



CHAPTER XI

**Energy Efficient Fenestration
in accordance with
Regulation XA – Energy Usage in Building
SANS 10400-XA and SANS 204**

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- **Building Code Australia**
BCA 2007 Volume 1 & 2
- **W.W. Norton & Company**
Window Systems for High Performance Buildings
- **Lawrence Berkeley National Laboratory**
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- **National Fenestration Rating Council**
Procedure Manuals

Note: This Selection Guide replaces the following AAAMSA Publication which is hereby withdrawn in its entirety:

- Selection Guide for Glazed Architectural Aluminium Products – Introducing Energy Efficiency in Fenestration – June 2008

Any information contained in Selection Guides of earlier dates, which contradicts with data contained in this manual, is information superseded by this publication

AAAMSA – April 2012

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11. ENERGY USAGE IN BUILDING

GENERAL

This Chapter addresses the requirements for fenestration in respect of Regulation XA – Energy Usage in Building.

The performance requirements in respect of Regulation N- Glazing are addressed elsewhere in this Selection Guide and are to be complied with as well i.e. **Both Regulation XA and N are applicable to fenestration!**

Regulation XA: Energy Usage in Buildings was published in Government Gazette # 34586 date 9 September 2011 effective two months from date of notice i.e. 9 November 2011.

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) having 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 requirements 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 SANS 10400 Part XA; 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 SANS 10400XA, or
- (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 XA.

Regulation XA3 invokes SANS 10400 XA which states in paragraph:

4.4.4 Fenestration

“Quote”

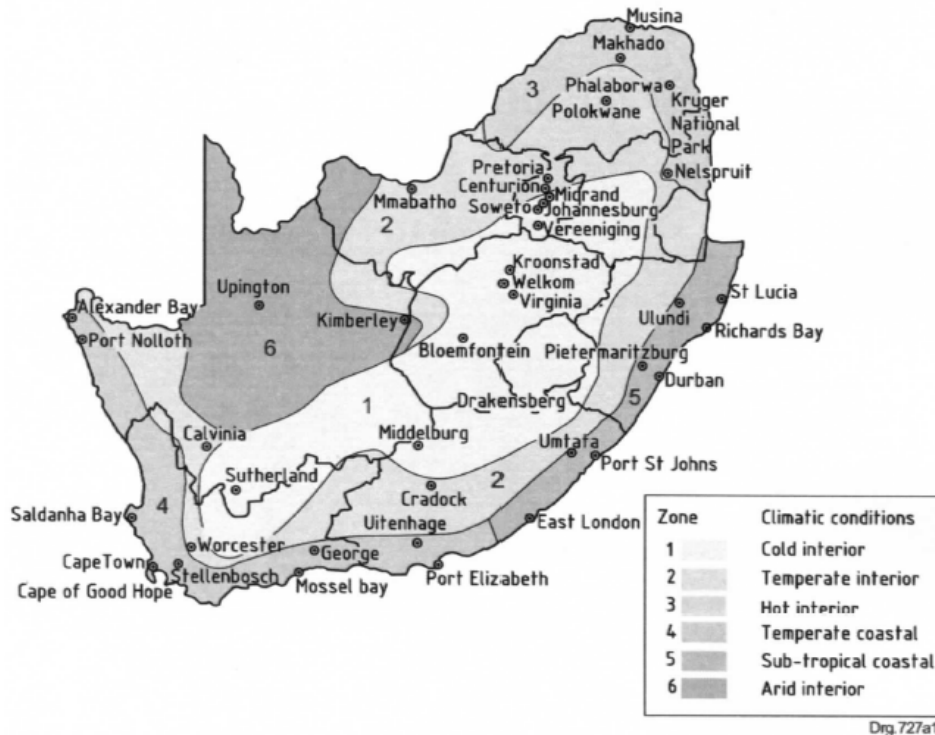
4.4.4.1 Buildings with up to 15% fenestration area to net floor area per storey comply with the minimum energy performance requirements.

4.4.4.2 Buildings with a fenestration area to net floor area per storey that exceeds 15% shall comply with the requirements for fenestration in accordance with SANS 204.

4.4.4.3 All fenestration air infiltration shall be in accordance with SANS 613.

“Unquote”

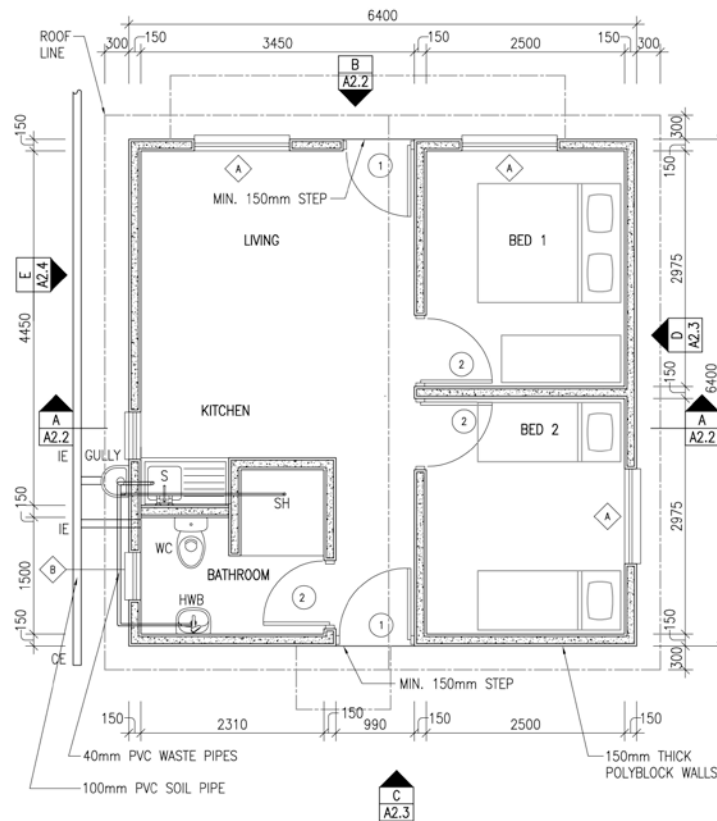
SANS 10400 XX also determines the Climatic Zones of South Africa in Normative Annex A as shown below:



Compliance with Regulation XA vests with the person registered in a professional category of registration in terms of the one of the Councils of the professions identified in the Council for the Built Environment Act, 2000 (sub-regulation A2(1)(g)) who must in terms of AZ4 comply with the requirements of the National Building Regulations. The above were published in Government Gazette #31084 dated 30 May 2008 effective 1 October 2008.

From the above it is abundantly clear that fenestration manufacturers and contractors are not responsible for compliance with Regulation XA and must follow the design as given by the appropriate registered professionals.

The following is a worked example of fenestration for a natural ventilated building:



Glazing calculations for compliance with Energy Usage Legislation (To be included on window schedules)

1. Total sq.m = 40,95m² Net floor area = 35,295m²
2. Constants for Conductance and Solar Heat Gain (refer table 11.1)
 Climatic Zone 1
 Conductance C₁ = 1,2 Solar Heat Gain C_{SHGC} = 0,15
3. Window area: Total = 3,96 sq.m
 North elevation = 2,16 m² East elevation = 1,08m²
 South elevation = 0 m² West elevation = 0,72m²
 Single glazing throughout. Default U = 7,9 SHGC = 0,81 (refer table 11.2)
4. No over hang – Solar exposure Factor E (refer table 11.3)
 North = 0,84 South = 0,61 East = 1,15 West = 1,40

Step 1: The aggregate conductance and aggregate solar heat gain of glazing must not exceed:

Conductance	= Net floor area x C _u	= 35,295 x 1,2	= <u>42,354</u>
Solar Heat Gain	= Net floor area x C _{SHGC}	= 35,295 x 0,15	= <u>5,29425</u>

Step 2: The aggregate conductance and SHG of glazing must be calculated:

Conductance – Default
 Window area x U = 3,96 x 7,9 = 31,284 (Less than 42.354 in Step 1)

Solar Heat Gain – Default
 Window area x SHGC x E

North –	2,16 x 0,81 x 0,84	= 1,47	
East –	1,08 x 0,81 x 1,15	= 1,01	
West –	0,72 x 0,81 x 1,40	= <u>0,82</u>	
			<u>3,30</u> (Less than 5.294 in Step 1)

11.1 EXTERNAL VERTICAL GLAZING

11.1.1 METHOD 1: FOR NATURAL VENTILATED BUILDINGS (SANS 204)

The glazing in each storey of a sole-occupancy unit, public space or other occupied space must be assessed separately in accordance with (a) and (b).

- (a) The aggregate conductance and aggregate solar heat gain of the glazing in each storey of a building must not exceed the allowances obtained by multiplying the net floor area, measured within the enclosing walls, by
- for conductance, the constant C_U ; and
 - for solar heat gain, the constant C_{SHGC}

Obtained from Table below:

Table 11.1 – Constants for Conductance and Solar heat gain						
Climate zone	1	2	3	4	5	6
C_U	1,2	1,4	1,4	1,4	1,4	1,2
C_{SHGC}	0,15	0,12	0,10	0,13	0,11	0,13

- (b) The aggregate conductance and solar heat gain of the glazing in each storey must be calculated by adding the conductance and solar heat gain of each glazing element with the following formula:

- i) for conductance:

$$(A_1 \times U_1) + (A_2 \times U_2) + (A_3 \times U_3) + \dots$$

Where

$A_{1,2,3}$ etc = The area of each glazing element; and

$U_{1,2,3}$ etc = The total system U-value of each glazing element refer table 11.2; and

- ii) for solar heat gain:

$$(A_1 \times SHGC_1 \times E_1) + (A_2 \times SHGC_2 \times E_2) + (A_3 \times SHGC_3 \times E_3) + \dots$$

Where

$A_{1,2,3}$ etc = The area of each glazing element; and

$SHGC_{1,2,3}$ etc = The SHGC of the transparent or translucent element in each glazing element refer table 11.2; and

$E_{1,2,3}$ etc = The solar exposure factor for each glazing element obtained from Table 11.3

Table 11.2: WORST CASE WHOLE GLAZING ELEMENT PERFORMANCES VALUES				
Glass description	Performance values			
	Standard Aluminium/Steel Framing		Thermally broken aluminium or Timber or uPVC framing	
	Total U-value W/m ² K	SHGC	Total U-value W/m ² K	SHGC
Single - clear	7,9	0,81	5,6	0,77
Single – tinted	7,9	0,69	5,6	0,65
Single – low E ^a	5,73	0,66	4,06	0,63
Clear double ^b (3/6/3)	4,23	0,72	3,0	0,68
Tinted double ^b	4,23	0,59	3,00	0,56
Clear double ^b low E ^a	3,40	0,66	2,41	0,62
Tinted double ^b low E ^a	3,40	0,54	2,41	0,51
- By referring to “glazing elements: 11.4.4 (b) i) requires Total U-values and SHGCs and is assessed for the combined effect of glass and frames. The measurements of these Total U-values and SHGCs is specified in the guidelines of the National Fenestration Rating Council (NFRC), represented in RSA by the South African Fenestration and Insulation Energy Rating Association (SAFIERA). - Total U-value and SHGCs, based on the NFRC assessment methods are shown for some simple types of glazing elements in the table below. (Smaller numbers indicate better glazing element performance). The table gives worst case assessments, which can be improved by obtaining generic or custom product assessments from suppliers, manufacturers, industry associations (including their online resources) and from competent assessors registered with the South African Glass Institute (SAGI).				
^a Low E assumes emissivity of 0,2, or better.				
^b Low E coating to surface 3 of the double glazed unit.				

The above worst case whole glazing element performance values may be deviated from in the event that the fenestration contractor/manufacturer can provide certification issued by the South African Fenestration and Insulation Energy Rating Authority (SAFIERA) which operates under the aegis of the AAAMSA Group. This certification will confirm the performance in respect of thermal as well as mechanical performance of the specified products.

This SAFIERA Certificate therefore provides confirmation that products comply with the requirements of SANS 10400-N: Glazing and SANS 10400-XA: Energy Usage.

Example of
property section
Of SAFIERA Certificate

 	MB Innovations t/a Betcrete	
	Top hung Double Glazed	
	ENERGY PERFORMANCE RATINGS	
	U-Value (W/m ² .K)	Solar Heat Gain Coefficient
	4.13	0.49
	ADDITIONAL PERFORMANCE RATINGS	
	Air Infiltration	Visible Transmittance
	0.25 l/m²/s	0.49
	MECHANICAL PROPERTIES	
	Category	Design Wind load
	A4	2500 Pa
The Manufacturer stipulates that these ratings conform to applicable SAFIERA procedures for determining whole product performance. SAFIERA ratings are determined for a fixed set of environmental conditions and a specific product size. SAFIERA does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.		

TABLE 11.3: Solar Exposure Factor E - Climate Zone 1 (Refer table C1 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,84	1,08	1,15	0,87	0,61	1,05	1,40	1,24
0,05	0,71	0,97	1,05	0,78	0,52	0,96	1,30	1,13
0,10	0,65	0,90	0,99	0,74	0,49	0,91	1,25	1,04
0,15	0,58	0,83	0,93	0,69	0,47	0,86	1,18	0,97
0,20	0,52	0,77	0,88	0,65	0,44	0,82	1,12	0,91
0,25	0,48	0,72	0,84	0,62	0,42	0,78	1,06	0,85
0,30	0,44	0,68	0,80	0,59	0,40	0,75	1,01	0,80
0,35	0,40	0,63	0,75	0,57	0,38	0,71	0,95	0,75
0,40	0,36	0,58	0,71	0,54	0,36	0,67	0,90	0,69
0,50	0,33	0,51	0,66	0,49	0,33	0,63	0,83	0,60
0,60	0,30	0,43	0,61	0,45	0,31	0,58	0,76	0,51
0,70	0,28	0,39	0,56	0,42	0,29	0,54	0,71	0,45
0,80	0,26	0,35	0,50	0,38	0,26	0,50	0,66	0,40
0,90	0,24	0,32	0,46	0,35	0,25	0,46	0,61	0,38
1,00	0,22	0,29	0,42	0,32	0,23	0,42	0,56	0,36
1,10	0,21	0,26	0,40	0,30	0,23	0,41	0,52	0,32
1,20	0,20	0,24	0,37	0,29	0,23	0,39	0,48	0,29
1,30	0,19	0,23	0,34	0,27	0,21	0,36	0,45	0,27
1,40	0,18	0,22	0,32	0,26	0,19	0,34	0,42	0,26
1,50	0,17	0,21	0,30	0,25	0,19	0,32	0,40	0,24
1,60	0,16	0,19	0,28	0,24	0,18	0,31	0,38	0,21
1,70	0,16	0,19	0,27	0,23	0,18	0,29	0,36	0,20
1,80	0,15	0,18	0,26	0,22	0,17	0,28	0,34	0,20
1,90	0,15	0,18	0,25	0,21	0,17	0,27	0,32	0,19
2,00	0,14	0,17	0,24	0,21	0,17	0,26	0,31	0,17

TABLE 11.3: Solar Exposure Factor E - Climate Zone 2 (Refer table C2 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,82	1,09	1,19	0,96	0,68	1,04	1,30	1,16
0,05	0,69	0,96	1,07	0,85	0,57	0,92	1,19	1,04
0,10	0,63	0,88	1,01	0,79	0,54	0,86	1,11	0,94
0,15	0,57	0,82	0,95	0,75	0,51	0,81	1,05	0,88
0,20	0,51	0,76	0,89	0,70	0,48	0,76	0,99	0,83
0,25	0,48	0,72	0,85	0,67	0,46	0,72	0,95	0,77
0,30	0,45	0,67	0,80	0,64	0,43	0,69	0,90	0,72
0,35	0,42	0,63	0,76	0,60	0,41	0,65	0,85	0,67
0,40	0,39	0,58	0,71	0,57	0,38	0,62	0,81	0,62
0,50	0,37	0,52	0,65	0,52	0,36	0,56	0,73	0,55
0,60	0,35	0,46	0,58	0,47	0,33	0,51	0,65	0,48
0,70	0,32	0,42	0,54	0,43	0,31	0,47	0,59	0,44
0,80	0,30	0,37	0,50	0,40	0,28	0,43	0,52	0,40
0,90	0,28	0,34	0,46	0,37	0,26	0,40	0,49	0,35
1,00	0,26	0,31	0,42	0,34	0,25	0,37	0,46	0,31
1,10	0,25	0,28	0,39	0,32	0,23	0,35	0,43	0,29
1,20	0,24	0,26	0,36	0,30	0,22	0,33	0,40	0,27
1,30	0,23	0,25	0,34	0,28	0,21	0,31	0,37	0,26
1,40	0,21	0,23	0,32	0,27	0,20	0,29	0,34	0,24
1,50	0,21	0,22	0,30	0,25	0,19	0,28	0,32	0,23
1,60	0,20	0,22	0,29	0,23	0,18	0,27	0,30	0,21
1,70	0,19	0,21	0,27	0,22	0,18	0,25	0,29	0,20
1,80	0,18	0,20	0,25	0,21	0,17	0,23	0,27	0,20
1,90	0,18	0,19	0,24	0,21	0,17	0,22	0,26	0,19
2,00	0,17	0,17	0,24	0,21	0,16	0,21	0,25	0,19

TABLE 11.3: Solar Exposure Factor E - Climate Zone 3 (Refer table C3 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,56	1,04	1,42	1,18	0,66	1,16	1,36	1,01
0,05	0,47	0,94	1,32	1,08	0,57	1,05	1,26	0,90
0,10	0,44	0,85	1,25	1,02	0,54	0,99	1,19	0,83
0,15	0,41	0,79	1,17	0,96	0,50	0,93	1,13	0,78
0,20	0,38	0,73	1,10	0,90	0,46	0,87	1,06	0,73
0,25	0,36	0,69	1,05	0,85	0,44	0,83	1,00	0,68
0,30	0,35	0,64	0,99	0,81	0,42	0,79	0,95	0,64
0,35	0,34	0,60	0,93	0,76	0,40	0,75	0,90	0,60
0,40	0,32	0,56	0,88	0,71	0,38	0,72	0,84	0,56
0,50	0,30	0,49	0,81	0,65	0,35	0,64	0,77	0,50
0,60	0,28	0,43	0,74	0,58	0,31	0,57	0,71	0,44
0,70	0,26	0,39	0,67	0,53	0,29	0,53	0,65	0,40
0,80	0,24	0,35	0,59	0,47	0,27	0,50	0,60	0,35
0,90	0,22	0,32	0,54	0,44	0,25	0,46	0,56	0,32
1,00	0,20	0,29	0,50	0,40	0,24	0,43	0,53	0,29
1,10	0,20	0,28	0,46	0,37	0,22	0,40	0,48	0,28
1,20	0,19	0,26	0,42	0,34	0,21	0,37	0,43	0,26
1,30	0,18	0,24	0,39	0,33	0,20	0,35	0,42	0,25
1,40	0,17	0,22	0,35	0,31	0,20	0,32	0,41	0,23
1,50	0,17	0,21	0,34	0,29	0,18	0,32	0,38	0,22
1,60	0,17	0,20	0,33	0,27	0,16	0,31	0,35	0,21
1,70	0,16	0,19	0,31	0,25	0,16	0,29	0,34	0,20
1,80	0,15	0,19	0,30	0,24	0,16	0,28	0,33	0,19
1,90	0,15	0,18	0,28	0,24	0,15	0,26	0,30	0,18
2,00	0,15	0,18	0,25	0,24	0,15	0,24	0,27	0,17

TABLE 11.3: Solar Exposure Factor E - Climate Zone 4 (Refer table C4 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,84	1,08	1,15	0,87	0,61	1,05	1,40	1,24
0,05	0,71	0,97	1,05	0,78	0,52	0,96	1,30	1,13
0,10	0,65	0,90	0,99	0,74	0,49	0,91	1,25	1,04
0,15	0,58	0,83	0,93	0,69	0,47	0,86	1,18	0,97
0,20	0,52	0,77	0,88	0,65	0,44	0,82	1,12	0,91
0,25	0,48	0,72	0,84	0,62	0,42	0,78	1,06	0,85
0,30	0,44	0,68	0,80	0,59	0,40	0,75	1,01	0,80
0,35	0,40	0,63	0,75	0,57	0,38	0,71	0,95	0,75
0,40	0,36	0,58	0,71	0,54	0,36	0,67	0,90	0,69
0,50	0,33	0,51	0,66	0,49	0,33	0,63	0,83	0,60
0,60	0,30	0,43	0,61	0,45	0,31	0,58	0,76	0,51
0,70	0,28	0,39	0,56	0,42	0,29	0,54	0,71	0,45
0,80	0,26	0,35	0,50	0,38	0,26	0,50	0,66	0,40
0,90	0,24	0,32	0,46	0,35	0,25	0,46	0,61	0,38
1,00	0,22	0,29	0,42	0,32	0,23	0,42	0,56	0,36
1,10	0,21	0,26	0,40	0,30	0,23	0,41	0,52	0,32
1,20	0,20	0,24	0,37	0,29	0,23	0,39	0,48	0,29
1,30	0,19	0,23	0,34	0,27	0,21	0,36	0,45	0,27
1,40	0,18	0,22	0,32	0,26	0,19	0,34	0,42	0,26
1,50	0,17	0,21	0,30	0,25	0,19	0,32	0,40	0,24
1,60	0,16	0,19	0,28	0,24	0,18	0,31	0,38	0,21
1,70	0,16	0,19	0,27	0,23	0,18	0,29	0,36	0,20
1,80	0,15	0,18	0,26	0,22	0,17	0,28	0,34	0,20
1,90	0,15	0,18	0,25	0,21	0,17	0,27	0,32	0,19
2,00	0,14	0,17	0,24	0,21	0,17	0,26	0,31	0,17

TABLE 11.3: Solar Exposure Factor E - Climate Zone 5 (Refer table C5 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,52	0,84	1,29	1,24	0,87	1,27	1,32	0,85
0,05	0,44	0,74	1,19	1,13	0,75	1,17	1,23	0,75
0,10	0,41	0,68	1,11	1,07	0,68	1,09	1,15	0,69
0,15	0,39	0,64	1,06	1,00	0,61	1,02	1,08	0,64
0,20	0,37	0,59	1,01	0,94	0,55	0,94	1,00	0,60
0,25	0,35	0,56	0,95	0,88	0,52	0,89	0,96	0,57
0,30	0,33	0,52	0,90	0,82	0,48	0,85	0,92	0,53
0,35	0,32	0,49	0,84	0,76	0,45	0,80	0,88	0,50
0,40	0,30	0,45	0,79	0,69	0,42	0,75	0,83	0,47
0,50	0,27	0,41	0,72	0,64	0,38	0,67	0,75	0,42
0,60	0,25	0,37	0,66	0,59	0,34	0,60	0,66	0,38
0,70	0,24	0,34	0,59	0,53	0,32	0,56	0,62	0,35
0,80	0,22	0,31	0,53	0,47	0,30	0,52	0,58	0,32
0,90	0,20	0,28	0,49	0,44	0,27	0,48	0,53	0,30
1,00	0,19	0,26	0,45	0,41	0,25	0,43	0,48	0,28
1,10	0,18	0,24	0,41	0,37	0,23	0,41	0,45	0,27
1,20	0,18	0,23	0,37	0,33	0,22	0,39	0,42	0,26
1,30	0,17	0,22	0,35	0,32	0,22	0,36	0,40	0,24
1,40	0,17	0,21	0,32	0,30	0,22	0,32	0,37	0,22
1,50	0,16	0,20	0,30	0,28	0,20	0,31	0,36	0,22
1,60	0,15	0,18	0,28	0,26	0,18	0,29	0,34	0,21
1,70	0,14	0,18	0,28	0,24	0,18	0,29	0,32	0,20
1,80	0,13	0,18	0,27	0,22	0,17	0,28	0,30	0,18
1,90	0,13	0,18	0,25	0,22	0,17	0,26	0,29	0,17
2,00	0,12	0,17	0,23	0,21	0,16	0,24	0,28	0,17

TABLE 11.3: Solar Exposure Factor E - Climate Zone 6 (Refer table C1 of SANS 204)

P/H Refer Figure 11.2	Orientation Sector (refer Figure 11.3)							
	North	North East	East	South East	South	South West	West	North West
0,00	0,72	1,19	1,40	1,05	0,57	0,99	1,31	1,12
0,05	0,61	1,10	1,31	0,97	0,49	0,91	1,22	1,02
0,10	0,56	1,00	1,24	0,91	0,46	0,85	1,17	0,94
0,15	0,49	0,94	1,18	0,86	0,44	0,81	1,11	0,87
0,20	0,43	0,87	1,12	0,82	0,41	0,76	1,05	0,81
0,25	0,40	0,82	1,07	0,78	0,39	0,73	1,00	0,76
0,30	0,37	0,76	1,02	0,74	0,38	0,69	0,95	0,71
0,35	0,33	0,71	0,97	0,71	0,36	0,66	0,90	0,66
0,40	0,30	0,66	0,92	0,67	0,34	0,62	0,85	0,62
0,50	0,29	0,58	0,83	0,61	0,31	0,58	0,79	0,53
0,60	0,27	0,50	0,74	0,56	0,29	0,53	0,72	0,45
0,70	0,26	0,44	0,68	0,52	0,27	0,49	0,66	0,40
0,80	0,24	0,38	0,63	0,49	0,25	0,45	0,59	0,36
0,90	0,22	0,35	0,59	0,46	0,23	0,42	0,55	0,33
1,00	0,20	0,31	0,55	0,42	0,22	0,39	0,51	0,30
1,10	0,20	0,29	0,50	0,39	0,21	0,37	0,48	0,27
1,20	0,19	0,26	0,46	0,37	0,20	0,35	0,45	0,25
1,30	0,17	0,24	0,43	0,35	0,18	0,34	0,41	0,23
1,40	0,16	0,23	0,39	0,34	0,17	0,33	0,38	0,21
1,50	0,16	0,21	0,38	0,32	0,17	0,31	0,35	0,21
1,60	0,16	0,20	0,38	0,30	0,16	0,29	0,33	0,20
1,70	0,15	0,19	0,35	0,29	0,15	0,27	0,32	0,18
1,80	0,14	0,18	0,32	0,27	0,14	0,25	0,32	0,17
1,90	0,14	0,17	0,30	0,25	0,14	0,24	0,29	0,16
2,00	0,13	0,17	0,28	0,23	0,14	0,24	0,26	0,16

11.1.2 METHOD 2: FOR MECHANICALLY VENTILATED BUILDINGS

- a) The *glazing* in each storey of a building and facing each orientation must be assessed separately in accordance with (b) and (c).
- b) The aggregate *air-conditioning* energy value attributable to the *glazing* must not exceed the allowance obtained by multiplying the façade area of the orientation by the energy index in Table 11.4.

Table 11.4: ENERGY INDEX CLIMATIC ZONE					
1	2	3	4	5	6
0,220	0,257	0,221	0,220	0,180	0,227

- c) The aggregate *air-conditioning* energy value must be calculated by adding the *air-conditioning* energy value through each *glazing* element in accordance with the following formula:

$$A_1 [SHGC_1 (C_A \times S_{H1} + C_B \times S_{C1}) + C_C \times U_1] + A_2 [SHGC_2 (C_A \times S_{H2} + C_B \times S_{C2}) + C_C \times U_2] + \dots$$

Where:

$A_{1, 2}$ etc. = the area of each *glazing* element; and

C_A, B and C_C = the energy constants A, B and C for the specific orientation from Table 11.5; and

$SHGC_{1, 2}$, etc. = the $SHGC$ of each *glazing* element; and

$S_{H1, 2}$, etc. = the heating shading multiplier for each *glazing* element obtained from Table 11.6; and

$S_{C1, 2}$, etc. = the cooling shading multiplier for each *glazing* element obtained from Table 11.7; and

$U_{1, 2}$, etc. = the *Total U-value* of each *glazing* element refer Table 11.2

- d) For the purposes of c), where the *air-conditioning* energy value of a *glazing* element is calculated to be negative, it must be taken to be zero.

Table 11.5: ENERGY CONSTANTS (C_A , C_B AND C_C) (Refer table D1 of SANS 204)									
Climatic Zone	Energy Constants	Orientation Section							
		North	North East	East	South East	South	South West	West	North West
1	C_A	-0.37	-0.38	-0.59	-0.82	-0.87	-0.90	-0.85	-0.61
	C_B	1.53	1.66	1.39	0.80	0.38	0.66	1.07	1.34
	C_C	-0.01	-0.01	0.03	0.11	0.15	0.13	0.08	0.03
2	C_A	-0.06	-0.09	-0.18	-0.41	-0.47	-0.43	-0.28	-0.14
	C_B	1.46	1.55	1.32	0.75	0.41	0.68	1.13	1.38
	C_C	-0.02	-0.01	0.00	0.05	0.07	0.05	0.02	-0.01
3	C_A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C_B	1.01	1.16	1.08	0.69	0.41	0.67	1.01	1.09
	C_C	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
4	C_A	-0.37	-0.38	-0.59	-0.82	-0.87	-0.90	-0.85	-0.61
	C_B	1.53	1.66	1.39	0.80	0.38	0.66	1.07	1.34
	C_C	-0.01	-0.01	0.03	0.11	0.15	0.13	0.08	0.03
5	C_A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C_B	0.80	0.92	0.91	0.67	0.48	0.67	0.88	0.91
	C_C	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6	C_A	-0.16	-0.18	-0.30	-0.44	-0.45	-0.46	-0.40	-0.26
	C_B	1.25	1.37	1.18	0.68	0.35	0.60	0.98	1.20
	C_C	0.00	0.00	0.03	0.07	0.09	0.08	0.04	0.02

Table 11.6: HEATING SHADING MULTIPLIER (S _H) (Refer tableD2 of SANS 204)									
G Refer Figure 11.2	PH Refer Figure 11.2	Orientation Section (Refer Figure 11.1)							
		North	North East	East	South East	South	South West	West	North West
CLIMATIC ZONE 1 & 4									
Not more than 100mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.95	0.93	0.91	0.90	0.93	0.91	0.91	0.93
	0.4	0.82	0.82	0.78	0.79	0.86	0.81	0.78	0.80
	0.6	0.61	0.66	0.64	0.70	0.80	0.71	0.64	0.62
	0.8	0.31	0.46	0.49	0.63	0.74	0.63	0.52	0.41
	1.0	0.02	0.23	0.35	0.58	0.70	0.56	0.40	0.17
	1.2	0.00	0.04	0.23	0.53	0.66	0.51	0.30	0.02
	1.4	0.00	0.00	0.14	0.49	0.63	0.47	0.22	0.00
	1.6	0.00	0.00	0.10	0.45	0.60	0.44	0.16	0.00
	1.8	0.00	0.00	0.05	0.41	0.58	0.41	0.11	0.00
	2.0	0.00	0.00	0.01	0.37	0.55	0.38	0.05	0.00
More than 100mm but not more than 500mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.99	0.99	0.98	0.97	0.97	0.97	0.97	0.98
	0.4	0.96	0.94	0.91	0.89	0.93	0.91	0.91	0.94
	0.6	0.88	0.87	0.83	0.82	0.87	0.84	0.82	0.86
	0.8	0.75	0.78	0.73	0.70	0.83	0.76	0.71	0.75
	1.0	0.57	0.66	0.62	0.68	0.78	0.69	0.61	0.60
	1.2	0.33	0.51	0.51	0.64	0.75	0.63	0.52	0.44
	1.4	0.14	0.37	0.42	0.60	0.72	0.59	0.44	0.30
	1.6	0.10	0.25	0.33	0.57	0.69	0.55	0.36	0.20
	1.8	0.05	0.12	0.25	0.53	0.67	0.51	0.29	0.10
	2.0	0.00	0.00	0.17	0.50	0.64	0.48	0.21	0.00
More than 500mm but not more than 1200mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	0.4	0.99	0.98	0.97	0.96	0.97	0.96	0.96	0.98
	0.6	0.97	0.96	0.93	0.92	0.94	0.92	0.92	0.96
	0.8	0.94	0.93	0.89	0.87	0.91	0.88	0.87	0.92
	1.0	0.88	0.88	0.83	0.82	0.87	0.83	0.81	0.86
	1.2	0.79	0.82	0.77	0.77	0.85	0.79	0.75	0.79
	1.4	0.66	0.73	0.69	0.73	0.82	0.75	0.68	0.69
	1.6	0.48	0.63	0.62	0.69	0.79	0.70	0.61	0.57
	1.8	0.30	0.53	0.54	0.66	0.76	0.66	0.55	0.45
	2.0	0.13	0.42	0.47	0.63	0.74	0.62	0.48	0.33

CLIMATIC ZONE 3 & 5
In climate zones 3 and 5, the heating shading multiplier is to be taken as 1.0

Table 11.6: HEATING SHADING MULTIPLIER (S _H) (Refer table D2 of SANS 204)									
G Refer Figure 11.2	PH Refer Figure 11.2	Orientation Section (Refer Figure 11.1)							
CLIMATIC ZONE 2 & 6									
Not more than 100mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.96	0.95	0.92	0.90	0.94	0.92	0.92	0.95
	0.4	0.86	0.83	0.79	0.78	0.87	0.83	0.80	0.85
	0.6	0.66	0.65	0.63	0.69	0.81	0.74	0.66	0.70
	0.8	0.30	0.41	0.43	0.62	0.77	0.66	0.50	0.47
	1.0	0.00	0.08	0.22	0.56	0.74	0.60	0.35	0.15
	1.2	0.00	0.00	0.08	0.52	0.71	0.54	0.21	0.00
	1.4	0.00	0.00	0.04	0.48	0.69	0.50	0.12	0.00
	1.6	0.00	0.00	0.02	0.45	0.67	0.46	0.08	0.00
	1.8	0.00	0.00	0.01	0.42	0.66	0.43	0.04	0.00
	2.0	0.00	0.00	0.00	0.39	0.64	0.39	0.00	0.00
More than 100mm but not more than 500mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.99	0.99	0.98	0.97	0.98	0.97	0.98	0.99
	0.4	0.97	0.95	0.92	0.89	0.93	0.91	0.92	0.96
	0.6	0.91	0.88	0.84	0.81	0.88	0.85	0.85	0.90
	0.8	0.79	0.78	0.73	0.70	0.84	0.79	0.75	0.81
	1.0	0.59	0.63	0.62	0.67	0.80	0.73	0.65	0.69
	1.2	0.27	0.45	0.48	0.63	0.78	0.68	0.54	0.50
	1.4	0.03	0.28	0.35	0.59	0.75	0.63	0.44	0.31
	1.6	0.02	0.19	0.25	0.56	0.74	0.59	0.34	0.21
	1.8	0.01	0.09	0.14	0.52	0.72	0.55	0.25	0.10
	2.0	0.00	0.00	0.03	0.49	0.70	0.51	0.15	0.00
More than 500mm but not more than 1200m	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99
	0.4	0.99	0.98	0.97	0.97	0.97	0.96	0.97	0.99
	0.6	0.98	0.97	0.94	0.92	0.95	0.93	0.94	0.97
	0.8	0.95	0.94	0.90	0.88	0.92	0.89	0.90	0.94
	1.0	0.91	0.89	0.84	0.83	0.89	0.85	0.84	0.90
	1.2	0.82	0.82	0.78	0.78	0.86	0.82	0.78	0.84
	1.4	0.67	0.71	0.70	0.73	0.84	0.78	0.71	0.75
	1.6	0.45	0.58	0.60	0.70	0.81	0.74	0.64	0.62
	1.8	0.22	0.44	0.51	0.66	0.79	0.71	0.56	0.48
	2.0	0.00	0.30	0.42	0.62	0.77	0.67	0.49	0.35
Note: In climate zones 1, 2, 4 and 6, where G is more than 1200mm, the heating shading multiplier is to be taken as 1.0.									

TABLE 11.7: COOLING SHADING MULTIPLIER (S _C) (Refer table D3 of SANS 204)									
G Refer Figure 11.2	PH Refer Figure 11.2	Orientation Section (Refer Figure 11.1)							
		North	North East	East	South East	South	South West	West	North West
CLIMATIC ZONE 1 & 4									
Not more than 100mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.82	0.86	0.87	0.87	0.90	0.88	0.87	0.84
	0.4	0.63	0.69	0.72	0.74	0.80	0.74	0.72	0.67
	0.6	0.49	0.56	0.60	0.64	0.73	0.64	0.61	0.54
	0.8	0.40	0.46	0.51	0.56	0.68	0.57	0.52	0.44
	1.0	0.35	0.38	0.44	0.51	0.64	0.51	0.45	0.38
	1.2	0.32	0.34	0.39	0.48	0.61	0.47	0.41	0.35
	1.4	0.31	0.32	0.36	0.45	0.59	0.44	0.37	0.32
	1.6	0.30	0.30	0.33	0.42	0.57	0.42	0.34	0.31
	1.8	0.30	0.29	0.31	0.41	0.56	0.40	0.32	0.30
	2.0	0.30	0.28	0.29	0.39	0.55	0.38	0.31	0.29
More than 100mm but not more than 500mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.93	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	0.4	0.79	0.84	0.86	0.86	0.88	0.86	0.85	0.82
	0.6	0.64	0.71	0.75	0.76	0.81	0.76	0.74	0.68
	0.8	0.52	0.60	0.65	0.63	0.75	0.68	0.65	0.57
	1.0	0.43	0.51	0.57	0.61	0.71	0.61	0.57	0.48
	1.2	0.38	0.44	0.50	0.56	0.68	0.56	0.50	0.42
	1.4	0.35	0.39	0.45	0.52	0.65	0.52	0.46	0.38
	1.6	0.33	0.35	0.41	0.49	0.63	0.49	0.42	0.35
	1.8	0.32	0.33	0.38	0.47	0.62	0.46	0.39	0.33
	2.0	0.31	0.31	0.36	0.45	0.60	0.44	0.36	0.32
More than 500mm but not more than 1200mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98
	0.4	0.91	0.94	0.94	0.94	0.94	0.94	0.94	0.93
	0.6	0.82	0.87	0.88	0.88	0.90	0.88	0.87	0.85
	0.8	0.72	0.79	0.81	0.82	0.85	0.81	0.80	0.75
	1.0	0.62	0.70	0.74	0.76	0.81	0.75	0.73	0.66
	1.2	0.53	0.62	0.67	0.70	0.77	0.70	0.67	0.58
	1.4	0.47	0.55	0.62	0.65	0.74	0.65	0.61	0.51
	1.6	0.42	0.49	0.56	0.61	0.72	0.61	0.56	0.46
	1.8	0.38	0.44	0.51	0.57	0.69	0.57	0.51	0.42
	2.0	0.35	0.40	0.47	0.54	0.67	0.54	0.47	0.38

TABLE 11.7: COOLING SHADING MULTIPLIER (S _C) (Refer table D3 of SANS 204)									
G Refer Figure 11.2	PH Refer Figure 11.2	Orientation Section (Refer Figure 11.1)							
		North	North East	East	South East	South	South West	West	North West
CLIMATIC ZONE 2 & 6									
Not More than 100mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.81	0.85	0.87	0.86	0.90	0.88	0.87	0.84
	0.4	0.61	0.68	0.72	0.72	0.81	0.75	0.72	0.67
	0.6	0.46	0.54	0.59	0.61	0.74	0.64	0.60	0.53
	0.8	0.35	0.42	0.49	0.53	0.68	0.57	0.51	0.42
	1.0	0.28	0.34	0.42	0.47	0.64	0.50	0.44	0.34
	1.2	0.24	0.29	0.37	0.43	0.62	0.46	0.38	0.29
	1.4	0.22	0.26	0.33	0.39	0.59	0.42	0.34	0.26
	1.6	0.20	0.23	0.30	0.36	0.57	0.39	0.31	0.24
	1.8	0.20	0.21	0.27	0.34	0.56	0.37	0.29	0.22
	2.0	0.19	0.20	0.25	0.32	0.54	0.34	0.26	0.21
More than 100mm but not more than 500mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.93	0.95	0.96	0.95	0.96	0.95	0.95	0.95
	0.4	0.77	0.83	0.86	0.85	0.89	0.86	0.85	0.82
	0.6	0.62	0.70	0.74	0.74	0.82	0.77	0.74	0.68
	0.8	0.48	0.58	0.64	0.60	0.76	0.68	0.64	0.56
	1.0	0.37	0.48	0.55	0.58	0.72	0.61	0.56	0.46
	1.2	0.32	0.40	0.48	0.52	0.68	0.56	0.50	0.39
	1.4	0.28	0.35	0.43	0.48	0.66	0.52	0.44	0.34
	1.6	0.25	0.30	0.39	0.45	0.64	0.48	0.40	0.30
	1.8	0.23	0.27	0.35	0.42	0.62	0.45	0.37	0.27
	2.0	0.21	0.25	0.32	0.39	0.60	0.42	0.34	0.25
More than 500mm but not more than 1200mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98
	0.4	0.90	0.94	0.94	0.94	0.95	0.94	0.94	0.93
	0.6	0.81	0.86	0.88	0.89	0.91	0.88	0.88	0.85
	0.8	0.70	0.77	0.81	0.81	0.87	0.81	0.80	0.75
	1.0	0.58	0.68	0.74	0.74	0.82	0.76	0.73	0.66
	1.2	0.47	0.60	0.67	0.68	0.79	0.70	0.66	0.58
	1.4	0.40	0.52	0.61	0.62	0.75	0.65	0.60	0.50
	1.6	0.35	0.46	0.55	0.58	0.73	0.61	0.55	0.44
	1.8	0.31	0.41	0.50	0.54	0.70	0.57	0.50	0.39
	2.0	0.27	0.36	0.45	0.50	0.68	0.54	0.46	0.35

TABLE 11.7: COOLING SHADING MULTIPLIER (SC) (Refer table D3 of SANS 204)									
G Refer Figure 11.2	PH Refer Figure 11.2	Orientation Section (Refer Figure 11.1)							
		North	North East	East	South East	South	South West	West	North West
CLIMATIC ZONE 3 & 5									
Not more than 100mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.79	0.84	0.86	0.85	0.87	0.87	0.87	0.84
	0.4	0.57	0.66	0.71	0.70	0.76	0.73	0.72	0.67
	0.6	0.41	0.52	0.58	0.58	0.68	0.62	0.60	0.53
	0.8	0.32	0.40	0.47	0.48	0.62	0.54	0.50	0.43
	1.0	0.26	0.32	0.39	0.42	0.58	0.48	0.43	0.35
	1.2	0.22	0.28	0.33	0.38	0.56	0.43	0.37	0.30
	1.4	0.20	0.24	0.29	0.34	0.53	0.39	0.33	0.25
	1.6	0.19	0.22	0.26	0.32	0.52	0.36	0.29	0.22
	1.8	0.18	0.20	0.23	0.30	0.50	0.33	0.26	0.20
	2.0	0.17	0.18	0.21	0.28	0.49	0.31	0.24	0.18
More than 500mm but not more than 1200mm	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.92	0.94	0.95	0.94	0.93	0.94	0.95	0.94
	0.4	0.72	0.81	0.85	0.83	0.84	0.84	0.85	0.81
	0.6	0.54	0.68	0.73	0.72	0.77	0.75	0.74	0.68
	0.8	0.42	0.56	0.63	0.57	0.71	0.66	0.64	0.56
	1.0	0.34	0.46	0.54	0.54	0.66	0.59	0.56	0.47
	1.2	0.29	0.38	0.46	0.48	0.62	0.54	0.49	0.41
	1.4	0.25	0.32	0.40	0.43	0.60	0.50	0.44	0.35
	1.6	0.23	0.29	0.35	0.40	0.57	0.46	0.39	0.31
	1.8	0.21	0.26	0.32	0.37	0.56	0.42	0.36	0.38
	2.0	0.20	0.24	0.29	0.34	0.54	0.39	0.32	0.25
	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.2	0.97	0.98	0.98	0.98	0.96	0.98	0.98	0.98
	0.4	0.89	0.93	0.94	0.93	0.91	0.93	0.94	0.92
	0.6	0.74	0.85	0.88	0.86	0.86	0.86	0.87	0.84
	0.8	0.59	0.76	0.81	0.79	0.81	0.80	0.80	0.74
	1.0	0.49	0.66	0.73	0.72	0.77	0.73	0.72	0.66
	1.2	0.41	0.58	0.66	0.65	0.73	0.68	0.66	0.58
	1.4	0.35	0.51	0.59	0.59	0.69	0.63	0.60	0.51
	1.6	0.31	0.44	0.53	0.54	0.66	0.59	0.55	0.46
	1.8	0.28	0.39	0.48	0.50	0.64	0.55	0.50	0.41
	2.0	0.25	0.35	0.43	0.46	0.61	0.51	0.45	0.37
Note: In climatic zones 1, 2, 4 and 6, where G is more than 1200mm, the cooling shading multiplier is taken as 1.0									

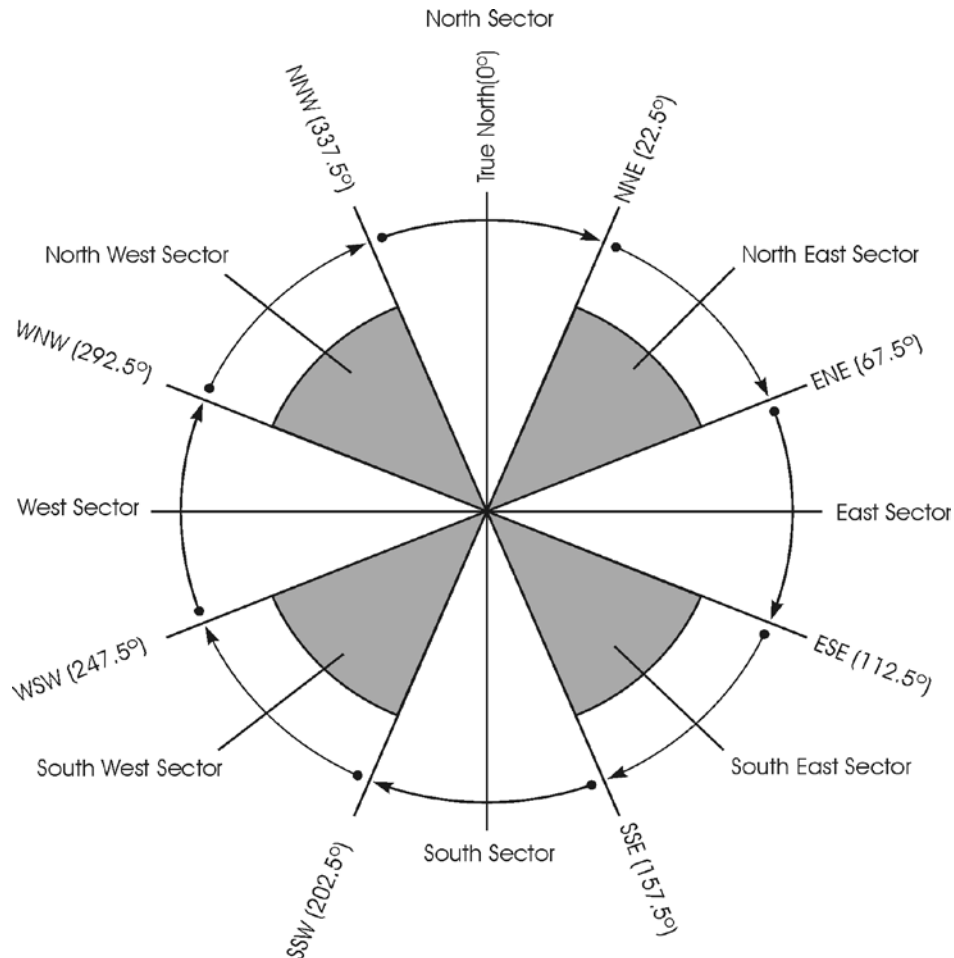


Figure 11.1: ORIENTATION SECTORS

Note:

1. The direction that all wall or glazing element faces is the direction of a perpendicular line from the wall or glazing element.
2. Figure 11.1 is based on True North and all angles are measured clockwise from True North. Survey angles on site plans are usually marked in angles from True North. These angles can be used to establish True North for a particular site.
3. Magnetic North, found by a magnetic compass, varies from True North over time and by different amounts in different locations. Magnetic North is not an acceptable approximation of True North.
4. The eight orientation sectors shown in Figure 11.1 do not overlap at their boundaries. North sector, for example, begins just clockwise after the NNW line and ends exactly on the NNE line. The start and end of other sections are determined in a similar way, as indicated by the outer curved arrows.

11.2 SHADING

Where shading is *required* it must-

- (a) be provided by an external permanent projection, such as a veranda, balcony, fixed canopy, eaves, shading hood or carport, which-
 - i) extends horizontally on both sides of the *glazing* for a distance not less than the projection distance P in Figure 11.2; or
 - ii) provide the equivalent shading to (i) with a reveal or the like; or
- (b) be provided by an external shading device, such as a shutter, blind, vertical or horizontal building screen with blades, battens or slats, which-
 - i) is capable of restricting at least 80% of the summer solar radiation; and
 - ii) if adjustable, is readily operated either manually, mechanically or electronically by the building occupants.

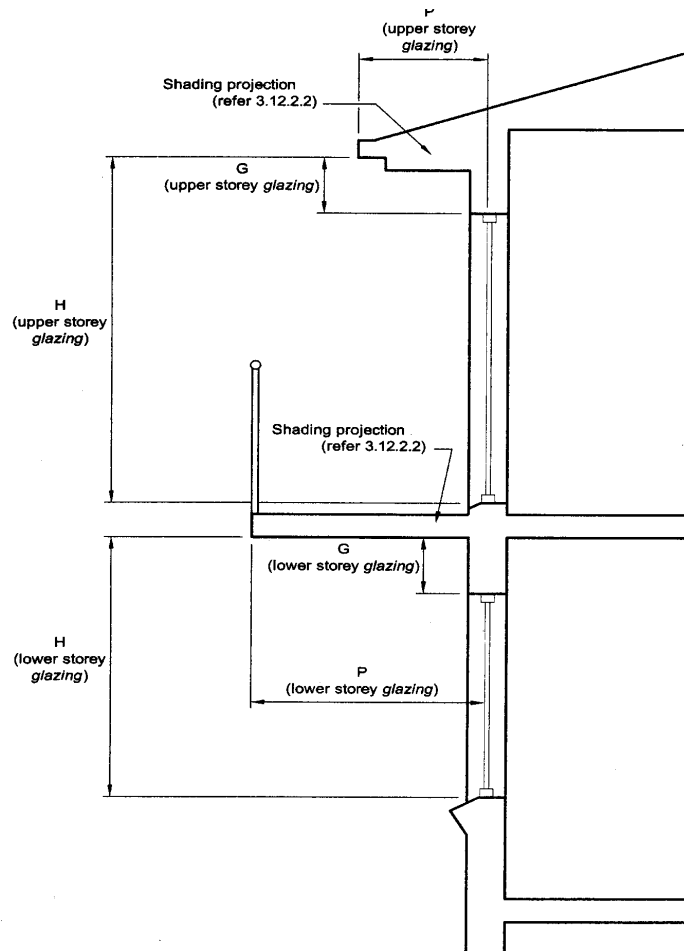


Figure 11.2: METHOD OF MEASURING P AND H

Note:

1. Shading devices can include fixed louvers, shading screens and other types of perforated or fixed angle slatted shades. However, such devices need to be designed for the climate and latitude to ensure that summer sun penetration is restricted, while winter sun access is achieved.
2. Gutters can only be considered as providing shading if attached to a shading projection such as a verandah, fixed canopy, eaves, shading hood, balcony or the like.
3. Shading devices can be either attached or located adjacent to the building. For example, a free-standing lattice screen may be considered to provide shading to glazing if it complies with 11.5.

11.3 PERMISSIBLE AIR LEAKAGE (SANS 204)

Maximum permissible air leakage for open-able windows shall be 2 l/m²/s with a pressure difference of 75Pa, when tested to SANS 613.

Maximum permissible air leakage for non-open-able windows is 0.306 l/m²/s with pressure difference of 75Pa, when tested to SANS 613.

For double action swing doors and revolving doors, the maximum permissible air leakage shall be 5 l/m²/s with a pressure difference of 75Pa, when tested to SANS 613.

11.4 ROOFLIGHTS (SANS 204)

Roof lights serving a habitable room, public area on an interconnecting space such as a corridor, hallway, stairway or the like.

- a) 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, must comply with Table 11.8.
- b) If the total area of roof lights is more than 10% of the floor area of the room or space they serve may only be used where the transparent and translucent elements of the roof lights including any imperforated ceiling diffuser achieves an SHGH of not more than 0.30 and a total U-value of not more than 2.0.

Table 11.8: Roof lights – Thermal Performance of Transparent and Translucent Elements

Roof light shaft index (see Note 1)	Total area of roof lights serving the room or space as a percentage of the floor area of the room or space		
	More than 1.5% and up to 3%	More than 3% and up to 5%	More than 5% and up to 10%
Less than 0.5	SHGC of not more than 0.75 and a Total U-value of not more than 5.0	SHGC of not more than 0.50 and a Total U-value of not more than 5.0	SHGC of not more than 0.25 and a Total U-value of not more than 2.5
0.5 to less than 1.0	Total U-value of not more than 5.0	SHGC of not more than 0.70 and a Total U-value of not more than 5.0	SHGC of not more than 0.35 and a Total U-value of not more than 2.5
1.0 to less than 2.5	Total U-value of not more than 5.0	Total U-value of not more than 5.0	SHGC of not more than 0.45 and a Total U-value
0.5 to less than 1.0	Total U-value of not more than 5.0	Total U-value of not more than 5.0	Total U-value of not more than 2.5

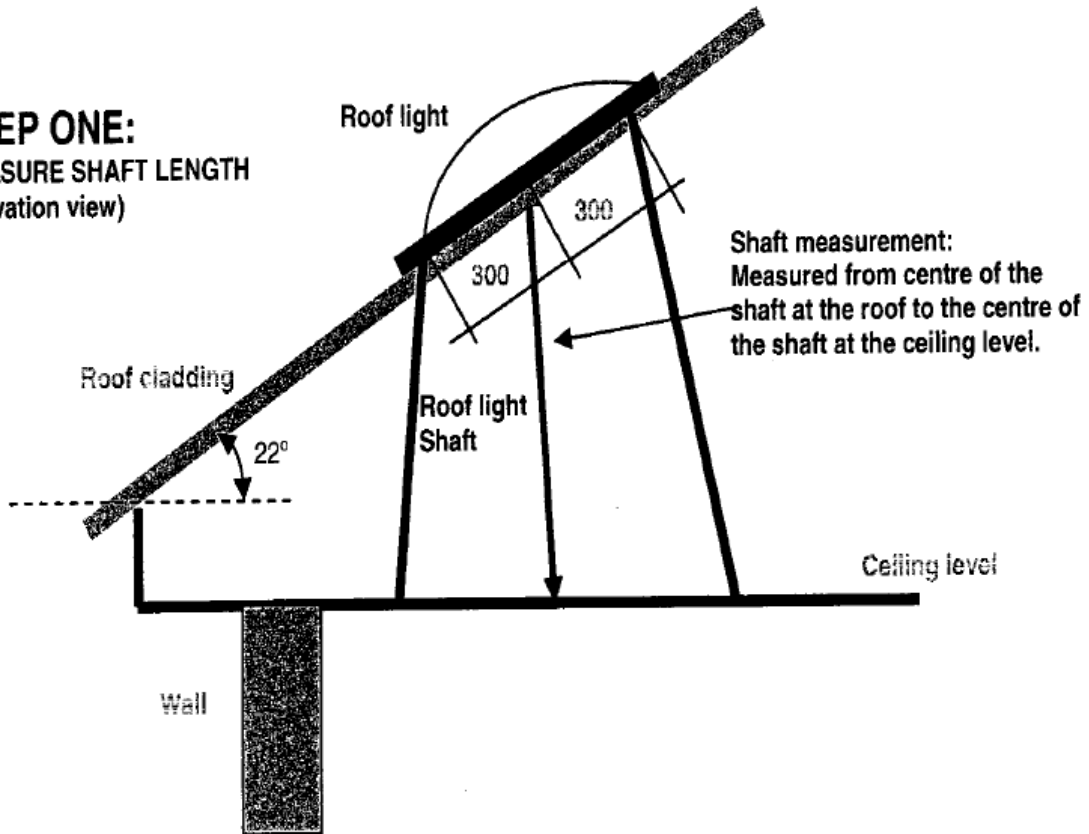
Notes:

1. The roof light shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level (or the diameter for a circular shaft) in the same units of measurement.
2. The total area of a roof lights is the combined area for all roof lights serving the room or space.
3. The area of a roof light is the area of the roof opening that allows light to enter the building.
4. The thermal performance of an imperforate ceiling diffuser may be included in the Total R-value of a roof light.

Determining roof light shaft index

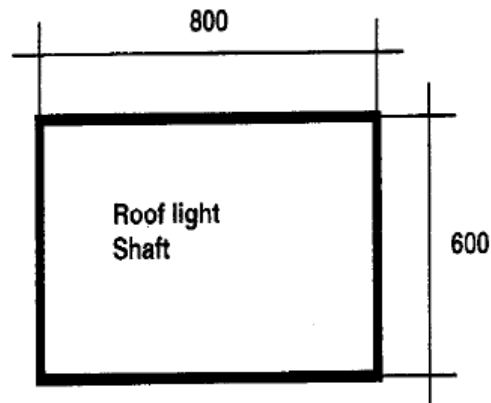
STEP ONE:

MEASURE SHAFT LENGTH
(Elevation view)



STEP TWO:

MEASURE AVERAGE INTERNAL
SHAFT OPENING AT CEILING LEVEL
(Plan view)



$$\text{Average internal opening} = (800 + 600) / 2 = 700$$

STEP THREE:

DIVIDE THE CENTRE SHAFT LENGTH (STEP ONE)
BY THE AVERAGE INTERNAL SHAFT OPENING
(STEP TWO)

$$\text{Roof light shaft index} = 707\text{mm height} / 700\text{mm average opening dimension} \approx 1.0$$