirements of –

(a) EN 81-41 – Safety rules for the construction and installation of lifts – Special lifts for the transport of persons and goods. Part 41: Vertical platforms intended for use by persons with impaired mobility; or

(b) EN 81-40 – Safety rules for the construction and installation of lifts – Special lifts for the transport of persons and goods. Part 40: Stairlifts and inclined lifting platforms intended for persons with impaired mobility; or

(c) ASME A18.1 – Safety standard for platform lifts and stairway chairlifts; or

(d) Code of Practice for installation, operation and maintenance of vertical platform lift with enclosed platform and automatic sliding doors; or

(e) other relevant standards which are acceptable to the Commissioner of Building Control; and

(f) except for stairlifts and chairlifts, with a telephone, intercom system or any other communication device that enables notification or direct communication with personnel who can initiate an emergency response; and

(g) for vertical platform lifts that are not installed in private homes solely for the use of the occupants, in addition to the above standards, they are provided with a video recorder that has the following minimum specifications –

(i) Capacity to record 24 hours a day, 7 days a week;

(ii) Capture footage of the entire lift platform and platform entrance, from floor to ceiling (if any), and landing area outside the lift platform in front of the landing doors;

(iii) Frame rate of at least 6 frames per second;

(iv) Video resolution of at least 352 x 240 pixels or CIF CCTV resolution; and

(v) Storage of video footage for at least 30 days.

For the purposes of this part:

"stairlift" means a motorised platform or seat installed in a stairway, which traverses the stairs when activated; and

"vertical platform lift" means a vertical lifting platform intended for use by people with impaired mobility, with or without wheelchair, travelling vertically between predefined levels along a guided path.

K.3.3 The requirements in paragraph K2.1 are deemed to be satisfied if home lifts are designed and installed in accordance with the requirements of –

(a) the SS 550 - Code of Practice for Installation, Operation and Maintenance of Electric Passenger and Goods Lifts; or

(b) other relevant standards which are acceptable to the Commissioner of Building Control.

(c) With a telephone, intercom system or any other communication device that enables notification or direct communication with personnel who can initiate an emergency response.

For the purposes of this part:

"home lift" means a lift, excluding a stairlift or a vertical platform lift, not being common property, installed in a private home solely for the use of its occupants.

K.3.4 The requirements in paragraph K2.3 are deemed to be satisfied if the mechanical fasteners are provided in accordance with the following:

(a) Mechanical fasteners are devices that can transmit mechanical load, keeping two or more elements of an assembly of fittings and fixtures in relative position, assuring continuity, stability and mechanical strength as needed.

(b) The fittings and fixtures must not be at risk of dislodging from its intended position, and the strength of the fastening means must not become undone, neither with the application of reasonable force, nor with the passage of time.

(c) Examples of mechanical fasteners include bolts and nuts, screws, pins and rivets.

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 window system shall have –

(a) window components, including 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) features and components to prevent the window from detaching, dislodging or falling during its intended use.

M.3 ACCEPTABLE SOLUTION

M.3.1 In the case of an 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, 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 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

Spontaneous breakage of glass

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 Except as provided in N.3.3, 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.

Falling glass resulting from bond failure of the structural sealant

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 that are to be designed and constructed to prevent any fall of façade panels in the event of bond failure of the structural sealant.

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

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

***Figure N1* – Four-sided SSG 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: Glass in Building - Structural Sealant Glazing and BS EN 15434: Glass in Building – Product Standard for Structural and/or Ultraviolet Resistant Sealant.

O PROTECTION FROM INJURY BY VEHICLES IN BUILDINGS

O.1 OBJECTIVE

O.1.1 The objectives of paragraphs O.2.1 and O.2.2 are to protect people from injury caused by a vehicle breaching designated spaces for vehicular access in a building.

O.2 PERFORMANCE REQUIREMENT

O.2.1 Where the whole or part of a floor of a building allows vehicular access, such as a vehicle park or a ramp or route for vehicular access, appropriate barriers shall be installed to prevent vehicles from breaching the perimeter of the floor of the building.

O.2.2 Where any part of a building allows vehicular access near an area where people are likely to be present, such as passenger pick-up point, vehicle park lift lobby and the like, appropriate measures shall be taken to prevent vehicles from encroaching into such areas.

O.3 ACCEPTABLE SOLUTION

O.3.1 The requirements in paragraphs O.2.1 and O.2.2 are deemed to be satisfied if a barrier is provided in accordance with the specifications set out in paragraph O.3.2.

O.3.2 Horizontal loading of barrier

O.3.2 The vehicular barrier should be capable of resisting forces set out in SS EN 1991.

P DAYLIGHT REFLECTANCE

P.1 OBJECTIVE

P.1.1 The objective of paragraph P.2.1 is to protect occupants of buildings in the vicinity of a building from loss of amenity caused by the reflection of sunlight off the external surface of that building, arising from the use of materials with high daylight reflectance.

P.2 PERFORMANCE REQUIREMENT

P.2.1 The external surface (including a roof) of a building must be designed and constructed in a manner such that any reflection of sunlight off the external surface of the building does not result in loss of amenity to occupants of other buildings in the vicinity of that building.

P.3 ACCEPTABLE SOLUTION

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

P.3.2 The material used for the building work is deemed acceptable if –

(a) the glass for the building work has a daylight reflectance not exceeding 20%

(b) any material, other than glass and paint on plastered or concrete surfaces, for the building work on –

(i) the façade of the building has a specular reflectance not exceeding 10%

(ii) the roof of the building, inclined at an angle not exceeding 20 degrees from the horizontal plane, has a specular reflectance not exceeding 10%

(iii) the roof of the building, inclined at an angle more than 20 degrees from the horizontal plane, has a daylight reflectance not exceeding 20% and a specular reflectance not exceeding 10%

(c) emulsion paint on plastered or concrete surfaces has a specular reflectance not exceeding 10%

Note 1 For the purpose of (b)(ii) and b(iii), in any building where the façade and the roof continue seamlessly, the area above the last finished floor will be considered the roof.

2 Daylight reflectance is the sum of specular reflectance and diffuse reflectance.

P.3.3 The testing of reflectance values for any material shall be conducted in accordance with ASTM E903: Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres, or equivalent, with an integrating sphere of minimum 150mm diameter.

Annex A – Structural design standards based on the Eurocodes and the corresponding Singapore National Annexes

Eurocode: Basis of structural design	**Associated National Annex (NA) to be used for design**
SS EN 1990 Basis of structural design.	NA to SS EN 1990

Eurocode 1 : Actions on structures	**Associated National Annex (NA) to be used for design**
SS EN 1991-1-1 Actions on structures. General actions – Densities, self-weight, imposed loads for buildings.	NA to SS EN 1991-1-1
SS EN 1991-1-2 Actions on structures. General actions – Actions on structures exposed to fire.	NA to SS EN 1991-1-2
SS EN 1991-1-4 Actions on structures. General actions - Wind actions.	NA to SS EN 1991-1-4
SS EN 1991-1-5 Actions on structures. General actions – Thermal actions.	NA to SS EN 1991-1-5
SS EN 1991-1-6 Actions on structures. General actions - Actions during execution.	NA to SS EN 1991-1-6
SS EN 1991-1-7 Actions on structures. General actions - Accidental actions.	NA to SS EN 1991-1-7
SS EN 1991-2 Actions on structures. Traffic loads on bridges.	NA to SS EN 1991-2
SS EN 1991-3 Actions on structures. Actions induced by cranes and machinery.	NA to SS EN 1991-3
SS EN 1991-4 Actions on structures. Silos and tanks.	NA to SS EN 1991-4

Eurocode 2 : Design of concrete structures	**Associated National Annex (NA) to be used for design**
SS EN 1992-1-1 Design of concrete structures. General rules and rules for buildings.	NA to SS EN 1992-1-1
SS EN 1992-1-2 Design of concrete structures. General rules - Structural fire design.	NA to SS EN 1992-1-2
SS EN 1992-2 Design of concrete structures. Concrete bridges - Design and detailing rules.	NA to SS EN 1992-2
SS EN 1992-3 Design of concrete structures. Liquid retaining and containment structures.	NA to SS EN 1992-3
SS EN 1992-4 Design of concrete structures. Design of fastenings for use in concrete.	NA to SS EN 1992-4

Eurocode 3 : Design of steel structures	**Associated National Annex (NA) to be used for design**
SS EN 1993-1-1 Design of steel structures. General rules and rules for buildings.	NA to SS EN 1993-1-1
SS EN 1993-1-2 Design of steel structures. General rules - Structural fire design.	NA to SS EN 1993-1-2
SS EN 1993-1-3 Design of steel structures. General rules - Supplementary rules for cold-formed members and sheeting.	NA to SS EN 1993-1-3
SS EN 1993-1-4 Design of steel structures. General rules - Supplementary rules for stainless steels.	NA to SS EN 1993-1-4
SS EN 1993-1-5 Design of steel structures. Plated structural elements.	NA to SS EN 1993-1-5
SS EN 1993-1-6 Design of steel structures. Strength and stability of shell structures.	Nil*

SS EN 1993-1-7 Design of steel structures. Plated structures subject to out of plane loading.	Nil*

Eurocode 3 : Design of steel structures	**Associated National Annex (NA) to be used for design**
SS EN 1993-1-8 Design of steel structures. Design of joints.	NA to SS EN 1993-1-8
SS EN 1993-1-9 Design of steel structures. Fatigue.	NA to SS EN 1993-1-9
SS EN 1993-1-10 Design of steel structures. Material toughness and through-thickness properties.	NA to SS EN 1993-1-10
SS EN 1993-1-11 Design of steel structures. Design of structures with tension components.	NA to SS EN 1993-1-11
SS EN 1993-1-12 Design of steel structures. Additional rules for the extension of EN 1993 up to steel grades S 700.	NA to SS EN 1993-1-12
SS EN 1993-2 Design of steel structures. Steel bridges.	NA to SS EN 1993-2
SS EN 1993-3-1 Design of steel structures. Towers, masts and chimneys -Towers and masts.	NA to SS EN 1993-3-1
SS EN 1993-3-2 Design of steel structures. Towers, masts and chimneys – Chimneys.	Nil*
SS EN 1993-4-1 Design of steel structures. Silos.	Nil*
SS EN 1993-4-2 Design of steel structures. Tanks.	Nil*
SS EN 1993-4-3 Design of steel structures. Pipelines	Nil*

SS EN 1993-5 Piling.	NA to SS EN 1993-5
SS EN 1993-6 Design of steel structures. Crane supporting structures.	NA to SS EN 1993-6

Eurocode 4 : Design of composite steel and concrete structures	**Associated National Annex (NA) to be used for design**
SS EN 1994-1-1 Design of composite steel and concrete structures. General rules and rules for buildings.	NA to SS EN 1994-1-1
SS EN 1994-1-2 General rules - Structural fire design.	NA to SS EN 1994-1-2
SS EN 1994-2 Design of composite steel and concrete structures. General rules and rules for bridges.	NA to SS EN 1994-2

Eurocode 5 : Design of timber structures	**Associated National Annex (NA) to be used for design**
SS EN 1995-1-1 Design of timber structures General – Common rules and rules for buildings.	NA to SS EN 1995-1-1.
SS EN 1995-1-2 Design of timber structures General – Structural fire design.	NA to SS EN 1995-1-2.
BS EN 1995-2 Design of timber structures. Bridges.	NA to BS EN 1995-2

Eurocode 7 : Geotechnical design	**Associated National Annex (NA) to be used for design**
SS EN 1997-1 Geotechnical design. General rules.	NA to SS EN 1997-1
SS EN 1997-2 Geotechnical design. Ground investigation and testing.	NA to SS EN 1997-2

Eurocode 8 : Design of structures for earthquake resistance	**Associated National Annex (NA) to be used for design**
SS EN 1998-1 Design of structures for earthquake resistance. General rules, seismic actions and rules for buildings.	NA to SS EN 1998-1

Eurocode 9: Design of aluminium structures	**Associated National Annex (NA) to be used for design**
BS EN1999-1-1 Design of aluminium structures. General structural rules.	NA to BS EN 1999-1-1
BS EN1999-1-2 Design of aluminium structures. Structural fire design	NA to BS EN 1999-1-2
BS EN1999-1-3 Design of aluminium structures. Structures susceptible to fatigue.	NA to BS EN 1999-1-3
BS EN1999-1-4 Design of aluminium structures. Cold-formed structural sheeting.	NA to BS EN 1999-1-4
BS EN1999-1-5 Design of aluminium structures. Shell structures.	NA to BS EN 1999-1-5

Note:
** - There is no UK National Annex for this part of the Eurocode.*

Annex B – Standardised Designs for replacement and reinstatement of safety barriers integrated with windows in existing residential buildings.

General Notes

The contractor shall ensure the specifications in the following General Notes are complied with.

List of Drawings

S/NO	DRAWING TITTLE
01	FULL HEIGHT WINDOW SCHEDULE (CASE 1-4)
02	FULL HEIGHT WINDOW SCHEDULE (CASE 5-7)
03	3/4 HEIGHT WINDOW SCHEDULE (CASE 1-4)
04	3/4 HEIGHT WINDOW SCHEDULE (CASE 5-7)
05	VERTICAL FRAME DETAILS
06	HORIZONTAL FRAME DETAILS
07	TYPICAL CONNECTION DETAIL (1)
08	TYPICAL CONNECTION DETAIL (2)

1.0 General

A. The Contractor shall check all drawings and verify dimensions on site prior to commencement of work.
B. All workmanship and materials shall be in strict compliance with the latest current editions of Singapore Standards.
C. The Contractor shall be responsible for the design of structural steel works at the fabrication stage, transportation stage and installation stage.
D. All dimensions shall be in millimeters or meter metric.
E. The total height of full height window frame shall be less than or equal to 2.65m for all type of windows including sliding windows and casement windows.
F. The total height of 3/4 height window frame shall be less than or equal to 2.05m for all type of windows including sliding windows and casement windows.
G. Maximum fixed glass panels width shall be equal or less than 1.0m for all type of windows including sliding windows and casement windows.
H. All cement grout shall be high strength non-shrink grout with minimum compression strength of 30MPa (7 days).
I. The contractor shall ensure that all the existing concrete strength shall be minimum grade C16/20.
J. Works shall be carried out in accordance with SS 212 Specification for Aluminium Alloy Windows and SS 341 Specification for Safety Glazing Materials for Use in Buildings.
K. Contractor shall put in place measures to prevent water leakage into the residential unit.
L. For demolition of existing safety barrier, method and construction of the demolition works shall be in accordance with SS 557:2010.
M. Contractor shall ensure that total window height ≤2.65m for all types of windows.
N. Contractor is to ensure that top and bottom surface where the anchor bolts are to be installed are RC structure.

2.0 Structural Steelwork

A. All steel sections shall be with material grade S275 unless otherwise stated and all the steel materials are designed to conforming with BS EN 1993 and compliance to BC1-2012 Class 1.
B. Quality of structural steel shall conform to Eurocode EN1993 and shall be obtained from an approved manufacturer.
C. The contractor shall propose the erection procedures at their own expense including stability system and calculations for the engineer to review and comment before proceeding with the erection. The contractor shall ensure the structural steel works is stable throughout the construction, paying attention to the safe erection of structural steelworks is accordance with EN1090.
D. It will be the responsibility of the contractor to provide adequate shoring and bracing during construction to take care of wind load and other loads during construction.
E. The contractors shall verify all the dimensions by measuring at the site and resolve all the discrepancies before commencement of the fabrication works.

F. All steelwork shall be hot-dip galvanized.

3.0 Aluminium

3.1 Aluminium Sections

A. All aluminium mullions and transoms shall be minimum RHS 100x50x3mm with material grade 6061-T6. Other sections shall be with material grade 6063-T5 designed to conforming with BS EN 1999-1-1, BS EN 1999-1-3 and BS EN 1999-1-4.

B. All aluminium sections shall refer to table below or equivalent,

	Characteristic value of 0.2% proof strength	Characteristic value of ultimate tensile strength
6061-T6	240 N/mm²	260 N/mm²
6063-T5	110 N/mm²	160 N/mm²

C. Rubber separator shall be provided between other sections which are different materials from aluminium to prevent galvanized corrosion.

3.2 Finish Aluminium Section

A. All visible surface of aluminium sections and other surfaces exposed to external environmental condition or visually shall be deemed to be coated PVDF2 (Primer: 5-10 microns; Colour: 30 micron; Clear: 10 microns) with approved Accredited Applicator.
B. Daylight Reflectance of the surface to comply with BCA requirement.
C. The paint system shall be maintenance free with the exception of regular cleaning as prescribed, be durable and have a colourfast of at least 20 years. The contractor shall collate comprehensive maintenance requirements from both paint manufacturer and the PVF 2 coating applicator for inclusion into the maintenance manuals.
D. The colour coat shall not contain less than 70% polyvinylidene fluoride.
E. The cured film shall be dense and consistent, with no seeding and free from flow lines, steaks, pin holes, blister, tear damage and other coating defects/surface imperfections when viewed from a distance of 1m under diffused daylight.
F. Prior to commencement of coating, Contractor shall submit samples showing the variations in colour and texture for confirmation.

4.0 Stainless steel

A. All bolts, nuts and washers shall be stainless steel unless otherwise stated.
B. Material data of A4-70 stainless steel bolts, nuts & screws

	Shear Strength	Tension Strength	Bearing Strength	Yield Strength	Tensile Strength
A4-70	310 N/mm²	373 kN/m²	828 kN/m²	450 kN/m²	700 kN/m²

C. All stainless steel fasteners bolts and nuts shall be nonmagnetic grade A4-70 as per SS EN 1993-1-4.
D. All stainless steel screws shall be non-magnetic grade A4-70 as per SS EN 1993-1-4.
E. All stainless steel screws shall be minimum M5 self-tapping screws at maximum spacing 400mm c/c unless otherwise stated.
F. Minimum edge distance of screws shall be 15mm unless otherwise stated.
G. Minimum spacing of screws shall be 25mm unless otherwise stated
H. All anchor bolts to concrete shall be stainless steel unless otherwise stated in the drawings.
I. Minimum concrete edge distance of the anchor bolts shall be 100mm unless otherwise stated.
J. Minimum spacing of the anchor bolts shall be 75mm unless otherwise stated.

5.0 Glazing Material

A. All setting blocks shall be 85±5, shore a durometer santoprene no less than 150mm long panel 1/4 points unless otherwise stated.
B. All glazing works shall comply to ASTM E1300-09a Standard Practice for Determine Load Resistance of Glass in Buildings
C. All glazing works shall comply to Section 8 of BS 6180: Barriers in and about Buildings - Code of Practice.
D. Allowable stress of heat-strengthen (HS) glass shall be minimum 32MPa.
E. All the 13.52mm thick laminated glazing as 6mm thick heat-strengthen glass + 1.52mm thick PVB + 6mm thick heat-strengthen glass for full height windows.
F. All the 9.52mm thick laminated glazing as 4mm thick heat-strengthen glass + 1.52mm thick PVB + 4mm thick heat-strengthen glass for 3/4 height windows.

6.0 Sealant

A. The Contractor must ensure that the silicone proposed is compatible with the type of glass and cladding used for the project.
B. Testing by the sealant manufacturer for compatibility, adhesion and staining for all substrates in contact with the sealant must be completed successfully.
C. Oil base sealants are not acceptable.
D. Records for sealant batch number and date of manufacturer, as well as units to which the sealant is applied shall be maintained and made available upon request.
E. All sealant, in so far as practical for the weather and structural integrity of the Exterior Wall System, should be supplied by one manufacturer with a reputable background in the sealant industry.
F. The Contractor shall maintain a sealant recommendation letter with endorsed details by the sealant manufacturer to ensure proper application and performance warrantee.
G. The Contractor shall maintain compatibility test of all material substrates interface with silicone sealant to ensure material compatibility and submission of laboratory report on sealant adhesion.
H. Non-structural (weatherseal) silicone to adopt shall be FS TI-S-001543A (COM-NBS) and ASTM C920, Type SIM, NS, Class 25 or equivalent.
I. The colour of weatherproof silicone sealant to be black or any standard colour from sealant manufacturer.
J. All weatherproof silicone sealant shall compatible with all substrates including PVB interlayer of laminated glass.
K. All external weather seal silicone shall be non-bleed non-stain sealant.
L. All weatherproof silicone sealant shall be with ±50% movement capacity.
M. Metal to metal shop joint or external facade shall be GE SCS9000 weather seal sealant or equivalent.
N. Silicone shall not be used to support dead weight of vertical glass or panels.
O. Where a test Prototype is subjected to 1.5 times design pressures and loads, the structural silicone and related structural components are required to withstand such loading without failure.
P. Weather sealant shall be applied at all screws' locations after the erection.

7.0 Insulation, gasket, and accessories

A. All gaskets and weather-strips to be extruded EPDM compatible extruded rubber or equivalent when in contact with silicone sealants.
B. Interior/ Exterior Set (Dry) Gasket

- The exterior "sponge" glazing gaskets shall be cellular complying with ASTM C50991, Option 2. Sponge gaskets shall have a hardness of 40 ±5 durometer Shore A and shall be compressed 20% to 35% in the final installed position.
- The interior "wedge" glazing gasket shall be non-cellular complying with ASTM C864-90 Option 2. Wedge gaskets shall have a hardness of 75 ±5 durometer Shore A for hollow profiles and 60 ±5 for solid profiles.
- Both gaskets shall be compatible for incidental point contact with structural or weather seal silicones.

C. Exterior Visual Gasket at Glass Butt Joint

- Exterior visual gaskets at glass butt joints shall be silicone.
- The design of these gaskets must prevent "roll out" or dislocation under all performance requirements.

D. Setting blocks

- Shall be silicone-rubber or silicone compatible rubber. In the case of structural silicone glazing, dense extruded silicone with a Shore A hardness of 85 ±5 durometer.
- Shall have a minimum length of 100mm and in accordance with BS 6262.
- Minimum width shall correspond to the glass thickness and retaining member but, in no case, shall be less than the glass thickness at point of contact.
- Shall be located at quarter points.
- Shall be secured against migration

E. Backing rod

- Only closed-cell (polyethylene) foam to be adopted as backing rod.
- Must be compatible with sealants and substrate.
- Use only round tools (no sharp edges) to install backing rod. Do not pierce the rod skin of closed-cell rod.
- Use specially designed extruded silicone gaskets at the weather seal joints between any butt glazed laminated vision glass lights to protect the PVB interlayer from the silicone

8.0 Load

A. Dead load

Glass: 2700 kg/m³ Alum: 2700 kg/m³ Steel: 7850 kg/m³

B. Structural

- Design wind pressure, WL: 1.5kN/m²
- Horizontal uniformly distributed line load, BL: 0.74 kN/m
- Horizontal infill load, BL: 1.0 kN/m²
- Horizontal point load, BL: 0.5 kN
- Aluminium/GMS to be separated by EPDM sheet or bituminous paint or equivalent
- Aluminium/concrete to be separated by EPDM sheet or bituminous paint or equivalent

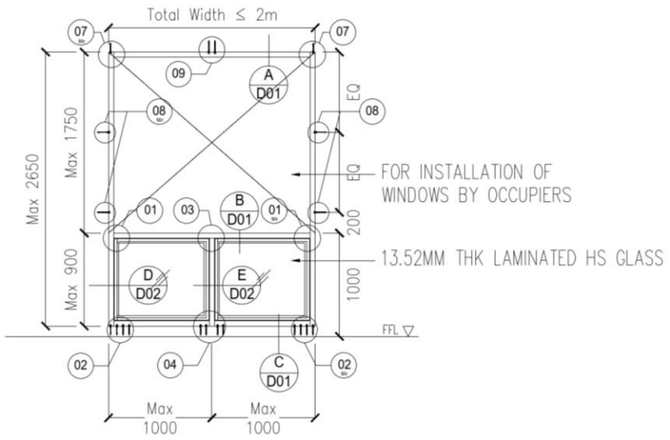
9.0 Abbreviation

SS	Stainless Steel (A4-70/ Grade 316)	L	Length
ST	Self tapping screw	HS	Heat strengthened
ALUM	Aluminium alloy	EQ	Equal/ Equivalent
W/	Width	NTS	Not to scale
THK	Thickness	GMS	Galvanized mild steel
MOIx	Moment of inertia about direction-x	C/C	Centre to centre
MOIy	Moment of inertia about direction-y	FFL	Floor finish level
hef	Effective embedment depth of anchor bolts	Mir	Mirror detail
Max	Maximum	<	Less than
Min	Minimum	≤	Less than or equal to

FULL HEIGHT WINDOW SCHEDULE (CASE 1-4)

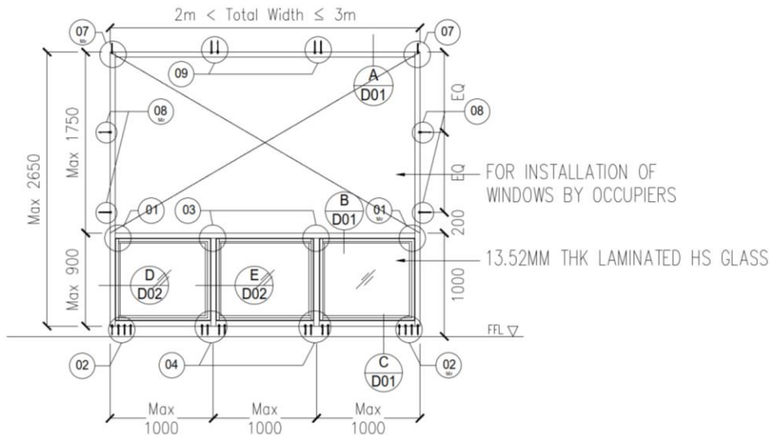
(1.)

Total Window Width ≤ 2.0m



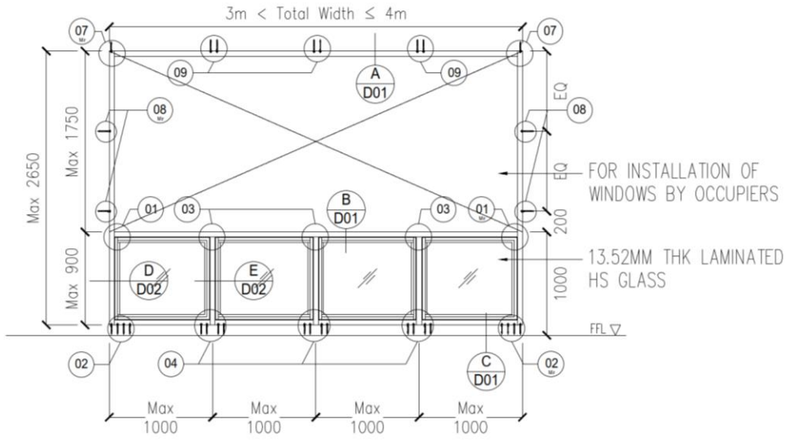
(2.)

2.0m < Total Window Width ≤ 3.0m



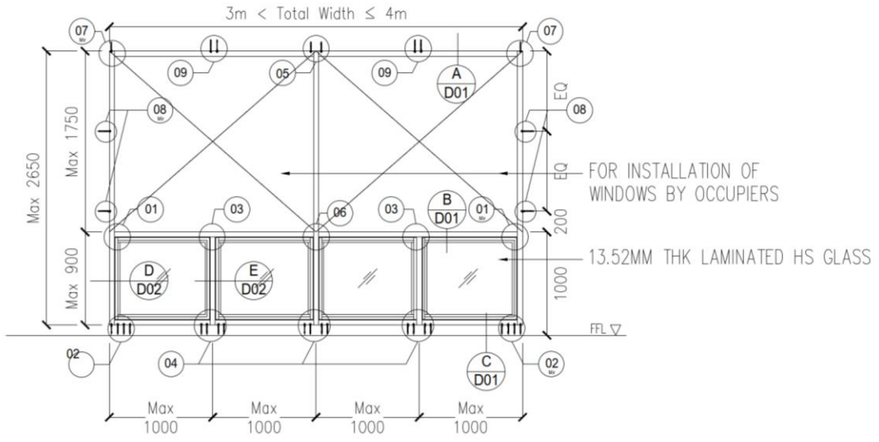
(3.)

3.0m < Total Window Width ≤ 4.0m



(4.)

3.0m < Total Window Width ≤ 4.0m



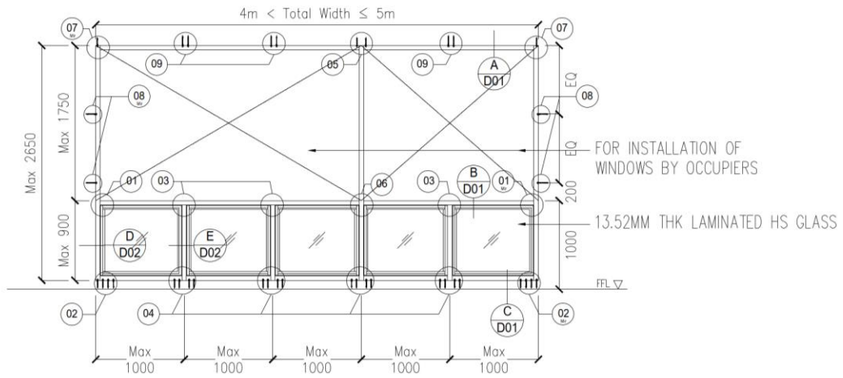
NOTES:

1. Total window height ≤ 2.65m for all types of windows.
2. All the window metal frames shall be minimum aluminium RHS 100x50x3mm (6061-T6) sections.
3. All the fixed glass panels shall be 13.52mm thick laminated glazing (6mm HS + 1.52mm PVB + 6mm HS)
4. The minimum allowable stress of HS glass shall be 32MPa.
5. All steel sections shall be with material grade S275.
6. Non-structural (weatherseal) silicone shall be FS TI-S-001543A (COM-NBS) and ASTM C920, Type SIM, NS, Class 25 or equivalent.
7. All cement grout shall be high strength non-shrink grout with minimum compression strength of 30MPa (7 days).

FULL HEIGHT WINDOW SCHEDULE (CASE 5-7)

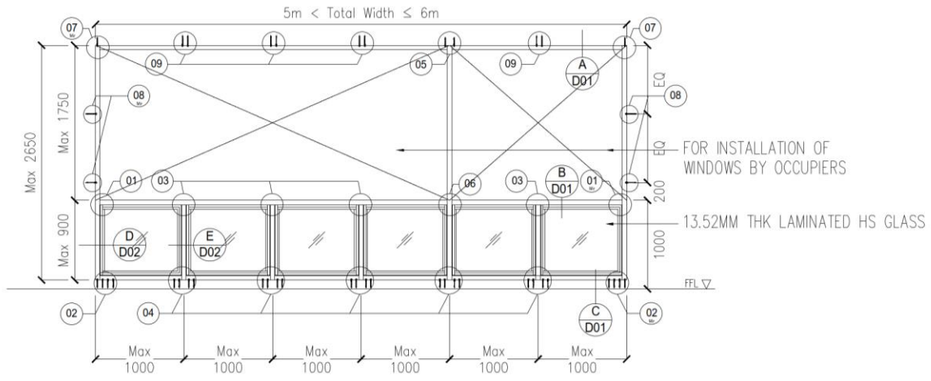
(5.)

4.0m < Total Window Width ≤ 5.0m



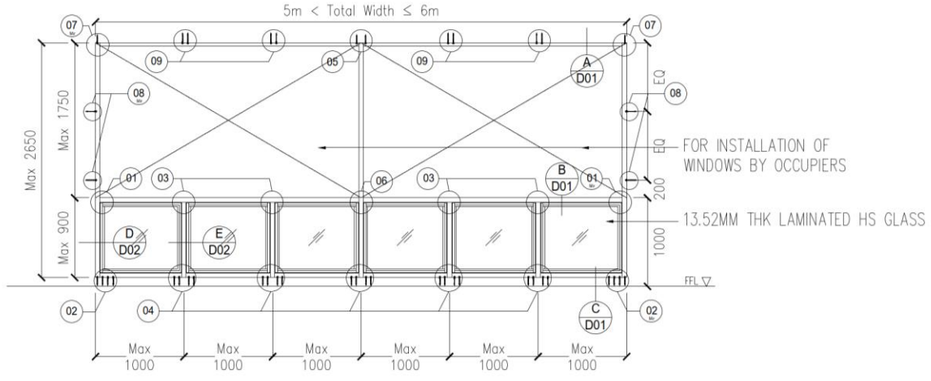
(6.)

5.0m < Total Window Width ≤ 6.0m



(7.)

5.0m < Total Window Width ≤ 6.0m



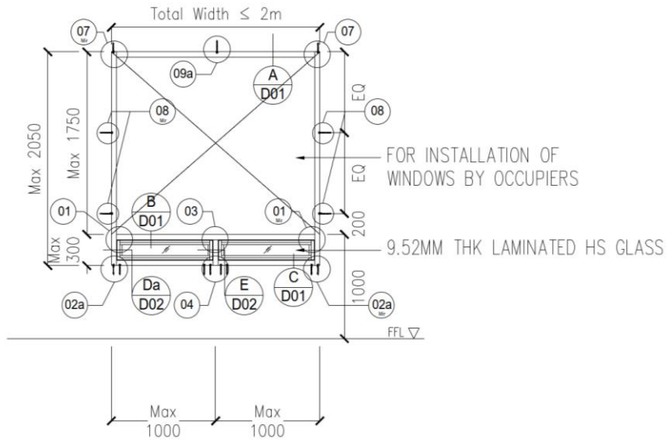
NOTES:

1. Total window height ≤ 2.65m for all types of windows.
2. All the window metal frames shall be minimum aluminium RHS 100x50x3mm (6061-T6) sections.
3. All the fixed glass panels shall be 13.52mm thick laminated glazing (6mm HS + 1.52mm PVB + 6mm HS).
4. The minimum allowable stress of HS glass shall be 32MPa.
5. All steel sections shall be with material grade S275.
6. Non-structural (weatherseal) silicone shall be FS TI-S-001543A (COM-NBS) and ASTM C920, Type SIM, NS, Class 25 or equivalent.
7. All cement grout shall be high strength non-shrink grout with minimum compression strength of 30MPa (7 days).

3/4 HEIGHT WINDOW SCHEDULE (CASE 1-4)

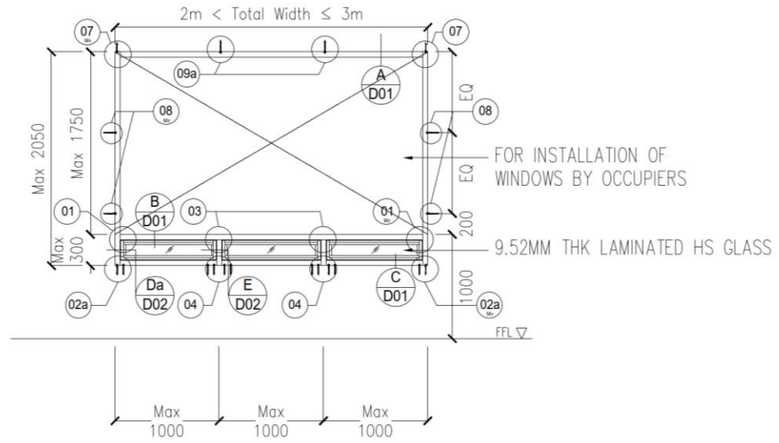
(1.)

Total Window Width ≤ 2.0m



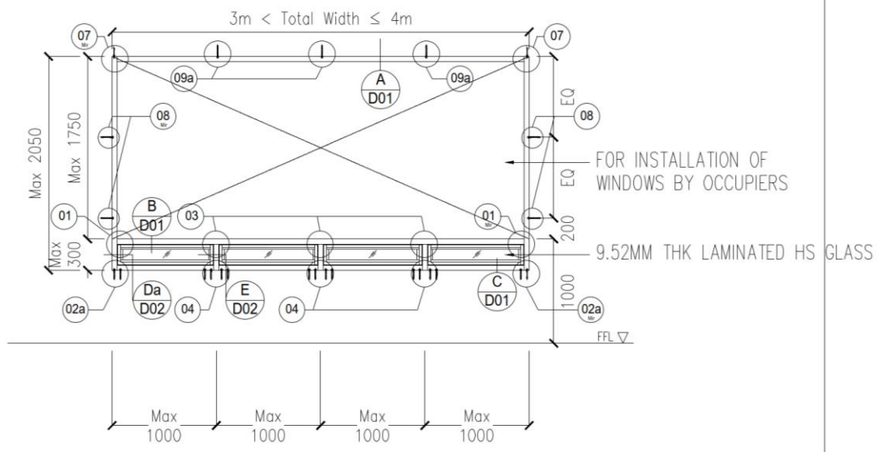
(2.)

2.0m < Total Window Width ≤ 3.0m



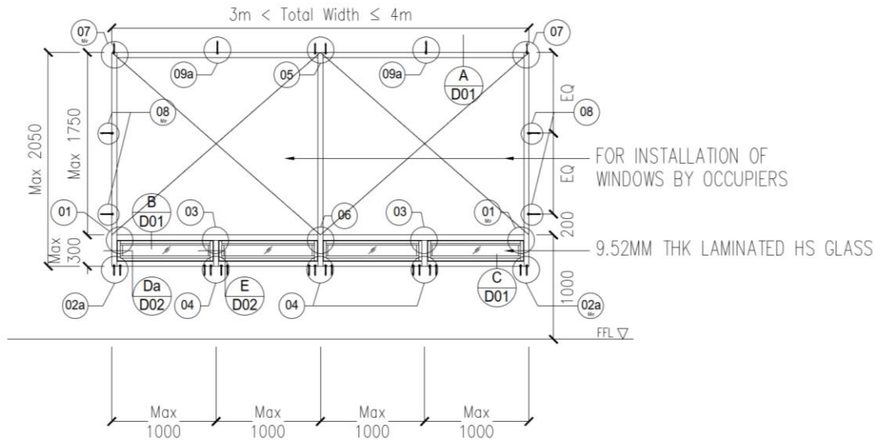
(3.)

3.0m < Total Window Width ≤ 4.0m



(4.)

3.0m < Total Window Width ≤ 4.0m



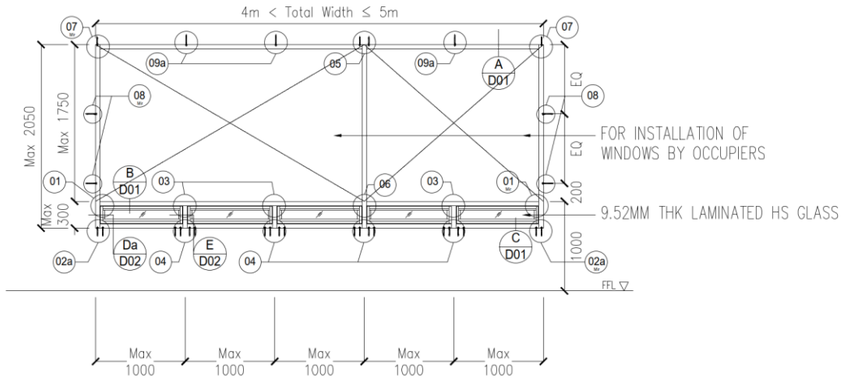
NOTES:

1. Total window height ≤ 2.05m for all types of windows.
2. All the window metal frames shall be minimum aluminium RHS 100x50x3mm (6061-T6) sections.
3. All the fixed glass panels shall be 9.52mm thick laminated glazing (4mm HS + 1.52mm PVB + 4mm HS)
4. The minimum allowable stress of HS glass shall be 32MPa.
5. All steel sections shall be with material grade S275.
6. Non-structural (weatherseal) silicone shall be FS TI-S-001543A (COM-NBS) and ASTM C920, Type SIM, NS, Class 25 or equivalent.
7. All cement grout shall be high strength non-shrink grout with minimum compression strength of 30MPa (7 days).

3/4 HEIGHT WINDOW SCHEDULE (CASE 5-7)

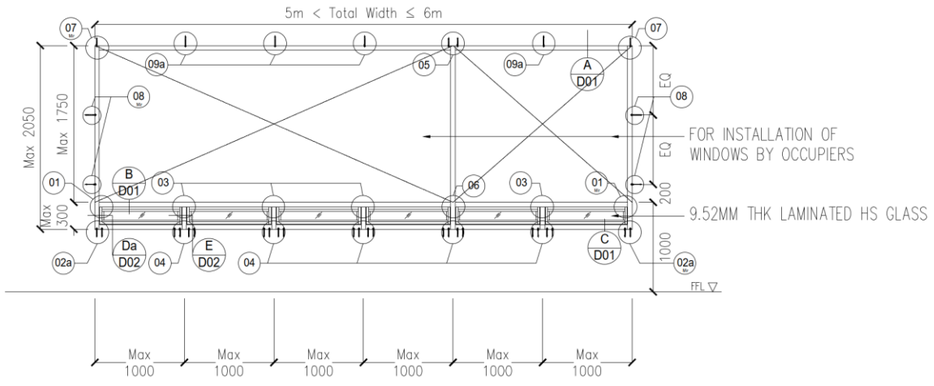
(5.)

4.0m < Total Window Width ≤ 5.0m



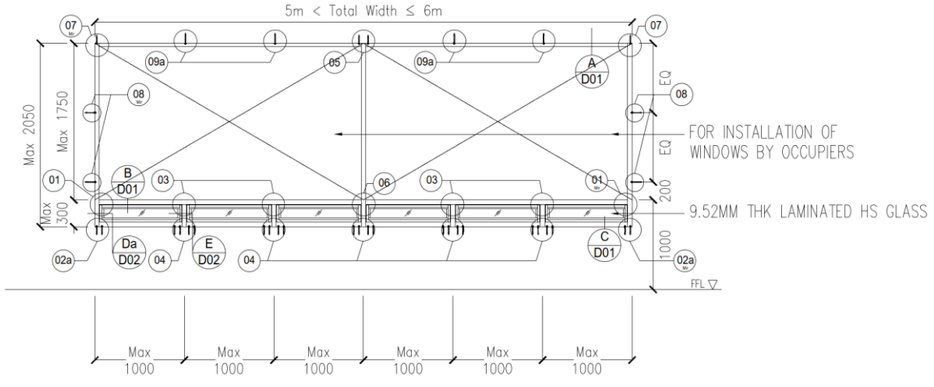
(6.)

5.0m < Total Window Width ≤ 6.0m



(7.)

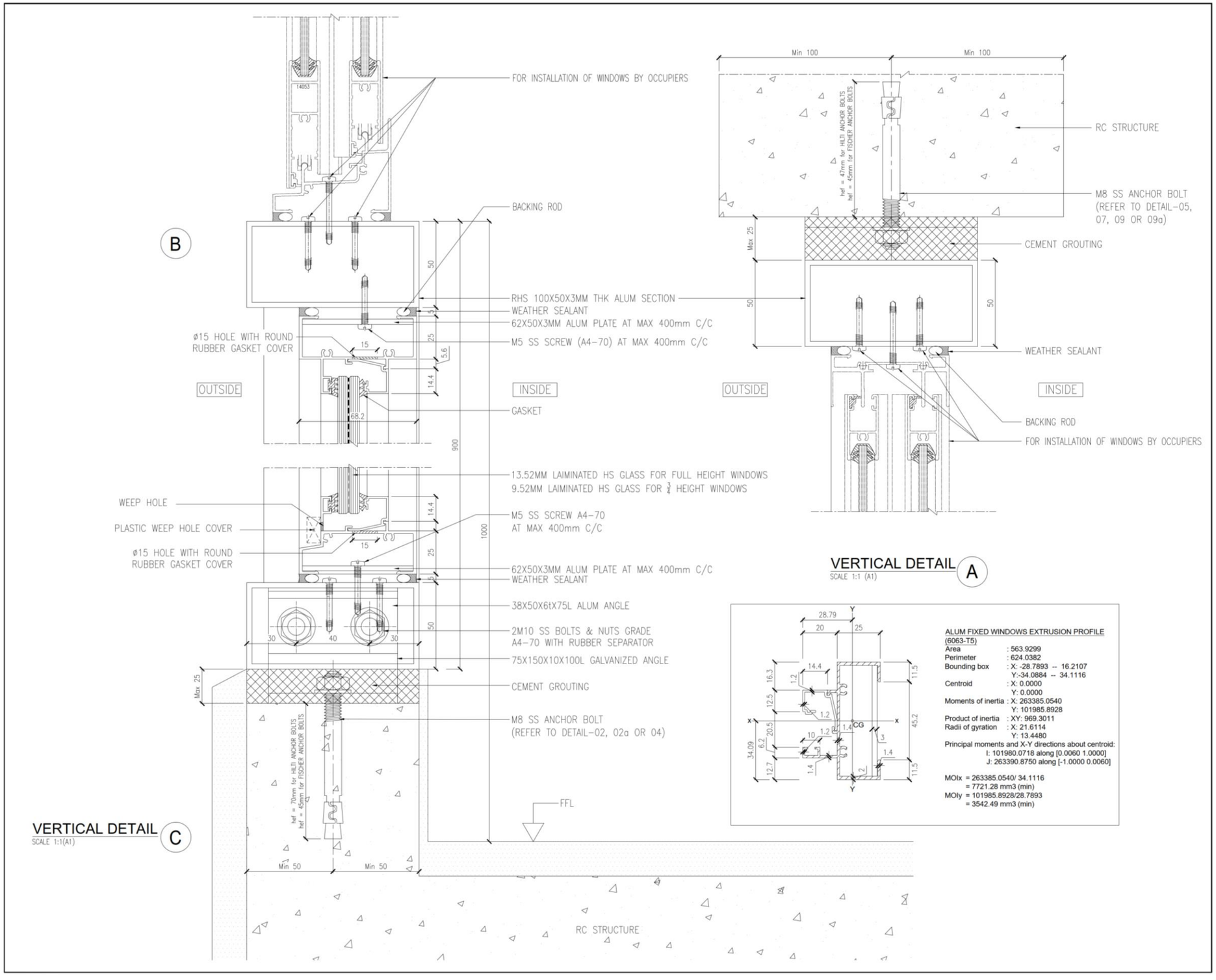
5.0m < Total Window Width ≤ 6.0m



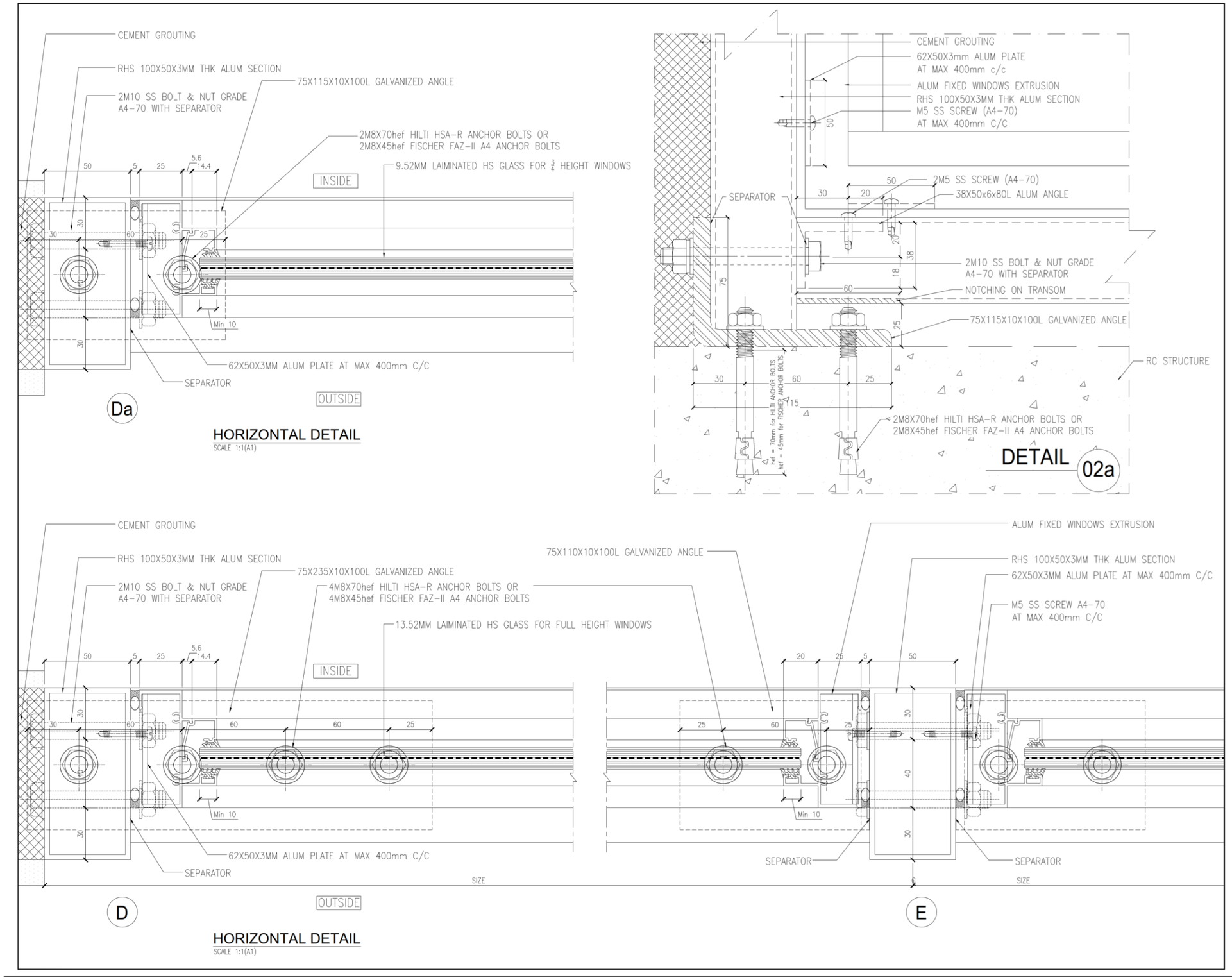
NOTES:

1. Total window height ≤ 2.05m for all types of windows.
2. All the window metal frames shall be minimum aluminium RHS 100x50x3mm (6061-T6) sections.
3. All the fixed glass panels shall be 9.52mm thick laminated glazing (4mm HS + 1.52mm PVB + 4mm HS).
4. The minimum allowable stress of HS glass shall be 32MPa.
5. All steel sections shall be with material grade S275.
6. Non-structural (weatherseal) silicone shall be FS TI-S-001543A (COM-NBS) and ASTM C920, Type SIM, NS, Class 25 or equivalent.
7. All cement grout shall be high strength non-shrink grout with minimum compression strength of 30MPa (7 days).

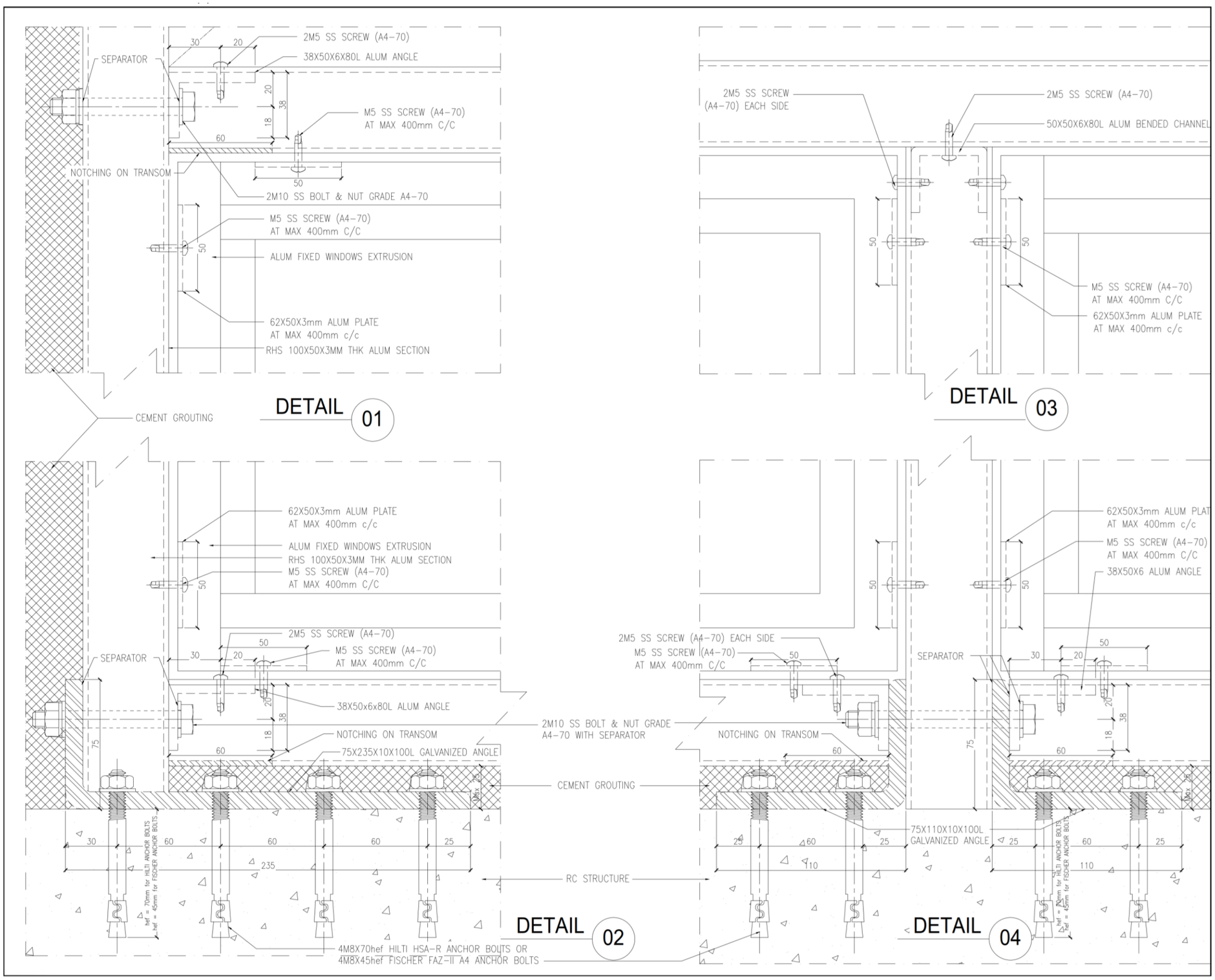
VERTICAL FRAME DETAILS



HORIZONTAL FRAME DETAILS



TYPICAL CONNECTION DETAIL (1)



TYPICAL CONNECTION DETAIL (2)