Building and Construction Authority

Approved Document

Draft

[Draft 07 – 15 Mar 2002]

C O N T E N T S

APPROVED DOCUMENT

A GENERAL

A.1.0 Introduction

A.1.1 The Approved Document is drafted in a performance format to provide greater flexibility for the use of new and innovative building products, systems and designs. The performance format is set out in a simple hierarchy, namely, objectives, performance requirements and acceptable solutions.

A.1.2 The objectives set out community expectations of a safe, disabled-friendly and energy efficiency building and the performance requirements outline the levels of performance which must be met in order for a building to meet the objectives. A user may choose to comply with the 'acceptable solutions' or may use an alternative solution that satisfies the performance requirements. The acceptable solutions is one of the means of achieving the performance requirements and, if complied, are conclusive proof that the performance requirements are satisfied.

A.1.3 Alternative solutions are proposals that can be demonstrated to comply with the relevant performance requirements or at least perform in an equivalent manner as in the acceptable solutions. Where an alternative solution is proposed, the following assessment methods may be used to determine whether the proposal complies with the performance requirements:

(a) documentary evidence;

(b) verification methods which may include calculations (analytical methods or mathematical models), tests or other methods acceptable to the Commissioner of Building Control;

(c) comparison with acceptable solutions to ensure that they at least perform in an equivalent manner; or

(d) expert judgements of suitably qualified and experienced technical experts.

A.2.0 **Related standards or codes**

A.2.1 For the purposes of this Approved Document, any reference to any Standard or Code of Practice is a reference to the current Standard or Code of Practice and includes all amendments or supplements made or issued from time to time.

A.3.0 **Abbreviations and symbols**

A.3.1 The following abbreviations and symbols are used in this Code:

Abbreviation or Symbol	Definition
BS	British Standard
CP	Code of Practice
^{o}	degree
K	Kelvin
kN	Kilonewton
kW	Kilowatt
kg	Kilogram
m	metre
m^2	square metre
m^3	cubic metre
mm	millimetre
mm^2	square millimetre
PSB	Singapore Productivity and Standards Board
SS	Singapore Standard
UDL	Uniformly Distributed Load

B STRUCTURAL DESIGN AND CONSTRUCTION

B.1.0 **Objective**

B.1.1 The objective of this part is to:

(a) safeguard people from injury caused by structural failure;

(b) safeguard people from loss of amenity caused by structural failure, and

(c) protect other property from physical damage caused by structural failure.

B.2.0 **Performance requirement**

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

(a) safely, and

(b) without causing such deflection or deformation of any part of the building, or such movement of the ground, as will impair the stability of any part of another building.

B.2.2 The building shall be constructed with proper materials which are appropriate for the circumstances in which they are used. Appropriate tests shall be performed on the materials and building works.

Note: *The building shall be designed and constructed with the following considerations:*

(a) the characteristics of the site, soil and ground water conditions;

(b) the condition and proximity of surrounding buildings;

(c) the stability of site formation, slopes and embankment;

(d) *the sequence and method of construction and removal of support;*

(e) *the consequences of failure;*

(f) *the nature and intended use of the building;*

(g) *the inherent limitations in the accuracy of the methods used to predict the stability of construction sites and buildings; and*

(h) *the variation in the properties of construction materials.*

B.3.0 **Acceptable solution**

B.3.1 The requirements in clauses B.2.1 and B.2.2 are deemed to be satisfied if a building is designed and constructed in accordance with the following:

B.3.1.1.0 **Loads**

B.3.1.1.1 The building shall resist loads determined in accordance with the following:

(a) Dead loads:

(i) BS 648; and

(ii) BS 6399:Part 1;

(b) Imposed floor and ceiling loads, dynamic loads due to crowd movement, loads on parapets and balustrades, loads on vehicular barrier for car parks, accidental loads:

(i) BS 6399:Part 1;

(c) Wind loads:

(i) BS 6399:Part 2**;**

(d) Imposed roof loads:

(i) BS 6399:Part 3;

(e) Single crane gantry loads:

(i) BS 2573:Part 1;

(f) Vehicular bridge live loads:

(i) BS 5400:Part 2**.**

Note: *Vehicular bridge live loads must comply with BS 5400: Part 2 with the following exceptions***:

(a) for HA Uniformly Distributed Load (UDL), a factor of 1.4 must be applied to the uniformly distributed load specified in BS 5400;

(b) for HA Wheel Load, a separate load case of an axle comprising two numbers of 120 kN wheel loads spaced at 2.0 m apart transversely must be considered. This is in addition to the 100 kN HA wheel load as specified in BS 5400;

(c) for HB Load, the structure must be designed for 45 units of type HB loading. One HB vehicle must be considered on the bridge with no other traffic load concurrently present and the HB vehicle may be considered to be confined to within a 5.0 m strip along the centre of the carriageway, and

(d) for Longitudinal Braking and Traction Load for HA Load, the nominal longitudinal load resulting from traction or braking of vehicles under HA loading must be 8 kN/m of loaded length plus 200 kN, subject to a maximum of 700 kN applied to an area one notional lane wide multiplied by the loaded length.

B.3.1.2.0 **Structural Design**

B.3.1.2.1 The design of the building shall comply with the following:

(a) Reinforced and prestressed concrete:

(i) Structural Use of Concrete – SS CP 65;

(b) Precast Concrete

(i) Precast Concrete Slab and Wall Panel – SS CP 81;

(c) Structural steel:

(i) Structural Use of Steelwork in Buildings – BS 5950;

(d) Foundation:

(i) Foundation – SS.CP 4; and

(ii) Code of Practice for Foundation – BS 8004;

(e) Aluminium:

(i) Structural Use of Aluminium – BS 8118;

(f) Timber:

(i) Structural Use of Timber – SS CP 7;

(g) Aqueous retaining concrete structures:

(i) Design of Concrete Structures for Retaining Aqueous Liquids – BS 8007;

(h) Retaining wall:

(i) Earth Retaining Structures – BS 8002;

(i) Assessment of concrete:

(i) Methods of Testing Concrete – BS 1881; and

(ii) Assessment of Concrete Strength in Existing Structures – BS 6089;

(j) Cranes:

(i) Rules for Design of Cranes – BS 2573:Part 1; and

(k) Bridges:

(i) Steel, Concrete and Composite Bridges – BS 5400.

Note: *Currently, there is a review of Singapore Standard SS CP 4 and the updated version will supersede both Standards or Code of Practice for Foundation.*

B.3.1.3.0 **Foundation**

B.3.1.3.1 The design and construction of the foundation of a building shall conform to the appropriate code of practice specified in clause B.3.1.2.1(c).

B.3.1.4.0 **Site investigation and instrumentation**

B.3.1.4.1 Identification and investigation of the soil and ground water conditions at a site shall be carried out and monitored in accordance with the following:

(a) Code of Practice on Site Investigation – BS 5930; and

(b) Method of Test for Soils for Civil Engineering Purposes – BS1377:Parts 1- 9.

B.3.1.5.0 **Site formation**

B.3.1.5.1 Site formation works shall conform to the Code of Practice on Earthworks – SS CP 18.

B.3.1.6.0 **Retaining structure**

B.3.1.6.1 The design and construction of temporary or permanent retaining structures used for stabilising slopes and embankments shall conform to the appropriate code of practice specified in clause B.3.1.2.1(g).

B.3.1.7.0 **Vibration Control**

B.3.1.7.1 Where works involving foundation or ground stability are carried out with the installation of piles, the vibration level shall be measured and controlled within the limits specified in the German Standards on Structural Vibration in Buildings - DIN 4150:Part 3.

B.3.1.8.0 **Survey**

B.3.1.8.1 The condition of adjacent buildings shall be surveyed and recorded before the commencement of works.

B.3.1.9.0 **Construction Materials**

B.3.1.9.1 Construction materials and their methods of mixing, fixing and preparation shall comply with the following:

(a) Cement:
  (i) Portland Cement – SS 26;

  (ii) Sulphate Resisting Portland Cement – BS 4027;

  (iii) Supersulphated Cement – BS 4248;

  (iv) Portland blast furnace Cement – SS 477;

  (v) High Slag blast furnace Cement – SS 476.

(b) Aggregates:

  (i) Coarse and Fine Aggregates – SS 31;

(c) Water:
  (i) Public supply;

(d) Concrete Reinforcement:

  (i) Hot Rolled Steel Bar – SS 2;

  (ii) Hard Drawn Mild Steel Wire – SS 18;

  (iii) Welded Steel Fabric – SS 32; and

  (iv) Carbon Steel Bar – BS 4449.

(e) Prestressing Tendon:

  (i) BS 8110; and

(ii) BS 5400: Part 7;

(f) Prestressing Steel:

(i) High Tensile Steel Wire and Strand – BS 5896; and

(ii) Hot Rolled and Processed High Tensile Alloy Steel Bar – BS 4486;

(g) Concrete mix:

(i) Minimum Grade 30;

(h) Admixture:

(i) Pigment – BS 1014; and

(ii) Accelerating Admixture, Retarding Admixture and Water Reducing Admixture – BS 5075: Part 1;

(iii) Superplasticizing Admixtures – BS 5075 : Part 3

(i) Steel:

(i) Weldable Structural Steel – BS 7668;

(ii) Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions – BS EN 10137: Parts 1 – 3;

(iii) Hot Rolled Product in Weldable Fine Grain Structural Steel – BS EN 10113: Parts 1–3; and

(iv) Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels – BS EN 10210.

(j) Aluminium and Aluminium Alloys:

(i) Sheet, Strip and Plate – BS EN 485;

(ii) Wrought Product: Temper Designation – BS EN 515;

(iii) Chemical Composition And Form of Wrought Product – BS EN 573;

(iv) Extruded Rod Or Bar, Tube and Profiles – BS EN 755: Part 1; and

(v) Bar, Extruded Round Tube and Section For General Engineering Use – BS 1474.

(k) Timber:

(i) SS CP 7;

(l) Stone:

(i) BS EN 1926;

(m) Brick:

(i) SS 103.

B.3.1.10.0 **Construction Tests**

B.3.1.10.1 Construction tests for the materials and the structural members or elements of a building shall comply with the following:

(a) Cement:

(i) Ordinary and Rapid-hardening Cement – SS 26, SS 397;

(ii) Portland blast furnace cement – SS 477;

(iii) High Slag blast furnace cement – SS 476

(b) Aggregate:

(i) Testing Aggregates – SS 812;

(c) Water:

(i) Methods of Test for Water for Making Concrete – BS 3148;

(d) Concrete:

(i) Testing Concrete – BS 1881;

(e) Steel Reinforcement:

(i) Hot Rolled Steel Bars for the Reinforcement of Concrete – SS 2;

(ii) Hard Drawn Mild Steel Wire for the Reinforcement of Concrete – SS 18;

(iii) Welded Steel Fabric for the Reinforcement of Concrete – SS 32; and

(iv) Specification for Carbon Steel Bars for the Reinforcement of Concrete – BS 4449.

(f) Structural Steel:

(i) Plates and Wide Flats made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions – BS EN 10137:Parts 1-3;

(g) 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;

(h) Weld Quality:

(i) Method of Magnetic Particle Flaw Detection – BS 6072;

(ii) Non-destructive Testing.
Penetrant Testing – BS EN 571;

(iii) Non-destructive Examination of Welded Joints.
Ultrasonic Examination of Welded Joints – BS EN 1714;

(iv) Methods for Ultrasonic Examination of Welds – BS 3923 Part 2; and

(v) Non-destructive Examination of Welds. Radiographic Examination of Welded Joints – BS EN 1435;

(i) Pile Load Test:

(i) Code of Practice for Foundations – BS 8004.

C HEADROOM AND CEILING HEIGHT

C.1.0 **Objective**

C.1.1 The objective of this provision is to safeguard people from –

(a) injury caused by inadequate headroom; and

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

C.2.0 **Performance requirement**

C.2.1 Rooms and spaces in a building must be provided with adequate headroom and with adequate height for their intended uses.

C.3.0 **Acceptable solution**

C.3.1 The requirements in clause C.2.1 are deemed to be satisfied if the following requirements are complied with:

C.3.1.1.0 **Headroom**

C.3.1.1.1 The headroom of every room or access route and circulation space must not be less than 2.0 m.

C.3.1.2.0 **Ceiling height**

C.3.1.2.1 The ceiling height of rooms and spaces in a building, other than those mentioned in clause C.3.1.2.2, must not be less than 2.4 m.

C.3.1.2.2 The ceiling height for the following rooms or spaces must not be less than 2.2 m:

(a) toilets, bathrooms or lavatories;

(b) corridors; and

(c) store rooms.

Note (1) *The headroom is measured from the finished floor level to the underside of any beam or obstruction except fittings and fixtures.*

(2) *The ceiling height is measured from the finished floor level to –*

(a) the underside of any false or suspended ceiling; or

(b) the soffit of a slab.

(3) *The term "access route" shall include a covered walkway or footway of a building.*

(4) *Where openable casement windows are used, consideration should be given to the potential danger which they may pose to people using the building.*

(5) *This requirement does not apply to –*

(a) an attic room;

(b) equipment and plant rooms; and

(c) the underside of a staircase or escalator if such staircase or escalator is not located along an access route or circulation space.

D BARRIER-FREE ACCESSIBILITY

D.1.0 **Objective**

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

D.2.0 **Performance requirement**

D.2.1 At least one access route shall have features to enable persons with disabilities to:

(a) approach the building or the vehicle park; and

(b) have access to and within those spaces where they may be expected to work or visit, or which contain sanitary facilities.

D.2.2 Sufficient appropriate sanitary facilities must be provided at places intended for access by persons with disabilities.

D.2.3 Sufficient signages shall be provided to guide persons with disabilities to such facilities.

D.3.0 **Acceptable solution**

D.3.1 The requirements in clauses D.2.1 to D.2.3 are deemed to be satisfied if provisions and facilities for persons with disabilities are provided in accordance with the current Code on Barrier-Free Accessibility in Buildings.

E STAIRCASES

E.1.0 **Objective**

E.1.1 The objective of this provision is to safeguard people from injury during movement from one level to another in a building and to facilitate access.

E.2.0 **Performance requirement**

E.2.1 A staircase must provide a safe and suitable passage for movement of people.

E.2.2 It must have –

(a) handrails or guides to assist movement;

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

(c) sufficient headroom to avoid injury; and

(d) barriers against falling from 1.0 m or more from an open side.

Note *The term "staircase" in this Section includes a flight of 2 steps or more.*

E.3.0 **Acceptable solution**

E.3.1 The requirements in clauses E.2.1 and E.2.2 are deemed to be satisfied if a staircase is designed and constructed in accordance with the following requirements:

E.3.1.1.0 **Projection**

E.3.1.1.1 No projection, other than handrails, is allowed in a staircase within a height of 2.0 m from the landing or pitch line.

E.3.1.2.0 **Width of staircase**

E.3.1.2.1 The width of every staircase must not be less than 900 mm.

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

E.3.1.3.0 **Risers and treads**

E.3.1.3.1 The height of riser must not be more than 175 mm.

E.3.1.3.2 The width of tread of any straight-flight staircase must not be less than 250 mm except that in a residential unit, the width of tread may not be less than 225 mm.

E.3.1.3.3 The width of a tapered tread or winder in a spiral, circular or geometric staircase measured at a distance of 500 mm from the narrower end must not be less than 225 mm for residential units and 250 mm in other buildings.

E.3.1.3.4 The risers and treads within each flight of stairs shall be of uniform height and size.

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

(2) *This requirement does not apply to –*

(a) plant and equipment rooms; and

(b) attic rooms in residential buildings

E.3.1.4.0 **Landings**

E.3.1.4.1 Landings must be provided at every floor level and door opening.

E.3.1.4.2 Except for spiral, circular or geometric staircase, intermediate landings must be provided in between floor levels at intervals of not more than 18 risers.

E.3.1.4.3 The length of any intermediate landing of a straight-run staircase shall not be less than 900 mm.

Note: *The length of the intermediate landing is measured in the direction of travel.*

E.3.1.4.4 A landing must not have any step or drop except that in a residential unit one winder is allowed in every 90^{o} turn.

Note *This requirement does not apply to the production area in an industrial building.*

E.3.1.5.0 **Headroom**

E.3.1.5.1 The headroom of any staircase must not be less than 2.0 m.

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

E.3.1.6.0 **Handrails**

E.3.1.6.1 A handrail must be provided on at least one side of the flight of staircase.

Note (1) *A handrail need not be provided for a flight of not more than 5 steps.*

(2) *A handrail may terminate at the landing and the ends of the handrail should be properly formed or rounded off so that they do not pose a danger to the user.*

E.3.1.6.2 The height of the handrail must be between 750 mm and 900 mm above the pitch line.

E.3.1.7.0 **Protection from falling**

E.3.1.7.1 The open sides of a staircase shall be protected by barriers in accordance with Section H of this Code.

Note *Section H of this Code is on Safety from Falling.*

F LIGHTING

F.1.0 **Objective**

F.1.1 The objective of this provision is to safeguard people from injury, illness or loss of amenity due to isolation from natural lighting and lack of artificial lighting.

F.2.0 **Performance requirement**

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

F.3.0 **Acceptable solution**

F.3.1 The requirement in clause F.2.1 is deemed to be satisfied by the provision of –

(a) natural lighting complying with clause F.3.2.0; or

(b) artificial lighting complying with clause F.3.3.0.

F.3.2 In the case of residential buildings, only the provision of natural lighting is deemed to satisfy this requirement.

F.3.2.0 **Natural lighting**

F.3.2.1 Natural lighting must be provided for every room in a residential building except –

(a) a bathroom, toilet or lavatory;

(b) store room;

(c) basement; or

(d) civil defence shelter.

F.3.2.2 The aggregate light transmitting area for each room must not be less than 10% of the floor area of the room to be lighted.

F.3.2.3 The windows or other openings must be located such that they open to the exterior of the building or an adjoining open space.

Note

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

(2) *There is no specific requirement for natural lighting for other types of buildings. Such buildings are to be provided with natural lighting and/or artificial lighting consistent with their functions or use.*

(3) *Natural lighting need not be provided for rooms and spaces for transitory use such as:*

(a) *rooms having a floor area not exceeding 6.0 m2;*

(b) *lobbies or vestibules having a floor area of not exceeding 6.0 m2; and*

(c) *corridors or passageways not exceeding 13.0 m in length.*

(4) *For the purpose of promoting energy efficiency in buildings, the use of artificial lighting is to be discouraged in residential buildings.*

F.3.3.0 **Artificial lighting**

F.3.3.1 The artificial lighting system for a building, where provided, must be in accordance with the Code of Practice for Artificial Lighting of Buildings – SS CP 38.

G VENTILATION

G.1.0 **Objective**

G.1.0 The objective of this provision is to safeguard people from loss of amenity due to lack of fresh air.

G.2.0 **Performance requirement**

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

G.3.0 **Acceptable solution**

G.3.1 The requirement in clause G.2.1 is deemed to be satisfied by the provision of –

(a) natural ventilation complying with clause G.3.2.0; or

(b) mechanical ventilation or air-conditioning system complying with clause G.3.3.0.

G.3.2 In the case of residential buildings, only the provision of natural ventilation is deemed to satisfy this requirement.

G.3.2.0 **Natural ventilation**

G.3.2.1 Natural ventilation must consist of openable windows or other openings with an aggregate area of not less than 5% of the floor area of the room or space required to be ventilated and must be provided in every room in a residential building except –

(a) a bathroom, toilet or lavatory;

(b) store room;

(c) basement; or

(d) civil defence shelter.

G.3.2.2 A car park which is to be naturally ventilated shall be provided with permanent openings with an aggregate area of not less than 15% of the floor area at each level. The openings shall be evenly distributed along the external walls to facilitate cross-ventilation throughout the car park.

G.3.2.3 The windows or other openings must be located such that they open to the exterior of the building or an adjoining open space.

Note *Ventilation need not be provided for rooms and spaces for transitory use such as:*

(a) rooms having a floor area not exceeding 6.0 m^2;

(b) lobbies or vestibules having a floor area of not exceeding 6.0 m^2;

(c) corridors or passageways not exceeding 13.0 m in length.

G.3.3.0 **Mechanical ventilation**

G.3.3.1 The mechanical ventilation or air-conditioning system must comply with the Code of Practice for Mechanical Ventilation and Air-Conditioning in Buildings – SS CP 13.

H SAFETY FROM FALLING

H.1.0 Objective

H.1.1 The objective of this provision is to safeguard people from injury caused by falling.

H.2.0 Performance requirement

H.2.1 Where people could fall 1.0 m or more from one level to another, a barrier shall be provided.

Note *This requirement does not apply to roofs or other areas without permanent access.*

H.2.2 Adequate means shall be provided to prevent people from falling over and falling through.

H.3.0 Acceptable solution

H.3.1 The requirements in clauses H.2.1 to H.2.2 are deemed to be satisfied if the following are complied with:

H.3.1.1.0 Height of barrier

H.3.1.1.1 The height of barrier at any location shall not be less than 900mm.

Note

(1) *Barriers are not required at special service or usage areas such as loading/unloading bays, stages for performance or entertain-ment.*

(2) *The height of barrier is measured from the finished floor level vertically to the top of the barrier.*

(3) *If there is a curb of not less than 150 mm wide, the height should be measured from the top of the curb vertically to the top of the barrier.*

(4) *The height of barrier at the flight of stairs is measured from the pitch line vertically to the top of the barrier.*

H.3.1.2.0 Horizontal loading

H.3.1.2.1 A barrier must be designed to withstand a horizontal loading as prescribed in the *Code of Practice for Dead and Imposed Loads – BS 6399:Part 1*.

H.3.1.2.2 Where the barrier is constructed of glazing, the glass panel must comply with clause H.3.1.2.1.

H.3.1.3.0 **Size of opening**

H.3.1.3.1 The size of any opening or gap in a barrier –

(a) in a residential building, child-care centre, shopping complex and place of public resort where small children are expected to frequent, shall not be large enough as to permit the passage of a sphere having a diameter of 100 mm; or

(b) in any other building shall not be large enough as to permit the passage of a sphere having a diameter of 150 mm.

J ENERGY EFFICIENCY

J.1.0 **Objective**

J.1.1 The objective of this provision is to facilitate efficient use of energy.

J.2.0 **Performance requirement**

J.2.1 For a building intended to be air-conditioned, the building envelope must be designed and constructed with energy conservation measures to reduce –

(a) solar heat gain through the roof;

(b) heat transmission through the opaque walls;

(c) heat transmission through the window fenestration;

(d) solar radiation through the window fenestration; and

(e) air leakage through doors, windows and other openings on the building.

J.2.2 For a building not intended to be air-conditioned, the roof must be designed and constructed with energy conservation measures to reduce solar heat gain.

J.2.3 All lighting, air conditioning and mechanical ventilation installations must be energy efficient.

J.3.0 **Acceptable solution**

J.3.1. The requirements in clauses J.2.1 to J.2.3 are deemed to be satisfied if the following are complied with:

J.3.1.1.0 **Building envelope**

J.3.1.1.1 For a building intended to be air-conditioned –

(a) the overall thermal transfer value for the gross area of exterior walls as determined from the equations set out in the approved document shall not exceed 45 W/m^2; and

(b) where the roof is provided with skylights or any other material, translucent or otherwise, which allows the passage of light through, the overall thermal transfer value for the gross area of the roof, as determined from the formulae set out in the approved document shall not exceed $45W/m^2$; or

(c) for any other type of roof not mentioned in paragraph (*b*), the average thermal transmittance for the gross area of the roof, as determined from the formulae set out in the approved document shall not exceed the limit prescribed in Table J1 for the corresponding average weight group.

TABLE J1

Maximum thermal transmittance for roof of air-conditioned building

Weight group	Weight range (kg/m^2)	Maximum thermal transmittance ($W/m^{2^\circ}K$)
Light	Under 50	0.5
Medium	50 to 230	0.8
Heavy	Over 230	1.2

J.3.1.1.2 For a building not intended to be air-conditioned the thermal transmittance value of the roof shall not exceed the limit specified in Table J2 for the corresponding weight group.

TABLE J2

Maximum thermal transmittance for roof of non air-conditioned building

Weight group	Weight range (kg/m^2)	Maximum thermal transmittance ($W/m^{2^\circ}K$)
Light	Under 50	0.8
Medium	50 to 230	1.1
Heavy	Over 230	1.5

J.3.1.2.0 **Air tightness and leakage**

J.3.1.2.1 All windows on the building envelope shall not exceed the air leakage rates specified in SS 212.

J.3.1.2.2 Where shops or other units are designed such that they are located along the perimeter of the building envelope –

(a) the door openings of such shops or units shall be designed to face the interior of the building; or

(b) where the door opening of any shop or unit is designed to open to the exterior of the building, then –

(i) that shop or unit with the door opening to the exterior shall be completely separated from the other parts of the building; and

(ii) that shop or unit, if it is to be air-conditioned, shall have its own individual air-conditioning system separate and independent from the main or central system.

Note: *This clause applies to –*

(a) "shops or other units" in a shopping complex or, in the case of a mixed-use building, to the shopping podium of the complex; and

(b) those "shops or other units" where the doors open into an exterior open space, external corridor, passageway or pedestrian walkway.

J.3.1.3.0 **Air conditioning and mechanical ventilation system**

J.3.1.3.1 The design and installation of any air conditioning and mechanical ventilation shall be in accordance with SS CP 13.

J.3.1.3.2 At least one thermostat for the regulation of space temperature shall be provided for each separate air handling system and zone.

J.3.1.3.3 Each air handling system shall be equipped with manually adjustable automatic timing devices or manual devices or automatic control systems for shutting off or reducing the energy used for the air-conditioning system during periods of non-use or alternative uses of building spaces or zones served by the system.

J.3.1.3.4 The coefficient of performance of chillers shall comply with the rating limits specified in SS CP 24.

J.3.1.4.0 **Artificial lighting**

J.3.1.4.1 The lighting load density of artificial lighting system in a building shall comply with the limits specified in SS CP 24.

J.3.1.5.0 **Automatic control device**

J.3.1.5.1 In any hotel building, an automatic control device, acceptable to the Commissioner of Building Control, shall be installed in every guestroom for the purpose of automatically switching off the lighting and reducing the air-conditioning when a guestroom is not occupied.

J.3.1.6.0 **Energy auditing**

J.3.1.6.1 All buildings used or intended to be used as offices, hotels or shops or a combination thereof shall be provided with data logging facilities for the collection of data for energy auditing.

J.3.1.6.2 Suitable means for the monitoring of energy consumption shall be provided to all incoming power supply to a building and the sub-circuits serving the following:

(a) a central air-conditioning system;

(b) a major mechanical ventilation system;

(c) a vertical transportation system;

(d) a domestic water pumping system;

(e) a security lighting system;

(f) the general power supply to tenancy areas;

(g) the general lighting supply to tenancy areas;

(h) the general power supply to owner’s premises; and

(i) the general lighting supply to owner’s premises.

J.3.1.7.0 **System analysis approach**

J.3.1.7.1 In lieu of complying with clauses J.3.1.1.0, J.3.1.2.0 and J.3.1.3.0, compliance may be demonstrated by using the systems analysis option in accordance with the Building Energy Standard (BEST) Manual. When using the systems analysis option, the proposed building shall provide equal or better conservation of energy than the standard design as defined in the BEST Manual. All energy comparison calculations submitted shall be stamped and authenticated by a qualified person.

Note *For non air-conditioned building, it is only required to show compliance with clauses J.3.1.1.2 and J.3.1.4.0.*