MAJOR CHANGES TO THE SPECIFICATION OF THERMAL INSULATION

GENERAL

Government regulations will be introduced in 2011 specifying minimum insulation levels for all new homes and buildings built in South Africa. Small alterations or renovations to existing buildings requiring a building permit may also have to comply with the regulations.

1. ENERGY EFFICIENCY

With the introduction of the Energy Efficiency Standards, i.e. SANS 10400 Part XA The application of the National Building Regulations Part X: Environmental sustainability Part XA: Energy usage in buildings and SANS 204 Energy efficiency in buildings in August 2011, to intervene and to reduce peak electricity demand usage, thermal insulation will play an integral part in the future design of a building.

SANS 10400-XA Energy usage in buildings, provides deemed-to-satisfy requirements for compliance with the National Building Regulations.

SANS 204 Energy efficiency in buildings specifies the design requirements for energy efficiency in buildings and of services in buildings with natural environmental control and artificial ventilation or air conditioning systems. This includes aspects such as orientation of the building, shading, window design, and choice of insulation materials.

Roofs are exposed to both high solar radiant heat gains in summer and high heat losses during winter nights. The roof-ceiling combination therefore warrants special attention from a thermal point of view.

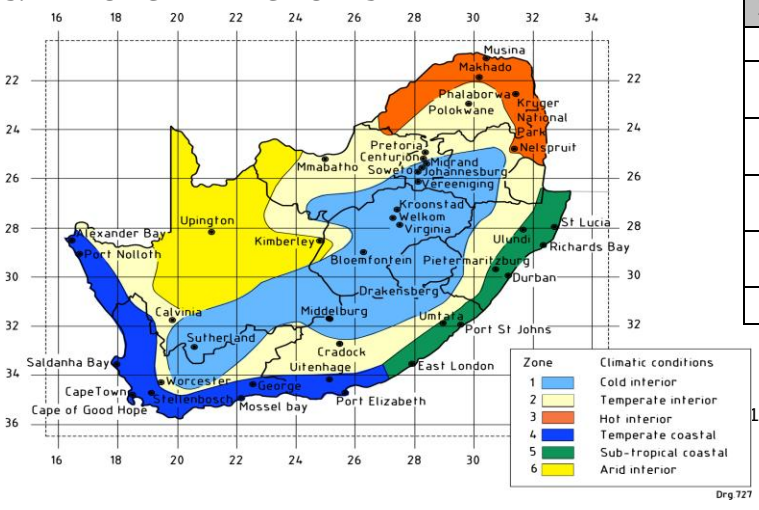
Design values for thermal resistance and thermal conductivity, which will be met throughout the intended service life of the product in the given application, is therefore critical. Additionally Deemed-To-Satisfy (DTS) thicknesses of insulation promotes the environmental benefits of energy savings. For critical design purposes a rational design is recommended.

2. CLIMATIC REGIONS

South Africa has been divided into 6 climatic regions. The deemed-to-satisfy provisions are based on climate zones, including dry bulb temperatures; thermal neutrality, humidity and southern coastal condensation risk.

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.

3. MAP OF CLIMATIC ZONES



Zone	Description	Major Centres
1	Cold interior	Johannesburg, Bloemfontein
2	Temperate interior	Pretoria, Polokwane
3	Hot interior	Makhado (Louis Trichardt), Nelspruit
4	Temperature Coastal	Cape Town, Port Elizabeth
5	Sub-tropical Coastal	East London, Durban, Richards Bay
6	Arid interior	Upington, Kimberley

4. THERMAL INSULATION

In accordance with SANS 204 Energy Efficiency in Buildings-

Insulation shall comply with minimum required *R*-values (see Table 1) and be installed so that it:

a) abuts or overlaps adjoining insulation, or is sealed,
b) forms a continuous barrier with ceilings, walls, bulkheads or floors that contribute to the thermal barrier, and
c) does not affect the safe or effective operation of any services, installation, equipment or fittings.

Thermal insulation material shall be either;

a) non-combustible when tested in accordance with SANS 10177-5, and may be installed in all occupancy classes; or
b) if classified as combustible according to SANS 10177-5, it shall be tested and classified in accordance to SANS 428 protocol for its use and application.

Reflective insulation shall be installed and supported:

a) 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,
b) with the reflective insulation tightly fitted and taped against any penetration, door or window opening, and
c) with each adjoining sheet of roll membrane being
    1) overlapped by not less than 100 mm, or
    2) taped together.

The *R*-value of reflective insulation is affected by the airspace between a reflective side of the reflective insulation and the building lining or cladding. Dust build-up reduces *R*-values.

Bulk insulation shall be installed so that

a) it maintains its position and thickness, other than where it crosses roof battens, water pipes or electrical cabling, and
b) 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.

Table 1 - Minimum Total R-Values for Roofs & Ceilings

Climate zones	**1**	**2**	**3**	**4**	**5**	**6**
Minimum required Total *R-value* (m^2.K/W) (for roof solar absorptance of more than 0,55)	3.7	3.2	2.7	3.7	2.7	3.5
Direction of heat flow	Up	Up	Down & Up	Up	Down	Up

In accordance with SANS 10400-XA Energy usage in buildings a roof system shall achieve the minimum total *R-value* specified in Table 1 for the direction of heat flow.

The direction of heat flow in Table 1 is considered to be the predominant direction of heat flow for the hours of occupation of the building. It takes into account the higher rate of occupancy of houses at night time rather than day time.

Where “downwards” is specified in Table 1, this indicates summer heat (a downwards heat flow into the building) is the major concern. A combined downward and upwards requirement means that summer and winter (heating and cooling) have a roughly similar level of energy use on an annual basis, while an upward flow indicates that heat loss from the building during winter is the major concern.

In hot humid climates where buildings are naturally ventilated, high down R-values and low up R-values are appropriate for roofs and ceilings.

Note:
Condensation could occur in three areas; the cold interior (Climatic Zone 1), the temperate interior (Climatic Zone 2) and the temperate coastal area (Climatic Zone 4), therefore vapour barriers, adequate ceiling insulation and roof ventilation must be provided.

Typical data and deemed-to-satisfy thicknesses of generic insulation products

Description			Climatic Zones					
			1	2	3	4	5	6
Minimum required Total *R*-value (m².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
Estimated Total *R*-Value (m².K/W) of roof and ceiling materials (Roof covering & plasterboard only)			0.35 – 0.40				0.41 – 0.53	0.35 -0.40
Estimated Minimum added *R*-Value of Insulation (m².K/W)			2.30 – 3.35				2.15 – 2.29	3.10 – 3.15
Generic insulation Products	**Density Kg/m³**	**Thermal Conductivity W/(m.k.)**	**Recommended deemed-to-satisfy min thickness (mm) of insulation product**					
Cellulose Fibre Loose-Fill	27.5	0.040	135	115	100	135	100	130
Flexible Fibre Glass Blanket	10-18	0.040	135	115	100	135	100	130
Flexible BOQ Polyester Fibre Blanket	24	0.038	130	110	90	130	90	125
Flexible Polyester Blanket	11.5	0.046	160	140	120	160	110	150
Flexible Mineral/Rockwool	60-120	0.033	115	100	80	115	80	100
Flexible Ceramic Fibre	84	0.033	115	100	80	115	80	100
Rigid Expanded Polystyrene (EPS)SD	15	0.035[a]	120	100	90	120	80	115
Rigid Extruded Polystyrene (XPS)	32	0.028[a]	100	80	70	100	65	90
Rigid Fibre Glass Board	47,5	0.033	115	100	80	115	80	100
Rigid BOQ Polyester Fibre Board	61	0.034	115	100	80	115	80	110
Rigid Polyurethane Board	32	0.025[a]	85	70	60	85	60	80

NOTE Aforementioned deemed-to-satisfy recommended levels of insulation could be achieved by the use of reflective foils, bulk insulation or rigid board insulation or in combination with one another. Maximum efficiency may be achieved at reduced thicknesses taking the aforementioned into account.

[a] Thermal efficiencies are dependant on material thickness, density, age, operating temperature and moisture.

Note: The deemed-to-satisfy requirements ensures compliance with a functional regulation whereas a rational design is a design by a competent person involving a process of reasoning and calculation and which may include a design based on a standard or other suitable document to show compliance with the requirements of the functional regulation.

Working example:

Climatic zone: The first fundamental matter that needs to be determined before applying the DTS provisions is the climatic zone in which the building is to be located. The climatic zone map of South Africa shows diagrammatically the extent of each zone and the table detailing the applicable climatic zone for common locations. In this case, the applicable climatic zone for Cape Town is 4.

Insulation: Roofs in climatic zone 4 are required to achieve a minimum total *R*-value of 3,7 in the upwards direction (see table). A pitched tiled roof with a flat ceiling in climatic zone 4 achieves a total *R*-value of 0,35. This means that additional insulation that achieves a minimum *R*-value of 3,35 (3,7 - 0,35) in the upward direction is required to be installed in the roof.

The deemed-to-satisfy recommended levels of insulation can be achieved by the use of reflective foils, bulk insulation or rigid board insulation or in combination with one another. Rational design is always an option.

Note: Compression of bulk insulation: The *R*-value of bulk insulation is reduced if it is compressed. The allocated space for bulk insulation must therefore allow the insulation to be installed so that it maintains its correct thickness. This is particularly relevant to wall and cathedral ceiling framing whose members can only accommodate a limited thickness of insulation. In some instances, larger framing members or thinner insulation material, such as polystyrene boards, may be necessary to ensure that the insulation achieves its required *R*-value.

5. FIRE PERFORMANCE

According to SANS 10400 the Application of the National Building Regulations Part A General principles and requirements, the professional engineer or other approved competent person takes responsibility for the rational fire design. It also clearly states that materials used must comply with the relevant standard specification and the occupancy of any building shall be classified and designated according to the appropriate occupancy class.

Professionals must beware of misrepresentation of products and must realize their professional indemnity is at stake. They must insist on fire reports and when in doubt, make an enquiry to the relevant testing authorities. Too often buildings are designed and built without taking fire safety into consideration at all.

In accordance with SANS 10400 Part T Fire Protection, any insulation, roof lining or waterproof membrane not used as a ceiling and used under a roof covering as part of a roof assembly, is tested in accordance with SANS 10177-5 and found to be combustible, such material shall be acceptable should it be classified, marked and installed in accordance with the requirements of SANS 428.

SANS 428 - The fire performance classification of thermal insulated building envelope systems 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.

Having the insulation products directly exposed to large scale fires gives the most transparent results for specifiers to assess the products and be confident that the appropriateness of their selection would not be compromised by an unsuitable application.

The fire performance classification of insulation materials is directly linked to occupancy classes as specified in SANS 10400 Part A, Application of the National Building Regulations, which highlight the importance of not allowing changes of the specified material once the appropriate type of insulation material has been decided on. Consideration should also be given to the occupancy and contents of the structure and a good fire safety design should address this issue. If “cheaper” insulation is required the fire classification specified must still be adhered to, i.e. in accordance with the occupancy class specified.

PRODUCT IDENTIFICATION CLASSIFICATION IN ACCORDANCE WITH SANS 428

Classification Type Combustibility	Class	Description of materials behaviour and occupancies
	A	Non-combustible
	B	Combustible
Surface Fire Properties		
	A1 or B1	No flame spread
	A2 or B2	Low flame spread (no flaming droplets or burning brand)
	A3 or B3	Low flame spread (with flaming droplets or burning brand)
	A4 or B4	Average flame spread (no flaming droplets or burning brand)
	A5 or B5	Average flame spread (with flaming droplets or burning brand)
	A6 or B6	Rapid fire spread
Use - Occupancy and class of occupancy description (use or limitation) in accordance with occupancy classifications see **SANS 10400 Part A**		
	1	No limitations
	2	All occupancies, except for the proviso listed in SANS 10400-T
	3	All single-storey and double-storey buildings, except A1, C1, C2, E1, E2, E3, E4, H1 and H2
	4	All single-storey buildings, except A1, C1, C2, D1, E1, E2, E3, E4, H1 and H2
	5	All single-storey buildings, except A1, A2, A3, C1, C2, D1, E1, E2, E3,E4, F1, F3, G1, H1, H2, J1 and J4
	6	Not acceptable for any application
Permissible Application		
Tested with or without sprinklers: **SP**: Protected by a sprinkler system. **USP**: Not protected by a sprinkler system.	H	Horizontal (under-roof) only
	V	Vertical (side cladding) only
	HV	Horizontal and vertical application

The classification is required in terms of SANS 10400 Part T Fire Protection. The classified products shall bear the manufacturer's name; date manufactured, batch number, trade name and SANS 428 Classification. This classification shall be fixed permanently to the original product and container/packaging and include the end-use conditions of approval, i.e. Fire Performance Classification.

The symbolic classification will inform the professional and /or consumer about the limitations and usage of a product. This information will appear on the product, technical data sheet as well as the packaging.

Example: Non-combustible material	: A	/A1	/1	/HV
Example: Combustible material	: B	/B1	/2	/HV
	Combustibility	/ Surface Fire Properties	/ Use	/ Application

Example A / A1 / 1 / HV

Example B / B1 / 2 / HV

Example B / B6 / 6 / Not acceptable

6. COMPLIANCE

SANS 10400-A The application of the National Building Regulations Part A: General principles and requirements establishes general requirements for satisfying the National Building Regulations issued in terms of the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977).

Building plans submitted to the local authorities shall comply with the requirements of Form 1, Schedule A and B and Form 2 in order to be approved.

7. SELECTION & SPECIFICATIONS OF THERMAL INSULATION MATERIALS

The selection and specification of the thermal insulation material should comply with the following:

- the relevant South African National Standards published by the SABS and applicable to the product;
- conform to the requirements of the South African National Building Regulations;
- is appropriate for the intended use and application for the particular occupancy or building classification in accordance with SANS 10400 Part A General principles and requirements;
- comply with the fire safety requirements of SANS 10400 Part T Fire Protection and tested in accordance with the requirements of SANS 428 Fire performance classification of thermal insulated building envelope systems requirements.
- thermal performance specifications comply with the recommended R-value for the relevant climatic zones in accordance with SANS 10400-XA Energy usage in buildings.
- Valid test reports

Professionals will no longer be able to disregard the importance of roof insulation as far as the new energy efficiency and fire standards are concerned by settling for “something similar but cheaper”.

Contractors often compromise the Code for Safety to Life from Fire in Buildings and Structures, known as the Life Safety Code, by proposing insulation products similar to what has been specified by professionals, but cheaper, to cut building cost, with total disregard to fire safety. The Consumer Protection Act shall eliminate such practices in future.

Careful consideration should therefore be given to the type of roof insulation materials at specification stage and to comply with the required new performance criteria according to the new classification system in order to avoid any litigation.

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