A – Z Summary for Roofing Contractors

SANS 10400-XA and SANS 204 ENERGY EFFICIENCY INFORMATION

A roof assembly (total R-value of all components) shall achieve the Minimum total R-value specified in the table below for the direction of heat flow.

MINIMUM TOTAL R-VALUES OF ROOF ASSEMBLIES						
Description	**Climatic Zones**					
	Cold interior	Temperate interior	Hot interior	Temperate Coastal	Sub-tropical Coastal	Arid interior
	1	2	3	4	5	6
Minimum required total R-value (m^2·K/W)	3.7	3.2	2.7	3.7	2.7	3.5
Direction of heat flow	Up	Up	Down & Up	Up	Down	Up
Directions of heat flow are as follows: • Upwards R-Values: Resistance to heat flow upwards (winter / heating conditions) • Downwards R-Values: Resistance to heat flow downwards (summer / cooling conditions)						
METAL SHEETING						
R-value of roof covering material	0,30				0,36	0,30
R-value of ceiling	0,05					
Added R-value of insulation	3,35	2,85	2,35	3,35	2,29	3,15
CLAY TILE ROOF ASSEMBLIES						
R-value of roof covering material	0,35				0,48	0,35
R-value of ceiling	0,05					
Added R-value of insulation	3,30	2,80	2,30	3,30	2,17	2,80

A, B C.....

Air infiltration and leakage: In climatic zones 1, 2, 4 and 6 all tile roofs in these climatic zones shall have a tile underlay or radiant barrier and the joints shall be sealed. The joints in sheeted roofs shall be sealed.

Building envelope: Roofs, external walls, and floors that form the building envelope and any opening such as windows and doors in the external fabric.

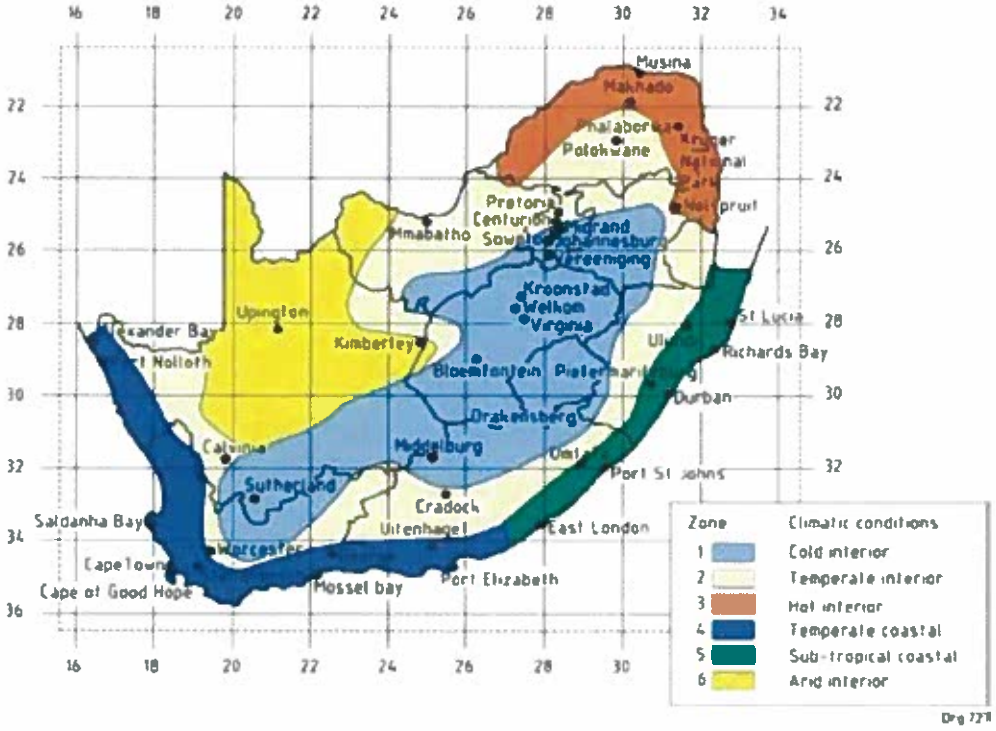
Bulk insulation shall be installed so that it maintains its position and thickness, other than where it crosses roof battens, water pipes or electrical cabling, and in ceilings, it overlaps the wall member by not less than 50 mm or is tightly fitted against a wall where there is no insulation in the wall.

Building sealing: Roofs, external walls, and floors that form the building envelope and any opening such as windows and doors in the external fabric shall be constructed to minimize air leakage. The building sealing can be done by methods such as caulking, or adding skirting, architraves or cornices.

Climatic regions: South Africa has been divided into 6 climatic regions. To achieve the best results, building design and construction materials should be appropriate to the climate of a region. The recommendations for the correct 'R-value' are based on the climatic conditions in particular zones. While each of the six climate zones have different heating and cooling needs, the same principles of energy efficient design apply, with their application varying slightly, e.g. different levels of insulation or thermal mass or variations in window sizes, orientation and shading.

CLIMATIC ZONES		
ZONE	**DESCRIPTION**	**MAJOR CENTRES**
Zone 1	Cold interior	Johannesburg, Bloemfontein
Zone 2	Temperate interior	Pretoria, Polokwane
Zone 3	Hot interior	Louis Trichardt, Nelspruit
Zone 4	Temperate Coastal	Cape Town, Port Elizabeth
Zone 5	Sub-tropical Coastal	East London, Durban, Richards Bay
Zone 6	Arid interior	Upington, Kimberley

CLIMATIC ZONE MAP



Deemed-to-satisfy Provisions (a level of performance for a given criteria which will satisfy the requirements which will ensure compliance with the functional regulation) for roof assemblies (which includes insulation) in accordance with SANS 10400-XA Energy usage in buildings and SANS 204 Energy efficiency in buildings.

Fire Classification: Thermal insulation material shall be either classified as; non-combustible when tested in accordance with SANS 10177-5, and may be installed in all occupancy classes or classified as combustible according to SANS 10177-5, and shall then be tested and classified in accordance to SANS 428 protocol for its use and application. When in doubt go to www.tiasa.org.za to technical information to obtain the TIASA Fire Register which will obtain all the products of TIASA Members with the fire classification.

Fire performance: Whilst thermal efficiency is important, thermal insulation must first and foremost comply with health and safety regulations. It is no use specifying or using a product that has good thermal properties but is a fire hazard. In accordance with SANS 10400 Part T Fire Protection, any roof insulation tested in accordance with SANS 10177-5 and found to be combustible, such material shall be acceptable if tested, classified, marked and installed in accordance with the requirements of SANS 428.

Installation of insulation: The best insulation can be ruined if incorrectly installed, which would not only affect the insulation performance but also safety related issues. Ensure that products are installed strictly in accordance with the manufacturer's installation specifications. Use TIASA Contractors or other accredited installers as recommended by the suppliers.

Insulation standards specify that the insulation products should bear the manufacturer's name, trade name, thermal resistance (R-Value) and fire classification obtained. This information must be fixed permanently to the original product, data sheet and container/ packaging. If there is no identification mark – don't use it!

Law: Energy efficiency regulation which came into effect on 9 November 2011 applicable to all new buildings and additions. The regulation specifically require that a building shall be designed and constructed in an energy efficient manner according to the requirements as set out in the regulation, to fulfil the user needs and to have features and services which is energy efficient.

The energy efficiency building regulation requirements stipulate that new buildings would have to have solar water heaters or heat pumps or other similar technologies. The building orientation, roof assembly (including insulation), walls and windows would have to meet minimum requirements to prevent heat loss in winter, or heat gain during summer, in order to meet the energy efficiency targets.

Occupancy classes: Building Occupancy applicable to Regulation XA1 obtainable in SANS 10400 Part A.

Product Standards: South African National Standards (SANS) as provided by the SABS for products to be tested to.

Product suitability: It is the responsibility of the professional designer, i.e. Architect or Engineer to determine the suitability of the products intended to be used, at design stage, not that of the Quantity Surveyor or Contractor.

R-value: The level or performance of an insulation product is measured by its Thermal Resistance or 'R-value.' The greater the 'R-value', the more effective is the insulation at resisting conducted heat flow into the building in summer, and out of it in winter. The recommendations for the 'R-value' are based on the climatic conditions in particular locations (zones).

Reflective insulation shall be installed and supported with the necessary airspace in order to achieve the required R-value between a reflective side of the reflective insulation and a building lining or cladding, tightly fitted and taped and with each adjoining sheet of roll membrane being overlapped by not less than 100 mm. Reflective insulation or Radiant Barriers on its own is not sufficient to comply with the requirements and needs to be used in conjunction with bulk insulation materials. Refer TIASA deemed-to-satisfy guide to achieve the required added levels of intervention to comply with SANS 10400-XA and SANS 204.

Safety alert: Ensure that the installation of thermal insulation around electrical equipment and accessories complies with the "Safety Alert" issued by TIASA and with the mandatory safety standard SANS 10142-1, also known as the Code of Practice for the Wiring of Premises.

SAFETY HAZARD: DO NOT INSTALL INSULATION OVER DOWN LIGHTERS AND TRANSFORMERS.

SANS 428: The fire performance classification of thermal insulated building envelope systems. This standard was developed to determine the comparative burning behaviour and predict their potential for a self-propagating fire spread in a building fire environment by measuring the maximum flame spread when exposed to a test fire.

Thermal insulation shall comply with minimum required R-values and be installed so that it abuts or overlaps adjoining insulation, or is sealed, and forms a continuous barrier with ceilings, walls, bulkheads or floors that contribute to the thermal barrier.

Thermal requirements for roof assemblies in SANS 10400-XA and SANS 204 are exactly the same. The extent of the specific requirements will generally vary depending on the use of the building, the climate zone in which it is located and the R-value (thermal resistance).

Warning: DO NOT INSTALL INSULATION OVER DOWN LIGHTERS AND TRANSFORMERS.
See safety alert on www.tiasa.org.za.

Contractors beware - do not change specifications for something similar or cheaper. The fire rating could be different!
When in doubt ask for a valid test report or 'Certificate of conformance' or contact TIASA.

Guides available from TIASA free of charge!

- The Guide to Energy Efficient Thermal Insulation in Buildings
- Thermal Insulation – A Guide for the installation of fibrous Blankets/Mats/Batts
- TIASA DTS Leaflet – Guide to the level of insulation to achieve deemed-to-satisfy

TIASA - Contact details:

Tel: (011) 805 5002
Website: www.tiasa.org.za

National Building Regulations:

Compliance Options and Professional Responsibilities

The amendments to the National Building Regulations for Energy Usage in Buildings have been implemented and SANS 10400XA Energy Usage in Building established to meet these requirements. In this article the modus operandi of the new Regulatory Environment is outlined.

The South African Constitution clause 24 requires that the Environment is protected, and this clause has provided an imperative to government and citizens, to established a Regulatory Environment which will move the nation towards a more sustainable future.

The publication of the Amended National Building Regulations and SANS10400XA; Energy Usage in building is a milestone in the progress towards sustainability for the South African building sector.

The combination of effect of Regulation and the voluntary upgrade of the national stock of buildings, in response to market forces, should cause a gradual shift in improvement of performance of all buildings as per Figure 1 below.

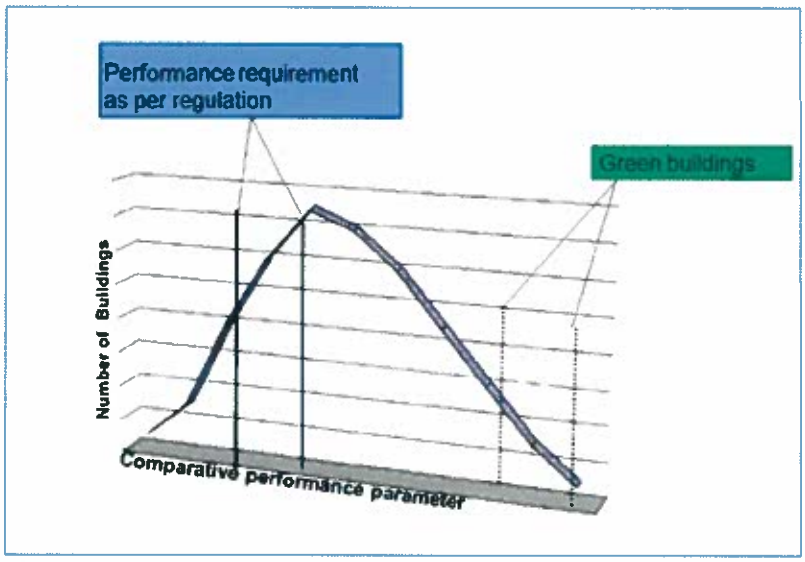


Figure 1: Gradual movement towards compliance and increasing green building population

Over a period of time, the addition of the new and compliant buildings will add to the total building set and the proportion of non-compliant buildings will drop. The leadership position of the Green Buildings Council of South Africa will be preserved, possibly by the addition of further stars and other sustainability measures, and the bar will continue to be raised with some buildings eventually achieving an energy positive status.

In line with public sentiment and this gradual improvement in the standard of energy efficiency of prestigious buildings, the norms for compliance with Regulation for all buildings will need to be revised at some time in the future. The SANS10400XA documents will therefore need to be continuously reviewed in order to continue to be relevant to the needs of society.

The SABS Technical Committee SC 59G:Construction Standards –Energy efficiency and Energy use in the built environment, is established in part for this purpose.

THE AMENDED REGULATIONS AND DATE OF IMPLEMENTATION

As per Notice R711, in the Government Gazette of 9 September 2011, the amendments to the National Building Regulations are made in terms of the National Building Regulations and Standards Act 103 of 1977 and require:

XA1: That buildings use energy efficiently and reduce Greenhouse Gas Emissions in accordance with requirements detailed.

XA2: That not more than 50% of the annual volumetric requirement of domestic hot water may be supplied by means of electrical resistance heating.

XA3: Provides for three methods by which compliance with the functional Regulation (XA1) is demonstrated. Compliance with the requirements of Part XA of SA National Standard 10400 will be deemed to be in conformity with the requirements of Part XA of the National Building Regulations.

The Regulations, as published, are legally effective from 10 November 2011, and the Government is bound to promote and defend their implementation, via the mechanisms and procedures established to control new buildings. This is a function of municipalities and specifically Building Control Officers.

In this regard the Regulator has assisted with the development of foundation training material, and has embarked upon a programme to train Building Control Officers in the implementation of the Regulations.

The phasing in of the regulation was over a shorter than normal 60-day period; however, the following relaxations may nonetheless be applied for:

- Application for a specific dispensation can be made for a building project to be exempted from the provisions if the design has commenced within six months of the date of gazetting of the new Regulations. This is provided for in Part A of the Regulations.
- Applicants have six months from the effective date of the Regulations to make this application.
- However, the Local Authority may not give an exemption from the implementation of the provisions if the building is not completed within a period of 12 months from the effective date of the regulations.

SANS 10400XA SATISFIES THE REGULATIONS

SANS10400 Part XA; Energy Usage in Buildings, is "Deemed-to-Satisfy" the Regulations. This document is therefore the logical starting point for those persons who need to demonstrate compliance with the Regulations, and this will apply to most projects except the Factories and Warehouse portion of a building.

Regulation XA3 and SANS10400XA set out three routes to compliance with SANS 10400XA, namely:

1. Prescriptive provisions for the building envelope and services per XA3(a)
2. A Reference Building route per XA3(b)
3. The Energy Usage and Demand performance requirement method per XA3(c)

The three methods of compliance are all "Deemed-to-Satisfy the Regulations," however, not all routes are generally available to all persons. A distinction is made between the projects for which compliance is demonstrated by way of a Rational Design by a "Competent Person – Energy," and projects for which the Building Envelope and Services route is followed. This latter route is available to all persons.

RATIONAL DESIGN OPTIONS

Two of the compliance routes established in Regulation XA3 and in SANS10400XA provide that a Rational Design may be performed in compliance of the Regulations by the Competent Person.

The definition of a Rational Design is provided in the Regulations and is the application of a process of reasoning and calculation, possibly based on a widely accepted standard or document. In the wider sense (the) document may be a computer programme, such as reputable energy modelling software, which are usually based on standards such as ANSI/ASHRAE Standard 140-2007.

The Rational Design in terms of SANS10400XA can only be performed by the "Competent Person" (Energy).

PRESCRIPTIVE ROUTE

Regulation XA3 (a) provides that route (i) (the Building Envelope and Services route) is generally available to the Appointed Person or his/her nominee, and is the person who may be responsible for the design of a building and compliance with the Regulations.

This route requires the detailed observance of all relevant provisions of SANS10400XA and SANS204, where specifically invoked.

ACCEPTANCE OF COMPETENCE AND THE COMPLIANCE ROUTE DECISION

Regulation A19 sets out the administrative requirement for the Responsible Person (the building owner) to make a declaration appointing a Professional (as identified by the Council for the Built Environment Act 43 of 2000), as the Appointed Person. This will in most cases be the architect, and this person is required to make a declaration as to the means by which the regulations will be satisfied, and to provide the names of the Competent Persons who will assist the Appointed Person, on the requisite Form 1.

The acceptance of responsibility by the Competent Person is set out on Form 2, together with a declaration by the Competent Person as to the qualifications, experience and contextual knowledge necessary to undertake such work, and the Local Authority's acceptance of the declarant as an approved Competent Person.

The responsibility assumed by the appointed Competent Person for a portion of the system is acknowledged in Form 3, which also contains critical design Information and a Certificate of Completion.

A Certification of Completion by the approved Competent Person is required in terms of Sub-regulation A19 (12): This provides that, 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.

The implications for this are that the Competent Person (Energy) retains responsibility for seeing the energy aspects of project through to completion.

ENERGY USAGE AND DEMAND COMPLIANCE ROUTE

The energy efficiency performance requirements for the building types in occupancy categories specified (Offices, Shopping Centres and Institutional Buildings) are set out as per Tables 2 & 3 below.

It will be necessary to perform a calculation or modelling of the theoretical annual energy usage and energy demand, to assess whether the required energy and demand criteria of Tables 2 & 3 are met.

Even for a very simple building, it will be difficult to calculate the Annual Energy Usage to the degree of accuracy required. It is therefore assumed that most such estimates will be performed with software and computer programmes developed for the purpose.

TABLE 2

Maximum energy demand per building classification for each climatic zone

Classification of occupancy of building	Description of building	Maximum energy demand[a] VA/m² — Zone 1	2	3	4	5	6
A1	Entertainment and public assembly	85	80	90	80	82	85
A2	Theatrical and 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 shop (including shopping malls)	90	85	95	85	85	90
G1	Offices	80	75	85	75	75	80
H1	Hotel	90	85	95	85	85	90

[a]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.

TABLE 3

Maximum annual energy usage per building classification for each climatic zone

Classification of occupancy of building	Description of building	Maximum annual energy usage kWh/m²/annum — Zone 1	2	3	4	5	6
A1	Entertainment and public assembly	420	400	440	390	400	420
A2	Theatrical and 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 shop (including shopping malls)	240	245	260	240	260	255
G1	Offices	200	190	210	185	190	200
H1	Hotel	650	600	585	600	620	630

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

TABLE 4

Design occupancy times

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

The theoretical annual energy consumption of the buildings is calculated using (Agrément South Africa) Certified thermal calculation software, and climatic data as published by Agrément South Africa, to formulate the energy usage forecast.

In order to achieve a uniform basis for assessing building performance, standardised stipulations are required to be made when using energy design software. These cover the following areas:

- Occupancy hours
- Occupancy density
- Small power internal heat gains
- Temperature set points for operation of the building
- Ventilation assumptions

THE BUILDING ENVELOPE AND SERVICES ROUTE

All buildings, including residential buildings, hospitals and those classes of building which are not built according to a rational design by a "Competent Person" and the performance requirements of Tables 2 & 3, need to be designed and built in accordance with paragraph 4.2.1 (b) of the Standard.

This section contains requirements for walls, fenestration and roofs, floors if in-slab heating is installed, and for hot water.

The orientation, shading and building services invoke the provisions of SANS 204: Energy Efficiency in buildings and these are hence deemed-to-satisfy.

This will require the Architect and/or Engineering Professionals and the Contractors to ensure that the prescriptive requirements of SANS10400XA and relevant parts of SANS204 are met.

This method of compliance is required to be selected by the Appointed Person at the outset of the project and may be implemented by the Professional Design and the Construction Team without the appointment of a Competent Person - Energy.

THE REFERENCE BUILDING ROUTE

A reference building is initially designed with all of the elements necessary in terms of the above Building Envelope and Components route, and is then compared with the planned design.

The initial building is modelled with the prescriptive aspects built into a base case design in order to establish a reference energy usage and demand budget. SANS10400XA is specific in regard to certain aspects of the building's shell, but the balance of the detailed Deemed-to-Satisfy requirements for Building Services are to be found in SANS204.

The design is thereafter modified with the required features of the professional team, and the annual energy usage and demand is compared to the reference building.

If the modified design shows an equivalent or improved energy usage over the reference building, it can be said to comply with the regulations.

Some potential for flexibility is built into the standard by the introduction of the so-called "Reference building method."

This will give opportunity to the Architect or the Engineering Professionals or the Contractor to introduce innovative energy efficiency aspects, which will yield the same or more energy efficient building than would be achieved by the application of the Building Envelope and Components methods.

This (Reference Building) method is exclusively available to the Competent Person - Energy.

GUIDANCE AND COMMENTS AS TO THE CHOICE OF COMPLIANCE ROUTES

The factors influencing the choice of compliance route are:

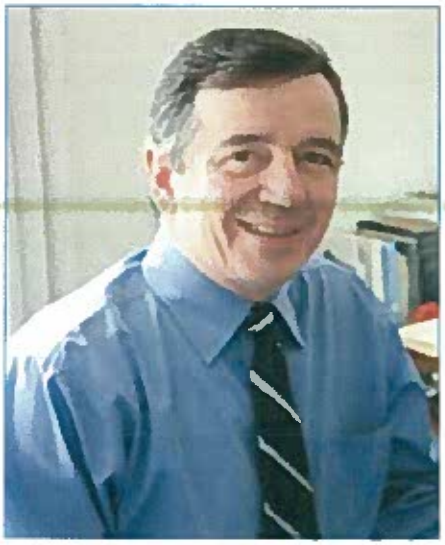
- the size of projects
- and the skills blend in the professional team
- client preferences and willingness to pay for energy modelling

Clients will be advised to appoint a professional team with the requisite skills in the energy usage area. Thus the Architect and Quantity Surveyor should be aware of the need to design for energy efficiency aspects, even if simply to meet the regulations, but also to make the appointment of the Competent Person – Energy, who can add considerable value to the project.

If the Competent Person – Energy is not appointed, then the project has only the option of the prescriptive Building Envelope and Services route available to them.

If the Competent Person has at his or her disposal a team with the requisite energy modelling expertise, then designs can be checked for compliance at an early stage, and a cost-effective design can be developed by way of the Rational Design options available in the regulations.

This article concludes the two-part series on SANS 10400XA authored by Howard Harris. Howard holds a B.Sc.(Chem), a C.A.(S.A.) and M.Eng. (Mech) degrees, and is a Certified Energy Manager and Certified (Energy) Measurement & Verification Practitioner. He has produced a Training Manual for the Application of SANS 10400XA, Energy Usage in building, and has a Handbook for the same subject in print. To find out more about these publications, please e-mail billy@trademax.co.za or visit the Web site www.structatherm.co.za.



Howard Harris