THE NATIONAL BUILDING REGULATIONS
(as issued in terms of THE NATIONAL BUILDING REGULATIONS AND STANDARDS ACT 104 OF 1977)

The National Building Regulations (NBR) was amended by a notice in the Government Gazette on 11 September 2011 to include the first chapter on environmental sustainability. This regulation came into effect on 11 November 2011.

As part of the amendments to include Regulation XA, some other regulations also needed to be changed to make provision for additional requirements as per Regulation XA.

The following were added to Regulation A7:

(m) where provided, the location, type and capacity of water heating installations; and

(n) where provided, details of fenestration and insulation required to satisfy the energy usage requirements of regulation XA.

To comply with Regulation A7(m) it should be noted that it is not only the position (location) of the water heater that is required, but also a description of the type as well as details of the installation. This must be read together with SANS10252-1 and therefore complete water layout drawings for water heating installations are required.

Similar, to comply with Regulation A7(n), window and door schedules as well of sections through roofs etc. will be required to show compliance.

The following were added to Regulation A19:

(c) Where regulation XA is satisfied by a competent person in accordance with the requirements of SANS 10400 Part XA, the competent person who is responsible for such determination shall on completion of the construction and commissioning of the building submit to the local authority a fully completed Form 4 as contained in SANS 10400-A.

It is important to note here that in terms of SANS10400-XA competent persons are required to certify certain aspects although it is seen as a deemed-to-satisfy requirement. The

competent persons here is not necessarily a competent person (energy efficiency) as defined by SANS10400-XA, but can be a person that can prove that he is competent in that specific field, for example energy demand and consumption calculations and fenestration calculations.

This will omit the need for local authorities to “check” plans for compliance as the competent person will be required to submit Form 2 to be accepted as a competent person for that specific task and thereafter certify in Form 4 that the work was executed as per the design approved.

SANS10400-XA

The national standard SANS10400-XA provides a solution (recipe) for compliance with Regulation XA, which are the minimum requirements. If the designer needs to show compliance with the regulation by using any other means it is seen as a rational design or assessment as per Regulation A19.

The primary function of this document is to give guidance on how to comply with Regulation XA by using the solutions as given in SANS10400 XA, but will also provide guidance on what to do if the designer cannot comply with Regulation XA by following the solutions given in SANS10400 XA.

WHICH TYPE OF BUILDINGS HAS TO COMPLY WITH REGULATION XA?

Regulation XA1 reads as follow:

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.

Regulation A20 defines these building types as follow:

A1	***Entertainment and public assembly***	*Occupancy where persons gather to eat, drink, dance or participate in other recreation.*
A2	***Theatrical and indoor sport***	*Occupancy where persons gather for the viewing of theatrical, operatic, orchestral, choral, cinematographical or sport performances.*
A3	***Places of instruction***	*Occupancy where school children, students or other persons assemble for the purpose of tuition or learning.*
A4	***Worship***	*Occupancy where persons assemble for the purpose of worshipping.*
C1	***Exhibition hall***	*Occupancy where goods are displayed primarily for viewing by the public.*
C2	***Museum***	*Occupancy comprising a museum, art gallery or library.*
E1	***Place of detention***	*Occupancy where people are detained for punitive or corrective reasons or because of their mental condition.*

E2	***Hospital***	*Occupancy where people are cared for or treated because of physical or mental disabilities and where they are generally bed-ridden.*
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*
E4	***Health care***	*Occupancy which is a common place of long term or transient living for a number of unrelated persons consisting of a single unit on its own site who, due to varying degrees of incapacity, are provided with personal care services or are undergoing medical treatment.*
F1	***Large shop***	*Occupancy where merchandise is displayed and offered for sale to the public and the floor area exceeds 250 m^2.*
F2	***Large shop***	*Occupancy where merchandise is displayed and offered for sale to the public and the floor area does not exceed 250 m^2.*
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.*
G1	***Offices***	*Occupancy comprising offices, banks, consulting rooms and other similar usage.*
H1	***Hotel***	*Occupancy where persons rent furnished rooms, not being dwelling units.*
H2	***Dormitory***	*Occupancy where groups of people are accommodated in one room*
H3	***Domestic residence***	*Occupancy consisting of two or more dwelling units on a single site.*
H4	***Dwelling house***	*Occupancy consisting of a dwelling unit on its own site, including a garage and other domestic outbuilding, if any.*
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*

The sections of buildings where the main occupancy is excluded above but where the section fits one of the above descriptions have to comply with Regulation XA, for example:

A motor dealership's (garage) can be classified as a B2 (medium risk commercial) and is therefore excluded from compliance with Regulation XA. However, the building does contain office space (G1) and exhibition areas for sale purposes (F1 or F2) and these sections of the building do have to comply with Regulation XA.

WHAT ABOUT EXISTING BUILDINGS AND ALTERATIONS TO EXISTING BUILDINGS?

The regulation states that "*buildings and extensions to buildings in respect of which plans and specifications are to be drawn and submitted in terms of the Act*" need to comply. Two questions arise from this, namely

1. For which buildings are plans to be drawn and submitted for approval?
2. Is it the extension or the whole of the existing building that must comply?

All new buildings need to comply with the regulations. It should also be noted that approval to erect a building was given by a local authority as per the plans submitted and approved. Any changes to the approved building plan may be seen as illegal building work as the Act clearly states that approval must be granted by the local authority for the erection of all buildings. The change of use (ex. converting a dwelling (H4) into an office (G1), may require the submission of a building plan as it may cause the building now not to comply with the functional regulations in the NBR for the new occupancy. It may then be required by the local authority that certain aspects of the building being made compliant.

Extensions to buildings, as well as the affected sections of the existing building, have to comply with the energy efficiency regulations. As the existing building had to comply previously with the regulations before approval was granted, it will still be seen as complying with the NBR and no changes to the existing part to comply with energy usage regulations will be required.

All buildings that were erected illegally, with other words with no approved building plans or that differ substantially from the approved building plans will have to be submitted as a new application and therefore will have to comply with the latest regulations, including energy usage in buildings, as per the NBR.

THE BUILING ENVELOPE AND SERVICES AS PER REGULATION XA1(b)

There are two ways that can be used to comply with Regulation XA:

1. By minimising the use of energy while maintaining comfort levels
2. By ensuring that the building envelope and services are as such that it will not cause the unnecessary use of energy to maintain comfort levels.

Option 1 will most likely be used for the design of complex buildings where a multi-disciplinary team is appointed and Option 2 for most residential and small scale building designs.

This document will concentrate on the Building Envelope and Services.

A common error made by designers of buildings is to isolate the different components that have to be complied with and not to see them as an integrated solution on how to comply with the NBR.

Clause 4.2.1 (b) list eight (8) aspects that the designer must comply with to satisfy the NBR:

- Building Orientation
- Shading of the northern wall
- Fenestration
- Floors
- Walls
- Roof assembly
- Services that use or control the use of energy
- Hot water supply requirement

Non-compliance with only one of the above will result in a non-compliance with the requirements of the NBR. It should also be noted that compliance with fenestration as per SANS10400-XA cannot be achieved if compliance with shading and building orientation are not met. There is no restriction on the type of frame and glass of the fenestration to be used, so the conventional use of steel or aluminium frames with clear glass is acceptable.

BUILDING ORIENTATION

The orientation of the building must be as per SANS204.

The North Sector is indicated as between 337.5° (NNW) and 22.5° (NNE), but the ideal orientation will be as per the composite graphs showing the energy usage for heating and cooling of buildings in six major cities in South Africa. These graphs indicate that an orientation outside -15° to 15° will result in an increased energy usage for heating and cooling in the buildings.

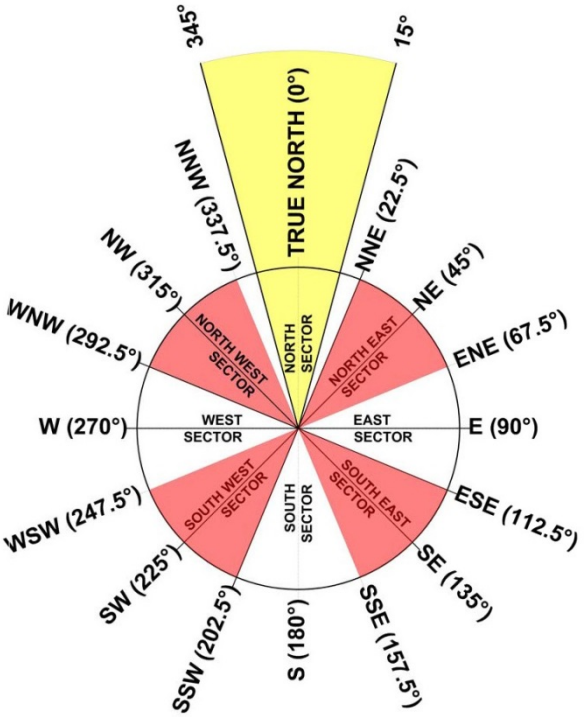


Fig. 1: Orientation sectors with orientation as per SANS204 indicated between 345° and 15°

The orientation of the façade with the major area of glass of the building therefore should ideally be between 345° and 15° (approximately true north) and the façades facing east, west and south should be provided with minimum fenestration for compliance with ventilation and lighting. The longer axis of the building should be east-west.

SANS10400-XA goes further by stating that the building must be compact in plan, rooms that are used most be paced on the northern side and that the size and number of windows on the eastern, western and southern sides be restricted to only those needed for compliance with SANS10400-O. Big windows on these sides of the building will have the result that the heat gain or loss will be more than a building that complies with the requirements.

If such orientation cannot be achieved, SANS10400-XA refers the designer to the solutions as per SANS204 (Energy Efficiency in Buildings) where the designer, by choosing specific glazing through a series of calculations, can prove that the requirements of the building envelope was not compromised.

SHADING

SANS10400-XA requires shading to the northern wall to be as per the requirements of SANS204. This shading must exclude summer solar radiation.

The figures in SANS204 indicate that:

- the sun angle must be taken into consideration and
- provide definitions for distances (P, G and H)

To comply with this requirement is more complicated that it appears.

First, the concept of “summer” must be defined. There is an astronomical summer and meteorological summer. Because shading is caused by blocking the rays of the sun, it is therefore logical to use the definition of “astronomical summer”. In *BOU/E9701, "Solar Charts for the Design of Sunlight and Shade for Buildings in South Africa."* **(**CSIR) the summer period requiring shading is September 23 to March 21 with an additional shading period suggested from March 21 to May 15. Therefore, summer must be regarded as the period from the 23rd of September to the 21st of March and during this period the shading provided must exclude the sun rays.

By acknowledging this, it is now quite easy to determine the sun angle to be used: that will be basically the same as the latitude of the site where the building is to be erected.

Before the designer can determine the sun angle, the following basics must be understood:

- P is the horizontal distance from the edge of the shading device (roof overhang, canopy etc.) to the surface of the glass – it includes the distance that the glazing (window) is set back into the wall
- H is the vertical distance from the base of the glazing (window sill or threshold of glass doors) to the underside of the shading device (roof overhang, canopy etc.)

- G is the vertical distance from the head of the glazing (lintel) to the underside of the shading device (roof overhang, canopy etc.)
- Ø is the angle of the sun during the period defined as summer

From the above the following can be derived: the height of the glazing plus the value of G will give you the value of H.

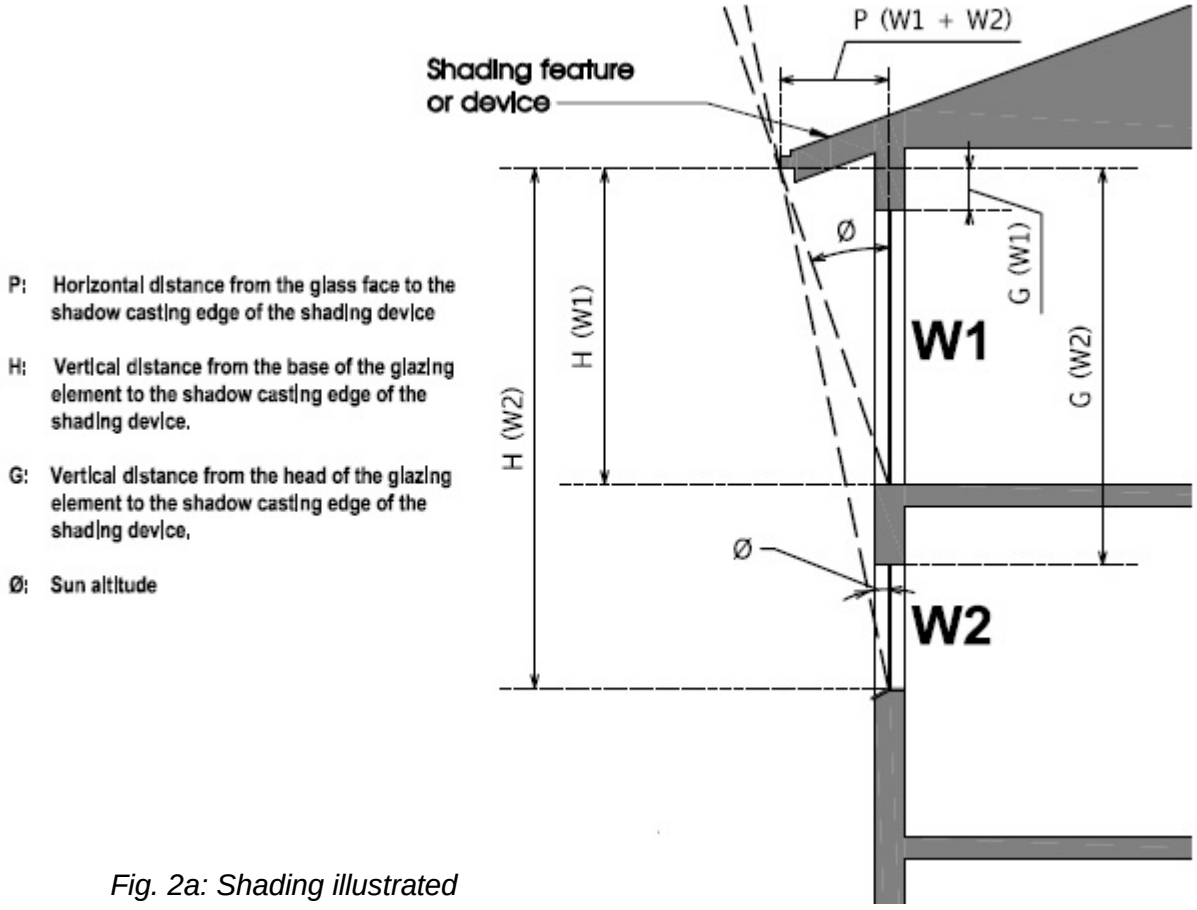


Fig. 2a: Shading illustrated

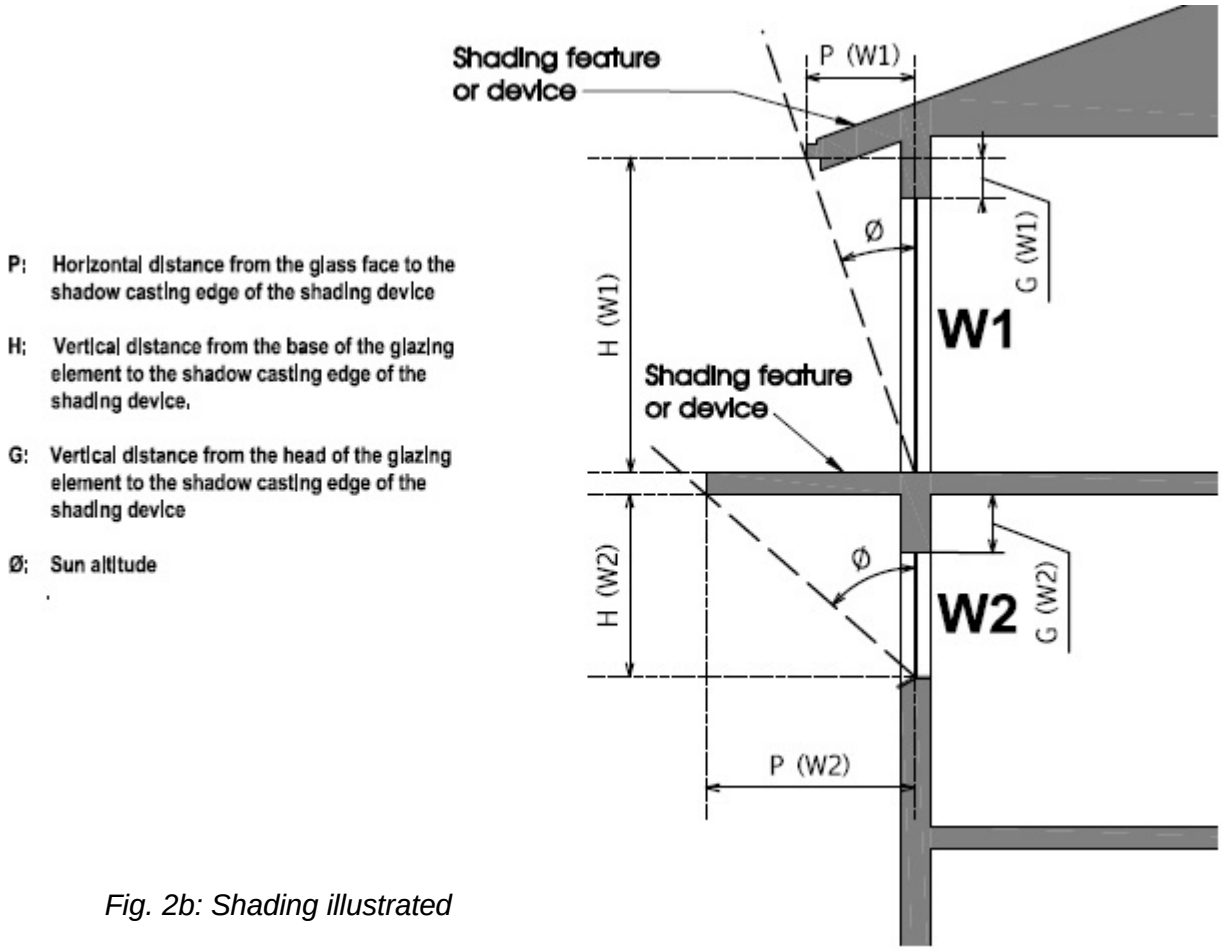


Fig. 2b: Shading illustrated

It is important to remember that the shading applied to the northern wall (P) should not be just to the front of the glazing, but also to the sides of the glazing to provide shading to the glazing during the whole day.

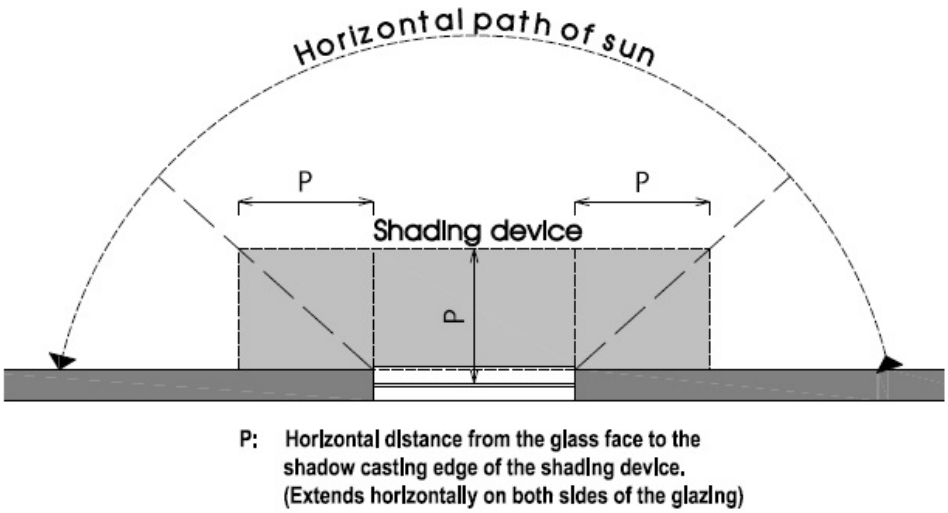


Fig. 2c: Shading illustrated

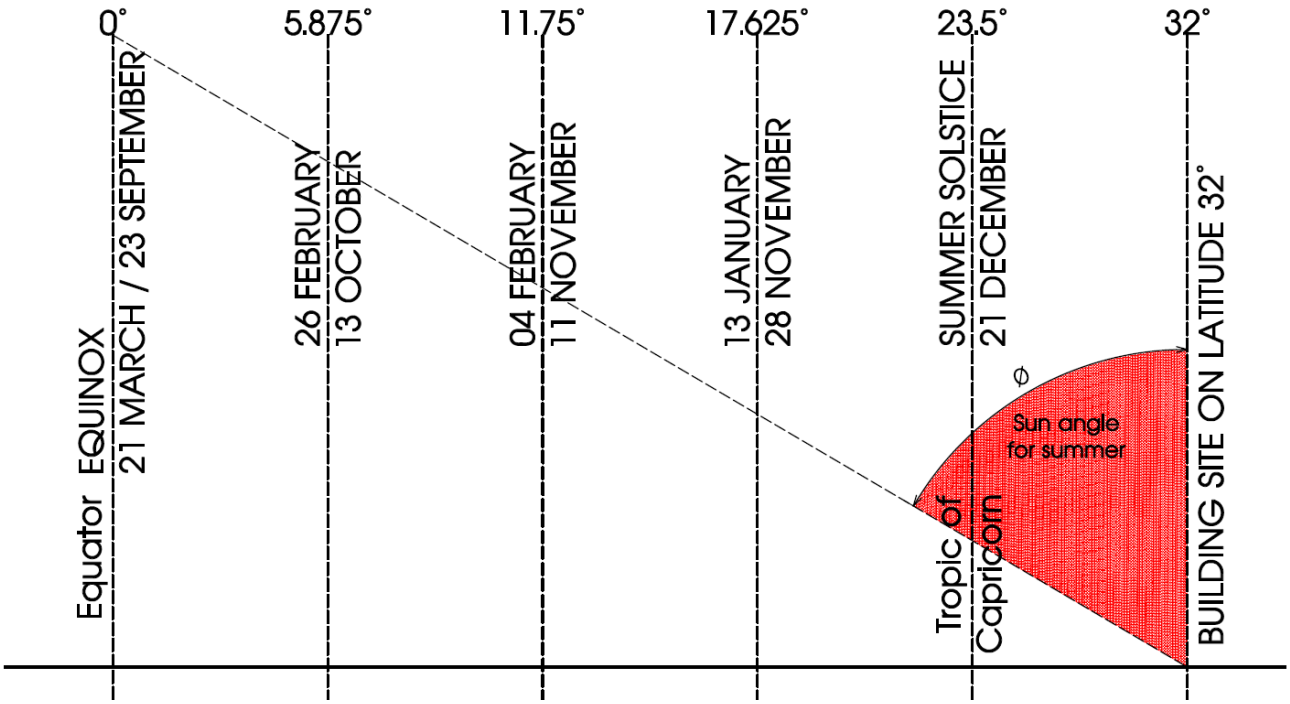


Fig. 3: Sun angle illustrated

By knowing the sun angle as well as the H-value (that can be measured from drawings) it is now possible to determine the P-value (shading required).

For example:

A building in Tarkastad with a maximum window height on the northern façade of 1 500mm and a G-value of 300mm.

Tarkastad is situated on latitude 32°. The H-value is 1 800mm. The P-value can now be calculated as follow:

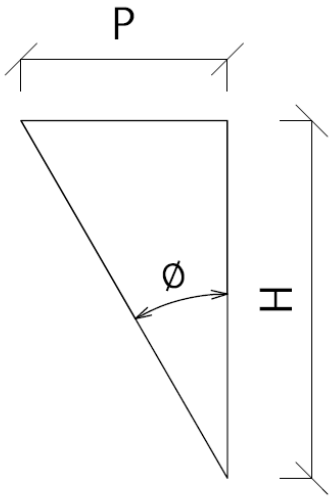


Fig. 4: How to calculate P

Ø = 32°, H = 1 800mm

TanØ = P/H, therefore

P = TanØ × H

P = Tan32 × 1 800

P = 0.62 × 1 800

P = 1 116

This means that the shading to be provided to the northern wall to comply with SANS10400-XA must not be less than 1,116m!

The following table provides the latitude as well as the value of TanØ for most of the towns in South Africa.

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Aberdeen	32,47	32,47	0,64
Acornhoek	24,62	24,62	0,46
Addo	33,53	33,53	0,66
Adelaide	32,70	32,70	0,64
Adendorp	32,25	32,25	0,63
Albertinia	34,18	34,18	0,68
Alexander Bay	28,67	28,67	0,55
Alexandria	33,63	33,63	0,67
Algoa Bay	33,83	33,83	0,67
Alice	32,80	32,80	0,64
Alicedale	33,25	33,25	0,66
Aliwal North	30,75	30,75	0,59
Allanridge	27,75	27,75	0,53
Amatikulu	29,05	29,05	0,56
Amersfoort	26,98	26,98	0,51
Apies	25,25	25,25	0,47
Arlington	28,02	28,02	0,53
Asbesberge	29,00	29,00	0,55
Ashton	33,83	33,83	0,67
Askham	26,98	26,98	0,51
Augrabies Falls	28,58	28,58	0,54
Aurora	32,67	32,67	0,64
Barberton	25,70	25,70	0,48
Barkly East	30,97	30,97	0,60
Barkly West	28,08	28,08	0,53
Baroe	33,22	33,22	0,65
Bathurst	33,50	33,50	0,66
Beaufort West	32,30	32,30	0,63
Bedford	32,67	32,67	0,64
Beestekraal	25,38	25,38	0,47
Belfast	25,70	25,70	0,48
Belmont	29,47	29,47	0,57
Benoni	26,18	26,18	0,49
Bergville	28,87	28,87	0,55
Bethal	26,45	26,45	0,50
Bethlehem	28,23	28,23	0,54
Bethulie	30,50	30,50	0,59
Bianco	33,92	33,92	0,67
Biesiesfontein	30,95	30,95	0,60
Bisho	32,83	32,83	0,65
Bitterfontein	31,02	31,02	0,60
Bizana	30,83	30,83	0,60
Bloemfontein	29,10	29,10	0,56
Bloemhof	27,63	27,63	0,52

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Blouberg	23,13	23,13	0,43
Boesmans	33,70	33,70	0,67
Boshof	28,52	28,52	0,54
Bothaville	27,38	27,38	0,52
Brak	29,58	29,58	0,57
Brandfort	28,67	28,67	0,55
Brandvlei	30,42	30,42	0,59
Bredasdorp	34,55	34,55	0,69
Breyten	26,27	26,27	0,49
Brits	25,62	25,62	0,48
Britstown	30,62	30,62	0,59
Bronkhorstspruit	25,77	25,77	0,48
Buffalo	28,72	28,72	0,55
Buffels	29,60	29,60	0,57
Bultfontein	28,30	28,30	0,54
Burgersdorp	31,00	31,00	0,60
Butterworth/Gcuwa	32,22	32,22	0,63
Caledon	34,23	34,23	0,68
Calitzdorp	33,55	33,55	0,66
Calvinia	31,47	31,47	0,61
Campbell	28,80	28,80	0,55
Cape Agulhas	34,87	34,87	0,70
Cape Town	33,92	33,92	0,67
Cape Town	33,92	33,92	0,67
Carletonville	26,38	26,38	0,50
Carnarvon	30,93	30,93	0,60
Carolina	28,08	28,08	0,53
Cathcart	32,30	32,30	0,63
Cedarville	30,38	30,38	0,59
Ceres	33,35	33,35	0,66
Charlestown	27,43	27,43	0,52
Christiana	27,87	27,87	0,53
Citrusdal	32,58	32,58	0,64
Clanwilliam	32,18	32,18	0,63
Clocolan	28,92	28,92	0,55
Colenso	28,73	28,73	0,55
Colesberg	30,75	30,75	0,59
Coligny	26,28	26,28	0,49
Cookhouse	32,73	32,73	0,64
Cradock	32,13	32,13	0,63
Danielskuil	28,18	28,18	0,54

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Dannhauser	28,00	28,00	0,53
Darlington	33,17	33,17	0,65
Darnall	29,38	29,38	0,56
De Aar	30,65	30,65	0,59
Dealesville	28,68	28,68	0,55
Delareyville	26,68	26,68	0,50
Delportshoop	28,37	28,37	0,54
Derdepoort	24,62	24,62	0,46
Dewetsdorp	29,55	29,55	0,57
Dimabaza	32,83	32,83	0,65
Donnybrook	29,98	29,98	0,58
Dordrecht	31,33	31,33	0,61
Doring	31,90	31,90	0,62
Doringbos	31,98	31,98	0,62
Douglas	29,07	29,07	0,56
Duiwelskloof	23,70	23,70	0,44
Dullstroom	26,20	26,20	0,49
Dundee	28,18	28,18	0,54
Durban	29,82	29,82	0,57
East London	33,00	33,00	0,65
Edenburg	29,72	29,72	0,57
Edendale	29,65	29,65	0,57
Edenville	27,62	27,62	0,52
Elim	34,58	34,58	0,69
Elliot	31,37	31,37	0,61
Elliotdale/Xhora	31,92	31,92	0,62
Emalahleni	25,85	25,85	0,48
Emmaus	29,03	29,03	0,55
Empangeni	28,83	28,83	0,55
Engcobo	31,62	31,62	0,62
Erfenisdam	28,50	28,50	0,54
Ermelo	26,52	26,52	0,50
Eshowe	28,83	28,83	0,55
Estcourt	29,00	29,00	0,55
False Bay	34,25	34,25	0,68
Fauresmith	29,73	29,73	0,57
Ficksburg	28,85	28,85	0,55
Fort Beaufort	32,77	32,77	0,64
Fouriesburg	28,63	28,63	0,55
Frankfort	27,28	27,28	0,52
Fraserburg	31,92	31,92	0,62

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Gamtoos	33,97	33,97	0,67
Gariep	30,67	30,67	0,59
Garies	30,53	30,53	0,59
Gatyana	32,27	32,27	0,63
Gcuwa	32,33	32,33	0,63
George	33,97	33,97	0,67
Germiston	26,25	26,25	0,49
Ghatti	31,27	31,27	0,61
Gingindlovu	29,03	29,03	0,55
Glencoe	28,18	28,18	0,54
Goodhouse	28,95	28,95	0,55
Gourits	34,35	34,35	0,68
Graaff-Reinet	32,22	32,22	0,63
Grahamstown	34,50	34,50	0,69
Graskop	24,93	24,93	0,46
Greytown	29,02	29,02	0,55
Griekwastad	28,82	28,82	0,55
Groblersdal	25,25	25,25	0,47
Grootdrink	28,55	28,55	0,54
Groot-Kei	32,68	32,68	0,64
Grootvloer	30,00	30,00	0,58
Hanover	31,07	31,07	0,60
Harding	30,58	30,58	0,59
Harrismith	28,25	28,25	0,54
Hartbees	28,75	28,75	0,55
Hartswater	27,57	27,57	0,52
Hebertsdale	34,02	34,02	0,68
Heidelberg	34,10	34,10	0,68
Heilbron	27,27	27,27	0,52
Hennenman	27,98	27,98	0,53
Hermanus	34,45	34,45	0,69
Hertzogville	28,15	28,15	0,54
Hlobane	27,70	27,70	0,53
Hluhluwe	28,02	28,02	0,53
Hofmeyr	31,65	31,65	0,62
Hondeklipbaai	30,32	30,32	0,58
Hoopstad	27,83	27,83	0,53
Hopefield	33,05	33,05	0,65
Hopetown	29,57	29,57	0,57
Hotazel	27,28	27,28	0,52
Houtkraal	30,38	30,38	0,59

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Humansdorp	34,03	34,03	0,68
Idutywa	32,13	32,13	0,63
Ingwavuma	27,15	27,15	0,51
Ixopo	30,18	30,18	0,58
Jagersfontein	29,73	29,73	0,57
Jamestown	31,10	31,10	0,60
Johannesburg	26,17	26,17	0,49
Kakamas	28,75	28,75	0,55
Kamieskroon	30,15	30,15	0,58
Kareeberge	30,98	30,98	0,60
Keimoes	24,68	24,68	0,46
Kendrew	32,53	32,53	0,64
Kenhardt	29,32	29,32	0,56
Kestell	28,28	28,28	0,54
Kimberley	28,72	28,72	0,55
King William's Town	32,85	32,85	0,65
Kirkwood	33,37	33,37	0,66
Klawer	31,73	31,73	0,62
Klerksdorp	26,88	26,88	0,51
Klipdale	34,32	34,32	0,68
Klipplaat	33,02	33,02	0,65
Knysna	34,03	34,03	0,68
Koffiefontein	29,50	29,50	0,57
Kokstad	30,53	30,53	0,59
Komatipoort	25,42	25,42	0,48
Kompasberg	31,75	31,75	0,62
Komsberg	32,67	32,67	0,64
Koppies	27,33	27,33	0,52
Koster	25,87	25,87	0,48
Kraai	30,67	30,67	0,59
Kranskop	28,00	28,00	0,53
Kroonstad	27,72	27,72	0,53
Krugersdorp	26,08	26,08	0,49
Kruisfontein	33,98	33,98	0,67
Kuruman	27,47	27,47	0,52
Kwabhaca	30,85	30,85	0,60
Kwadukuza	29,45	29,45	0,56
KwaMashu	29,75	29,75	0,57
Kwa-Nobuhle	33,83	33,83	0,67
Ladismith	33,47	33,47	0,66
Lady Grey	30,72	30,72	0,59

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Ladysmith	28,53	28,53	0,54
Laingsburg	33,15	33,15	0,65
Lambert's Bay	32,08	32,08	0,63
Langeberg	33,92	33,92	0,67
Langklip	28,20	28,20	0,54
Leeu Gamka	32,78	32,78	0,64
Letaba	23,98	23,98	0,44
Letjiesbos	32,57	32,57	0,64
Libode	31,55	31,55	0,61
Lichtenburg	26,13	26,13	0,49
Little Karbo	33,75	33,75	0,67
Loeriesfontein	31,00	31,00	0,60
Loskop Dam	25,38	25,38	0,47
Lothair	26,37	26,37	0,50
Louis Trichardt	23,02	23,02	0,42
Louwsburg	27,62	27,62	0,52
Loxton	31,50	31,50	0,61
Luckhoff	29,73	29,73	0,57
Lutzputs	28,05	28,05	0,53
Luvuvhu	22,42	22,42	0,41
Lydenburg	25,17	25,17	0,47
Maclear	31,03	31,03	0,60
Madadeni	27,72	27,72	0,53
Mafikeng	28,83	28,83	0,55
Magaliesburg	26,00	26,00	0,49
Makwassie	27,28	27,28	0,52
Malmesbury	33,47	33,47	0,66
Mangaung	29,17	29,17	0,56
Maretsane	26,15	26,15	0,49
Margate	30,83	30,83	0,60
Marquard	28,67	28,67	0,55
Matatiele	30,33	30,33	0,59
Matjiesfontein	33,23	33,23	0,66
Matroosberg	33,38	33,38	0,66
Maxesibenj	30,82	30,82	0,60
Mbashe	32,25	32,25	0,63
Mdantsane	32,93	32,93	0,65
Memel	27,63	27,63	0,52
Messina	22,33	22,33	0,41
Middelburg Eastern Cape	31,50	31,50	0,61
Middelburg Mpumalanga	25,82	25,82	0,48

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Middelwit	24,85	24,85	0,46
Mkomazi	30,20	30,20	0,58
Mkuze	27,17	27,17	0,51
Mmabatho	25,82	25,82	0,48
Modderrivier	29,03	29,03	0,55
Modimolle	56,59	56,59	1,52
Mogalakwena	22,63	22,63	0,42
Mokolo	23,23	23,23	0,43
Molteno	31,37	31,37	0,61
Mombela	25,48	25,48	0,48
Mooi River	29,22	29,22	0,56
Mookgopong	24,53	24,53	0,46
Moorreesburg	33,10	33,10	0,65
Mopane	22,62	22,62	0,42
Morgenzon	26,75	26,75	0,50
Moshaweng	26,58	26,58	0,50
Mosselbaai	34,18	34,18	0,68
Mount Fletcher	30,67	30,67	0,59
Mqanduli	31,82	31,82	0,62
Mtamvna	31,10	31,10	0,60
Mtubatuba	28,50	28,50	0,54
Mtwalume	30,50	30,50	0,59
Murraysburg	31,97	31,97	0,62
Mzimkulu	30,73	30,73	0,59
Mzimvubu	31,63	31,63	0,62
Nababeep	29,60	29,60	0,57
Nelspoort	32,12	32,12	0,63
New Hanover	29,37	29,37	0,56
Newcastle	27,75	27,75	0,53
Niekerkshoop	29,32	29,32	0,56
Nieuwoudtville	32,38	32,38	0,63
Niew Bethesda	31,85	31,85	0,62
Nigel	26,45	26,45	0,50
Nkandla	28,62	28,62	0,55
Nongoma	27,97	27,97	0,53
Northam	24,93	24,93	0,46
Nossob	26,92	26,92	0,51
Noupoort	31,17	31,17	0,60
Nqutu	28,22	28,22	0,54
Nuwerus	31,13	31,13	0,60
Odendaalsrus	27,80	27,80	0,53

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Okiep	29,65	29,65	0,57
Olifantshoek	27,95	27,95	0,53
Orkney	26,97	26,97	0,51
Osizweni	27,82	27,82	0,53
Ottosdal	26,77	26,77	0,50
Oudtshoorn	33,58	33,58	0,66
Paarl	33,75	33,75	0,67
Pakhuis	32,15	32,15	0,63
Pampoenpoort	31,05	31,05	0,60
Park Rynie	30,42	30,42	0,59
Parys	26,87	26,87	0,51
Patensie	33,77	33,77	0,67
Paulpietersburg	27,38	27,38	0,52
Peddie	33,23	33,23	0,66
Pella	29,02	29,02	0,55
Pepani	25,82	25,82	0,48
Petrus Steyn	27,63	27,63	0,52
Petrusburg	29,07	29,07	0,56
Philippolis	30,25	30,25	0,58
Philipstown	30,42	30,42	0,59
Pienaarsrivier	25,25	25,25	0,47
Piet Retief	27,02	27,02	0,51
Pietermaritzburg	29,58	29,58	0,57
Piketberg	32,92	32,92	0,65
Pilgrim's Rest	27,92	27,92	0,53
Pinetown	29,80	29,80	0,57
Pofadder	29,17	29,17	0,56
Polokwane	23,90	23,90	0,44
Port Alfred	33,60	33,60	0,66
Port Elizabeth	33,97	33,97	0,67
Port Nollth	29,28	29,28	0,56
Port Shepstone	30,73	30,73	0,59
Port St Johns/Umzimvubu	31,63	31,63	0,62
Porterville	33,00	33,00	0,65
Postmasburg	28,30	28,30	0,54
Potchefstroom	26,68	26,68	0,50
Potgietersrus	24,17	24,17	0,45
Pretoria	25,73	25,73	0,48
Prieska	29,67	29,67	0,57
Prince Albert	33,20	33,20	0,65
Punda Maria	22,67	22,67	0,42

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Queenstown	31,87	31,87	0,62
Qumbu	31,17	31,17	0,60
Quoin Point	34,77	34,77	0,69
Ramathlhabama	25,62	25,62	0,48
Randfontein	26,13	26,13	0,49
Reddersburg	29,68	29,68	0,57
Reitz	27,80	27,80	0,53
Reivilo	27,60	27,60	0,52
Richards Bay	28,80	28,80	0,55
Riebeek -Oos	33,17	33,17	0,65
Riversdale	34,12	34,12	0,68
Robertson	33,77	33,77	0,67
Roodepoort	26,18	26,18	0,49
Rosmead	31,48	31,48	0,61
Rouxville	30,42	30,42	0,59
Rustenburg	25,68	25,68	0,48
Sakrivier	30,90	30,90	0,60
Saldanha Bay	33,10	33,10	0,65
Sannaspos	29,10	29,10	0,56
Sannieshof	26,50	26,50	0,50
Satara	24,48	24,48	0,46
Seekoei	30,30	30,30	0,58
Senekal	28,33	28,33	0,54
Settlers	25,03	25,03	0,47
Simonstown	34,23	34,23	0,68
Sishen	27,78	27,78	0,53
Smithfield	30,15	30,15	0,58
Soekmekaar	23,50	23,50	0,43
Soweto	26,23	26,23	0,49
Springbok	29,70	29,70	0,57
Springs	26,22	26,22	0,49
Standord	26,92	26,92	0,51
Tarkastad	32,00	32,00	0,62
Thadiq	24,67	24,67	0,46
Theunissen	28,43	28,43	0,54
Tom Burke	23,08	23,08	0,43
Tongaat	29,55	29,55	0,57
Touws	33,75	33,75	0,67
Tsineng	27,08	27,08	0,51
Tsolo	31,30	31,30	0,61
Tulbagh	33,27	33,27	0,66

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Ubombo	27,52	27,52	0,52
Ugie	31,17	31,17	0,60
Uitenhage	33,67	33,67	0,67
Ulco	28,35	28,35	0,54
Umkomaas	30,22	30,22	0,58
Umtata	31,60	31,60	0,62
Umzimvubu	30,25	30,25	0,58
Uniondale	33,65	33,65	0,67
Upington	28,42	28,42	0,54
Utrecht	27,63	27,63	0,52
Vaalwater	24,25	24,25	0,45
Vanrhynsdorp	31,60	31,60	0,62
Vanwyksvlei	30,30	30,30	0,58
Ventersburg	28,12	28,12	0,53
Venterstad	30,78	30,78	0,60
Vereeninging	26,50	26,50	0,50
Verneukpan	30,00	30,00	0,58
Verulam	29,63	29,63	0,57
Victoria West	31,42	31,42	0,61
Villiers	27,03	27,03	0,51
Virginia	28,13	28,13	0,53
Volksrust	27,40	27,40	0,52
Vredefort	27,00	27,00	0,51
Vredenburg	32,93	32,93	0,65
Vrendendal	31,68	31,68	0,62
Vryburg	26,33	26,33	0,49
Vryheid	27,75	27,75	0,53
Wakkerstroom	27,70	27,70	0,53
Warden	27,83	27,83	0,53
Warrenton	28,15	28,15	0,54
Wasbank	28,25	28,25	0,54
Waterberge	24,17	24,17	0,45
Waterval-Boven	25,67	25,67	0,48
Weenen	28,80	28,80	0,55
Welkon	28,00	28,00	0,53
Wepner	29,70	29,70	0,57
Western Cape	34,00	34,00	0,67
Whitesands	34,38	34,38	0,68
Wilge	27,05	27,05	0,51
Wiliston	31,33	31,33	0,61
Willowmore	33,25	33,25	0,66

City / Town	Latitude (°S)	Ø (°) 23 Sept / 21 March	TanØ
Windsorton	28,27	28,27	0,54
Wolmaransstad	27,20	27,20	0,51
Wolseley	33,43	33,43	0,66
Worcester	33,65	33,65	0,67
Xhora	31,92	31,92	0,62
Zebediela	24,33	24,33	0,45
Zeerust	25,52	25,52	0,48

Table 1: Latitudes per city (continued)

FENESTRATION

To comply with the NBR, the fenestration of a building per storey cannot exceed 15% of the net floor area of the storey. It is important to note that this is only applicable to those buildings that do comply with the requirements of *orientation* and *shading*. The moment a building's orientation or shading does not comply, the heat gain through the fenestration will be more than that of a building that do comply. The designer will then have to prove that the energy performance requirements of the glazing of those buildings as well as those that do exceed 15%, are equal or better that a building that satisfy the requirements of SANS10400-XA. Therefore the designer can use the fenestration calculations of SANS204 that do take into consideration not only the glazing, but also the orientation and the shading. According to the Regulation A2 of the NBR this action to be taken (to prove) is classified as a 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*)

To calculate the net floor area, the internal floor area, inclusive of open stairways and lift shafts, as well as the area of the voids formed by "double volumes" must be calculated and from that the area occupied by fixed vertical elements (internal walls) must be subtracted. Areas occupied by build-in cupboards should be taken as part of the net floor area as they are situated within the building envelope.

All roof lights are seen as fenestration and the area thereof must be added to the fenestration area. If the fenestration area to the net floor area then exceeds 15%, calculations for roof lights must be done as shown in SANS204. This in terms of Regulation A2 will also be regarded as a rational design.

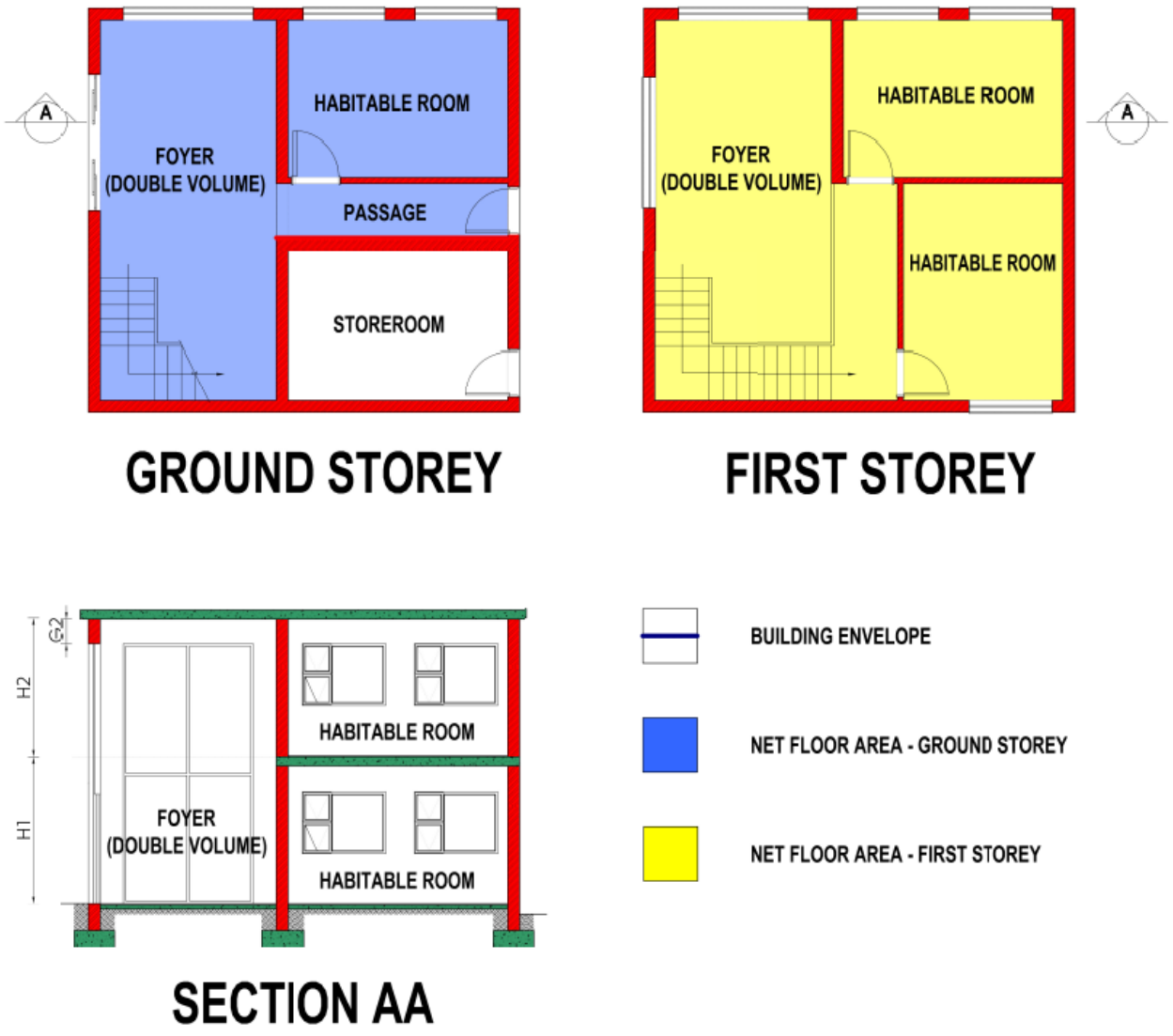


Fig 5: Building Envelope and Net Floor Area

FLOORS

All floors with any kind of heater in it (in slab, under carpet etc) must be insulated underneath the floor with an insulation material with an R-value of at least 1.

There is no other requirement in SANS10400-XA for floors to comply with Regulation XA.

WALLS

SANS10400-XA divides walls into non-masonry and masonry walls.

Non-masonry walls are light weight walls like timber and dry walls and must have a minimum total R-value for the different climatic zones.

For climatic zones 1 and 6 a minimum total R-value of 2.2 is required and for climatic zones 2, 3, 4 and 5 a minimum total R-value of 1.9 is required.

To calculate the total R-value the designer has to look at the different components of the wall, get the R-value of those different components and add them together to get the total R-value, for example:

A timber wall has three components: the external finish (timber), the internal finish (fibre cement walling) and the insulation in between. Add the R values of these different components together and the total thereof must be greater or equal than the required total R-value of 2.2 or 1.9, depending on the climatic zone.

Masonry walls are walls constructed with either clay or cement bricks or blocks which are bonded together by using mortar.

Walls constructed of double skin masonry walls (220 – 230mm collar jointed walls) with plaster applied to the inside will satisfy the requirements of Regulation XA. Cavity walls have the extra advantage of the added air cavity which gives the wall a better R-value and will therefore also comply.

For single-leaf walls to comply the unit (block) that is used in the construction must have a nominal thickness of at least 140mm. Added to that must be internal plaster as well as external rendering, a thin premixed surface of sand, cement and lime plaster applied to the masonry surface (commonly known as bag wash).

Other types of masonry walls, for example cast concrete and natural stone, must have a minimum R-value of 0.35. The designer therefore has to provide the R-value of other masonry walls.

ROOFS

All roof assemblies have to achieve a minimum R-value as indicated in Table 7 of SANS10400-XA. No roof assembly will comply with Regulation XA without the adding of insulation to the roof assembly.

Additional to that is that all metal sheeting fixed to metal purlins (steel frame buildings) must have a material with a minimum R-value of 0.2 installed between the sheeting and the purlin to create a thermal barrier.

SANS10400-XA provides guidelines for the R-value of the insulation that has to added to a conventional metal sheeted roof (22° - 45° pitch with horizontal flat ceiling) in Table 8 and a conventional tiled roof (22° - 45° pitch with horizontal flat ceiling) in Table 9.

For example: In climatic zone 1 we have to add additional insulation to a metal cladded roof with an R-value of at least 3.35.

For all other types of roofing like skillion, cathedral, thatch and concrete roofs the designer has to determine the R-value of such roof assembly and then calculate the R-value of the insulation that needs to be added to the roof assembly to comply with the required R-value as indicated in Table 7.

The thickness required of generic insulation products to be added to a roof assembly is given in Table 10 of SANS204 and can be used by the designer. However, it should be noted that the thickness as given for the different generic insulation products in Table 10 of SANS204 are for a metal cladded roofs of 22° to 45° only. The designer again has to calculate the required thickness of the insulation for all other roofs.

For example: What is the R-value of the insulation that we need to add to a roof consisting of a concrete slab as indicated in Figure 6 if the building is in climatic zone 1?

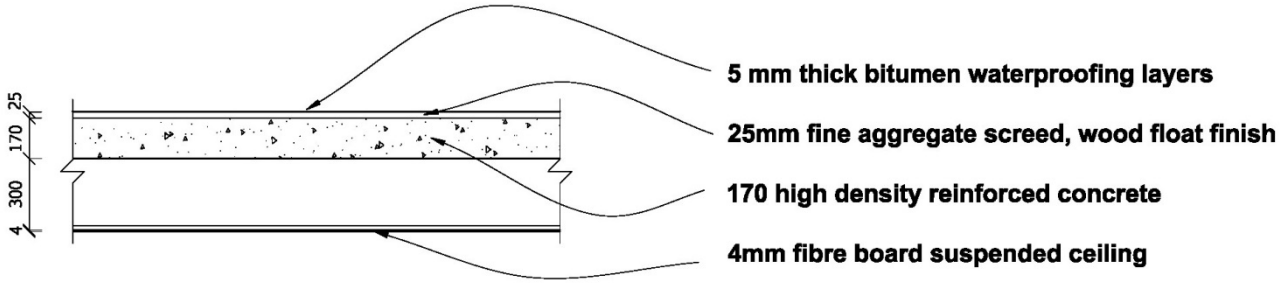


Fig 6: Roof assembly example

The easiest way to start is not to go and search for the R-values of the different components (some are given in the tables in SANS204, but to search for the K-value (thermal conductivity) of the material.

The $\frac{thickness\ of\ the\ material}{thermal\ conductivity}$ will give you the R-value.

1. R-value of outdoor air film as per Table F2 (SANS204) = 0.03
2. R- value of bitumen = $\frac{0.005}{0.5}$ = 0.01
3. R-value of screed = $\frac{0.025}{0.28}$ = 0.09
4. R-value of concrete slab = $\frac{0.170}{1.4}$ = 0.12
5. R-value of 300mm air as per Table F2 (SANS204) = 0.15
6. R-value of fibre board ceiling as per Table F3 (SANS204) = 0.06
7. R-value of indoor air film as per Table 2(SANS204) = 0.11

The sum of all the R-values = 0.57

In climatic zone 1 an R-value of 3.7 is required.

3.7 – 0.57 = 3.13

If a flexible fibre glass blanket is to be used to add the required insulation, the following:

Table 10 (SANS204) gives the K-value of flexible fibre glass blanket as 0.040

Thickness of material = thermal conductivity × required R-value
Thickness of material = 0.040 × 3.13 = 0.125m (125mm)

Designers must at all times remember to adhere to the restrictions placed on the use of combustible materials as per SANS10400-T and SANS428.

MATERIAL	K-VALUE (W/m.K)
Acrylic	0.2
Air (atmospheric gas)	0.024
Aluminium	205
Fibre-cement board	0.744
Fibre-cement sheets	0.166
Fibre-cement	2.07
Asphalt	0.75
Balsa wood	0.048
Bitumen	0.17
Bitumen/felt layers	0.5
Brass	109
Brickwork common	0.6 - 1.0
Brickwork dense	1.6
Cement portland	0.29
Cement mortar	1.73
Clay dry to moist	0.15 - 1.8
Clay saturated	0.6 - 2.5
Concrete lightweight	0.1 - 0.3
Concrete medium	0.4 - 0.7
Concrete dense	1.0 - 1.8
Concrete stone	1.7
Corkboard	0.043
Cork	0.07
Cotton wool	0.029
Earth dry	1.5
Felt insulation	0.04
Fibreglass	0.04
Fibre insulating board	0.048
Fibre hardboard	0.2
Foam glass	0.045
Glass	1.05
Glass window	0.96
Glass wool insulation	0.04
Granite	1.7 - 4.0
Gravel	0.7
Gypsym board	0.17
Hardboard high density	0.15
Hardwoods	0.16
Iron	80
Limestone	1.26 - 1.33
Marble	2.08 - 2.94
Mineral wool insulation	0.04
Paper	0.05
Plaster light	0.2

Plaster metal lath	0.47
Plaster sand	0.71
Plaster wood lath	0.28
Plastics	0.03
Plywood	0.13
Polypropylene	0.1 - 0.22
Polystyrene expanded	0.03
Porcelain	1.5
PVC	0.19
Quartz	3
Rock solid	2.0 - 7.0
Rock porous	0.5 - 2.5
Rubber natural	0.13
Sand dry	0.15 - 0.25
Sand saturated	2.0 - 4.0
Sandstone	1.7
Sawdust	0.08
Slate	2.01
Stainless steel	16
Styrofoam	0.033
Timber	0.14
Vermiculite	0.058
Water	0.58

Source – The Engineering Toolbox (http://www.engineeringtoolbox.com)

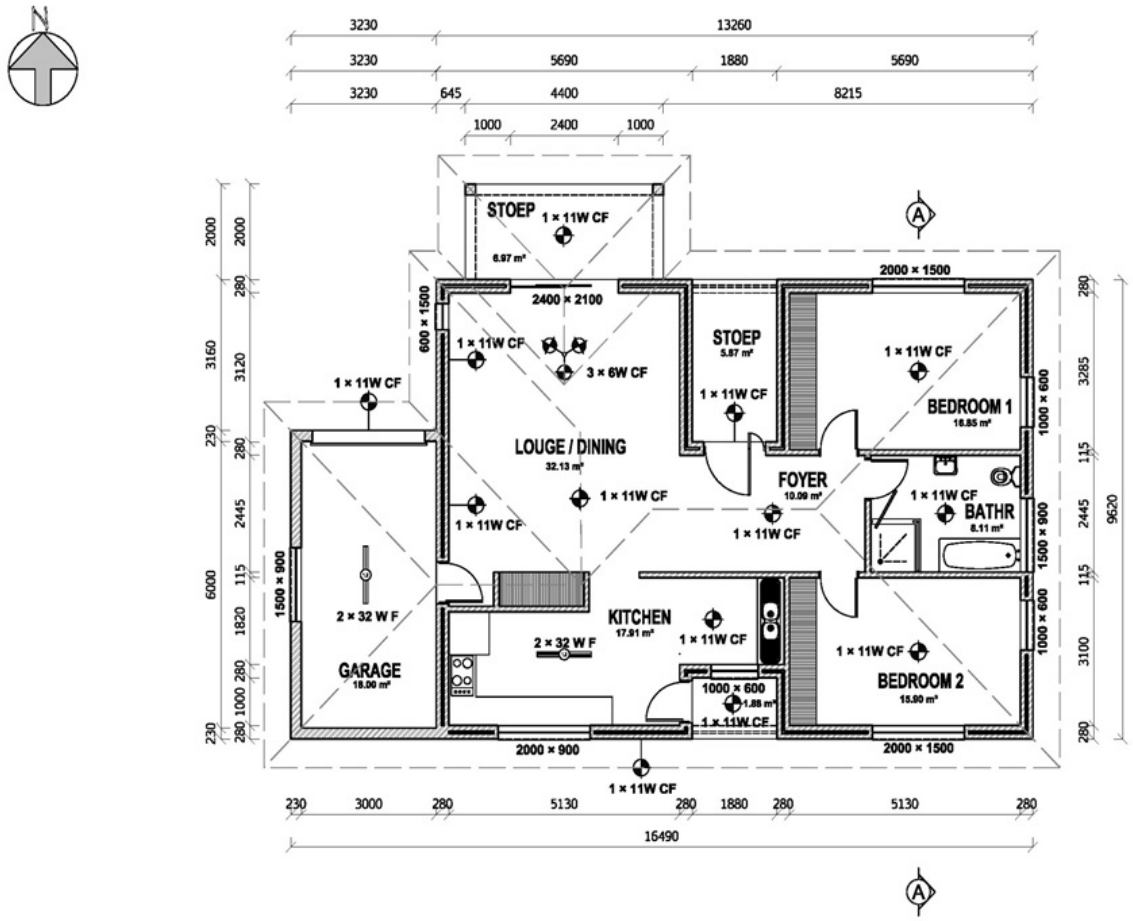
SERVICES: LIGHTS

The fact that the demand and consumption of energy used for lighting in buildings cannot exceed maximum values is not clearly indicated in SANS10400-XA. Regulation XA refers to the fact that the building envelope and services must comply and SANS10400-XA indicates that services that use or control the use of energy must comply with SANS204.

SANS204, under services, refers to lights and that lights in building must comply with a maximum demand as well as a maximum consumption figure as given in Table 12.

Therefore, the designer must provide a layout of the lights in the building, indicate the maximum energy (watts) that will be used by each light fitting and with calculations show that the demand and consumption will not be exceeded.

Example:



Energy Demand:

Allowed (Table 12 – SANS204): 5W/m²

5W/m² × 157.23m² = 786.15W

13 × 11W lamps = 143

3 × 6W lamps = 18

4 × 32W lamps = 128

289W

289W is less than 786.15W or

289W / 157.23m² = 1.84W/m² , which is less than 5W/m²

Energy Consumption:

Allowed: 5kWh/m².a or 5kWh/m² [a = 1 (year)]
5kWh/m².a × 157.23m² = 786.15kWh.a

Assume lights are on from 17:00 – 22:00 each day/year, that is 5h/day
52 (weeks) × 7 (days) × 5 (h) = 1 820h.a
Lamps = 289W or 0.289kW
0.289kW × 1 820h.a = 525.98kWh.a which is less than 786.15kWh.a

HOT WATER

Regulation XA2 is very clear about the hot water requirement:

"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."

The designer has to prove that, with whatever heating system is used, that at least 50% of the volume of the annual hot water requirement is heated by something else that an electrical element, except from fuel that is from a non-renewable source like gas and coal.

Guidance is given in SANS10400-XA on how the hot water requirement should be calculated, namely by using Tables 2 and 5 of SANS10252-1.

It is important to realise that SANS10400-XA also makes it mandatory for the designer to comply with SANS10252-1: it is not just the heating portion (geyser), but the complete system (from meter to tap) that must comply with SANS10252-1.

All hot water pipes exposed to the environment shall also be cladded with an insulating material that has an R-value of 1 or bigger for pipes with an internal diameter of 80mm or less and 1.5 if it has an internal diameter of greater than 80mm.

It should be noted that compliance with SANS10252-1 became compulsory in 2001 - the designer is referred to Regulation 14 of R509 (08 June 2001) published in terms of The Water Services Act (Act 108 of 1997) for water installations in buildings.

DEMAND AND CONSUMPTION

Regulation XA also allows the designer to show compliance by means of the energy demand and consumption of the building.

TABLES 2 & 3

A competent person can show compliance if he can prove that the energy demand (usage at a particular time) does not exceed the values as given in Table 2 of SANS10400-XA as well as prove that the consumption over a year will not exceed the values as given in Table 3 of SANS10400-XA.

Note should be taken that the tables provide data for seven (7) building occupancies of which data are available.

REFERENCE BUILDING

The second way of showing compliance with Regulation XA by using demand and consumption is to compare the designed building theoretical demand and consumption to that of a hypothetical building that complies with SANS10400-XA building envelope and services requirement.

This must also be done by a competent person by using software that has been certified by Agrément South Africa in terms of their published energy software protocol.

Wherever a competent person has to certify a calculation or assumption in terms of Regulation XA, Form 2 and Form 4 of SANS10400-A needs to be completed.