ISBN 978-0-626-40354-6

SANS 10400-XA:2021

Edition 2

SOUTH AFRICAN NATIONAL STANDARD

The application of the National Building Regulations

Part X: Environmental sustainability

Part XA: Energy usage in buildings

WARNING
This document references other documents normatively.

Published by the South African Bureau of Standards
1 Dr Lategan Road Groenkloof ✉ Private Bag X191 Pretoria 0001
Tel: +27 12 428 7911 Fax: +27 12 344 1568
www.sabs.co.za

SABS

This page has been left blank intentionally

COPYRIGHT PROTECTED DOCUMENT

SANS 10400-XA:2021
Edition 2

Table of changes

Change No.	Date	Scope

Foreword

This South African standard was prepared by National Committee SABS/TC 060, *Standards which address the National Building Regulations (NBRS)*, in accordance with procedures of the South African Bureau of Standards, in compliance with annex 3 of the WTO/TBT agreement.

This document was approved for publication in November 2021.

This document supersedes SANS 10400-XA:2011 (edition 1).

Compliance with the requirements of this document will be deemed to be compliance with the requirements of part XA of the National Building Regulations, issued in terms of the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977).

Compliance with this document cannot confer immunity from legal obligations.

SANS 10400 consists of the following parts, under the general title *The application of the National Building Regulations*:

Part A: General principles and requirements

Part B: Structural design.

Part C: Dimensions.

Part D: Public safety.

Part F: Site operations.

Part G: Excavations.

Part H: Foundations.

Part J: Floors.

Part K: Walls.

Part L: Roofs.

Part M: Stairways.

Part N: Glazing.

Part O: Lighting and ventilation.

Part P: Drainage.

Foreword *(concluded)*

Part Q: Non-water-borne means of sanitary disposal.

Part R: Stormwater disposal.

Part S: Facilities for persons with disabilities.

Part T: Fire protection.

Part V: Space heating.

Part W: Fire installation.

Part X: Environmental sustainability.

Part XA: Energy usage in buildings.

Annex B forms an integral part of this document. Annexes A, C, D, E and F are for information only.

This document should be read in conjunction with SANS 10400-A.

Contents

NATIONAL BUILDING REGULATIONS

PART X — ENVIRONMENTAL SUSTAINABILITY

XA ENERGY USAGE IN BUILDINGS

XA1: In order to contribute to the reduction of greenhouse gases buildings, and extensions to buildings in respect of which plans and specifications are to be drawn and submitted in terms of the Act, having A1, A2, A3, A4, C1, C2, E1, E2, E3, E4, F1, F2, F3, G1, H1, H2, H3, H4 and H5 occupancies or building classifications in accordance with regulation A20, excluding garage and storage areas contained within such occupancies, shall be designed and constructed so that they

a) are capable of using energy efficiently while fulfilling user needs in relation to vertical transport, if any, thermal comfort, lighting and hot water; or

b) have a building envelope and services which facilitate the efficient use of energy appropriate to their function and use, internal environment and geographical location.

Equipment and plant required for conducting the business of the occupant shall be excluded from these requirements.

XA2: At least 50 % (volume fraction) of the annual average hot water heating requirement shall be provided by means other than electrical resistance heating including but not limited to solar heating, heat pumps, heat recovery from other systems or processes and renewable combustible fuel.

XA3: The requirements of sub-regulation XA1 shall be deemed to be satisfied when such building is designed and constructed in accordance with the following requirements:

a) has an orientation, shading, services and building envelope in accordance with this part of SANS 10400; or

b) is the subject of a rational design by a competent person, which demonstrates that the energy usage of such building is equivalent to or better than that which would have been achieved by compliance with the requirements of this part of SANS 10400,

c) has a theoretical energy usage performance, determined using certified thermal calculation software, less than or equal to that of a reference building in accordance with SANS 10400-Part XA.

This page is intentionally left blank

The application of the National Building Regulations

Part X:
Environmental sustainability

Part XA:
Energy usage in buildings

1 Scope

This part of SANS 10400 provides deemed-to-satisfy requirements for compliance with part XA (Energy usage in buildings) of the National Building Regulations.

NOTE The prescribed energy efficiency performance levels according to the South African Energy Trajectory of The National Energy Efficiency Strategy as published by the Department of Energy are given in annex A.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the South African Bureau of Standards.

ANSI/NFRC 100, *Procedure for determining fenestration product U-factors.*

ANSI/NFRC 200, *Procedure for determining fenestration product solar heat gain coefficient and visible transmittance at normal incidence.*

SANS 151, *Fixed electric storage water heaters.*

SANS 613, *Fenestration products – Mechanical performance criteria.*

SANS 1307, *Domestic storage solar water heating systems.*

SANS 1352, *The installation, maintenance, replacement and repair of domestic air source water heating heat pump systems.*

SANS 1539, *Appliances operating on liquefied petroleum gas (LPG) or natural gas (NG) – Safety aspects.*

SANS 1687, *Domestic air source water heating heat pump systems.*

SANS 1808-24, *Water supply and distribution system components – Part 24: Gas-operated water heaters.*

SANS 5151, *Non-ducted air conditioners and heat pumps – Testing and rating for performance.*

SANS 8301/ISO 8301, *Thermal insulation – Determination of steady-state thermal resistance and related properties – Heat flow meter apparatus*.

SANS 10087-1, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.*

SANS 10106, *The installation, maintenance, repair and replacement of domestic solar water heating systems.*

SANS 10252-1, *Water supply and drainage for buildings – Part 1: Water supply installations for buildings.*

SANS 10254, *The installation, maintenance, replacement and repair of fixed electric storage water heating systems.*

SANS 10400-O, *The application of the National Building Regulations – Part O – Lighting and ventilation.*

SANS 13253/ISO 13253, *Ducted air-conditioners and air-to-air heat pumps – Testing and rating for performance.*

SANS 54511-2/EN 14511-2, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 2: Test conditions.*

SANS 54511-3/EN 14511-3, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 3: Test methods.*

3 Terms and definitions

For the purposes of this document, the definitions given in Regulation AZ2 of The National Building Regulations (some of which are repeated for convenience) and the following apply.

3.1
building envelope
elements of a building that separate the outside environment from internal spaces where these internal spaces are required to have a controlled internal environment for thermal comfort

NOTE It excludes internal spaces such as garages, storerooms, and enclosed verandas only where these areas have suitably performing separating walls, floors roofs and ceilings and their components such as windows, doors and roof lights meet external performance requirements for energy efficiency

3.2
category 1 building
building which

a) is designated as being of class A3, A4, F2, G1, H2, H3, or H4 occupancy in terms of Regulation A20

b) has no basements,

c) has a maximum length of 6,0 m between intersecting walls or members providing lateral support, and

d) has a floor area that does not exceed 80 m^2

3.3
certified thermal calculation software
software that is certified by the Board of Agrément South Africa, in terms of Agrément South Africa's Energy Software Protocols, as being fit for thermal modelling or calculation purposes in terms of the National Building Regulations

NOTE Board of Agrément South Africa is the body that operates under the delegation of authority of the Minister of Public Works.

3.4
competent person
person who is qualified by their education, training, experience, and contextual knowledge to make a determination regarding the performance of a building or part thereof in relation to a functional regulation or to undertake such duties as may be assigned to them in terms of the National Building Regulations

3.5
CR-value
time constant (hours) of a composite element, such as a wall, and being the arithmetical product of total C-value and the total R-value

3.6
deemed-to-satisfy requirement
non-mandatory requirement, the compliance with which ensures compliance with a functional regulation

3.7
door
glazed or un-glazed, framed, or frameless hinged, pivoting, revolving, roll-up, retracting, sliding, stacking or tilting barrier at the entrance, exit, side of a building or fire escape forming part of a building envelope

3.8
energy efficiency ratio
EER
ratio of output heating energy to input electrical energy of a water heating device

3.9
electrical resistance heating
electric current derived from the national electrical supply grid passed through a conductor to produce heat

3.10
equipment
control devices and components of systems other than appliances which are not permanently installed and integrated for the express purpose of providing control of environmental conditions for the building

3.11
fenestration
glazed opening in a building envelope, including windows, doors, and roof lights

3.12
fenestration area
area that includes glazing and framing elements that are fixed or movable, opaque, translucent, or transparent

3.13
functional regulation
regulation that sets out in qualitative terms what is required of a building or building element or building component in respect of a characteristic, without specifying the method of construction, dimensions, or materials to be used

3.14
nett floor area
floor area within the building envelope, including the area occupied by vertical elements such as internal walls as well as lift wells, enclosed stairs, and storage areas and rooms

3.15
orientation
direction that a building envelope element faces, i.e. the direction of a vector perpendicular to and pointing away from the surface outside of the element

3.16
reference building
hypothetical building that has the same building envelope dimensions, internal layout, functionality, external arrangements and orientation as the proposed building with the deemed-to-satisfy provisions applied and is used to determine the maximum allowable energy usage per annum and average demand for the proposed building

3.17
roof assembly
building cover and its supporting structure, including any ceiling attached to such structure and any additional components such as insulation

3.18
roof covering
covering of the upper exterior surface of a building or shelter which provides protection against weather, notably rain or snow, and heat, wind and sunlight

3.19
roof light
opaque, translucent, or transparent element in a roof which is within 0 °and 70 ° of the horizontal plane

3.20
R-value
thermal resistance (m^2.K/W) of a component

NOTE This is the inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area.

3.21
shading
minimizing or excluding solar energy from reaching fenestration

3.22
solar heat gain coefficient
SHGC
unitless quantity depicting the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation

3.23
spacer system
series of brackets and sub-purlins, or a halter for standing seam profile, that provide

a) a cavity between the underside of the cladding and top of purlins to accommodate the required thickness of flexible bulk insulation without compression,

b) a platform for the mechanical anchoring of the cladding to the supporting structure,

c) transfer of imposed loads on the cladding to the supporting structure without excessive deformation whilst retaining stability, and

d) minimal thermal bridging

3.24
surface density
area density (also known as a real density, superficial density, areic density, mass thickness, column density, or density thickness) of a two-dimensional object calculated as the mass per unit area

NOTE For a walling system, the area density is the total mass per square meter of a walling system.

3.25
total R-value
sum of the R-values of the individual component layers in a composite element, including the air space and associated surface thermal resistances, measured in m².K/W. R-values

NOTE The R-values of the individual component layers are in accordance with the constants and generic conductance values of SANS 694 or the results when tested to SANS 8301.

3.26
total U-value
thermal transmittance (W/m²K) of the composite element, including the air space and associated surface emittance

3.27
whole glazing element
glazing and frame as a unit

4 Requirements

4.1 The functional regulation XA1 contained in part XA of the National Building shall be deemed to be satisfied where the building can use energy efficiently while fulfilling user needs in relation to

a) the vertical transport, if any,

b) thermal comfort,

c) lighting and

d) hot water

by any one of the means given in 4.2, 4.3 or 4.4.

4.2 In any building of occupancy classified in terms of Regulation A20 as A1, A2, A3, A4, E2, E3, F1, F2, F3, G1, H1, H2, H3, H4 and H5, a competent person that satisfies the requirements of Regulation A19 of The National Building Regulations, certifies that such building (excluding garage, storage, and other defined areas) has a theoretical annual energy consumption and demand less than or equal to the values specified in table 1 and table 2.

NOTE 1 Modelling conditions are provided in annex B.

NOTE 2 Only those occupancies for which data are available are listed in tables 1 and 2.

4.3 In any building of occupancy classified in terms of Regulation A20 as A1, A2, A3, A4, C1, C2, E1, E2, E3, E4, F1, F2, F3, G1, H1, H2, H3, H4, and H5, a competent person that satisfies the requirements of Regulation A19 of The National Building Regulations, demonstrates, by using certified thermal calculation software, that the building (excluding garage, storage areas and other defined areas) under consideration has a theoretical energy usage and demand less than or equal to a reference building that complies with the requirements of 4.4.

NOTE Modelling conditions are provided in annex B.

4.4 In any new building or portion of addition or alteration (or both) to an existing building (excluding garage, storage, and other defined areas) of occupancy classified in terms of Regulation A20 as A1, A2, A3, A4, C1, C2, E1, E2, E3, E4, F1, F2, F3, G1, H1, H2, H3, H4, and H5,

a) the orientation is in accordance with the requirements of 5.1,

b) the shading is in accordance with the requirements of 5.2,

c) fenestration is in accordance with the requirements of 5.3,

d) floors are in accordance with the requirements of 5.4,

e) external walls are in accordance with the requirements of 5.5,

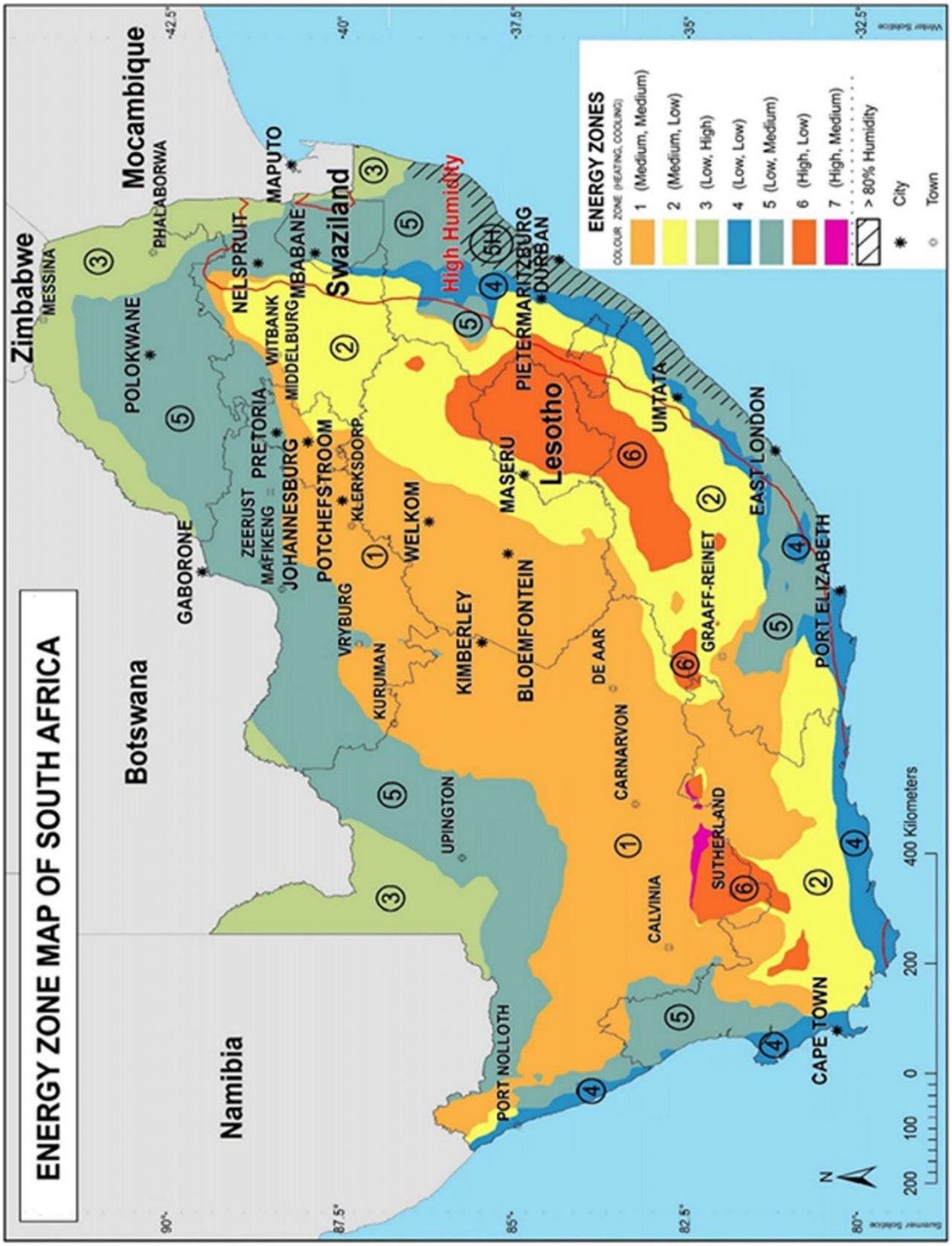
f) roof and ceiling assemblies are in accordance with the requirements of 5.6,

g) the building sealing is in accordance with the requirements of 5.7, and

h) services that use energy or control the use of energy, excluding equipment and plant required for conducting the business of the occupant, but including fixed space cooling, fixed space heating and all fixed lighting, are required to provide energy efficiency levels in accordance with the requirements of clause 6.

NOTE 1 Energy zones are in accordance with figure 1.

NOTE 2 Cities and towns listed alphabetically by Energy zones are listed in annex C.



Drg.1113a

NOTE Energy zone map
Available from:
https://csir.maps.arcgis.com/apps/webappviewer/index.html?id=79602766e2b54ede82625c939ac1814b)

Figure 1 — Energy zone map

Table 1 — Maximum annual energy consumption per building classification for each energy zone (kWh/m²/a) (Energy zones as shown in figure 1 and annex C)

1	2							
Class of occupancy	**Energy zones**							
	1	**2**	**3**	**4**	**5**	**5H**	**6**	**7**
A1 **Entertainment and public assembly** Occupancy where persons gather to eat, drink, dance or participate in other recreation.	75	75	95	70	95	95	80	80
A2 **Theatrical and indoor sport** Occupancy where persons gather for the viewing of theatrical, operatic, orchestral, choral, cinematographical or sport performances.	95	95	110	90	110	110	105	105
A3 **Places of instruction** Occupancy other than primary or secondary schools, where students or other persons assemble for the purpose of tuition or learning.	110	155	110	125	140	140	120	120
A3 **Places of instruction** Occupancy where school children assemble for the purpose of tuition or learning	60	65	55	60	55	60	65	65
A4 **Worship** Occupancy where persons assemble for the purpose of worshipping.	70	45	45	40	50	40	70	70
E2 **Hospital** Occupancy where people are cared for or treated because of physical or mental disabilities and where they are generally bed-ridden.	325	335	225	295	295	230	345	345
E3 **Other institutional (residential)** Occupancy where groups of people who either are not fully fit, or who are restricted in their movements or their ability to make decisions, reside and are cared for	120	95	90	90	100	80	130	130
F1 **Large shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area exceeds 250 m².	125	200	155	180	185	150	125	125
F2 **Small shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area does not exceed 250 m².	75	150	100	125	130	95	80	80

Table 1 (*concluded*)

1	2							
Class of occupancy	**Energy zones**							
	1	**2**	**3**	**4**	**5**	**5H**	**6**	**7**
F3 Wholesaler's store Occupancy where goods are displayed and stored and where only a limited selected group of persons is present at any one time.	125	200	155	180	185	150	125	125
G1 **Offices** Large multi-storey office buildings, banks, consulting rooms and similar uses with lifts and energy consuming services that operate on a typical daytime occupancy.	90	105	110	95	110	95	100	100
G1 **Offices** Stand-alone blocks and / or campus of buildings that form an office park but operate separately	70	150	190	145	180	165	75	75
H1 **Hotel** Occupancy where persons rent furnished rooms, not being dwelling units.	125	130	100	115	125	95	140	140
H2 **Dormitory** Occupancy where groups of people are accommodated in one room	155	170	160	175	160	160	160	180
H3 **Domestic residence** Occupancy consisting of two or more dwelling units on a single site.	90	100	50	80	85	60	110	110
H4 **Dwelling house** Occupancy consisting of a dwelling unit on its own site, including a garage and other domestic outbuilding, if any.	95	100	50	80	85	60	110	110
H5 **Hospitality** Occupancy where unrelated persons rent furnished rooms on a transient basis within a dwelling house or domestic residence with sleeping accommodation for not more than 16 persons within a dwelling unit	120	130	110	120	115	135	135	135

Table 2 — Maximum Annual demand intensity per building classification for each energy zone (VA/m^2) (see Energy zones as shown in figure 1 and annex C)

1	2							
Class of occupancy	**Energy zones**							
	1	**2**	**3**	**4**	**5**	**5H**	**6**	**7**
A1 **Entertainment and public assembly** Occupancy where persons gather to eat, drink, dance or participate in other recreation	30	30	38	28	38	38	32	32
A2 **Theatrical and indoor sport** Occupancy where persons gather for the viewing of theatrical, operatic, orchestral, choral, cinematographical or sport performances	38	38	44	36	44	44	42	42
A3 **Places of instruction** Occupancy other than primary or secondary schools, where students or other persons assemble for the purpose of tuition or learning.	44	62	44	50	56	56	48	48
A3 **Places of instruction** Occupancy where school children assemble for the purpose of tuition or learning	24	26	22	24	22	24	24	24
A4 **Worship** Occupancy where persons assemble for the purpose of worshipping	28	18	18	16	20	16	28	28
E2 **Hospital** Occupancy where people are cared for or treated because of physical or mental disabilities and where they are generally bed-ridden.	130	134	90	118	118	92	138	138
E3 **Other institutional (residential)** Occupancy where groups of people who either are not fully fit, or who are restricted in their movements or their ability to make decisions, reside and are cared for	48	38	36	36	40	32	52	52
F1 **Large shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area exceeds 250 m²	50	80	62	72	74	60	50	50
F2 **Small shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area does not exceed 250 m²	30	60	40	50	52	38	32	32
F3 **Wholesaler's store** Occupancy where goods are displayed and stored and where only a limited selected group of persons is present at any one time	50	80	62	72	74	60	50	50

Table 2 (*concluded*)

1	2							
Class of occupancy	**Energy zones**							
	1	**2**	**3**	**4**	**5**	**5H**	**6**	**7**
G1 **Offices** Large multi-storey office buildings, banks, consulting rooms and similar uses with lifts and energy consuming services that operate on a typical daytime occupancy.	36	42	44	38	44	38	40	40
G1 **Offices** Stand-alone blocks or campus (or both) of buildings that form an office park but operate separately	28	60	76	58	72	66	30	30
H1 **Hotel** Occupancy where persons rent furnished rooms, not being dwelling units	80	60	46	54	54	44	80	80
H2 **Dormitory** Occupancy where groups of people are accommodated in one room	80	74	94	78	90	90	80	80
H3 **Domestic residence** Occupancy consisting of two or more dwelling units on a single site.	58	66	40	56	56	46	60	60
H4 **Dwelling house** Occupancy consisting of a dwelling unit on its own site, including a garage and other domestic outbuilding, if any	58	66	40	56	56	46	60	60
H5 **Hospitality** Occupancy where unrelated persons rent furnished rooms on a transient basis within a dwelling house or domestic residence with sleeping accommodation for not more than 16 persons within a dwelling unit	58	58	62	56	60	60	60	60

5 Building envelope

5.1 Orientation

Orientation shall be defined as one of either North, North-East, East, South East, South, South–West, West or North-West as shown in figure 2, and refers to the façade that contains the largest combined area of fenestration elements for solar heat gain in Energy zones 1, 2, 3, 4, 5, 6 and 7 or the façade with the largest openings for ventilation in Energy zone 5H.

NOTE 1 For energy zones see figure 1.

NOTE 2 Buildings should be orientated to face North East, North or North-West as shown figure 2 to facilitate winter solar gain, except for in Zone 5H.

NOTE 3 In Zone 5H buildings should be orientated to make use of the prevailing winds (see figure 3) to cool the building through natural ventilation.

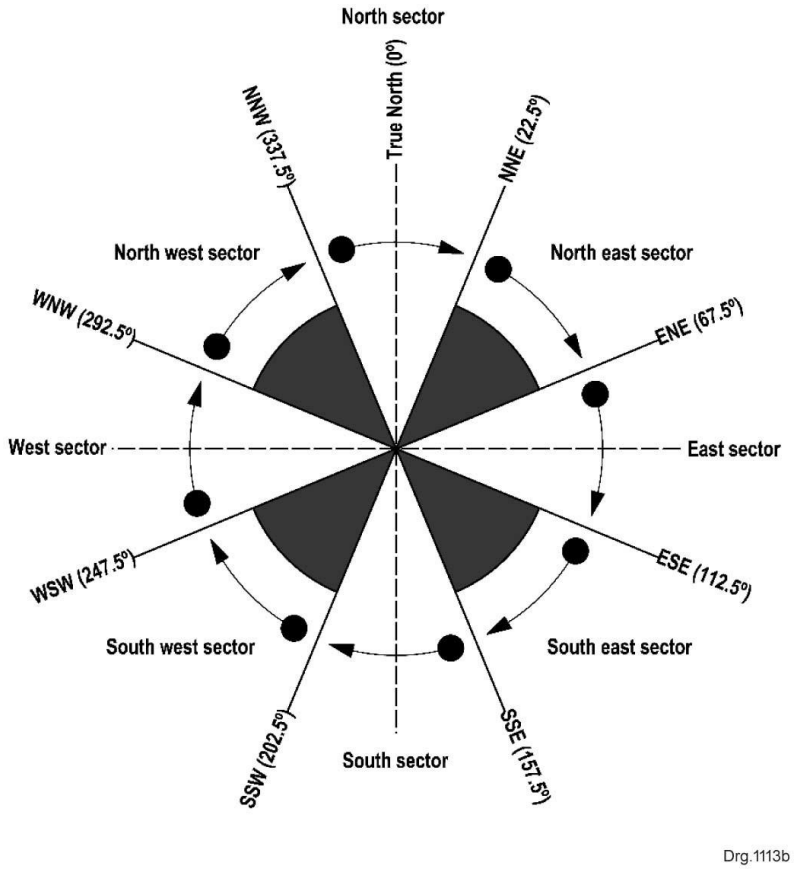
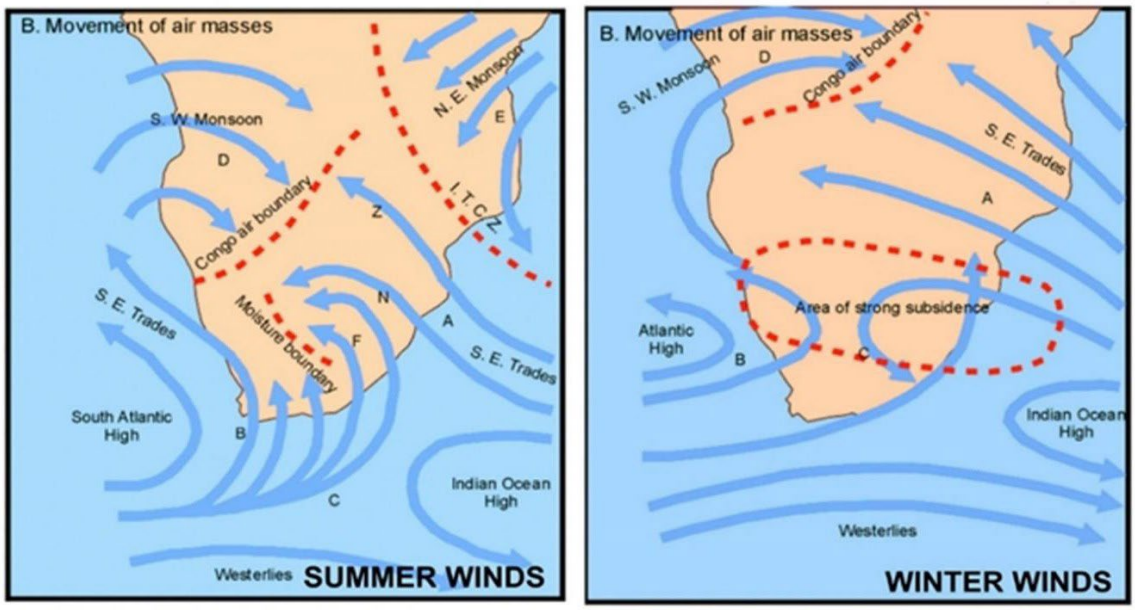


Figure 2 — Orientation sectors



Drg.1113m

NOTE Adapted from the National Laboratory of Sustainable Energy.

Figure 3 — Prevailing winds of South Africa

5.2 Shading

NOTE Shading against summer solar radiation can be provided by

a) shading devices,

b) glass tinting and coating,

c) fenestration types and design, or

d) size of area of glazing per elevation.

5.2.1 Where shading is implemented to satisfy fenestration requirements, the building shall

a) have a permanent feature such as a veranda, balcony, fixed canopy, eaves, or shading hood with opaque property, which

   1) extends horizontally on both sides of the glazing for the same projection distance, P in figure 4 for elevations with West, North-West, North, North-East and East Sector orientation, and

   2) provides the equivalent shading with a reveal or other method.

b) alternatively have an external shading device, such as a shutter, blind, building screen with vertical or horizontal blades, battens or slats, which

   1) can restrict at least 80 % by area of astronomical summer solar radiation, and

   2) if adjustable, is readily operated either manually, mechanically, or electronically by the building occupants.

NOTE 1 Designers should make provision to ensure that there is not excessive shading of desirable winter solar gains.

NOTE 2 Astronomical summer refers to the period from spring equinox though to autumnal equinox (in the southern hemisphere the period 23 September until 21 March).

5.2.2 The projection of the shading device (P) shall not be less than the height (H) multiplied by the factor given in table 3 for the appropriate latitude for the site.

NOTE 1 Exceeding dimension P will prevent beneficial winter sun from striking the fenestration. Examples of shading are given in annex D.

NOTE 2 Screens attached to the exterior of the building can act as a chimney in case of a fire and measures to avoid such a situation arising should be taken note of.

NOTE 3 Fixed vertical shading devices should not compromise the requirements for natural lighting in accordance with SANS 10400-O.

Table 3 — Multiplier for shading projection on facades with West, North-West, North, North-East and East sector orientation

1	2
Latitude (º South)	**Multiplier**
≤ 22º	0,33
≤ 24º	0,36
≤ 26º	0,40
≤ 28º	0,42
≤ 30º	0,46
≤ 32º	0,50
>32º	0,54
NOTE A list of towns with their latitudes are provided in table C.1,	

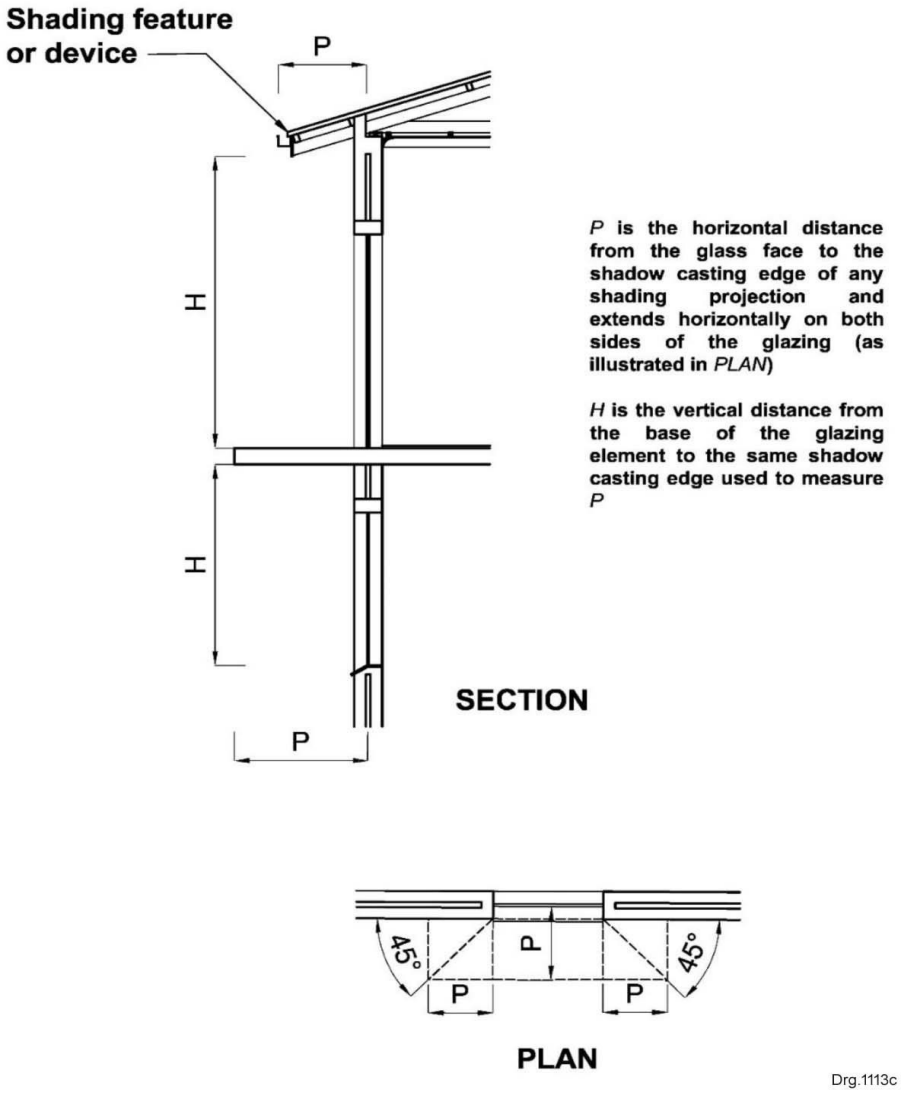


Figure 4 — Explanation of the shading device/feature

5.3 Fenestration

5.3.1 Fenestration includes fenestration applied to external walls and roofs forming part of the building envelope.

NOTE 1 Glazing elements require total U-values and SHGCs and are assessed for the combined effect of glass and frames. The measurements of these total U-values and SHGCs are specified in the guidelines of the National Fenestration Rating Council (ANSI/NFRC) and the indicative ranges of these performance values are given in annex E.

NOTE 2 Any centre of glass values (for both U and SHGC values) of any fenestration product that has not been calculated in a whole glazed system should not be used.

5.3.2 Total U-values provided or calculated (or both) shall be determined in accordance with ANSI/NFRC 100.

5.3.3 The Solar Heat Gain Coefficient (SHGC) provided or calculated (or both) shall be determined in accordance with ANSI/NFRC 200.

5.3.4 The weighted average (by fenestration area) per storey of vertical fenestration with West, North-West, North, North-East and East sector orientation (see figure 2) shall have performance values certified by the glazier or a competent person to be equal or less than the relevant value given in table 4.

5.3.5 The weighted average (by fenestration area) per storey of vertical fenestration with South-West, South, and South-Eastern orientation (see figure 2) shall have performance values certified by the glazier or a competent person to be equal or less than the relevant value given in table 4.

NOTE 1 Values calculated in 5.3.4 and 5.3.5 are independent of each other and therefore will in no way affect each other. Should one exceed the performance requirement the performance cannot be compromised in the second. The requirements of each clause are to be satisfied independent of the other.

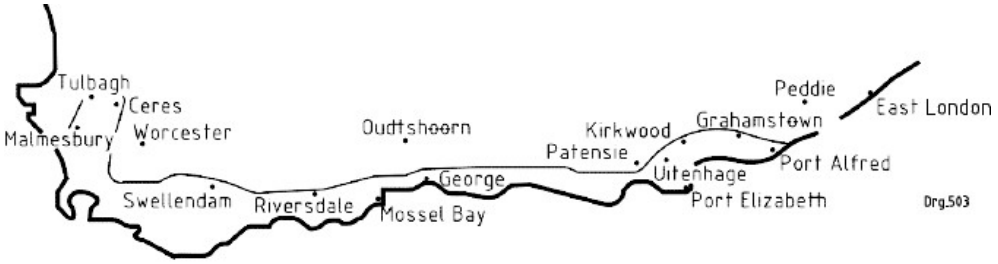
NOTE 2 These values are strictly applicable to the storey considered. Should the performance of one storey exceed requirements this cannot be traded off in a second storey.

Table 4 — Area weighted average maximum whole fenestration element performance values for vertical fenestration

1	2	3		
Total fenestration area for each storey/nett floor area for each storey (%)	**U-Value ($W/m^2.K$)**	**Maximum solar heat gain coefficient (SHGC)**		
		Vertical fenestration with West, North-West, North, North-East and East sector orientation (see figure 2)		**Vertical fenestration with South-West, South and South-Eastern orientation** (see figure 2)
		With shading in accordance with 5.2.2	**With no shading or not in accordance with 5.2.2**	**All**
≤ 20 %	Any solution	Any solution	Any solution	Any solution
≤ 25 %	5,20	0,66	0,49	Any solution
≤ 30 %	4,40	0,53	0,44	Any solution
≤ 35 %	3,80	0,49	0,40	Any solution
≤ 40 %	3,30	0,44	0,35	Any solution
≤ 45 %	3,00	0,40	0,33	Any solution
≤ 50 %	2,60	0,35	0,30	Any solution
≤ 55 %	2,40	0,33	0,28	Any solution
≤ 60 %	2,20	0,30	0,25	Any solution
>60 %	2,00	0,28	0,22	Any solution

5.3.6 To reduce the formation of condensation in the Southern Cape Condensation Problem Area (see figure 5 and table C.1) the U-values of fenestration shall be achieved by means other than single low emissivity glass to maintain the energy efficiency properties.

NOTE The use of single low emissivity glass increases condensation formation thereby negatively impacting the U value and causing the installation to fall short of its certified performance.



The SCCP area is readily identified by combining the following environmental features:

a) It lies south of the major mountain ranges in the Southern Cape.

b) It includes the area that receives winter and all-year-round rainfall.

c) It receives an annual rainfall of between 250 mm and 500 mm per year.

Towns that lie on the SCCP boundary

Albertinia	Gouda	Katara	Prince Alfred	Swellendam
Alicedale	Grahamstown	Kirkwood	Riebeek East	Tulbagh
Barrington	Greyton	Langholm	Riebeek West	Uitenhage
Bathurst	Hamlet	Lindeshof	Riversdale	Villiersdorp
Blanco	Hankey	Louterwater	Riviersonderend	Wellington
Bluecliff	Heidelberg	Malmesbury	Ruiterbos	Wolseley
Ceres	Herbertsdale	Mamre	Stormsvlei	
Franschhoek	Joubertina	Paarl	Suurberg	
Genadendal	Kammiebos	Port Alfred	Suurbraak	

Towns that lie within the SCCP area

Addo	Dana Bay	Kalbaskraal	Papiesvlei	Stellenbosch
Alexandria	Despatch	Kareedouw	Paradise Beach	St Francis Bay
Amsterdamhoek	Droë Vlakte	Kariega	Paterson	Still Bay
Askraal	Elgin	Kasuka	Pearly Beach	Storms River
Aston Bay	Elim	Kenton on Sea	Philadelphia	Strand
Atlantis	Fairfield	Kleinmond	Plettenberg Bay	Struis Bay
Baardskeerdersbos	Firgrove	Klipdale	Pniel	Sunland
Bellevue	Fish Hoek	Knysna	Port Beaufort	Swartkops
Bethelsdorp	Gans Bay	Kommetjie	Port Elizabeth	The Crags
Betty's Bay	George	Kruisfontein	Protem	Vermaaklikheid
Bloubergstrand	Gordon's Bay	Kuilsrivier	Riethuiskraal	Viljoenskroon
Bluecliff	Gouritsmond	Kylemore	Rietpoel	Vlees Bay
Boesmansrivier-mond	Grabouw	Loerie	Rondevlei	Waenhuiskrans
	Groot Brakrivier	Malgas	Salem	Wilderness
Boknesstrand	Groot Jongensfontein	Melkbosstrand	Scarborough	Windmill
Botrivier	Hartenbos	Milnerton	Sea View	Witsand
Brandwag	Hawston	Mossel Bay	Sedgefield	Wittedrif
Bredasdorp	Hermanus	Muizenberg	Simon's Town	Witteklip
Caledon	Hermon	Napier	Sinksabrug	Woodlands
Cape Town	Herold's Bay	Noanaha	Skipskop	Wydgeleë
Clarkson	Hout Bay	Onrus	Slangrivier	
Coega	Humansdorp	Oukraal	Somerset West	
Coerney	Jeffreys Bay	Oyster Bay	Southwell	
Colchester		Pacaltsdorp	Stanford	

Figure 5 — The Southern Cape Condensation Problem Area (SCCP)

5.3.7 The maximum air leakage for windows and doors shall comply with the requirements of SANS 613.

5.3.8 Roof lights (sloped/horizontal glazing as shown in figure 6) serving a space in the building envelope shall:

a) be acceptable if the total area of roof lights is less or equal to 1,5 % of the floor area or space they serve;

b) comply with table 5 if the total area of roof lights is more than 1,5 % but not more than 10 % of the floor area or space they serve; and

c) achieve an SHGC of not more than 0,25 and a total U-value of not more than 2,0 W/m².K if the total area of roof lights is more than 10 % of the floor area of the room or space they serve.

NOTE The thermal performance of an imperforate ceiling diffuser may be included in the total U-value of a roof light.

Table 5 — Roof lights — thermal performance of fenestration

1	2	3
Ratio fenestration/ space served	**U-Value (W/m².K)**	**SHGC**
<1,5 %	Any	Any
1,5 % to ≤ 3%	≤ 5,8	≤ 0,75
>3 % to ≤ 5 %	≤ 5,8	≤ 0,50
>5 % to ≤ 10 %	≤ 2,7	≤ 0,25
>10 %	≤ 2,0	≤ 0,25

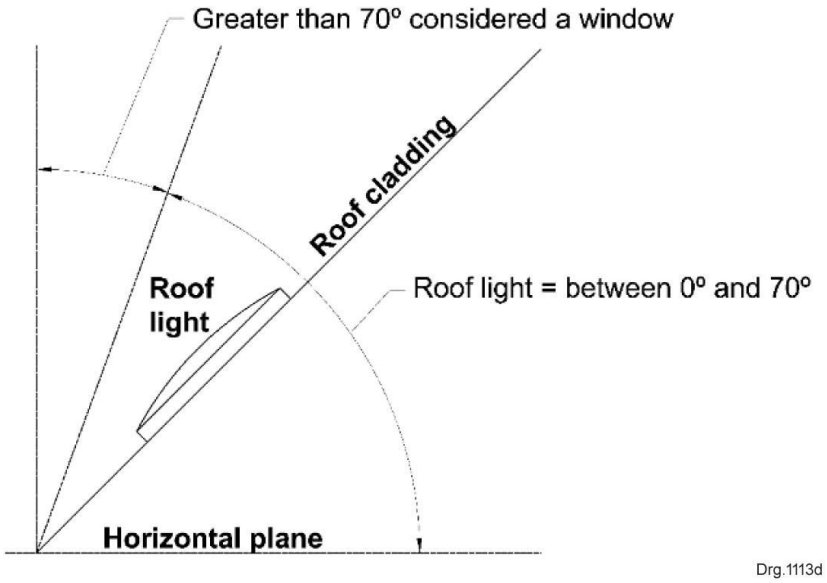


Figure 6 — Defining a roof light

5.4 Floors

5.4.1 Where an underfloor heating system (for example, in-screed, under laminate heating, under carpet heating, under-tile heating, cut-in under floor heating, and water-based under floor heating) is installed, the floor shall be insulated with insulation that has a minimum R-value of not less than 1,0 m².K/W such as to prevent heat loss to the surrounding and adjacent ground.

5.4.2 A suspended floor that is part of a building's envelope shall have insulation that will retain its thermal properties under moist conditions and be installed for

a) Energy zones 1, 2, 6 and 7 and shall achieve an insulation R-value of 1,5 m².K/W.

b) Energy zones 3 and 4, 5 and 5H and shall achieve an insulation R-value of 1,0 m².K/W.

5.5 External walls

5.5.1 The minimum total R-value requirements for an external wall for buildings other than category 1 buildings with a surface density equal or greater than 270 kg/m² shall be in accordance with table 6.

5.5.2 Single-leaf masonry walls in category 1 buildings shall have a nominal wall thickness greater than or equal to 140 mm.

NOTE Nominal wall thickness refers to the thickness of a wall excluding the thickness of any plaster applied.

5.5.3 Walls for buildings with a surface density less than 270 kg/m² shall achieve a minimum total R-value or a minimum CR-value (by the addition of capacity or resistance (or both)) shall be in accordance with table 7.

Table 6 — Minimum R-value requirements for walls with a surface density greater than or equal to 270 kg/m²

1	2	3	4
Walls			
Surface density	**Energy zones**	**R-value (m^2.K/W)**	**Minimum requirement** [a]
>270 kg/m^2	1	0,6	50mm cavity wall
	2	0,6	50mm cavity wall
	3	0,4	Collar jointed wall
	4	0,6	50mm cavity wall
	5	0,4	Collar jointed wall
	5H	0,4	Collar jointed wall
	6	0,6	50mm cavity wall
	7	0,6	50mm cavity wall
[a] Walls built with FBX, FBS and FBA clay bricks and high-density concrete face bricks and blocks do not need to be plastered. All other walls need to be plastered internally and externally.			

Table 7 — Minimum R-value requirements or CR-value requirements for walls with a surface density less than 270 kg/m²

1	2	3
Walls		
Energy zones	**R-Value (m^2K/W)**	**CR-Value (h)**
1	2,2	100
2	2,2	100
3	1,9	80
4	1,9	80
5	1,9	80
5H	1,9	80
6	2,2	100
7	2,2	100

5.5.4 A walling construction that has any metal sheet, metal studs, metal tracks or metal battens fixed to each other shall have a thermal break consisting of a material with an R-value of not less than 0,2 m².K/W installed between the metal structural elements.

5.5.5 Spaces such as garages, enclosed verandahs, glasshouses, solariums, storerooms or pool enclosures to the main building (see figure 7) shall either be excluded from or be included in the building envelope but, where excluded, shall not compromise the thermal performance of the main building envelope.

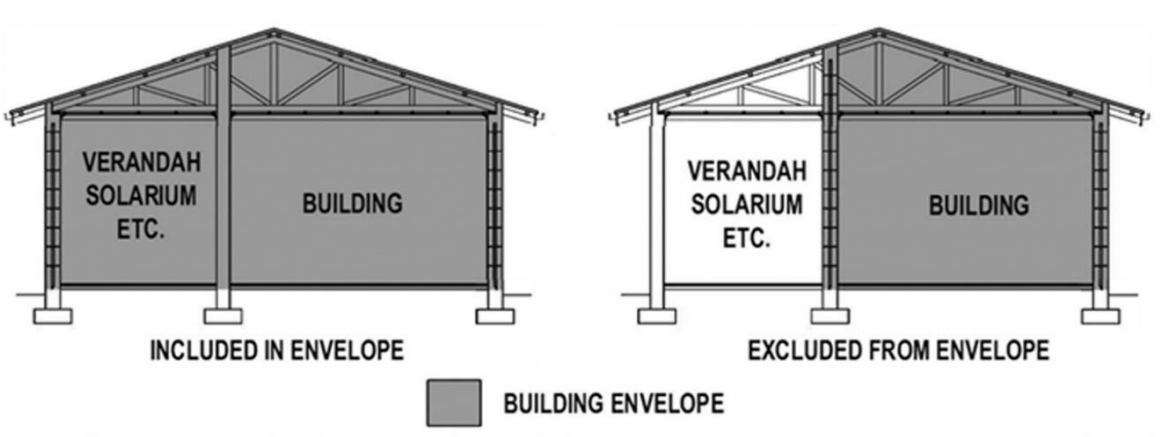


Figure 7 — Separation of attachments

5.6 Roof assembly

5.6.1 Thermal insulation shall be installed so that it

a) abuts or overlaps adjoining insulation, or is sealed,

b) forms a continuous barrier with ceilings, walls, bulkheads, or floors that contribute to the thermal barrier, and

c) does not affect the safe or effective operation of any services, equipment, or lighting installation.

5.6.2 A roof assembly shall achieve the minimum total R-value of the specified requirement in table 8 for the direction of heat flow.

NOTE 1 R-values are calculated in accordance with the constants and generic conductance values of SANS 694 and the results when tested to SANS 8301

NOTE 2 Table 9 provides generic thermal resistance values considered to be achieved by reflective foil laminates.

5.6.3 A roof assembly that has flexible bulk insulation material installed between the underside of the cladding and the top of the supporting member for the cladding shall have a spacer system, the depth of the spacer system to be equal to the material thickness required, to eliminate the compression of flexible bulk insulation. (See annex F)

5.6.4 The total R-value of a roof assembly which incorporates a reflective surface and adjacent airspace, shall include the combined R-value achieved by the emittance of the reflective surface and the associated airspaces in accordance with table 9.

5.6.5 In a roof assembly that consists of thatch the thickness of the thatch shall be as follows:

a) Fine thatching grass or reed in all zones except 5H: 210 mm or R value of 3,7 m².K/W.

b) Fine thatching grass or reed in zone 5H: 175 mm or R value of 2,7 m².K/W.

c) Water reed: 300 mm.

NOTE 1 Fine thatching grass or reed has a stem/butt diameter between 1,4 mm and 4 mm.

NOTE 2 Water reed has a stem/butt diameter between 1 mm and 7 mm.

5.6.6 Bulk insulation shall be installed so that in ceilings, it overlaps the wall member by not less than 50 mm or is tightly fitted against a wall where there is no insulation in the wall.

NOTE Care should be taken when installing thermal insulation to ensure that it does not interfere with the safety or performance of domestic services and fittings such as heating flues, recessed light fittings, light transformers and general plumbing and electrical components.

Table 8 — Minimum total R-values of roofs assemblies and levels of thermal insulation

1			2			
Description			**Energy zones**			
			1, 2, 4, 6, 7	**3**	**5**	
					5	**5H**
Minimum required Total R-Value (m².K/W)			3,7	3,7	3,7	2,7
Direction of heat flow			Up	Up and Down	Down	
Minimum total R-value (m².K/W) of roof and ceiling materials (Roof covering includes outside air film, non-reflective unventilated air space and plasterboard only).			0,30 to 0,35		0,36 to 0,48	
Estimated minimum added R-Value of insulation (m².K/W)			3,35	3,35	3,35	2,35
Product			Recommended levels (thickness in mm) of thermal insulation to be used equivalent to R-Value required. Thermal conductivity values used are generic.			
Generic insulation product	Density (kg/m³)	K-value (W/m.K)	mm	mm	mm	mm
Cellulose fibre bonded	30,00	0,038	130	130	130	90
Cellulose fibre loose-fill	27,50	0,040	135	135	135	100
Glass wool blanket	10 to 18	0,040	135	135	135	100
Polyester fibre blanket	11,50	0,046	160	160	160	110
Polyester fibre blend board	24,00	0,038	130	130	130	90
Expanded Polystyrene (EPS) Standard Density (SD)	15,00	0,035[a]	120	120	120	85
Extruded Polystyrene (XPS)	32,00	0,028[a]	100	100	100	65
Fibre glass board	47,50	0,033	115	115	115	80
Mineral/Rockwool	40.00 to 140.00	0,033	115	115	115	80
Polyester fibre blend board	61,00	0,034	115	115	115	80
Polyurethane and polyisocyanurate board	32,00	0,025[a]	85	85	85	60
NOTE 1 Zone 5H high humidity to be considered.						
NOTE 2 Thermal conductivity values used are generic.						
NOTE 3 Manufacturers will round up thicknesses to nearest production standard.						
[a] Thermal efficiency is dependent on material thickness, blowing agent, density, age, operating temperature, and moisture.						

Table 9 — R-values considered to be achieved by reflective foil laminates

1	2	3					
Emissivity of added reflective insulation	**Direction of heat flow**	**R-value added by reflective insulation** (m².K/W)					
		Pitched roof (≥ 10 º) with horizontal ceiling		**Flat skillion or pitched roof (≤ 10 º) with horizontal ceiling**	**Pitched roof with cathedral ceilings**		
		Natural ventilated roof space	Non-ventilated roof space		22º	30º	45º
0.2 outer 0.05 inner	Downwards	1,21	1,12	1,28	0,96	0,86	0,66
0.2 outer 0.05 inner	Upwards	0,59	0,75	0,68	0,72	0,74	0,77
0.9 outer 0.05 inner	Downwards	1,01	0,92	1,06	0,74	0,64	0,44
0.9 outer 0.05 inner	Upwards	0,40	0,55	0,49	0,51	0,52	0,53

NOTE 1 This table is applicable where an air space between the external roof cladding and a ceiling assembly is divided by the positioning of a reflective foil to create two air gaps. Reflective foil insulation values include a minimum 15 mm air gap on either side. Reflective insulation should work in conjunction with an air gap to be effective.

NOTE 2 The reflective surface with the lowest emissivity should preferably be facing downwards.

NOTE 3 0.2 outer value is used where the roof is sealed, and no dust can accumulate. 0,9 outer value is used where dust can impair performance. Bright metal surfaces can generally be taken as 0,05 emissivity.

NOTE 4 The R-value of reflective insulation is affected by the airspace between a reflective side of the reflective insulation and the building lining or cladding. The thermal performance of reflective insulation is influenced by dust and could be adversely affected.

5.7 Building sealing

5.7.1 Roofs, external walls, and floors that form the building envelope and any opening such as windows and doors in the external fabric shall be constructed to minimize air leakage.

NOTE The building sealing can be done by methods such as caulking, or adding skirting, architraves, or cornices.

5.7.2 Ceiling voids and attics, with the exception of thatched roofs, in all energy zones except energy zone 5H, where the building is naturally ventilated, the building shall be designed to minimize air infiltration. Accordingly, wall plate and roof junctions shall be sealed. All tiled roofs shall have a tile underlay or radiant barrier.

5.7.3 The chimney or flue of an open solid fuel burning appliance shall be provided with a damper or flap that can be closed to seal the chimney or flue.

NOTE A solid fuel burning device is a heater that burns material such as timber or coal. This does not apply to gas and liquid fuel burning devices.

5.7.4 A foam or rubber compressible strip or a fibrous seal to restrict air leakage shall be fitted to each edge of an external door and other such opening that

a) serves a conditioned space, or

b) serves a habitable room.

6 Services

6.1 Hot water supply

NOTE 1 The following types of water heating technology may be used to meet the requirements of Regulation XA:

a) Domestic solar water heaters that comply with 6.1.2;

b) Domestic heat pumps that comply with 6.1.3;

c) Sustainably sourced timber and invasive vegetation;

d) Biogas;

e) Natural gas;

f) Liquid Petroleum Gas; and

g) Heat recovery from building or external processes.

NOTE 2 If electrical resistance heating elements are used to supplement the above listed technologies, the supplementary heating may be used only to the extent of 50% of the annual average hot water requirements by volume.

NOTE 3 Unless preventative measures are taken the energy efficiency ratio (EER) of the system may drop below the 50% (EER=0,5) level and reach as low as 20% (EER=0,2).

NOTE 4 The EER of a solar hot water system may be boosted by (inter alia) increasing the volume of water stored to beyond the minimum volume specifications of table 10 and by specifying an electronic timer/controller.

6.1.1 Minimum storage capacities for hot water cylinders used with domestic solar water heaters and domestic heat pumps are provided in table 10.

6.1.2 Domestic solar water heaters shall comply with the requirements of SANS 1307 and shall be installed in accordance with SANS 10106.

6.1.3 Domestic hot water heat pumps shall comply with the requirements of SANS 1687 and shall be installed in accordance with SANS 1352.

6.1.4 Instantaneous gas water heaters shall comply with the requirements of SANS 1808-24 and SANS 1539 and shall be installed in accordance with SANS 10252-1 and SANS 10087-1.

6.1.5 Storage gas water heaters shall comply with the requirements of SANS 151, SANS 1808-24 and SANS 1539 and shall be installed in accordance with SANS 10254 and SANS 10087-1.

6.1.6 All exposed pipes to indoor or outdoor air, conveying hot water to and from the hot water cylinders and heating systems, shall be insulated with pipe insulation material with an R-value in accordance with table 11.

6.1.7 Piping to be insulated includes all supply and return hot water piping, cold water supply piping within 1 m of the connection to the heating or cooling system and pressure relief piping within 1 m of the connection to the heating or cooling system.

Table 10 — Minimum storage requirement for hot water cylinders used with domestic solar water heaters and domestic heat pumps (stored at 60 ºC for health reasons)

1	2	3	4
Occupancy description and application of hot water	**Occupancy classification**	**Average annual hot water usage per capita per day (at 60 °C)**	**24 h water storage requirement in litres at 60 ºC minimum temperature (for solar water heaters storage volumes shall be 50 % larger)**
Entertainment and public assembly	**A1**		
Sedentary		10 L/p/d	6 L/p
Active		40 L/p/d	25 L/d
Theatrical and indoor sport	**A2**		
Cultural activities		10 L/p/d	6 L/p
Sporting activities		40 L/p/d	25 L/d
Places of instruction	**A3**	10 L/p/d	6 L/p
Places of detention	**E1**		
Awaiting trial		140 L/p/d	62.5 L/p
Convicted		52 L/p/d	35 L/p
Hospitals (including clinics)	**E2**		
General hospitals		130 L/p/d	30 L/p
Clinic with beds (overnight stay)		130 L/p/d	30 L/p
Day hospital		65 L/p/d	18 L/p
Day clinic		10 L/p/d	6 L/p

Table 10 (*concluded*)

1	2	3	4
Occupancy description and application of hot water	**Occupancy classification**	**Average annual usage per capita per day (at 60 °C)**	**24 h water storage requirement in litres at 60 ºC minimum temperature (for solar water heaters storage volumes shall be 50 % larger)**
Other institutional (residential)	**E3**	120 L/p/d	75 L/p
Health care	**E4**	120 L/p/d	75 L/p
Large shop	**F1**	10 L/p/d	6 L/p
Small shop	**F2**	10 L/p/d	6 L/p
Wholesaler's store	**F3**	10 L/p/d	6 L/p
Offices	**G1**		
Without canteens		10 L/p/d	6 L/p
With canteens		28 L/p/d	20 L/p
Hotels	**H1**	140 L/p/d	62.5 L/p
Dormitory	**H2**	100 L/p/d	50 L/p
Residential	**H3**		
Category 1		64 L/p/d	45 L/p
Retirement village residential units		52 L/p/d	35 L/p
All other		115 L/p/d	50 L/p
Dwelling house	**H4**		
Category 1		64 L/p/d	45 L/p
All other		115 L/p/d	50 L/p
Hospitality	**H5**	140 L/p/d	62.5 L/p

Table 11 — Minimum R-value of pipe insulation

1	2
Internal diameter of pipe mm	**Minimum R-value** m².K/W
≤ 80	1,00
>80	1,50
NOTE R-values in this table are based on the formula for flat surfaces i.e. R-value = m/k-value where (m) denotes thickness	

6.2 Lighting

6.2.1 The lighting power density for all lighting as calculated by aggregating the connected lighting energy demand per occupancy and dividing this total by the net floor area for the relevant occupancy shall not exceed the lighting power density values set out in table 12.

NOTE Connected lighting includes internal and external lighting arrangements served by the electrical supply of the building

6.2.2 The use of light-emitting diodes (LED) and compact fluorescents (CFL) in occupancies H3 and H4 shall be deemed to comply with the requirements of 6.2.1. Any other lighting technologies used in occupancies H3 and H4 shall not exceed the lighting power density values set out in table 12.

6.2.3 Occupancy and daylight sensors shall be installed in occupancies, excluding those classified as H3 and H4 in terms of Regulation A20, and these occupancy and daylight sensors shall be so installed that no area serviced by a specific sensor is more than 100 m².

Table 12 — Maximum lighting power density for the class of occupancy

1	2	3
Occupancy classification	**Occupancy description**	**Lighting power density** W/m²
A1	Entertainment and public assembly	2
A2	Theatrical and indoor sport	8
A3	Places of instruction	10
A4	Worship	4
C1	Exhibition halls	10
C2	Museums	4
E1	Places of detention	4
E2	Hospital	8
E3	Other institutional residences	8
E4	Health care	8

Table 12 (*concluded*)

1	2	3
Occupancy classification	**Occupancy description**	**Lighting power density** W/m²
F1	Large shops	20
F2	Small shops	8
F3	Wholesale store	8
G1	Offices	8
H1	Hotels	4
H2	Dormitory	4
H3	Domestic residences	4
H4	Dwelling houses	4
H5	Hospitality	4

6.3 Air conditioning

The minimum required level of energy efficiency for unitary and packaged air-conditioning equipment shall be in accordance with table 13.

Table 13 — Minimum coefficient of performance, cooling mode (COP_C), heating mode (COP_H) of unitary and packaged air-conditioning equipment

1	2	3	4
Equipment type	**Capacity range (kW)** [a]	**Minimum COP_C**	**Minimum COP_H**
Through-the-wall consoles [a]	<7	2,8	1,0
Unitary splits [b]	<7	3,0	3,2
Air-cooled packaged and split units [c]	7 < 19	2,9	3,0
	19 < 40	2,9	3,0
	40 < 70	2,8	2,9
	>70	2,7	2,8
Water-cooled packaged units [d]	<19	3,3	3,5
	19 < 40	3,3	3,5
	40 < 70	3,2	3,3
	70 < 223	3,2	3,3

Table 13 (*concluded*)

1	2	3	4
Equipment type	**Capacity range (kW) [a]**	**Minimum COP_C**	**Minimum COP_H**
Air-cooled water chillers [d]	All	2,8	–
Air-cooled heat pump chillers [d]	All	2,8	3,0
Water-cooled, positive displacement water chillers [d]	<264	4,3	–
	264 < 528	4,4	–
	528 < 1 055	4,9	–
	>1 055	5,4	–
Water-cooled, centrifugal water chillers [d]	<528	5,3	–
	528 < 1 055	5,3	–
Water-cooled, centrifugal water chillers [d]	1 055 < 2 110	5,9	–
	>2 110	5,9	–

[a] If resistance heating is used, heating power consumption shall not exceed cooling power consumption except in the case of equipment of <10 kW.

[b] COP_C and COP_H shall be determined at the temperatures stipulated in SANS 54511-2 and in accordance with SANS 5151.

[c] COP_C and COP_H shall be determined at the temperatures stipulated in SANS 54511-2 and in accordance with SANS 13253.

[d] COP_C and COP_H shall be determined at the temperatures stipulated in SANS 54511-2 and in accordance with SANS 54511-3.

Annex A
(informative)

South African Energy Trajectory

A.1 The Draft National Energy Efficiency Strategy published by the Department of Energy (Government Gazette, 23 December 2016), identifies the need to establish 15-year trajectories for the successive tightening of the energy performance component of building standards for the public, commercial and residential building sectors.

A.2 Subject to any other corrections that may be applied to table 2, future revisions to this part of SANS 10400 will be guided by the intended energy trajectory in table A.1.

NOTE The Energy Trajectory is adapted from the proposal for a revision and extension of table 2 of SANS 204:2011; Solid Green, for GIZ, May 2015.

A.3 The proposed Energy trajectory is to achieve 8 % reduction on previous maximum energy demand and maximum annual consumption every two years.

A.4 The intended energy trajectory normalized to 2021 is given in table A.1

Table A.1 — Intended energy trajectory normalized to 2021

1	2
Year	**Percentage normalized to 2021**
Year 2021 and 2022	92 %
Year 2023 and 2024	85 %
Year 2025 and 2026	78 %
Year 2027 and 2028	72 %
Year 2029 and 2030	66 %

Annex B
(normative)

Modelling conditions

B.1 Where the theoretical annual energy consumption of a building (excluding garages and storage areas) is calculated the following modelling assumptions shall be used:

a) the design population shall be accordance with National building Regulation A21;

b) artificial lighting shall be accordance with table 12;

c) the space temperature shall be within the range of 19 °C to 25 °C for a minimum of 95 % of occupied hours; and

d) artificial ventilation, heating and cooling provided, shall be in accordance with the requirements of SANS 10400-O.

B.2 The internal heat gains to be built into the energy model shall be as set follows

a) the design population calculated in accordance with National Building Regulation A21 at an average rate of 75 W sensible heat gain per person,

b) hot meals in a dining room, restaurant, or café, at a rate of 30 W heat gain per person with the number of people calculated in accordance with National Building Regulation A21,

c) Appliances and equipment shall be in accordance with table B.1, and

d) lighting, occupancy and plug loads calculated with utilization hours and usage ratios shall be in accordance with table B.2.

B.3 Hot water shall be supplied at the consumption rates in accordance with table 10 and equipment designed to maintain and supply the water storage temperature at 60 °C.

Table B.1 — Internal heat gains for appliances and equipment

1	2
Classification of occupancy of buildings	**Internal heat gain** W/m²
G1	15
F1	5
Other occupancies	No load

Table B.2 — Design utilization rates

1	2	3	4	5	6
Occupancies A1, A2, A3					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,48	1	0,66	0,25	0,05
Saturday	0,4	0,15	0,3	0,2	0,1
Sunday & holiday	0,2	0,08	0,15	0,1	0,05
Lighting, occupancy and plug loads	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,48	1	0,66	0,25	0,05
Saturday	0,4	0,15	0,3	0,2	0,1
Sunday & holiday	0,2	0,08	0,15	0,1	0,05
Occupancies E1, E2, E3					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,35	0,8	0,8	0,65	0,2
Saturday	0,35	0,8	0,8	0,65	0,2
Sunday & holiday	0,23	0,53	0,53	0,43	0,13
Lighting, occupancy, and equipment plug loads	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,35	0,8	0,8	0,65	0,2
Saturday	0,35	0,8	0,8	0,65	0,2
Sunday & holiday	0,23	0,53	0,53	0,43	0,13
Occupancies F1, F2, F3					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,03	0,8	0,8	0,3	0
Saturday	0,03	0,8	0,66	0	0
Sunday & holiday	0,01	0,4	0,33	0	0
Lighting, occupancy, and equipment plug loads	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-00:00
Weekdays	0,07	0,8	0,8	0,31	0,05
Saturday	0,07	0,8	0,61	0,05	0,05
Sunday & holiday	0,07	0,8	0,61	0,05	0,05

Table B.2 (*continued*)

1	2	3	4	5	6
Occupancy G1					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,13	0,8	0,77	0,23	0
Saturday	0,08	0,5	0,37	0	0
Sunday & holiday	0,04	0,25	0,19	0	0
Lighting, occupancy, and equipment plug loads	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,16	0,8	0,77	0,24	0,05
Saturday	0,11	0,5	0,38	0,05	0,05
Sunday & holiday	0,11	0,5	0,38	0,05	0,05
Lighting, occupancy, and equipment plug loads	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,16	0,35	0,77	0,24	0,05
Saturday	0,11	0,5	0,38	0,05	0,05
Sunday & holiday	0,11	0,5	0,38	0,05	0,05
Occupancies H2, H3, H4					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,88	0,37	0,36	0,73	1
Saturday	1	0,43	0,43	0,97	1
Sunday & holiday	1	0,43	0,43	0,97	1
Lighting	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,13	0,13	0,14	0,24	0,1
Saturday	0,09	0,2	0,14	0,3	0,18
Sunday & holiday	0,09	0,2	0,14	0,3	0,18
Equipment Plug load	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,53	0,57	0,59	0,78	0,6
Saturday	0,53	0,57	0,59	0,78	0,6
Sunday & holiday	0,53	0,57	0,59	0,78	0,6

Table B.2 (*concluded*)

1	2	3	4	5	6
Occupancies H1, H5					
Occupancy hours of the day	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,88	0,27	0,3	0,7	0,9
Saturday	0,8	0,33	0,34	0,85	0,75
Sunday & holiday	0,4	0,17	0,17	0,43	0,38
Lighting	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,22	0,35	0,26	0,78	0,45
Saturday	0,18	0,35	0,26	0,68	0,45
Sunday & holiday	0,18	0,35	0,26	0,68	0,45
Equipment Plug load	0:00-08:00	08:00-11:00	11:00-18:00	18:00-22:00	22:00-24:00
Weekdays	0,53	0,57	0,59	0,78	0,6
Saturday	0,53	0,57	0,59	0,78	0,6
Sunday & holiday	0,53	0,57	0,59	0,78	0,6

Annex C
(informative)

List of cities and towns by energy zones

Table C.1 provides a list of cities and towns indicating their Energy zone, longitude, and latitude as well if it falls into the Southern Cape Condensation Problem Area (SCCP) to be used in conjunction with figure 1 and relevant clauses.

Table C.1 — List of cities and towns by energy zones

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Aberdeen	Eastern Cape	24.062	32.476	1	No
Acornhoek	Mpumalanga	31.005	24.597	5	No
Addo	Eastern Cape	25.690	33.541	5	Yes
Adelaide	Eastern Cape	26.293	32.706	2	No
Adendorp	Eastern Cape	25.551	32.301	1	No
Albertinia	Western Cape	21.568	34.197	4	Yes
Alexander Bay	Northern Cape	16.491	28.609	4	No
Alexandria	Eastern Cape	26.412	33.654	4	Yes
Algoa Bay	Eastern Cape	25.795	33.826	5	No
Alice	Eastern Cape	26.828	32.778	4	No
Alicedale	Eastern Cape	26.082	33.317	4	Yes
Aliwal North	Eastern Cape	26.709	30.688	2	No
Allanridge	Free State	26.644	27.754	1	No
Amatikulu	KwaZulu-Natal	31.532	29.043	5H	No
Amersfoort	Mpumalanga	29.870	27.005	2	No
Arlington	Free State	27.852	28.029	2	No
Asbesberge	Northern Cape	23.167	28.812	1	No
Ashton	Western Cape	20.053	33.835	1	No
Askham	Northern Cape	20.782	26.983	3	No
Augrabies Falls	Northern Cape	20.340	28.591	3	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Barberton	Mpumalanga	31.055	25.790	5	No
Barkly East	Eastern Cape	27.594	30.967	6	No
Barkly West	Northern Cape	24.524	28.537	1	No
Baroe	Eastern Cape	24.566	33.225	1	No
Bathurst	Eastern Cape	26.821	33.503	5	Yes
Beaufort West	Western Cape	22.586	33.341	1	No
Bedford	Eastern Cape	26.078	32.678	2	No
Beestekraal	Northern Cape	27.597	25.375	5	No
Belfast	Mpumalanga	31.569	24.491	5	No
Bergville	KwaZulu-Natal	29.345	28.731	2	No
Bethal	Mpumalanga	29.463	26.454	2	No
Bethlehem	Free State	28.303	28.231	2	No
Bethulie	Free State	25.976	30.495	1	No
Biesiesfontein	Western Cape	17.883	31.016	5	No
Bisho	Eastern Cape	27.441	32.848	4	No
Bitterfontein	Western Cape	18.265	31.041	5	No
Bizana	Eastern Cape	29.854	30.858	2	No
Bloemfontein	Free State	26.218	29.113	1	No
Bloemhof	North West	25.602	27.652	1	No
Boshof	Free State	25.240	28.540	1	No
Bothaville	Free State	26.567	27.394	1	No
Brandfort	Free State	26.455	28.702	1	No
Brandvlei	Northern Cape	20.479	30.466	1	No
Bredasdorp	Western Cape	20.040	34.532	4	Yes

Table C.1 (*continued*)

1	2	2	3	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Breyten	Mpumalanga	29.989	26.302	2	No
Brits	North West	27.781	25.630	5	No
Britstown	Northern Cape	23.502	30.590	1	No
Bronkhorstspruit	Gauteng	28.743	25.809	1	No
Bultfontein	Free State	26.147	28.287	1	No
Burgersdorp	Eastern Cape	26.331	30.996	6	No
Butterworth	Eastern Cape	28.141	32.330	4	No
Caledon	Western Cape	19.429	34.231	2	Yes
Calitzdorp	Western Cape	21.688	33.530	2	No
Calvinia	Northern Cape	19.775	31.473	1	No
Campbell	Northern Cape	23.723	28.799	1	No
Cape Agulhas	Western Cape	20.041	34.531	4	Yes
Cape Town	Western Cape	18.423	33.915	4	Yes
Carletonville	Gauteng	27.395	26.368	1	No
Carnarvon	Northern Cape	22.127	30.969	1	No
Cathcart	Eastern Cape	27.141	32.297	2	No
Cedarville	Eastern Cape	29.038	30.387	6	No
Ceres	Western Cape	19.311	33.369	2	Yes
Charlestown	KwaZulu-Natal	29.877	27.407	2	No
Christiana	North West	25.167	27.913	1	No
Citrusdal	Western Cape	19.016	32.594	1	No
Clanwilliam	Western Cape	18.891	32.175	5	No
Clocolan	Free State	27.568	28.915	2	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Colenso	KwaZulu-Natal	29.823	28.745	5	No
Colesberg	Northern Cape	25.108	30.707	1	No
Coligny	North West	26.319	26.311	1	No
Cookhouse	Eastern Cape	25.803	32.748	2	No
Cradock	Eastern Cape	25.618	32.170	2	No
Danielskuil	Northern Cape	23.548	28.186	1	No
Dannhauser	KwaZulu-Natal	30.060	28.014	1	No
Darlington	Eastern Cape	25.547	32.463	2	No
Darnall	KwaZulu-Natal	31.349	29.268	5H	No
De Aar	Northern Cape	24.011	30.650	1	No
Dealesville	Free State	25.767	28.674	1	No
Delareyville	North West	25.444	26.688	5	No
Delportshoop	Northern Cape	24.310	28.415	1	No
Derdepoort	North West	26.387	24.639	5	No
Dewetsdorp	Free State	26.664	29.582	2	No
Dimabaza	Eastern Cape	27.223	32.837	4	No
Donnybrook	KwaZulu-Natal	29.879	29.928	2	No
Dordrecht	Eastern Cape	27.047	313.377	6	No
Doringbos	Western Cape	19.220	31.971	5	No
Douglas	Northern Cape	23.773	29.052	1	No
Duiwelskloof	Limpopo	30.144	23.695	5	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Dullstroom	Mpumalanga	30.102	25.417	2	No
Durban	KwaZulu-Natal	31.026	29.847	5H	No
East London	Eastern Cape	27.903	33.014	5	No
Edenburg	Gauteng	28.061	26.051	1	No
Edenville	Free State	27.668	27.555	2	No
Elliot	Eastern Cape	27.883	31.333	6	No
Elliotdale	Eastern Cape	28.684	31.966	5	No
Emalahleni	Mpumalanga	29.211	25.872	2	No
Emmaus	KwaZulu-Natal	29.401	28.860	2	No
Empangeni	KwaZulu-Natal	31.889	28.741	5H	No
Engcobo	Eastern Cape	28.002	31.673	2	No
Erfenisdam	Free State	26.782	28.502	1	No
Ermelo	Mpumalanga	29.987	26.525	2	No
Eshowe	KwaZulu-Natal	31.475	28.890	5H	No
Estcourt	KwaZulu-Natal	29.872	29.006	2	No
False Bay	KwaZulu-Natal	32.397	27.968	5H	No
Fauresmith	Free State	25.315	29.748	1	No
Ficksburg	Free State	27.880	28.876	2	No
Fort Beaufort	Eastern Cape	26.627	32.780	4	No
Fouriesburg	Free State	28.209	28.621	6	No
Frankfort	Free State	28.493	27.277	2	No
Fraserburg	Northern Cape	21.513	31.016	7	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Gamtoos	Eastern Cape	25.028	33.961	4	Yes
Gariep	Northern Cape	16.454	28.627	4	No
Garies	Northern Cape	17.990	30.565	1	No
Gatyana	Eastern Cape	28.250	32.401	5	No
Gcuwa	Eastern Cape	28.150	32.331	4	No
George	Western Cape	22.458	33.951	4	Yes
Germiston	Gauteng	28.158	26.209	1	No
Gingindlovu	KwaZulu-Natal	31.586	29.031	5H	No
Glencoe	KwaZulu-Natal	30.153	28.179	5	No
Gourits	Western Cape	21.880	34.337	4	Yes
Graaff-Reinet	Eastern Cape	24.535	32.251	1	No
Grahamstown	Eastern Cape	26.525	33.307	4	No
Graskop	Mpumalanga	30.840	24.934	5	No
Greytown	KwaZulu-Natal	30.588	29.064	4	No
Griekwastad	Northern Cape	23.249	28.848	1	No
Groblersdal	Limpopo	29.396	25.168	5	No
Grootdrink	Northern Cape	22.279	26.495	5	No
Groot-Kei	Eastern Cape	28.384	32.680	5	No
Grootvloer	Northern Cape	20.750	31.146	1	No
Hanover	Northern Cape	24.444	31.072	1	No
Harding	KwaZulu-Natal	29.882	30.572	5H	No
Harrismith	Free State	29.126	28.271	2	No
Hartbees	Northern Cape	20.526	28.759	3	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Hartswater	Northern Cape	24.810	27.754	1	No
Hebertsdale	Western Cape	21.763	34.015	4	Yes
Heidelberg	Gauteng	28.356	26.499	2	No
Heidelberg	Western Cape	20.956	34.089	4	No
Heilbron	Free State	27.973	27.294	2	No
Hennenman	Free State	27.022	27.972	1	No
Hermanus	Western Cape	19.239	34.420	2	Yes
Hertzogville	Free State	25.508	28.128	1	No
Hlobane	KwaZulu-Natal	30.987	27.711	4	No
Hluhluwe	KwaZulu-Natal	32.271	28.021	5	No
Hondeklipbaai	Northern Cape	17.277	30.318	4	No
Hoopstad	Free State	25.910	27.833	1	No
Hopefield	Western Cape	18.349	33.058	4	No
Hopetown	Northern Cape	24.087	29.624	1	No
Hotazel	Northern Cape	22.962	27.203	5	No
Houtkraal	Northern Cape	24.094	30.393	1	No
Idutywa	Eastern Cape	28.305	32.099	4	No
Ingwavuma	KwaZulu-Natal	31.996	27.133	5	No
Ixopo	KwaZulu-Natal	30.061	30.153	5H	No
Jagersfontein	Free State	25.424	29.761	1	No
Jamestown	Eastern Cape	26.804	31.131	6	No
Johannesburg	Gauteng	28.039	26.202	1	No
Kakamas	Northern Cape	20.616	28.768	3	No
Kamieskroon	Northern Cape	17.931	30.212	1	No
Kareeberge	Northern Cape	21.165	30.714	1	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Keimoes	Northern Cape	20.980	28.722	5	No
Kendrew	Eastern Cape	24.486	32.493	5	No
Kenhardt	Northern Cape	21.152	29.348	5	No
Kestell	Free State	28.702	28.307	1	No
Kimberley	Northern Cape	24.761	28.741	1	No
King William's Town	Eastern Cape	27.375	32.879	4	No
Kirkwood	Eastern Cape	25.446	33.401	5	No
Klawer	Western Cape	18.626	31.779	5	No
Klerksdorp	North West	26.665	26.867	1	No
Klipdale	Western Cape	19.966	34.306	4	Yes
Klipplaat	Eastern Cape	24.390	33.016	5	No
Knysna	Western Cape	23.050	34.035	4	No
Koffiefontein	Free State	25.003	29.407	1	No
Kokstad	KwaZulu-Natal	29.418	30.539	2	No
Komatipoort	Mpumalanga	31.950	25.430	3	No
Kompasberg	Eastern Cape	24.541	31.765	6	No
Komsberg	Northern Cape	20.780	32.692	6	No
Koppies	Free State	27.573	27.242	1	No
Koster	North West	26.898	25.869	1	No
Kraai	Eastern Cape	24.013	32.484	1	No
Kranskop	KwaZulu-Natal	30.862	28.967	5H	No
Krugersdorp	Gauteng	27.771	26.103	1	No
Kruisfontein	Eastern Cape	24.739	34.007	4	No
Kuruman	Northern Cape	23.357	27.433	1	No
Kwabhaca	Eastern Cape	28.994	30.901	2	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Kwadukuza	KwaZulu-Natal	31.289	29.328	5H	No
KwaMashu	KwaZulu-Natal	30.962	29.751	5H	No
Kwa-Nobuhle	Eastern Cape	25.388	33.818	4	No
Ladismith	Western Cape	21.268	33.498	2	No
Lady Grey	Eastern Cape	27.216	30.711	6	No
Ladysmith	KwaZulu-Natal	29.782	28.559	5	No
Laingsburg	Western Cape	20.854	33.193	2	No
Lambert's Bay	Western Cape	18.305	32.095	5	No
Langebaan	Western Cape	8.037	33.081	4	No
Langeberg	Western Cape	20.130	33.782	2	No
Langklip	Northern Cape	20.329	28.213	3	No
Leeu Gamka	Western Cape	21.977	32.777	1	No
Lepalale	Limpopo	27.717	23.687	3	No
Letaba	Limpopo	30.067	23.900	5	No
Letjiesbos	Western Cape	22.271	32.563	1	No
Libode	Eastern Cape	22.248	32.553	4	No
Lichtenburg	North West	26.160	26.151	1	No
Loeriesfontein	Northern Cape	19.445	30.953	1	No
Loskop Dam	Mpumalanga	29.329	25.429	5	No
Lothair	Mpumalanga	30.438	26.391	2	No
Louis Trichardt	Limpopo	29.904	23.046	5	No
Louwsburg	KwaZulu-Natal	21.283	27.576	5	No
Loxton	Northern Cape	19.405	30.941	1	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Luckhoff	Free State	24.787	29.748	1	No
Lutzputs	Northern Cape	20.666	28.387	3	No
Luvuvhu	Limpopo	31.268	22.402	3	No
Maclear	Eastern Cape	28.350	31.070	2	No
Madadeni	KwaZulu-Natal	30.072	27.752	2	No
Mahikeng	North West	25.632	25.857	5	No
Magaliesburg	Gauteng	27.542	25.989	1	No
Makwassie	North West	25.996	27.319	1	No
Malmesbury	Western Cape	18.724	33.463	1	Yes
Mangaung	Free State	26.496	29.322	1	No
Maretsane	North West	25.421	26.142	5	No
Margate	KwaZulu-Natal	30.376	30.854	5H	No
Marquard	Free State	27.428	28.665	2	No
Matatiele	Eastern Cape	28.815	30.346	6	No
Matjiesfontein	Western Cape	20.580	33.228	2	No
Matroosberg	Western Cape	19.655	33.374	6	No
Maxesibenj	Eastern Cape	28.830	30.855	2	No
Mbashe	Eastern Cape	28.327	31.728	2	No
Mdantsane	Eastern Cape	27.709	32.968	5	No
Memel	Free State	29.568	27.681	2	No
Middelburg	Eastern Cape	25.006	31.493	2	No
Middelburg	Mpumalanga	29.456	25.763	2	No
Middelwit	North West	27.036	24.852	5	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Mkomazi	KwaZulu-Natal	29.472	29.633	2	No
Mkuze	KwaZulu-Natal	32.038	27.617	5	No
Mmabatho	North West	25.615	25.834	5	No
Modderrivier	Northern Cape	24.638	29.022	1	No
Modimolle	Limpopo	28.404	24.701	5	No
Mogalakwena	Limpopo	29.011	24.193	5	No
Molteno	Eastern Cape	26.351	31.393	6	No
Mbombela	Mpumalanga	30.962	25.469	5	No
Mooi River	KwaZulu-Natal	29.997	29.207	2	No
Moorreesburg	Western Cape	18.664	33.138	5	Yes
Mopane	Limpopo	29.852	22.623	3	No
Morgenzon	Mpumalanga	29.617	26.731	2	No
Mosselbaai	Western Cape	22.110	34.129	4	Yes
Mount Fletcher	Eastern Cape	28.504	30.690	6	No
Mqanduli	Eastern Cape	28.762	31.819	5	No
Mtubatuba	KwaZulu-Natal	32.185	28.416	5H	No
Mtwalume	KwaZulu-Natal	30.630	30.491	5H	No
Murraysburg	Western Cape	23.766	31.967	1	No
Musina	Limpopo	30.037	22.330	3	No
Mzimvubu	KwaZulu-Natal	29.544	31.615	5H	No
Nababeep	Northern Cape	17.784	29.589	1	No
Nelspoort	Western Cape	23.003	32.116	1	No
New Hanover	KwaZulu-Natal	30.527	29.354	4	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Newcastle	KwaZulu-Natal	29.926	27.755	2	No
Niekerkshoop	Northern Cape	22.837	29.327	1	No
Nieuwoudtville	Northern Cape	19.100	31.372	5	No
Nigel	Gauteng	28.471	26.423	2	No
Nkandla	KwaZulu-Natal	31.057	28.586	5	No
Nongoma	KwaZulu-Natal	31.634	27.896	5	No
Northam	Limpopo	27.263	24.953	5	No
Noupoort	Northern Cape	24.952	31.178	2	No
Nqutu	KwaZulu-Natal	30.681	28.206	4	No
Nuwerus	Western Cape	18.357	31.149	5	No
Odendaalsrus	Free State	26.701	27.880	1	No
Okiep	Northern Cape	17.874	29.594	1	No
Olifantshoek	Northern Cape	22.737	27.941	1	No
Orkney	North West	26.689	27.008	1	No
Osizweni	KwaZulu-Natal	30.119	27.786	2	No
Ottosdal	North West	26.006	26.812	1	No
Paarl	Western Cape	18.970	33.764	2	Yes
Pakhuis	Western Cape	18.989	32.139	5	No
Pampoenpoort	Northern Cape	22.657	31.061	1	No
Park Rynie	KwaZulu-Natal	30.737	30.317	5H	No
Parys	Free State	27.460	26.898	1	No
Patensie	Eastern Cape	24.813	33.758	4	No
Paulpietersburg	KwaZulu-Natal	30.819	27.428	4	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Peddie	Eastern Cape	27.119	33.198	5	No
Pella	Northern Cape	19.155	29.034	5	No
Pepani	North West	23.780	26.251	5	No
Petrus Steyn	Free State	28.129	27.649	2	No
Petrusburg	Free State	25.414	29.115	1	No
Philippolis	Free State	25.274	30.266	1	No
Philipstown	Northern Cape	24.473	30.437	1	No
Pienaarsrivier	Limpopo	28.295	25.208	5	No
Piet Retief	Mpumalanga	30.808	27.005	4	No
Pietermaritzburg	KwaZulu-Natal	30.377	29.601	4	No
Piketberg	Western Cape	18.757	32.908	5	No
Pilgrim's Rest	Mpumalanga	30.756	24.907	1	No
Pinetown	KwaZulu-Natal	30.861	29.813	5H	No
Pofadder	Northern Cape	19.392	29.125	5	No
Polokwane	Limpopo	29.453	23.909	5	No
Port Alfred	Eastern Cape	26.893	33.588	5	Yes
Port Elizabeth	Eastern Cape	25.622	33.962	4	Yes
Port Nolloth	Northern Cape	16.882	29.257	4	No
Port Shepstone	KwaZulu-Natal	30.453	30.739	5H	No
Port St Johns	Eastern Cape	29.543	31.621	5H	No
Porterville	Western Cape	18.993	33.015	1	Yes
Postmasburg	Northern Cape	23.063	28.331	1	No
Potchefstroom	North West	27.096	26.719	1	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Pretoria	Gauteng	28.190	25.744	5	No
Prieska	Northern Cape	22.747	29.666	1	No
Prince Albert	Western Cape	22.027	33.214	2	No
Punda Maria	Limpopo	31.016	22.691	3	No
Queenstown	Eastern Cape	26.868	31.895	2	No
Qumbu	Eastern Cape	28.869	31.160	2	No
Quoin Point	Western Cape	19.638	34.781	4	Yes
Randfontein	Gauteng	27.706	26.173	1	No
Reddersburg	Free State	26.178	29.651	1	No
Reitz	Free State	28.428	27.801	2	No
Reivilo	North West	24.182	27.565	1	No
Richards Bay	KwaZulu-Natal	32.053	28.750	5H	No
Riebeek -Oos	Eastern Cape	26.149	33.202	5	No
Riversdale	Western Cape	21.255	34.042	4	Yes
Robertson	Western Cape	19.888	33.799	2	Yes
Roodepoort	Gauteng	27.869	26.160	1	No
Rosmead	Eastern Cape	25.119	31.491	2	No
Rouxville	Free State	26.835	30.416	2	No
Rustenburg	North West	27.278	25.635	5	No
Sakrivier	Northern Cape	20.438	30.882	1	No
Saldanha Bay	Western Cape	17.943	33.007	4	No
Sannaspos	Free State	26.548	29.160	1	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Sannieshof	North West	25.808	26.531	1	No
Seekoei	Northern Cape	25.016	30.308	1	No
Senekal	Free State	27.618	28.321	2	No
Settlers	Limpopo	28.542	24.957	5	No
Simonstown	Western Cape	18.435	34.193	4	Yes
Sishen	Northern Cape	22.983	27.783	5	No
Smithfield	Free State	26.530	30.212	1	No
Soekmekaar	Limpopo	29.928	24.493	5	No
Springbok	Northern Cape	17.886	29.665	1	No
Springs	Gauteng	28.441	26.256	2	No
Standerton	Mpumalanga	29.226	26.954	2	No
Stellenbosch	Western Cape	18.866	33.931	2	Yes
Tarkastad	Eastern Cape	26.260	32.006	2	No
Theunissen	Free State	26.714	28.400	1	No
Thohoyandou	Limpopo	30.458	22.977	3	No
Tom Burke	Limpopo	27.988	23.070	3	No
Tongaat	KwaZulu-Natal	31.141	29.543	5H	No
Touws	Western Cape	21.153	33.790	2	Yes
Tsineng	Northern Cape	23.078	27.088	5	No
Tsolo	Eastern Cape	28.753	31.309	2	No
Tulbagh	Western Cape	19.141	33.284	1	Yes
Tzaneen	Limpopo	30.169	23.821	5	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Ubombo	KwaZulu-Natal	32.083	27.563	5	No
Ugie	Eastern Cape	28.236	31.194	2	No
Uitenhage	Eastern Cape	25.397	33.757	4	Yes
Ulco	Northern Cape	24.220	28.335	1	No
Umkomaas	KwaZulu-Natal	30.796	30.207	5H	No
Umtata	Eastern Cape	28.789	31.592	4	No
Umzimvubu	Eastern Cape	28.993	30.902	2	No
Uniondale	Western Cape	23.123	33.659	2	No
Upington	Northern Cape	21.217	28.459	5	No
Utrecht	KwaZulu-Natal	30.322	27.656	2	No
Vaalwater	Limpopo	28.111	24.299	5	No
Vanderbijlpark	Gauteng	27.839	26.697	1	No
Vanrhynsdorp	Western Cape	18.743	31.609	5	No
Vanwyksvlei	Northern Cape	21.825	30.366	1	No
Ventersburg	Free State	27.136	28.086	1	No
Venterstad	Eastern Cape	25.799	30.778	1	No
Vereeninging	Gauteng	27.928	26.675	1	No
Verneukpan	Northern Cape	21.067	30.133	1	No
Victoria West	Northern Cape	23.121	31.404	1	No
Villiers	Free State	28.599	27.028	2	No
Virginia	Free State	26.874	28.098	1	No
Volksrust	Mpumalanga	29.886	27.367	2	No

Table C.1 (*continued*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Vredefort	Free State	27.365	27.006	1	No
Vredenburg	Western Cape	17.987	32.906	4	No
Vrendendal	Western Cape	18.505	31.664	5	No
Vryburg	North West	24.731	26.955	1	No
Vryheid	KwaZulu-Natal	30.795	27.767	4	No
Wakkerstroom	Mpumalanga	30.149	27.349	2	No
Warden	Free State	28.965	27.854	2	No
Warrenton	Northern Cape	24.845	28.109	1	No
Wasbank	KwaZulu-Natal	30.103	28.314	5	No
Waterberge	Limpopo	28.311	24.331	5	No
Waterval-Boven	Mpumalanga	30.328	25.643	2	No
Waterval-Onder	Mpumalanga	30.383	25.648	2	No
Weenen	KwaZulu-Natal	30.084	28.851	2	No
Welkom	Free State	26.732	27.978	1	No
Wepener	Free State	27.039	29.729	2	No
Wilge	Mpumalanga	28.987	25.976	2	No
Wiliston	Northern Cape	20.919	31.340	1	No
Willowmore	Eastern Cape	23.487	33.295	2	No
Windsorton	Northern Cape	24.713	28.331	1	No
Wolmaransstad	North West	25.985	27.200	1	No
Wolseley	Western Cape	19.198	33.414	2	Yes
Worcester	Western Cape	19.444	33.646	2	No

Table C.1 (*concluded*)

1	2	3	4	5	6
City/Town	**Province**	**Longitude (°E)**	**Latitude (°S)**	**Energy zone**	**SCCP**
Xora	Eastern Cape	28.656	31.953	5	No
Zebediela	Limpopo	29.249	24.301	5	No
Zeerust	North West	26.086	25.544	5	No

Annex D
(informative)

Types of shading devices

The types of shading devices that may comply are not limited to the examples in figure D.1.

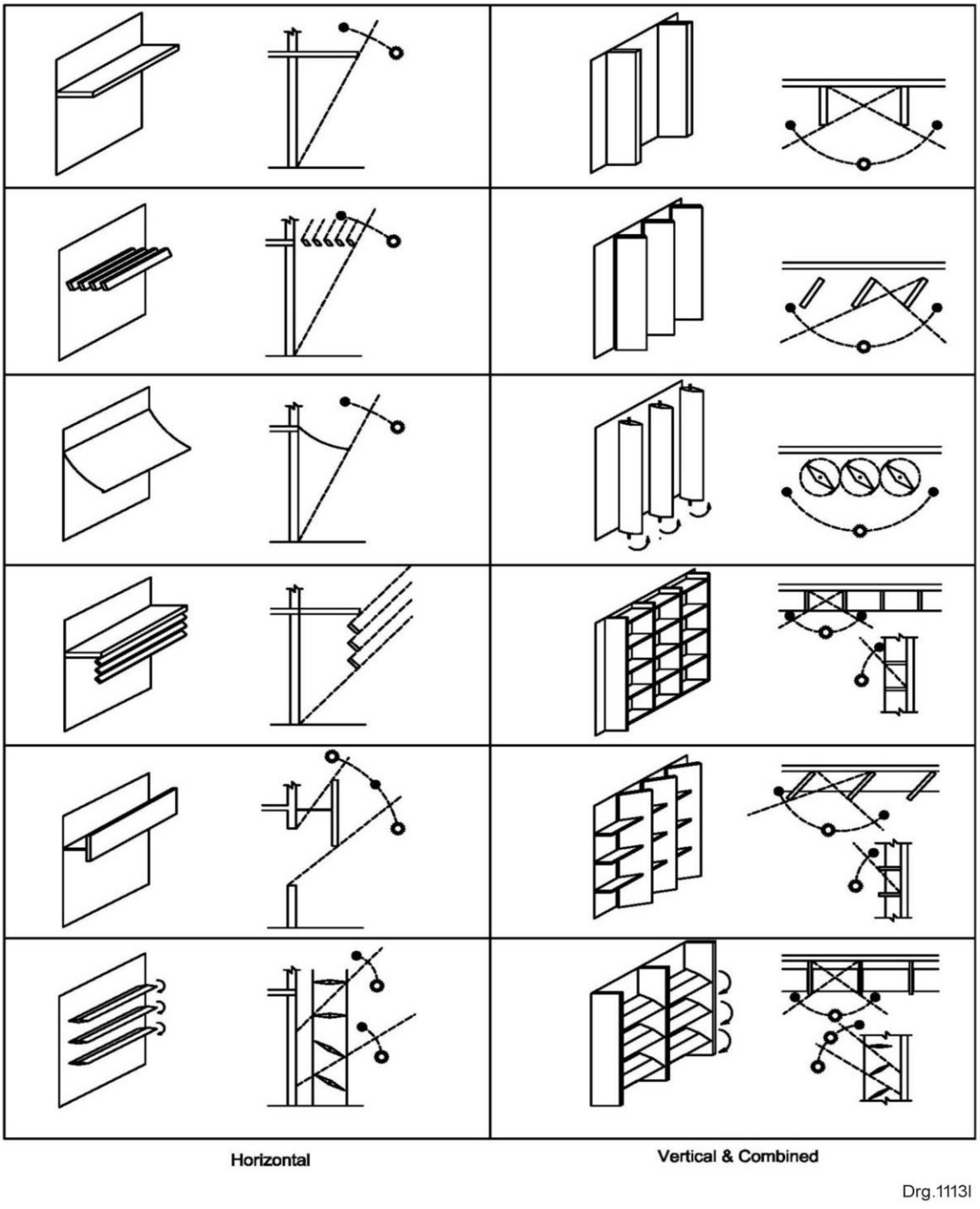


Figure D.1 — Shading devices

Annex E
(informative)

Whole glazing element performance values

Table E.1 provides ranges of whole glazing element performance values to be used in conjunction with table 4 to specify fenestration.

Table E.1 — Indicative ranges of whole glazing element performance values

1		2	3			
Glass description		**Comment**	**Performance values**			
			Total U-value range (W/m².K		**SHGC range**	
			Metal framing	**Timber/ Thermal break/ uPVC framing**	**Metal framing**	**Timber/ Thermal break/ uPVC framing**
Single - (monolithic or laminated)	Clear	Minimal variation in glass U-value and SHGC for difference glass thicknesses.	7,9 to 5,5	5,6 to 4,3	0,81 to 0,64	0,77 to 0,51
	Tinted	Glass SHGC depends on glass thickness and type of tint.	7,9 to 5,6	5,6 to 4,3	0,65 to 0,33	0,61 to 0,25
	Coated	Glass U-value and SHGC depend on coating type.	7,8 to 3,8	5,5 to 2,9	0,68 to 0,36	0,64 to 0,27
	Tinted and coated	Glass U-value depends on coating type. Glass SHGC depends on coating type, type of tint and glass thickness.	7,8 to 3,8	5,5 to 3,1	0,45 to 0,31	0,42 to 0,23
Double	Clear	Glass U-value depends on cavity width.	6,2 to 3,1	3,8 to 2,5	0,72 to 0,63	0,68 to 0,47
	Tinted	Glass U-value depends on cavity width. Glass SHGC depends on type of tint, tinted glass thickness and on cavity width.	6,2 to 3,1	3,8 to 2,5	0,57 to 0,36	0,57 to 0,27
	Coated	Glass U-value depends on cavity width and type of coating. Glass SHGC depends on type of coating and cavity width.	6,1 to 2,4	3,8 to 2,1	0,60 to 0,22	0,59 to 0,17
	Tinted and coated	Glass U-value depends on cavity width and type of coating. Glass SHGC depends on type of coating, tinted glass thickness and cavity width.	6,1 to 2,5	3,8 to 2,1	0,41 to 0,21	0,37 to 0,16

Annex F
(informative)

The installation of insulation in roof assemblies

F.1 Some insulation products may not have been tested in accordance with SANS 8301 and stated insulation levels on some manufacturer's literature may not be achievable as it is the declared value and does not take aspects such as thermal bridging, compression etc. into account. The performance of the insulation used should be validated by test reports.

F.2 When installed in a building, insulation should form a consistent and continuous barrier (see 5.6.1(b)). This is important as any gaps within the barrier will allow heat in or out, which will undermine the effectiveness of the overall energy efficiency measures. However, certain gaps are essential especially adjoining services and light fittings where the proximity of insulation may create a fire hazard.

F.3 Heat can bypass insulation by travelling along metal framing systems. For this reason, a thermal break (spacer) in roofing systems where a metal frame member connects the outer cladding or roofing with the inner lining (insulation) should be provided (see 5.6.3). Without this thermal break the insulation's effectiveness can be reduced by as much as a half thereby requiring more insulation to achieve the same total R-Value.

F.4 The requirements for reflective insulation are given in 5.6.4. Insulating performance is achieved by the ability of the reflective insulation to "reflect" heat at one surface and not transmit it at another, combined with the insulating qualities of the thin air films adjacent to the reflective insulation. Some reflective insulation is also bonded to bulk or board insulation providing enhanced performance. Accordingly, the reflectivity value and the presence of an airspace are critical, because without this airspace the reflection will not occur. Generally reflective insulation has a dull or anti-glare (painted side) and a shiny silver side. Both sides will achieve a degree of reflectivity. However, the shiny side is the most effective. Overlapping of reflective insulation should not be less than specified by the installation specifications.

F.5 The requirements for bulk insulation are given in 5.6.6. The term bulk insulation includes glass fibre, cellulose fibre, polyester, polyisocyanurate and polystyrene. These materials tend to have a high percentage of air voids that retard heat movement. The thermal performance of bulk insulation is dependent on the material retaining the thickness specified by the manufacturer, in accordance with the required test results. The thickness of the insulation is critical because the air pockets within the material trap and retard heat flow. If the insulation is compressed it will lose some of these air pockets as the fibre contact increases, which in turn will reduce its capacity to achieve the design R-value.

F.6 Typical details of insulation installation are given in figures F.1, F.2, F.3, F.4 and F.5.

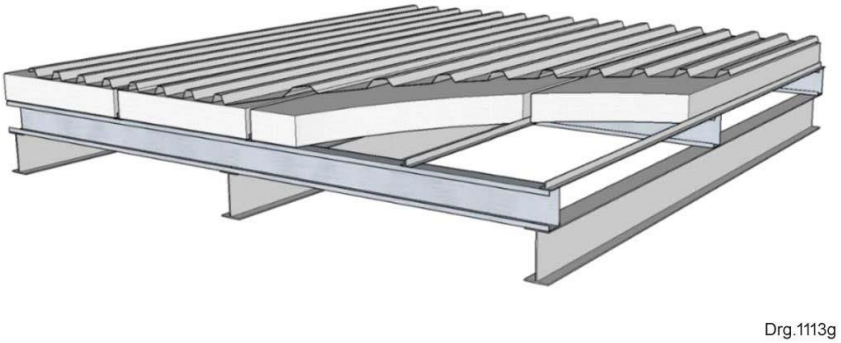


Figure F.1 — Rigid board insulation installed over purlin

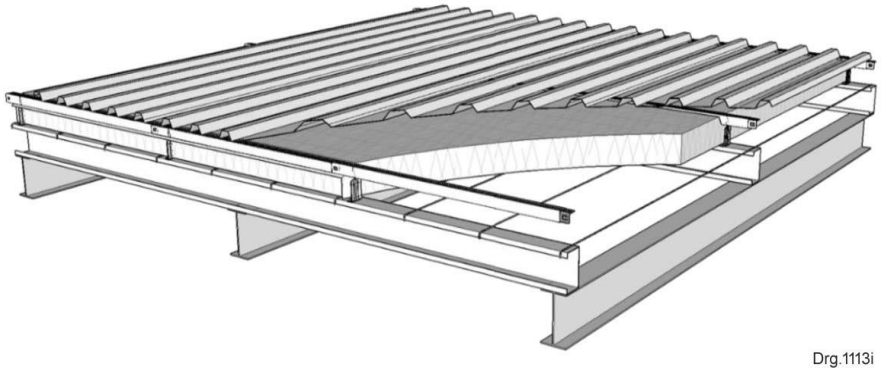


Figure F.2 — Bulk Insulation installed over purlin with mechanical spacer

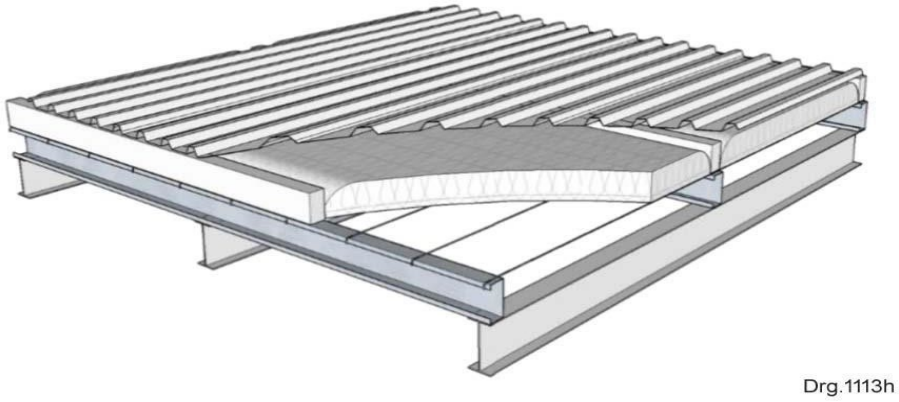


Figure F.3 — Bulk insulation installed over purlin with continuous solid spacer

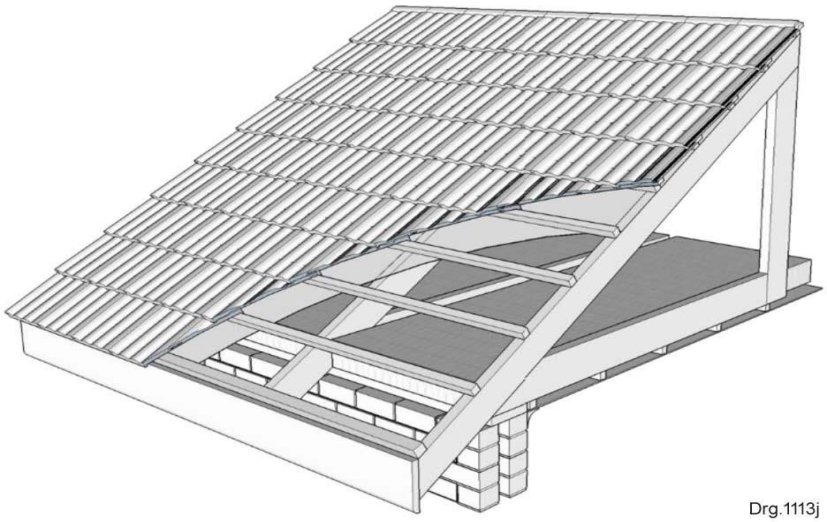


Figure F.4 — Tiled roof with reflective foil insulation installed over rafters with 38 mm airgap (brandering) and rigid bulk insulation installed on top of ceiling

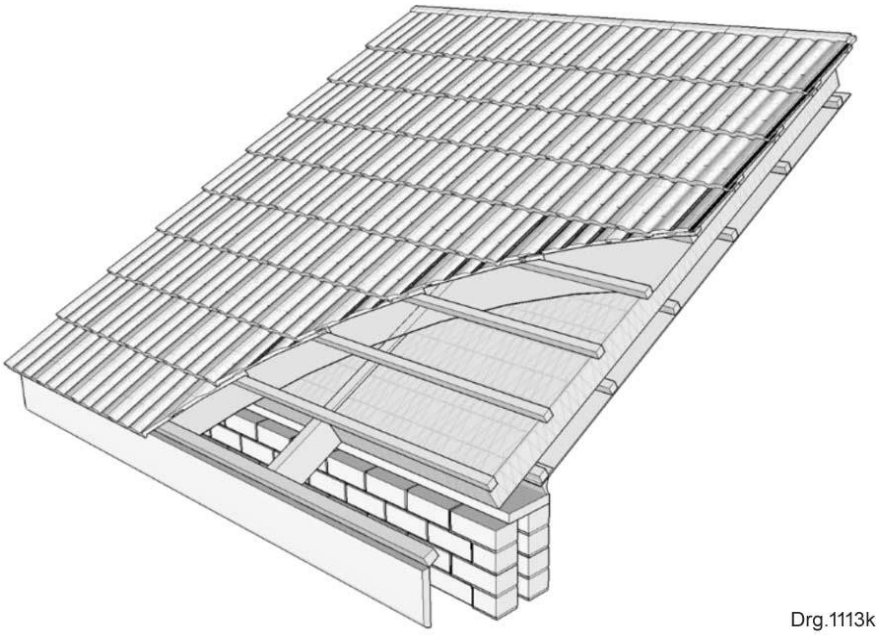


Figure F.5 — Tiled roof with reflective foil insulation installed over rafters with 38 mm airgap (brandering) and rigid bulk insulation fixed to underside of the rafters

Bibliography

SANS 10400-A, *The application of the National Building Regulations – Part A – General principles and requirements.*