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The South African Institute of Architectural Technologists
Die Suid-Afrikaanse Instituut van Argitekstegnoloë

building professionals to build the future

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which believes in loyalty and honesty
towards its members and the profession
and subscribes to the principles of
fairness and transparency in all its
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Vision

To stimulate the expression of
design and the application of
technology in architecture

SANS 10400 XA



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SANS 10400 PART XA - 2011

Part X: Environmental sustainability

Part XA: Energy usage in buildings

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The application of the National Building Regulations Forward

This South African standard was approved by **National Committee SABS SC 59G, Construction standards – Energy efficiency and energy use in the built environment**, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the **WTO/TBT agreement**.

This document was published in **August 2011**.

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).

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The application of the National Building Regulations Forward

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.

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Part O: Lighting and ventilation.

Part P: Drainage.

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.

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

Annex A forms an integral part of this document.

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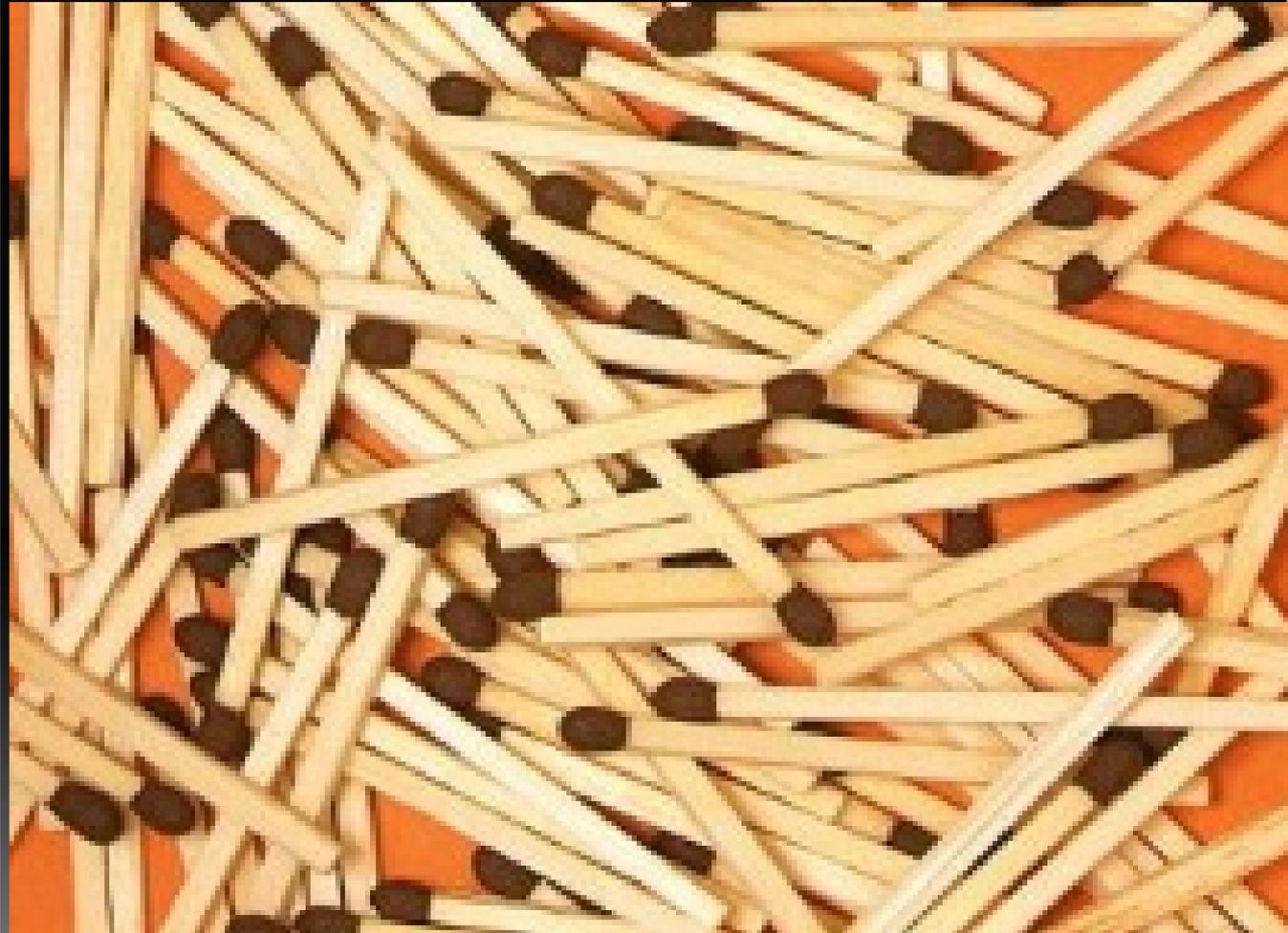


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The application of the National Building Regulations Scope

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.



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The application of the National Building Regulations Normative References

The following referenced documents are indispensable for the application of this document. 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 SABS Standards Division.

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ASTM C 177, *Standard test method for steady-state heat flux measurements and thermal transmission properties by means of the guarded-hot-plate apparatus.*

ASTM C 518, *Standard test method for steady-state thermal transmission properties by means of the heat flow meter apparatus.*

ASTM C 1363, *Standard test method for thermal performance of building materials and envelope assemblies by means of a hot box apparatus.*

SANS 204, *Energy efficiency in buildings.*

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

SANS 1307, *Domestic solar water heaters.*

SANS 6946/ISO 6946, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.*

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

SANS 10252-1:2004, *Water supply and drainage for buildings – Part 1: Water supply installations for buildings.*

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The application of the National Building Regulations Normative References

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

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

SANS 10400-K, *The application of the National Building Regulations – Part K: Walls.*

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

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The application of the National Building Regulations Definitions

For the purposes of this part of SANS 10400, the definitions given in SANS 10400-A (some of which are repeated for convenience) and the following apply.

3.1 Board of Agrément South Africa

body that operates under the delegation of authority of **the Minister of Public Works**



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The application of the National Building Regulations Definitions

3.2 building envelope

the **elements** of a building that separate a
habitable room from the **exterior** of a
building or a garage or storage area

3.3 certified thermal calculation software

software 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 these regulations

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The application of the National Building Regulations Definitions

3.4 competent person

person who is qualified by **virtue of his 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 him in terms of the **National Building Regulations**

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The application of the National Building Regulations Definitions

3.5 deemed-to-satisfy requirement

non-mandatory requirement, the
compliance with which ensures
compliance with a functional regulation

3.6 equipment

all 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.



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The application of the National Building Regulations Definitions

3.7 fenestration

any **glazed opening** in a building envelope
including windows, doors and skylights

3.8 fenestration area

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

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3.9 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 particular characteristic, without
specifying the method of construction,
dimensions or materials to be used

3.10 net floor area

floor area **excluding the area occupied
by vertical elements** including enclosed
lift wells and enclosed stairs.

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The application of the National Building Regulations Definitions

3.11 orientation

the direction of a **vector perpendicular** to
and pointing away from the surface outside
of the element of the building envelope
faces

3.12 plastering

application of a **suitable plaster**, sand,
portland cement and water to masonry
interiors and exteriors to achieve a **smooth**
surface

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The application of the National Building Regulations Definitions

3.13 reference building

a **hypothetical building** that is used to
determine the maximum allowable heating
load for the proposed building

3.14 rendering

application of a **thin premixed** surface of
sand, cement and lime plaster to a
masonry surface

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3.15 R-value

thermal resistance ($m^2 \cdot K/W$) 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.

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The application of the National Building Regulations Definitions

3.16 SHGC solar heat gain coefficient

ratio of the heat gain **entering the space through the fenestration area** to the incident solar radiation

3.17 suitable

capable of fulfilling or having fulfilled the **intended function**, or fit for its intended purpose Draft (3) SA Standard 20

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3.18 total R value

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

3.19 total U-value

the thermal transmittance (W/m².K) of the composite **element including the air space** and associated surface transmittance

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deemed-to-satisfy requirement

non-mandatory requirement, the compliance with which ensures compliance with a functional regulation

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 particular characteristic, without specifying the method of construction, dimensions or materials to be used

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rational assessment

assessment by a competent person of the adequacy of the performance of a solution in relation to requirements including as necessary, a process of reasoning, calculation and consideration of accepted analytical principles, based on a combination of deductions from available information, research and data, appropriate testing and service experience

rational design

design by a competent person involving a process of reasoning and calculation and which may include a design based on the use of a standard or other suitable document

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RATIONAL DESIGN

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The application of the National Building Regulations Requirements

4 Requirements

4.1 Hot water supply

4.1.1 In order to comply with functional regulation **XA2, contained in part XA** of the National Building Regulations, the following guidance is provided:

a) the volume of the **annual average hot water heating** requirements shall be calculated in accordance **with tables 2 and 5 of SANS 10252-1:2004**; and

b) if **solar water heating systems** are used, these shall comply with **SANS 1307, SANS 10106, SANS 10254 and SANS 10252-1**.

(Draft SANS1352 iso SANS10106 for Heat Pump installation)

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b) if solar water heating systems are used, these shall comply with **SANS 1307, SANS 10106, SANS 10254 and SANS 10252-1.**

4.1.2 Requirements for water installations in buildings shall be in accordance with **SANS 10252-1 and SANS 10254.**

4.1.3 All hot water service pipes shall be **clad with insulation** with a minimum *R*-value in accordance with table 1.

4.1.4 Thermal insulation, if any, shall be installed in **accordance with the manufacturer's instructions.**;

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Table 1 — Minimum *R*-value of pipe insulation

1	2
Internal diameter of pipe	Minimum <i>R</i> -value
< 80	1,00
> 80	1,50

a Determined with a hot surface temperature of 60 °C
and an ambient temperature of 15 °C.

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4.2 Energy Usage and Building Envelope

4.2.1 The functional regulation **XA3** contained in part XA of the National Building Regulations (see annex A) shall be **deemed to be satisfied where**,

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4.2 Energy Usage and Building Envelope

a) in any building of occupancy classified in terms of Regulation **A20** as **A1, A2, A3, A4, F1, G1, or H1**, a **competent person** certifies that such building (excluding garage and storage areas) has a **theoretical annual energy consumption and demand**, based on the design assumptions contained in 4.3, less than or equal to the values specified in tables 2 and 3; or

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b) 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**, the **orientation and shading** are in accordance with the requirements of **SANS 204**, **external walls** are in accordance with the requirements of **4.4.3**, **fenestration** is in accordance with the requirements of **4.4.4**, **roof assembly** construction is in accordance with the requirements of **4.4.5**, **if in-slab heating** is installed, it is in accordance with the requirements of **4.4.2** and **services that use energy or control the use of energy, including heating, air conditioning and mechanical ventilation** in accordance with **SANS 204**, and hot water systems in accordance with the requirements of **4.1** (**services exclude cooking facilities and portable appliances**); or

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c) 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** certifies that such building (excluding garage and storage areas) has a theoretical annual **energy consumption and demand** less than or equal to a reference building that complies with the requirements of 4.2.1 (b).

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4.2.2 The *R*-values, total *R*-values, total *U*-values and SHGC contained in **SANS 204** may be used to comply with the requirements of Regulation XA.

NOTE The occupancy categories listed in **tables 2 and 3** are those where there are sufficient collected data on actual building energy performance. Those excluded either have insufficient actual data, or are of such a nature that the internal processes are **high energy consumers**, or are of **such variability** in execution that a single norm would be unrepresentative

SANS 10400 XA

Table 2 Maximum energy demand per building classification for each climatic zone

1	2	3	4	5	6	7	8
Classification of occupancy of building	Description of building	Maximum energy demand a VA/m ²					
		1	2	3	4	5	6
A1	Entertainment / Public Assembly	65	80	90	80	80	85
A2	Theatrical / Indoor sport	85	80	90	80	80	85
A3	Places of instruction	80	75	85	75	75	80
A4	Worship	80	75	85	75	75	80
F1	Large shops / Malls	90	85	95	85	85	90
G1	Offices	80	75	85	75	75	80
H1	Hotel	90	85	95	85	85	90



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The **maximum demand** shall be based on the sum of 12 consecutive monthly maximum demand values per area divided by 12 per square meter which refers to the net floor area.

The climatic zones are given in Annex B

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Table 3 Maximum annual consumption per building classification for each climatic zone

1	2	3	4	5	6	7	8
Classification of occupancy of building	Description of building	Maximum energy consumption kWh/m ² .a) ^b					
		1	2	3	4	5	6
A1	Entertainment / Public Assembly	650	600	585	600	620	630
A2	Theatrical / Indoor sport	420	400	440	390	400	420
A3	Places of instruction	420	400	440	390	400	420
A4	Worship	120	115	125	110	115	120
F1	Large shops / Malls	240	245	260	240	260	255
G1	Offices	200	190	210	185	190	200
H1	Hotel	650	600	585	600	620	630

Table 4— Design occupancy times

1	3
Classification of occupancy of buildings	Design occupancy times hours per day/days per week
A1 and A2	18/7
A3 and G1	12/5
A4	6/4
F1	12/7
H1	24/7



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NOTE 1 The **annual consumption per square metre** shall be based on the sum of the monthly consumption of 12 consecutive months.

NOTE 2 **Non-electrical consumption**, such as fossil fuels, shall be accounted for on a non-renewable primary energy thermal equivalence basis by converting **mega joules to kilowatt hours**.

a) The climatic zones are given in **annex B**.

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got stopped for speeding yesterday!

I THOUGHT I COULD TALK MY WAY OUT OF IT UNTIL THE OFFICER
LOOKED AT MY DOG IN THE BACK SEAT





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4.3 Design assumptions

Where the **theoretical annual energy consumption** of a building (excluding garages and storage areas) is calculated, **certified thermal calculation software**, climatic data published by Agrément South Africa, and the following design assumptions shall be used:

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- a) where artificial ventilation systems are provided:
- 1) the **design occupancy times** are in accordance with table 4,
 - 2) the **space temperature** lies within the range of 19 °C to 25 °C for 98 % of the plant operation time,
 - 3) **ventilation** is provided in accordance with the requirements of SANS 10400-O;

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- 4) the internal heat gains in the building are from
- i) the **design population** calculated in accordance with table 5 at an average rate of **75 W sensible heat gain per person**;
 - ii) **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 table 5;

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- iii) **appliances and equipment** in accordance with table 6; and
- iv) **artificial lighting** calculated with the design occupancy times in accordance with table 4;
- b) **hot water supplies** comply with the requirements in 4.1; and
- c) the maximum **energy demand and maximum energy usage** are calculated for the **total building** and not for individual tenancies.

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Table 5 - Design population in accordance with SANS 10400

1	2
Class of occupancy of room or storey or portion thereof	Population
A1, A2, A4, A5	Number of fixed seats or 1 person per m ² if there are no fixed seats
E1, E3, H1, H3	2 persons per bedroom
G1	1 person per 15 m ²
E4	16 persons, provided that the total number of persons per room is not more than 4
C1, E2, F1, F2	1 person per 10 m ²
H5	16 persons per dwelling unit, provided that the total number of persons per room is not more than 4
C2, F3	1 person per 20 m ²
A3, H2	1 person per 5 m ²



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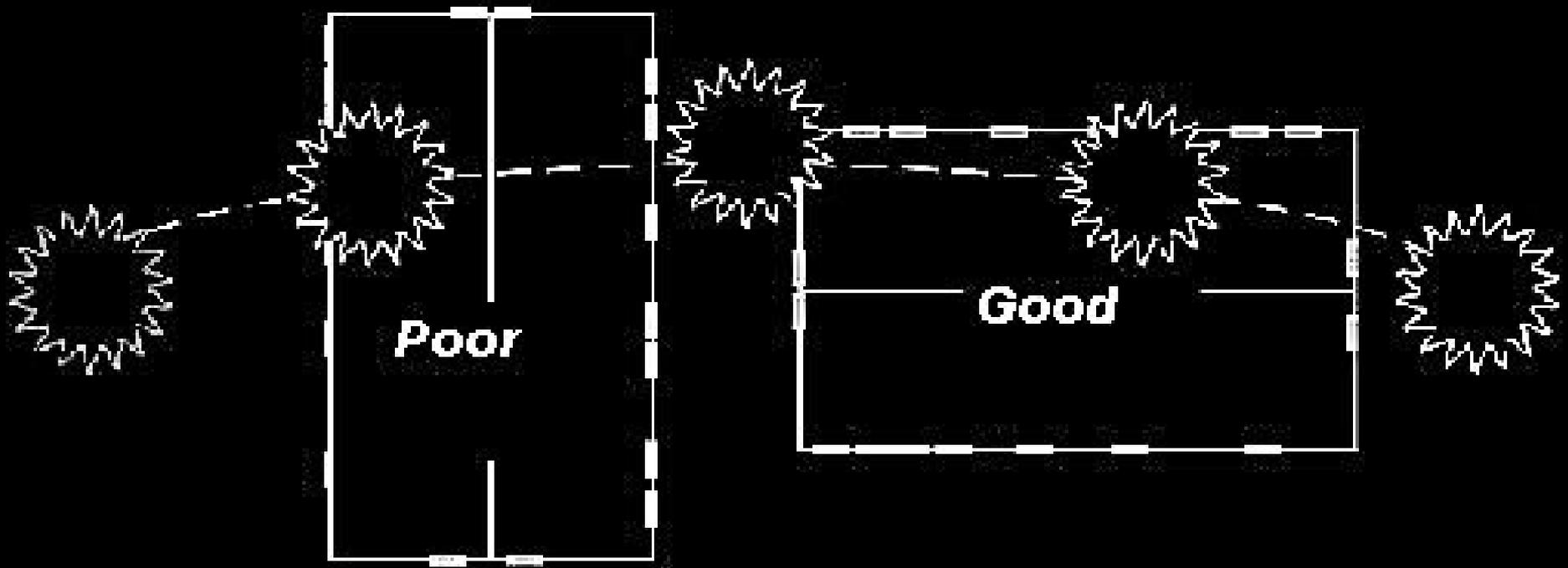
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4.4 Building Envelope requirements

4.4.1 Orientation

4.4.2.1 The building shall be **compact in plan**, with the rooms that are used most and the **major areas of glazing placed on the northern side** of the building to allow solar heat to penetrate the **glazing** during the winter months.

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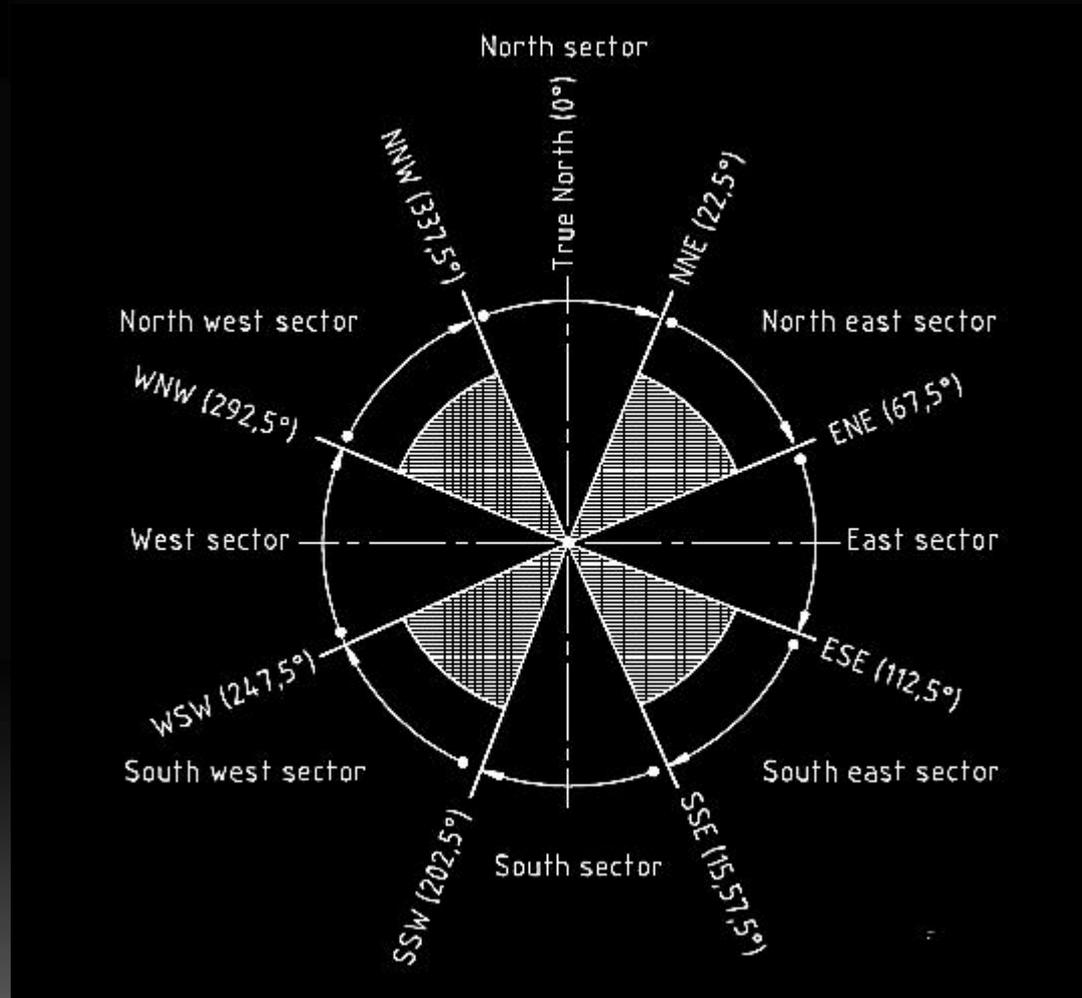


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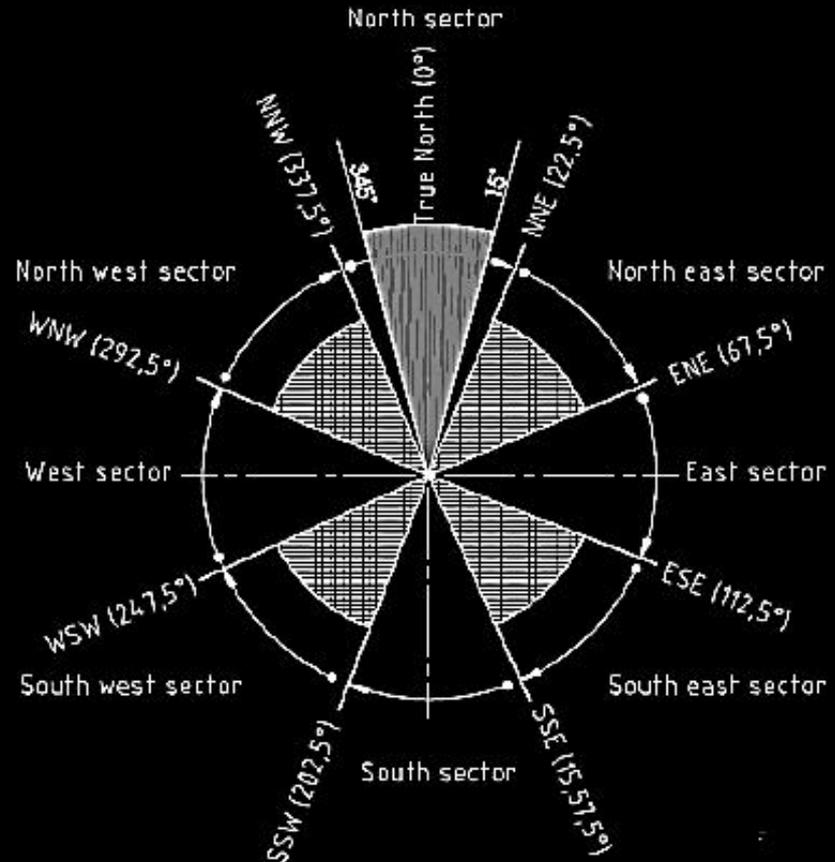


Fig. 1: Orientation to North as per SANS204

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Living spaces should be arranged so that the rooms where people spend **most of their hours are located on the northern side of the unit.** Uninhabited rooms, such as bathrooms and storerooms, can be used to **screen unwanted western sun** or to **prevent heat loss** on the **south-facing facades.** Living rooms should ideally be placed on the northern side.

The longer axis of the dwelling shall be orientated so that it runs as near east/west as possible.

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4.4.1.2 The roof overhang to the northern wall shall be sufficient to shade the windows from midday summer sunshine in accordance with **SANS 204**. Windows facing east and west should be limited in number and confined to the minimum required for daylight and ventilation.



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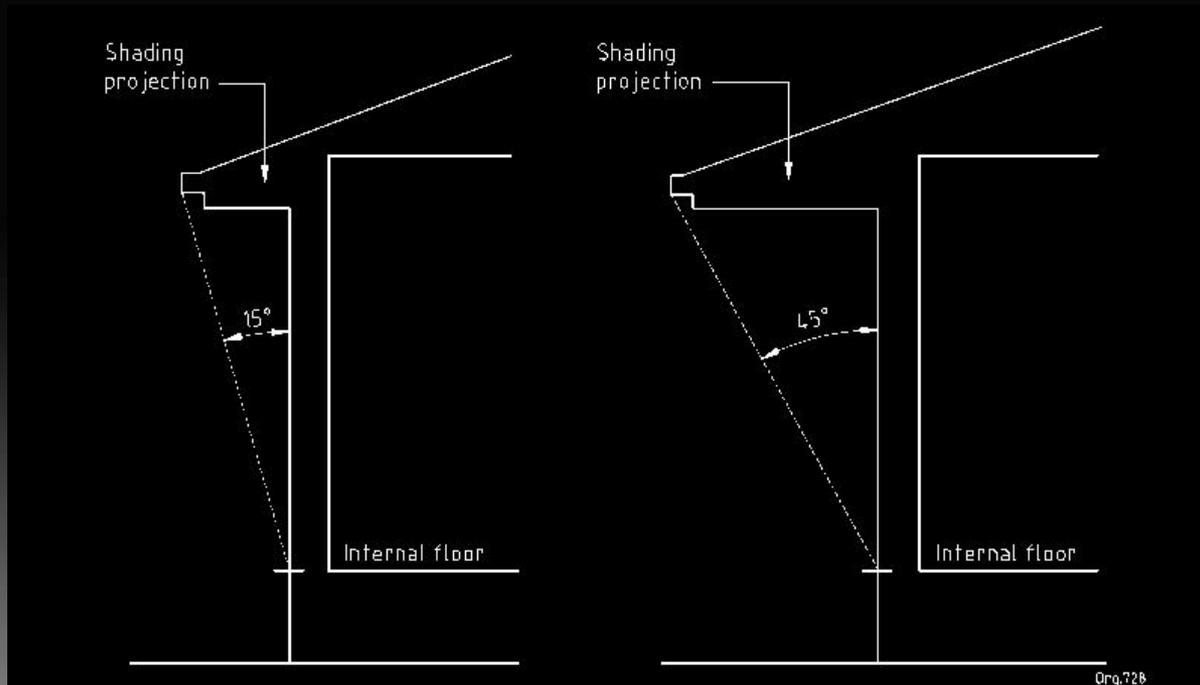


Figure 4 — Shading illustration

SUMMER SUN



SHADED FLOOR STAYS COOL
DURING SUMMER

WINTER SUN



SUN WARMS FLOOR DURING
WINTER

SUN SHADE DIAGRAM

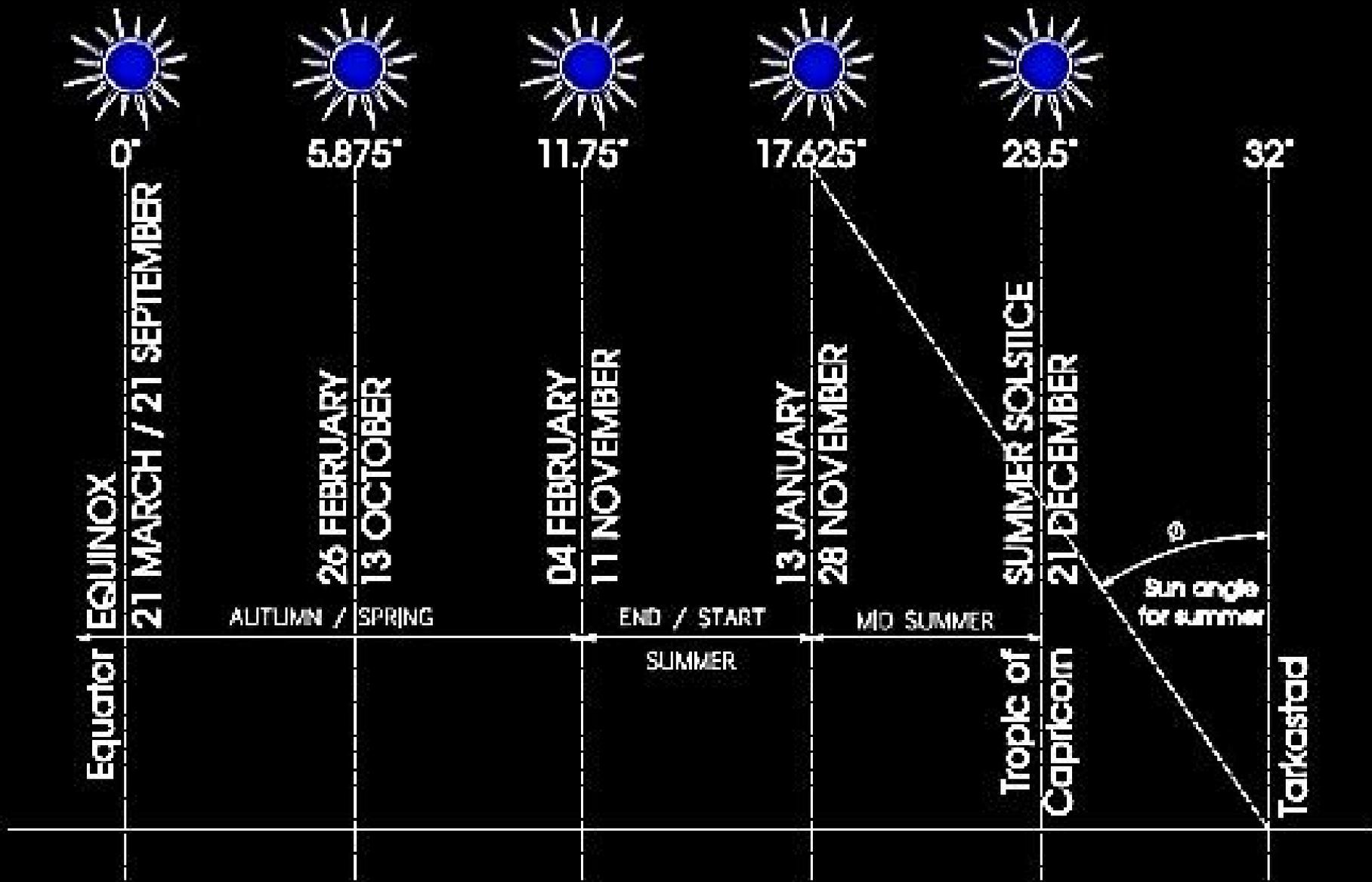


Fig. 2: Sun altitude / angle Illustration

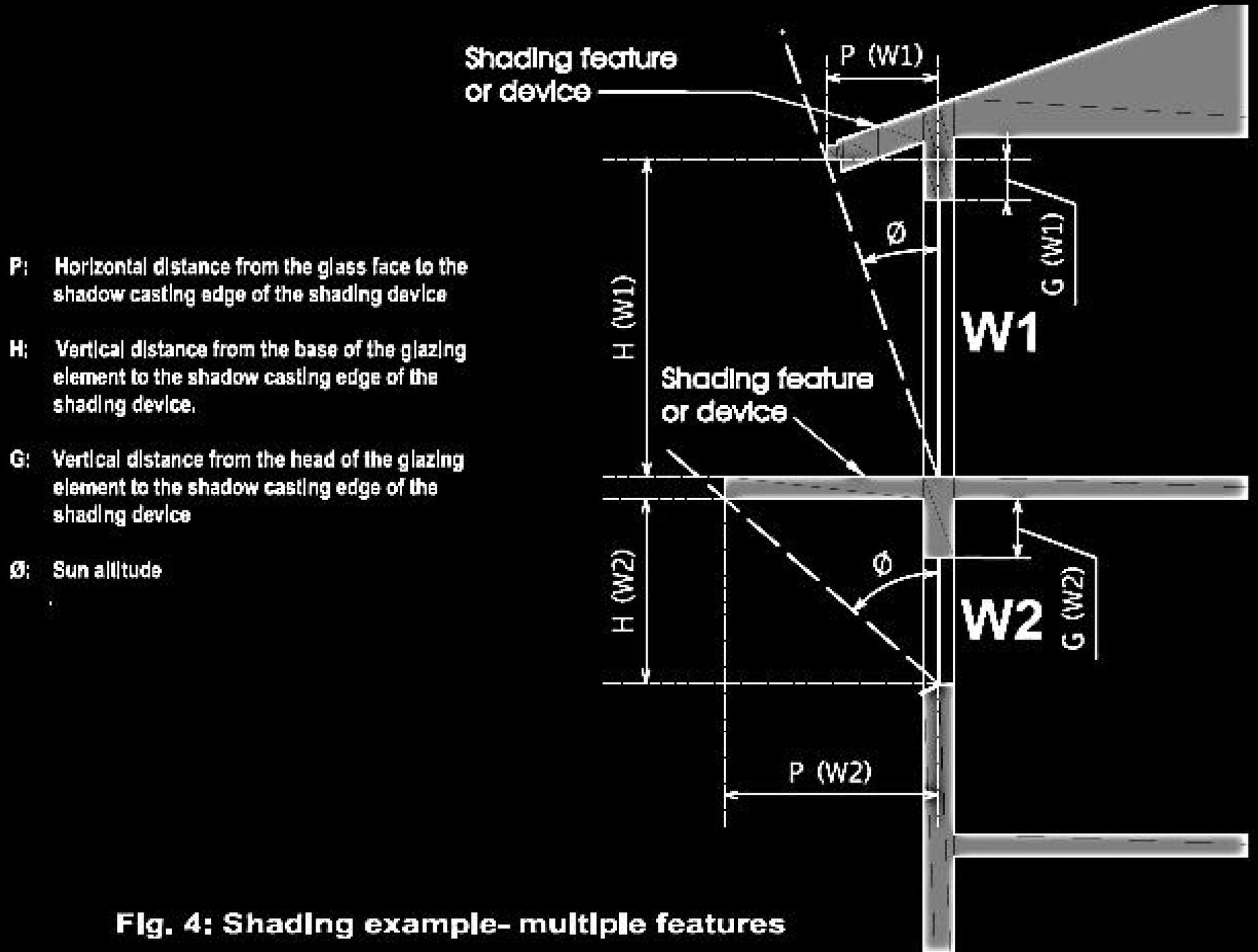


Fig. 4: Shading example- multiple features

- P:** Horizontal distance from the glass face to the shadow casting edge of the shading device
- H:** Vertical distance from the base of the glazing element to the shadow casting edge of the shading device.
- G:** Vertical distance from the head of the glazing element to the shadow casting edge of the shading device,
- θ :** Sun altitude

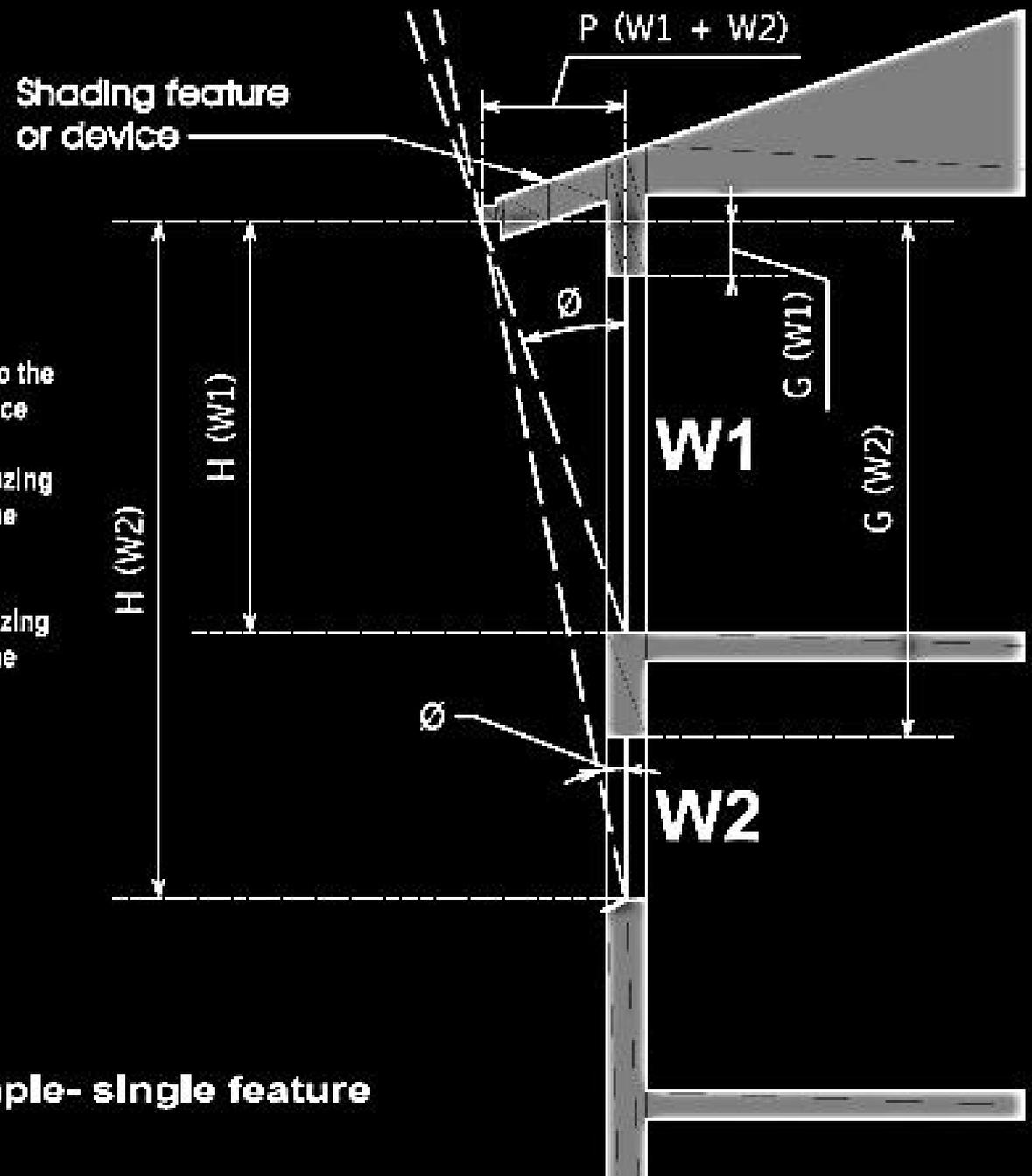


Fig. 3: Shading example- single feature

EXAMPLE:

1. Building in Albertinia, orientated 12° from true north
2. Fenestration area to nett floor area = 14%
3. Habitable rooms on northern side
4. Biggest window in height is 2 000 x 1 500
5. Vertical distance from window lintel to underside of roof overhang = 300mm

$$H = 1500 + 300 = 1800\text{mm}$$

ANNEXURE A

City / Town	Latitude ($^\circ\text{S}$)	θ ($^\circ$) 21 December	θ ($^\circ$) 13 January	θ ($^\circ$) 28 November	P as factor of H
Aberdeen	32.47	8.97	14.84	14.84	0.26
Acornhoek	24.62	1.12	6.99	6.99	0.12
Addo	33.53	10.03	15.90	15.90	0.28
Adelaide	32.70	9.20	15.07	15.07	0.27
Adendorp	32.25	8.75	14.62	14.62	0.26
Albertinia	34.18	10.68	16.55	16.55	0.30
Alexander Bay	28.67	5.17	11.04	11.04	0.20
Alexandria	33.63	10.13	16.00	16.00	0.29
Algoa Bay	33.83	10.33	16.20	16.20	0.29
...	---	---	---	---	---

P will then be: $0.30 \times 1800\text{mm} = 600\text{mm}$



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4.4.2 Floors

Where an **underfloor heating system** (e.g. in-screed, underlamine heating, undercarpet heating, undertile heating, cut-in underfloor heating, and water-based underfloor heating) is **installed**, the heating system shall be insulated underneath the slab with insulation that has a minimum *R*-value of **not less than 1,0**.

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4.4.3 External walls

4.4.3.1 Non-masonry walls shall achieve a
minimum total *R*-value of

a) climatic zones 1 and 6: **2,2**

b) climatic zones 2, 3, 4 and 5: **1,9.**

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4.4.3.2 The following types of masonry walling
comply with the *R*-value requirements:

a) **double skin masonry** with no cavity, plastered
internally; and face masonry that is either
plastered or **unplastered externally**; or

NOTE The cavity and grouted cavity walling
systems exceed the minimum ***R*-value of 0,35**.

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- b) **single leaf masonry walls** with a nominal wall thickness greater than or equal to **140 mm** (excluding plastering and rendering), plastered internally and rendered externally.

The requirements refer to the external walls of the **habitable portions** of the building fabric only.

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4.4.3.3 For walling types not covered in 4.4.4.2, such walls shall achieve a minimum total *R*-value of **0,35**. The total *R*-value shall be determined by means of a test conducted in accordance with **ASTM C 1363, ASTM C 518 or ASTM C 177**. Surface film resistance shall be in accordance with **SANS 6946**.

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4.4.4 Fenestration

4.4.4.1 Buildings with up to **15 % fenestration area to nett floor area per storey** are deemed to **satisfy** 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 The **fenestration air infiltration** shall be in accordance with **SANS 613**.

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4.4.5 Roof assemblies

4.4.5.1 A roof assembly shall achieve the minimum total *R*-value specified in table 7 for the direction of heat flow.

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Table 7 — Minimum total *R*-values of roof assemblies

Description	Climatic Zones					
	1	2	3	4	5	6
Minimum required total <i>R</i> -value (m ² .K/W)	3,7	3,2	2,7	3,7	2,7	3,5
Direction of heat flow	Up	Up	Down And up	Up	Down	Up



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4.4.5.2 A **roof assembly** that has metal sheet roofing fixed to **metal purlins, metal rafters** or metal battens shall have a thermal break consisting of a material with an *R*-value of **not less than 0,2 installed between the metal sheet roofing** and its supporting member.

4.4.5.3 **Metal sheeting** types of **roofing assembly** construction shall achieve the minimum total *R*-value in accordance with **4.4.6.1**, with the installation of insulation that has an *R*-value as specified in **table 8**

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Table 8 – Metal sheeting roof assemblies

Description	Climatic Zones					
	1	2	3	4	5	6
Direction of heat flow	Up	Up	Down and Up	Up	Down	Up
R-value (m ² K/W) Of roof covering material	0,3	0,3	0,3	0,3	0,36	0,3
R-value of ceiling	0,5	0,5	0,5	0,5	0,5	0,5
Added R-value of insulation	3,35	2,85	2,35	3,35	2,29	3,15



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4.4.5.4 Clay tile types of roofing assembly construction shall achieve the **minimum total R-value in accordance with 4.4.5.1** with the installation of insulation that has an R-value as specified in **table 9**.

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Table 9 – Clay Tile roof assemblies

Description	Climatic Zones					
	1	2	3	4	5	6
Direction of heat flow	Up	Up	Down and Up	Up	Down	Up
R-value of ceiling	0,5	0,5	0,5	0,5	0,5	0,5
Added R-value of insulation	3,30	2,80	2,30	3,30	2,17	2,80

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