TiPSASA™

THERMAL INSULATION PRODUCTS & SYSTEMS ASSOCIATION SA

A division of the SOUTHERN AFRICAN ASSOCIATION FOR ENERGY EFFICIENCY (SAEE)

on THERMAL INSULATION & ENERGY SAVING

April 2016

TIPSASA

TIPSASA (Thermal Insulation Products & Systems Association SA) is a non-profit organisation that supports and promotes energy efficiency. We assist Professionals and the Consumer to select the correct insulation products and/or systems to support energy efficiency in the building envelope.

Disclaimer

While every attempt was made to ensure that the information published in this report is accurate, no responsibility is accepted for any loss or damage that may arise out of the reliance of any person or entity upon any of the information this report contains.

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ABC OF THERMAL INSULATION

A – APPLICATIONS

The type of insulation you should choose depends on where you will use it and on your budget. While closed-cell foam products have a greater R-Value and provides stronger resistance against moisture and air leakage, the material is also much denser and is more expensive to install than Reflective Foil and Fibrous Bulk Insulation which is less expensive.

Consult the Association to decide what type of insulation is best for you and to recommend a professional insulation installer

Insulation Tips

- Consider factors such as your climate, home design, and budget when selecting insulation for your home.
- Use higher R-Value insulation, on exterior walls and in cathedral ceilings to get more insulation with less thickness.

Ensure proper airflow from the soffit to the attic. Ventilation helps with moisture control and reducing summer cooling bills, but don't ventilate your attic if you have insulation on the underside of the roof. Ask a qualified contractor for recommendations.

Whether you're using blown, poured, or batt material, the following preparations are important:

- Be careful how close you place insulation next to a recessed light fixture to avoid a fire hazard. Heat-producing fixtures should be isolated from the thermal insulation to prevent fire hazards. These include recessed lighting fixtures. Where down lights that penetrates the ceiling are used care must be taken not to have direct contact with insulation or to have the transformers underneath the insulation.

  Insulation can be installed around recessed fixtures without having to use baffles, but for safety reasons, clearances should be left around hot objects such as flues from fire places, recessed down lights and their transformers, whereas with loose fill it is a requirement.

- Insulation must be kept at least 5 cm back from these openings. If using blanket or batt insulation, leave a 5cm space on both sides of the fixtures and frame the openings with wood or metal baffles that extend at least 10cm above the depth of the insulation.

Note: Wherever possible avoid recessed light fittings as these are a major source of heat loss.

- If it is a DIY project follow the manufacturer's installation instructions, and wear the proper protective gear when installing insulation.

Long-Term Savings Tips

One of the most cost-effective ways to make your home more comfortable year-round is to add insulation to your attic/loft, including the attic trap or access door, which is relatively easy.

Where to Insulate

Adding insulation in the areas shown here below may be the best way to improve your home's energy efficiency. Insulate either the attic floor or under the roof.

1. Roofs (above ceiling)
2. Walls
3. Floors
4. Pipes

If it is an older house or building there might not be any insulation or only a 50mm blanket insulation which is not adequate and you could probably benefit by adding more.

If your attic has enough insulation and proper air sealing, and your home still feels drafty and cold in the winter or too warm in the summer, chances are you need to add insulation to the exterior walls. This is more expensive and usually requires a contractor, but it may be worth the cost—especially if you live in a very cold climate. If you replace the exterior siding on your home, consider adding insulation at the same time.

You may also need to add insulation to your crawl space or basement. Check with a professional contractor for recommendations.

New Construction and Additions

In accordance with the Energy Efficiency Regulation XA (see section E) it is compulsory to add insulation, when building a new home or addition. If you install wall and roof insulation you will save money and energy.

SHOULD I INSULATE MY HOME?

Insulate your home when:

- you have an older home and haven't added insulation.
  The majority of houses in South Africa do not have any insulation.
- you are uncomfortably cold in the winter or hot in the summer—adding insulation creates a more uniform temperature and increases comfort.
- you build a new home or addition (South African National Building Regulations XA)
- you pay high energy (electricity) bills.
- you are bothered by noise from outside—insulation muffles sound.

LOFT (CEILING) INSULATION

A significant proportion of a building's heat loss is through the roof, this is relatively easy to address with insulation laid between and above the ceiling between the tie beams/trusses.

Adding or "retrofitting" insulation to existing buildings provides a major opportunity to increase comfort, reduce energy costs and greenhouse gas emissions.

PITCHED ROOF INSULATION

In roof configurations where the internal ceiling line follows the pitch of a roof, thermal insulation have to be added between rafters and beams.

Pitched roofs can be upgraded by adding rigid insulation boards or batts between the existing rafters or below the rafter zone as a continuous layer.

MINIMUM DEEMED-TO-SATISFY REQUIREMENTS TOTAL R-VALUES OF ROOF ASSEMBLIES					
Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
3.7	3.2	2.7	3.7	2.7	3.5

WALL INSULATION

External walls should be insulated to reduce radiant, conducted and convected heat transfer.

Wall insulation can be installed:

- Within cavities
- On the inside and outside surface of solid walls

Cavity brick walls have high thermal mass, but without insulation are usually too cold in winter and often too hot in summer if exposed to prolonged heat wave conditions. If the cavity is insulated, the internal thermal mass (i.e. the internal brick skin) is protected from external temperature changes, and becomes highly effective at regulating temperatures within the building.

Insulate existing cavities by:

- Pumping in loose bulk material to a measured density
- Installing bulk insulation sheets/boards

If using a framed construction system, insulation should be placed in the wall framing. Insulation can also be installed on the outside of the framing (but the insulation must be weatherproof to be effective).

Note that the amount of insulation installed may depend on the thickness of the walls and the size of the framing.

If building a new home or renovation, consider increasing the thickness of the framing size to fit in more insulation. If using a solid construction system such as concrete, insulation should be placed on the inside of the solid wall within the cavity.

MINIMUM DEEMED-TO-SATISFY REQUIREMENTS TOTAL R-VALUES OF NON-MASONRY WALLS					
Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
2.2	1.9	1.9	1.9	1.9	2.2

FLOOR INSULATION

Floors do not always require insulation.

In accordance with SANS 10400-XA Energy usage in buildings, it is mandatory to install insulation if an underfloor heating system (e.g. in-screed, under laminate heating, under carpet heating, under tile heating, cut-in underfloor heating, and water-based underfloor heating) is installed. Insulate the heating system underneath the slab with insulation that has a minimum R-Value of not less than 1,0.

PIPES

All external hot water service pipes shall be clad with insulation with a minimum R-Value in accordance with SANS 10400-XA.

MINIMUM R-VALUE OF PIPE INSULATION	
Internal diameter of pipe	Minimum R-Value*
≤ 80mm	1.00
> 80mm	1.50
*Determined with a hot surface temperature of 60 °C and an ambient temperature of 15 °C.	

TYPICAL GENERIC INSULATING MATERIALS FOR USAGE AT TEMPERATURES HIGHER THAN AMBIENT										
Generic Material	Material Form	K-Value (W/(m·K))	Fire Rating	± Maximum Operating Temp °C	Cathedral Ceiling	Flat Ceiling	Concrete Floors & Edges	Timber Floors	Light Weight Walls	Masonry Walls
Cellulose Fibre	Fibre	0.040	B	60		•				
Expanded Polystyrene	Cellular	0.035*	B	80	•	•	•	•	•	•
Extruded Polystyrene	Cellular	0.028*	B	80	•	•	•	•	•	•
Glasswool	Fibre	0.040	A	350	•	•	•	•	•	•
Perlite	Granular	0.065	A	850	•	•	•	•	•	•
Phenolic Foam	Cellular	0.020	B	120	•	•	•	•	•	•
Polyester Fibre	Fibre	0.046	B	150	•	•		•	•	•
Polyethylene	Cellular	0.330	B	80	•	•		•	•	•
Polyurethane	Cellular	0.025*	B	120	•	•		•	•	•
Polyisocyanurate	Cellular	0.023*	B	140	•	•	•	•	•	•
Reflective Foil	Foil	N/A	B	80	•			•	•	•
Rockwool	Fibre	0.033	A	850	•	•	•	•	•	•

KEY:

Thermal values (*) Thermal Conductivity used for calculation of recommended thickness of generic insulation materials. Thermal efficiencies are dependent on material thickness, density, age, operating temperature and moisture.

Fire Rating:

A = Non-combustible – installation direction Horizontal (H) and Vertical (V)

B = Combustible – installation direction as per fire test report.

Note: Request product fire test reports from manufacturers.

B – BEEEE
(BUILDING ENVELOPE, ENVIRONMENT, ENERGY & ECONOMICS)

BUILDING ENVELOPE

Building envelope is a term used to describe the roof, walls and floors of a building. The envelope controls heat gain in summer and heat loss in winter. Well-designed envelopes maximize cooling air movement and limits exposure to direct sunlight in summer. In winter, they trap and store heat from the sun and minimise heat loss to the external environment. The fundamental principles of passive design, (refer page 43), are relatively simple but should be applied to a vast range of climates, building types and construction systems in South Africa.

ENVIRONMENT

Through installing insulation in buildings we can:

- save energy, keeping you warmer in winter and cooler in summer;
- save money on energy bills; and
- save the environment, by cutting our carbon footprint.

Reduce, Reuse, Recycle

Thermal insulation reduces the consumption of fossil fuels used to heat and cool buildings. Reduction of fossil fuel consumption decreases the volume of air pollutants released into the atmosphere.

Thermal insulation with recycled content uses less natural resources, divert materials from the waste stream, use less energy during manufacturing and create employment opportunities for the unemployed by collecting waste material.

The insulation industry is full of good examples of recycled material use:

- Cellulose Fiber uses recycled newspaper by weight; the rest is comprised of fire retardant chemicals and—in some products—acrylic binders.

- Glass wool (also named fibreglass) uses recycled glass

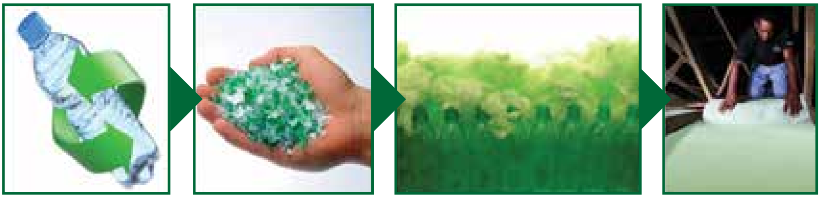
  Glass wool insulation is mostly made from recycled glass but it also includes some other ingredients - sand, soda ash, borax and limestone. These raw materials are weighed and mixed to the required formula. The other important component is resin, which is used to bind the glass wool together.

1. **BATCH:** Glass wool is made mainly of sand, soda-ash, limestone and recycled glass; stored in silos, they are weighed, mixed and poured into a furnace.
2. **MELTING:** The mixture is then melted at a temperature exceeding 1,400°C in an electric or gas furnace.
3. **FIBERIZING:** The liquid glass passes via a feeder to a fiberizing machine, where it is propelled through tiny holes by a centrifugal spinner - creating the fibers. These are sprayed with a binder and shaped into a blanket.
4. **FORMING:** Then the blanket passes through a curing oven. During this process, the blanket can be compressed to achieve its final thickness.
5. **CUTTING:** The blanket is then cut to the required width. Off-cuts are recycled. A facing can eventually be glued to the blanket.
6. **PACKAGING:** The end of the line is generally equipped with a rolling machine for mats and a stacking machine for boards.
7. **PALLETIZATION:** The glass wool can be compressed to up to a tenth of its volume. A total of 36 rolls of glass can be packed onto a single pallet.

- Mineral wool actually refers to two different materials: slag wool and rock wool. Slag wool is produced primarily from iron ore blast furnace slag, an industrial waste product and Rock wool is produced from natural rocks.
- Polyester Fiber uses recycled PET bottles.

  Polyester Fibre Thermal Insulation is made from the polyester of recycled PET bottles ("plastic" cooldrink bottles) that are heat bonded.

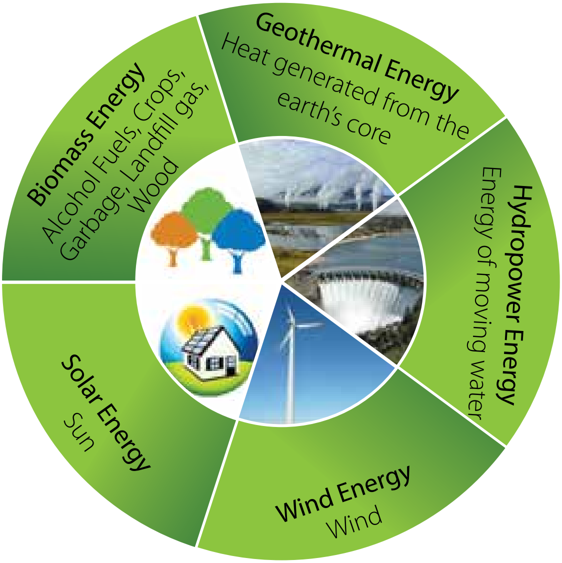
  Example: 171 x 500ml PET bottles = 6kg roll



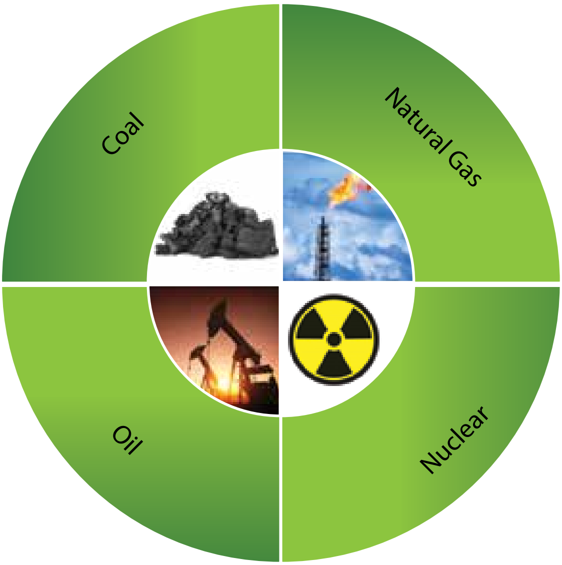
- Expanded Polystyrene (EPS) is 100% recyclable and re-usable. It can either be mechanically recycled into several applications or chemically converted into other products.

ENERGY

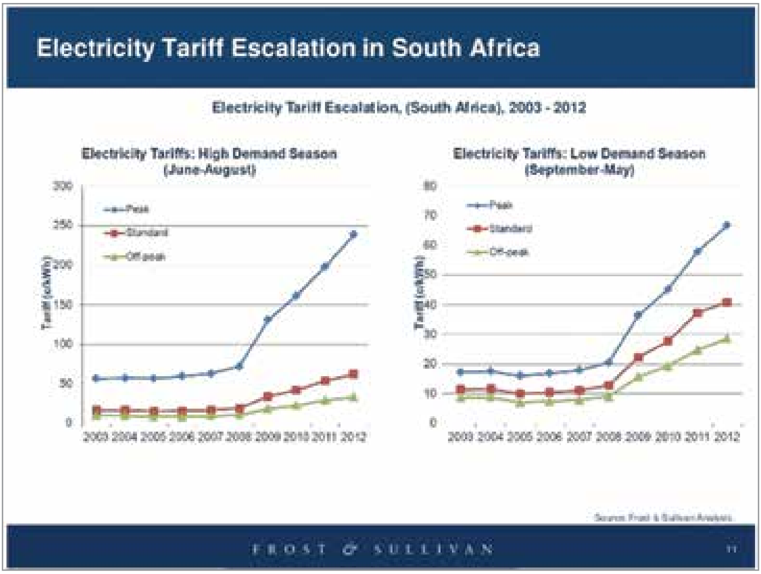
RENEWABLE ENERGY

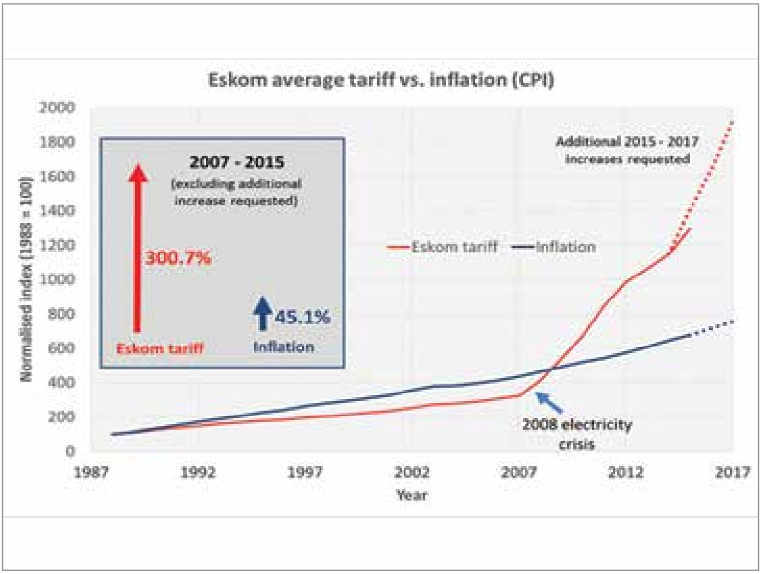


NON-RENEWABLE ENERGY

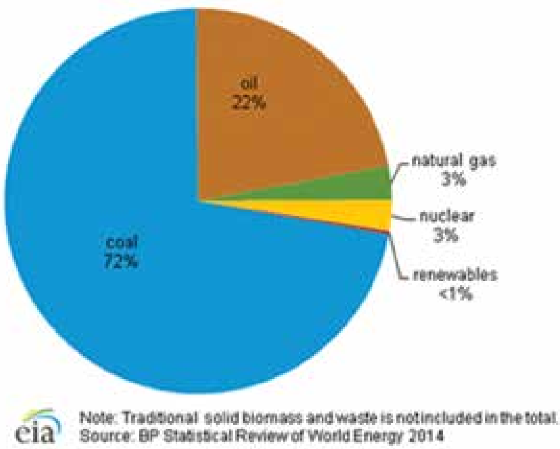


ECONOMICS

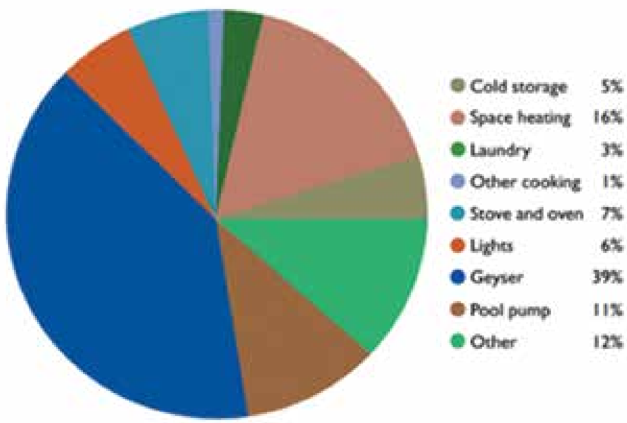

Electricity Tariff Escalation in South Africa
Electricity Tariff Escalation, (South Africa), 2003 - 2012
Electricity Tariffs: High Demand Season (June-August)
Electricity Tariffs: Low Demand Season (September-May)
Peak
Standard
Off-peak
Tariff (c/kWh)
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
FROST & SULLIVAN


Eskom average tariff vs. inflation (CPI)
2007 - 2015
(excluding additional increase requested)
300.7%
Eskom tariff
45.1%
Inflation
Additional 2015 - 2017 increases requested
Eskom tariff
Inflation
2008 electricity crisis
Normalised index (1988 = 100)
Year
1987 1992 1997 2002 2007 2012 2017

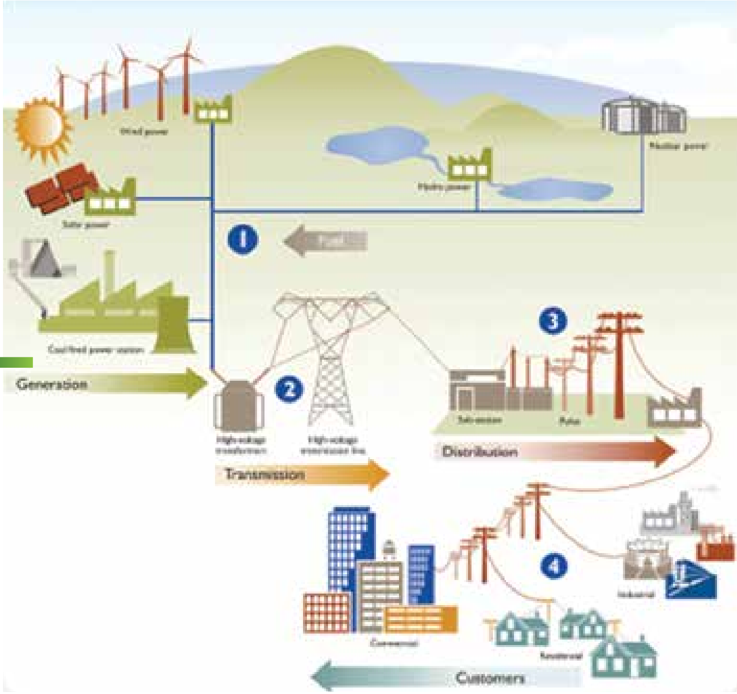
Total primary energy consumption in South Africa, 2013



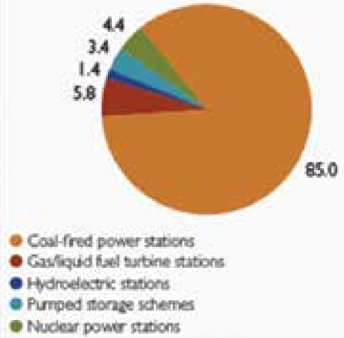
This graph, courtesy of Eskom, shows the amount of electricity an average household in South Africa uses in a month (up to December 2011)



Electricity: from power station to customer



Power station net maximum generating capacity mix (%)



C – CONDENSATION & CORROSION

Air always contains a certain amount of water vapour. This vapour can originate from many sources around the home—respiration, cooking, bathrooms and laundries, indoor plants, LPG gas heaters etc. When moist air is cooled below its dew point (i.e. cooled to a temperature at which it cannot contain all the water originally present), and if the cooling is caused by contact with a colder surface, the vapour changes to liquid droplets on that surface. This phenomenon is called condensation.

Condensation is more likely to occur:

- where there is a low ventilation rate within the walls or roof space, insufficient to remove water vapour (e.g. cathedral and flat roof ceilings);
- where daytime temperatures do not exceed 5°C (e.g. in alpine areas in winter); and
- where high amounts of water vapour are generated internally but not mechanically extracted.

Artificial cooling of buildings in some climates can cause condensation to form inside the layers of the building envelope. Such condensation can cause significant structural or cosmetic damage to the envelope before it is detected. Associated mould growth may also create health risks to the occupants. Effective control of condensation is a complex issue. In some locations a fully sealed vapour barrier may need to be installed on the more humid, or generally warmer, side of the insulation.

Corrosion protection - can be applied to the insulation by the use of various jacket materials. The corrosive atmosphere must be determined and a compatible material selected. Mastics may be used in atmospheres that are damaging to jacket materials.

Corrosion under insulation

D – DENSITY vs R-VALUE FOR COMMON INSULATION MATERIALS

An insulation's form and physical structure, environment, and application conditions can affect its apparent thermal conductivity.

Form and physical structure vary with the basic material and manufacturing process. Typical variations include density, cell size, diameter and arrangement of fibres or particles, degree and extent of bonding materials, transparency to thermal radiation, and type and pressure of gas within the insulation. The ASHRAE Figure 5 below, illustrates the variation with density of the apparent thermal conductivity at one mean temperature for a number of insulation materials used in building envelopes. For most mass-type insulation, there is a minimum that depends on the type and the form of the material, temperature, and direction of heat flow.

The "Figure 5" below is a plot from the ASHRAE Handbook of Fundamentals, 2005 edition, and page 23.15:

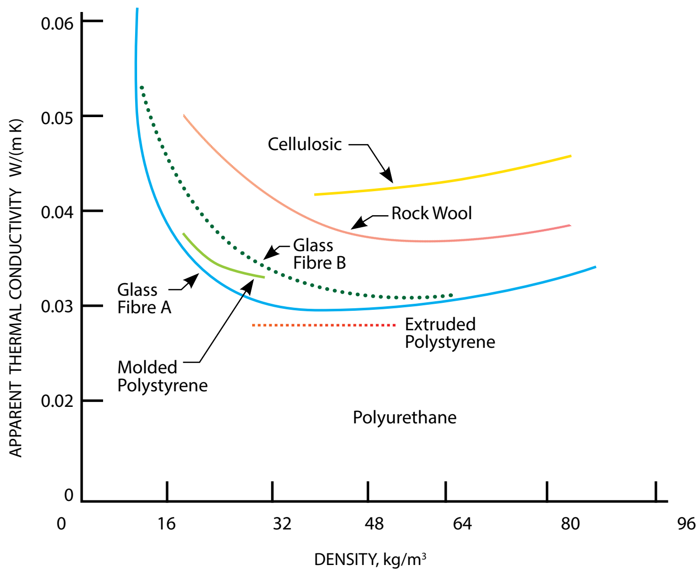


Figure 5 Apparent Thermal Conductivity Versus Density of Several Thermal Insulations Used as Building Insultaions

E – ENERGY EFFICIENCY REGULATIONS

Regulation 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 storages 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 its 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 XA2

At least 50 % by volume 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

Regulation XA3

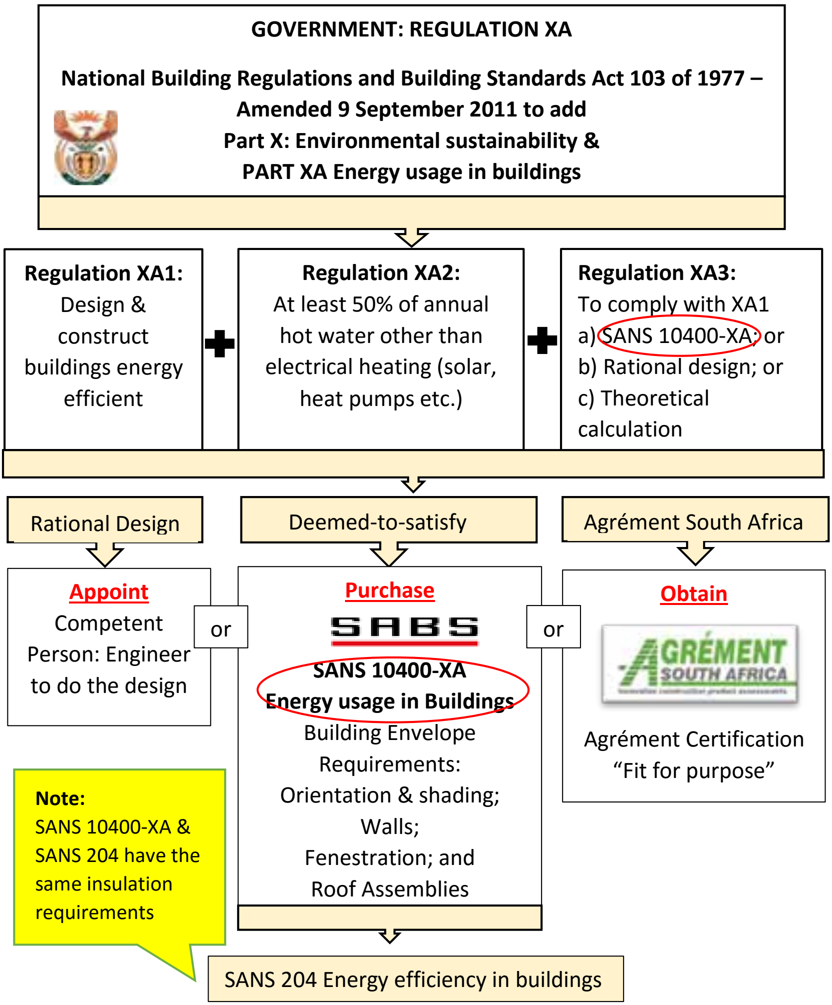
The requirements of sub-regulation XA1 shall be deemed to be satisfied when such building is designed and constructed in accordance with the following requirements:

a) has an orientation of the longest axis, shading, services and building envelope in accordance with SANS 10400-XA; or

b) is the subject of a rational design by a competent person, which demonstrates that the energy usage of such building is equivalent to or better than that which would have been achieved by compliance with the requirements of SANS 10400-XA; or

c) has a theoretical energy usage performance determined using certified thermal calculation software, less than or equal to that of a reference building in accordance with SANS 10400-XA.

Energy Efficiency Regulations



SANS 10400-A: 2010 EDITION 3

Regulation A2

Plans and Particulars to be furnished

A2 (1) Any person intending to erect any building, shall submit to the local authority the following plans and particulars, together with the application:

(g) a declaration by a person registered in a professional category of registration in terms of one of the councils for the professions identified in the Council for the Built Environment Act, 2000 (Act No. 43 of 2000) in the relevant portion of **Form 1** contained in SANS 10400-A as to how the applicable functional regulations shall be satisfied.

Regulation A19

Appointment of Persons Responsible for Design, Inspection and Assessment Duties

A19 (13) Where any person provides any information or certificate required in terms of this Regulation or which he or she knows to be incomplete or false, such person shall be guilty of an offence.

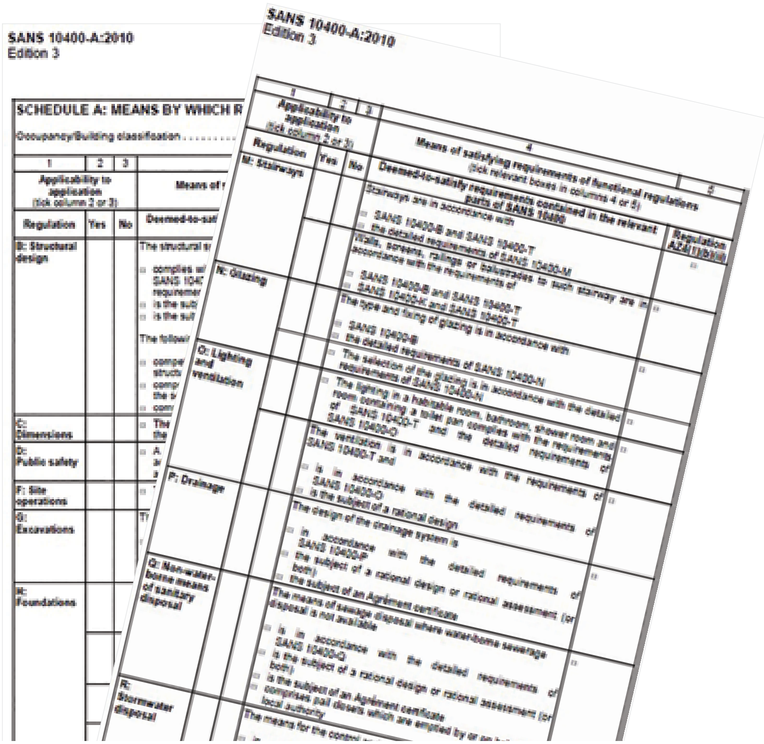
SANS 10400-A:2010
Edition 3

NATIONAL BUILDING REGULATIONS AND BUILDING STANDARDS ACT, 1977 (Act No. 103 of 197

FORM 1 DECLARATION BY PERSON RESPONSIBLE FOR PREPA APPLICATION FOR APPROVAL OF THE ERECTION OF BUILDING IN TERMS OF SECTION 4 OF THE ACT

SECTION 1: DECLARATION BY OWNER

SECTION 2: DECLARATION BY APPOINTED PROFESSIONAL PERSON


SANS 10400-A:2010
Edition 3

SCHEDULE A: MEANS BY WHICH R...

Occupancy/Building classification . . . .

1	2	3	
Applicability to application (tick column 2 or 3)			Means of ...
Regulation	Yes	No	Deemed-to-sat...
B: Structural design			The structural sy...
C: Dimensions			
D: Public safety			
F: Site operations			
G: Excavations			
H: Foundations			

SANS 10400-A:2010
Edition 3

1	2	3	4	5
Applicability to application (tick column 2 or 3)			Means of satisfying requirements of functional regulations (tick relevant boxes in columns 4 or 5)	
Regulation	Yes	No	Deemed-to-satisfy requirements contained in the relevant parts of SANS 10400	Regulation AZ4(1)(b)(ii)
M: Stairways			Stairways are in accordance with SANS 10400-B and SANS 10400-T the detailed requirements of SANS 10400-M Walls, screens, railings or balustrades to such stairway are in accordance with the requirements of SANS 10400-B and SANS 10400-T SANS 10400-K and SANS 10400-T	
N: Glazing			The type and fixing of glazing is in accordance with SANS 10400-B the detailed requirements of SANS 10400-N The selection of the glazing is in accordance with the detailed requirements of SANS 10400-N	
O: Lighting and ventilation			The lighting in a habitable room, bathroom, shower room and room containing a toilet pan complies with the requirements of SANS 10400-T and the detailed requirements of SANS 10400-O The ventilation is in accordance with the requirements of SANS 10400-T and is in accordance with the detailed requirements of SANS 10400-O is the subject of a rational design	
P: Drainage			The design of the drainage system is in accordance with the detailed requirements of SANS 10400-P the subject of a rational design or rational assessment (or both) the subject of an Agrément certificate	
Q: Non-water-borne means of sanitary disposal			The means of sewage disposal where water-borne sewerage disposal is not available is in accordance with the detailed requirements of SANS 10400-Q is the subject of a rational design or rational assessment (or both) is the subject of an Agrément certificate comprises pail closets which are emptied by or on behalf of the local authority	
R: Stormwater disposal			The means for the control ...	

SANS 10400 Part A Building Occupancy applicable to Regulation XA1			
A1	Entertainment & Public Assembly	E3	Other institutional (residential)
A2	Theatrical & indoor sport	E4	Health care
A3	Places of instruction	F1	Large shop
A4	Worship	F2	Small shop
A5	Outdoor sport	F3	Wholesalers' store
B1	High risk commercial service	G1	Offices
B2	Moderate risk commercial service	H1	Hotel
B3	Low risk commercial service	H2	Dormitory
C1	Exhibition hall	H3	Domestic residence
C2	Museum	H4	Dwelling house
D1	High risk industrial	H5	Hospitality
D2	Moderate risk industrial	J1	High risk storage
D3	Low risk industrial	J2	Moderate risk storage
D4	Plant room	J3	Low risk storage
E1	Place of detention	J4	Parking garage
E2	Hospital		

F – FIRE SAFETY

SANS 10400-T, Fire Safety, stipulates that when 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.

This Standard incorporates all factors required for fire-hazard or fire-risk assessment of the materials, products, or assemblies under actual fire conditions.

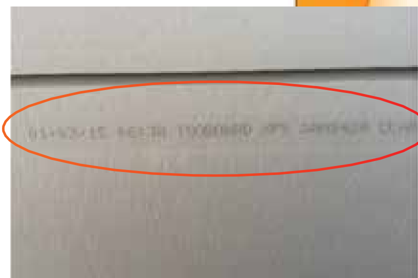
Standard testing procedures for thermal insulation to measure:

- Combustibility;
  SANS 10177-5, Fire testing of materials components and elements used in buildings Part 5: Non-combustibility at 750°C of building materials.
- Surface fire properties;
  SANS 10177-10, Fire testing of materials, components and elements used in buildings Part 10: Surface burning characteristics of building materials using the inverted channel tunnel test.

- Designated use and application. SANS 10177-11, Fire testing of materials, components and elements used in buildings Part 11: Large-scale fire performance evaluation of building envelope thermal insulation systems (with or without sprinklers)

For more information on insulation products classified in accordance with SANS 428, consult the TIPSASA Fire Database Register www.tipsasa.co.za

The fire performance rating classification must be printed on all insulation products and/or packaging and data sheets. Example: A/A1 or B/B1/2/H or V.

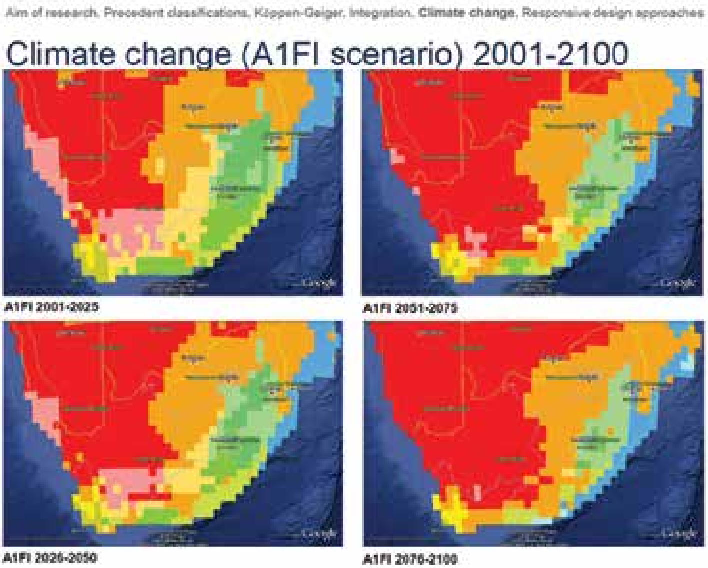


G – GLOBAL WARMING/ CLIMATE CHANGE

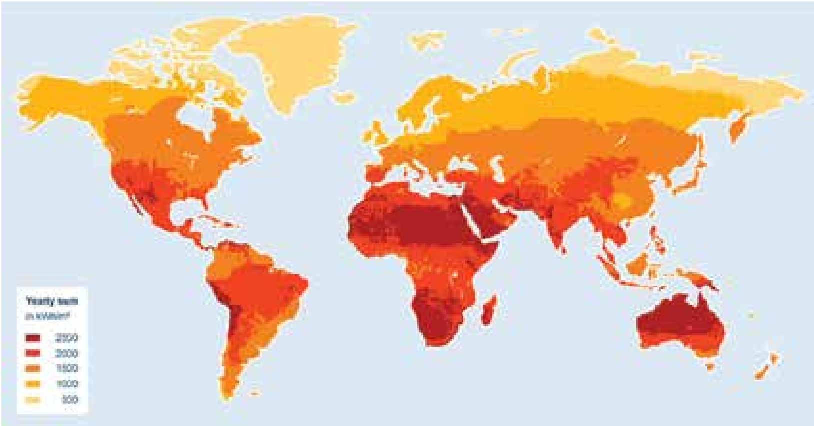
Still don't believe in global warming?

Observed and projected climate shifts 1901–2100 depicted by world maps of the Köppen-Geiger climate classification - Franz Rubel and Markus Kottek.

Tropical Climate   Arid Climate



There are three primary aspects to consider when investigating the thermal performance in the design of a building within South Africa. Firstly, an assessment should be conducted to determine optimal interior conditions which are favourable for the health, safety, comfort and overall well-being of the occupant. Secondly, climatic conditions should be considered to enable an optimal design which best suits the distinct conditions of the region. Lastly, the physical properties of structural elements used and the design strategy should enable optimal control of the interior environment (Van Straaten 1967). Based on the above predictions it is imperative to design buildings for the future to suite changing climatic conditions.



The solar radiation (insolation) map is based on values from Meteonorm.
Warmer colours indicate higher solar energy density (insolation, solar radiation, sunlight). As you can see from the map, insulation tends to be higher the closer we get to the equator.

Various thermal interventions options to address radiant heat exists.

Internal: Radiant heat barrier/Reflective Foil Laminate (RFL) insulation.

RFL"s (also known as Radiant Barriers) work on a different concept to conventional bulk insulation materials. Reflective insulation mainly resists radiant heat flow due to its high reflectivity and low emissivity (ability to re-radiate heat). It relies on the presence of an air layer (gap) of at least 25mm next to the shiny surface opposite to the source of heat flow. The insulation is installed across the rafters before the brandering is nailed down, thus providing the air gap. RFL is an excellent barrier for downward heat flow (summer heat gain), but only moderate for upward heat flow. For optimum energy savings install in conjunction with conventional bulk insulation.

External: Cool Roof Coatings

A cool roof reflects and emits the sun's energy (radiation) as light back to the sky instead of allowing it to enter the building below as heat. In many climate zones, a cool roof can substantially reduce the cooling load of the building. If a building does not have air conditioning, this keeps the building cooler and a more constant temperature. If a building has air conditioning, the equipment does not have to work as hard. However, cool roofs can also increase heating costs in winter months therefore it is necessary to have a certain amount of insulation.

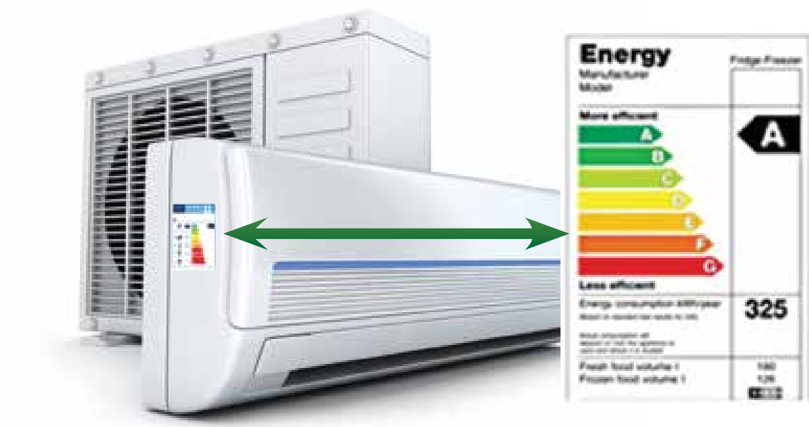
H – HEATING AND COOLING

Heating and cooling your home/building uses more energy and costs more money than any other system in your home—typically making up about 54% of your utility bill. Efficiency in this area can bring great savings. Heating and cooling depend on many contributing factors. The type of heating and cooling you choose, the design of your home/building, the spaces that can be closed off, the windows, draughts, orientation of the house, floor coverings and insulation.

By combining proper equipment maintenance and upgrades with recommended insulation, air sealing, and thermostat settings, you can cut your energy use for heating and cooling—and reduce environmental emissions—from 20%-50%.

Long-Term Savings Tips

Select energy-efficient products when you buy new heating and cooling equipment. Your supplier should be able to give you energy fact sheets for different types, models, and designs to help you compare energy usage.



I – INSULATION PRODUCT TYPES

There are many types of insulation, derived from natural, mineral or petrochemical sources. Thermal insulation acts as an inhibitor to heat transfer either by conduction, convection, radiation or a combination of these, reducing heat loss in winter to keep the building warm or reducing heat gain in summer to keep the building cool.

Insulation products are divided into four categories:

1. Bulk Insulation (Flexible – fibre)
2. Bulk Insulation (Rigid – Cellular or fibre))
3. Reflective Foil Insulation (RFL, also known as "Radiant Barrier")
4. Composite Bulk Insulation (Flexible or Rigid – Cellular or Fibre)

Composite Bulk Insulation is a combination of numbers 1 or 2 and 3.

Bulk Insulation

Materials of low thermal conductivity, that mainly resists (slows) the transfer of conducted and convected heat, relying on pockets of trapped air or low conductive gasses within its structure. Its thermal resistance is essentially the same regardless of the direction of heat flow through it and is proportional to its thickness, density and upper temperature.

Types of Bulk Insulation

Glass Wool (Fibreglass) manufactured from molten glass spun and formed into mats, rolls and blankets or fine fibres coated with a binding resin. Batts and blankets are light weight, fit standard tie beams and stud spaces, easy to cut and install. Should not be compressed or moistened. Butt all ends and edges together firmly. If installed carefully it will not slump or settle. During installation glass fibre can cause eye, skin and respiratory irritation, and manufacturer's safety recommendations should be followed. Limited operating temperatures are at 350°C.

Mineral Wool (Slag/Rock Wool) manufactured from molten industrial slag, which is fiberized, treated with oil and binders to suppress dust, and maintain shape. It is similar to glass fibre in texture and appearance but denser than glass-wool so R-Value per unit thickness is higher. Rock Wool is manufactured in a similar manner except that natural rock is used instead of slag. These materials have a high fire resistance, limiting operating temperature 850°C. It can cause eye, skin and respiratory irritation during installation.

Polyester Fibre made from polyester fibres (including recycled PET bottles) spun into a flexible mat. Available as batts or blankets. Easy to cut and install, non-irritable, with no known physical or health hazards. When exposed to a direct flame the product would melt and shrink away from the flame. Limited operating temperature 150°C.

Cellulose Fibre insulation is made from finely shredded recycled paper which is milled into a light fibrous matrix, which is chemically treated to resist fire and fungal growth. Due to the small size of the particles, cellulose can 'flow' around obstructions (nails, electrical wires, trusses, etc.) to give a uniform fill. If the insulation is not blown to manufacturer's recommended density and thickness it can settle over time, and the intended R-Value will not be achieved and maintained.

Examples: Flexible Bulk Insulation

Cellulose Fibre

Flexible Polyester Fibre

Glass Wool

Rockwool

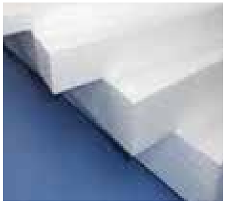
Expanded Polystyrene (EPS) is a lightweight, plastic foam insulation produced by trapping small amounts of pentane gas into solid beads of polystyrene. The pentane gas expands under the action of heat, applied as steam, to form perfectly closed cells of EPS. These cells occupy approximately 40 times the volume of the original polystyrene bead. The EPS beads are then moulded into blocks or boards in three standard densities; low, medium and high. EPS has excellent thermal properties, is moisture resistant, and provides environmentally safe lifetime durability. EPS is easy to install, non-toxic, contains no CFC's or HCFC's and is recyclable.

Extruded Polystyrene (XPS) is a closed cell polystyrene foam board, which retains gas but excludes water. It is produced on a continuous, fully automated extrusion process. It is manufactured in two densities; medium and high. The high density board should be used where the material will be exposed to relatively high pressures, such as below a concrete slab or in built-up roofing. Most commonly used for slab-edge and cavity brick wall insulation. Polystyrene will 'break-down' if left exposed to sunlight for prolonged periods, and must also be protected from solvents and non-compatible adhesives.

Examples: Rigid Bulk Insulation

Glass wool/Fibreglass

Extruded Polystyrene - XPS



Expanded Polystyrene -EPS

Polyurethane and Polyisocyanurate insulations are manufactured by chemical reactions between poly-alcohols and isocyanurates creating or forming tiny air cells. The cells contain refrigerant gases (fluorocarbons) instead of air. The boards are usually double-faced with foil, or sometimes come bonded with an interior or exterior finishing material. The boards must be protected from prolonged exposure to water and sunlight, and if used on the interior must be covered with a fire-resistant material, such as drywall. Due to the relatively high cost of these insulations, use is generally limited to areas which require a high R-Value but where space is very limited.

Phenolic Foam is manufactured from phenol formaldehyde resin, and is available as either an open or closed cell product. The boards usually come with a foil facing on one or both sides. It is much less combustible than other rigid insulations. It should be protected from prolonged exposure to sunlight and water. It is suitable for wall sheathing, and for use on the interior, both above and below grade. Use is generally limited to areas which require a high R-Value, but where space is very limited.

Polyurethane Foam is closed cell foam, which is usually pale yellow in colour, and can be used for a variety of spray applications. The material is mixed on site with special equipment for large applications. For small applications, single component foam is available in spray cans, for sealing around windows, doors, etc. The foam will act as an air barrier, but not a vapour barrier and should be protected from prolonged exposure to sunlight. When the foam is used in the interior of a house, it must be covered with a fire-resistant material, such as drywall.

Reflective Foil Insulation

Reflective Foil Insulation (Radiant Barrier) mainly resists radiant heat flow due to its reflectivity, low absorption, conductivity and low emissivity (ability to re-radiate heat). Reflective insulation works by letting through a small percentage of the radiant heat it receives absorbs and reflecting a percentage of the rest using a shiny surface. An air gap next to the reflective surface creates a layer of air, which is important for reducing absorption and lowering the emittance to the opposite side from the direction of the heat source, thereby reducing heat flow through the system.

Reflective insulation is more effective at reducing summer heat gain than slowing heat losses in winter and this should be taken into account at thermal design stage. It relies on the presence of a defined air space next to the shiny surface. The thermal resistance of reflective insulation varies with the direction of heat flow through it, i.e. vertical, horizontal or at a degree angle.

Reflective foil is valuable in combination with bulk insulation for maximum performance. It is a useful barrier against transfer of moisture. Reflective surfaces needs to remain clean and dust free. Dust build-up reduces the R-Value of the product. Reflective foil insulation should not be placed on top of ceilings or ceiling joists, nor under floors, as it is electrically conductive. Any such insulation must also be secured with non-conductive staples

Reflective Foil Insulation - RFL

Composite Bulk Insulation

Composite Bulk and reflective materials are available that combine some features of both types.

Examples include Foil bonded to bulk insulation, whether blankets, batts or boards i.e. foil faced blankets, foil faced batts and foil faced boards.

WARNING: FIRE TESTING

Insulation, composite insulation products and composite panels shall be tested with the maximum core or insulation thickness as stated in SANS 204.

DO NOT use insulation products in conjunction with other insulation types for "cheaper options" in order to comply with SANS 10400-XA Energy usage in buildings, unless it was tested to be used as such.

J – JOULES & JOBS

Joules

Joule definition: The International System unit of electrical, mechanical, and thermal energy.

The joule, symbol J, is a derived unit of energy in the International System of Units. It is equal to the energy transferred (or work done) to an object when a force of one newton acts on that object in the direction of its motion through a distance of one metre (1 newton metre or N·m). It is also the energy dissipated as heat when an electric current of one ampere passes through a resistance of one ohm for one second.

It is named after the English physicist James Prescott Joule (1818–1889). He laid the foundation for the theory of conservation of energy, which later influenced the First Law of Thermodynamics. He also formulated the Joule's laws which deal with the transfer of energy.

Job creation

As previously mentioned; thermal insulation with recycled content uses less natural resources, divert materials from the waste stream, use less energy during manufacturing and create employment opportunities for the unemployed by collecting waste materials.

Not only does it allow for waste to be collected and diverted it could also contribute to training unskilled workers to install thermal insulation seeing that the installation of thermal insulation has become mandatory in certain building occupancy classes in 2011. Not only will this create jobs but can also lead to young entrepreneurs starting their own small businesses, installing thermal insulation and saving energy. TIPSASA together with SAQCC accredited training providers, have embarked on a training initiative in 2016. This incorporated residential and industrial applications. Contact our offices for more information.

K – KILOWATT HOUR

Like a metre is a measurement of length, a kilowatt hour (kWh) is a measurement of energy. It measures or describes the amount of power used in a certain amount of time

All appliances carry a power rating that indicates the amount of power they use.

230-240V ~ 50-60 Hz

1000 W

Example of sticker (label) on the appliance.

This appliance has a power rating of 1000 W

1000 Watt is the same as 1 kWh (one kilowatt)

If I run a 1 kWh appliance for 1 hour it uses a total of 1 kWh of energy.

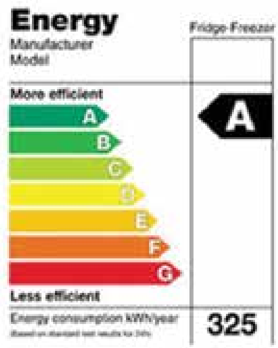
1 kW x 1 h = 1 kWh

L – LABELLING

How to Read the Energy Label

The Energy Guide label is required to be placed on all appliances by the manufacturers.

The label provides information about energy consumption, and shows you how much energy an appliance uses compared with similar models. Keep in mind that the numbers are averages: actual costs will differ somewhat depending on how you use them.



How to Read the Insulation Label

Information on the product label either inside the packaging or on the packaging should provide the manufacturer's name, and trade name or trademark, or both; the batch identification or date of manufacture; the nominal length, width and thickness of the material, in mm where appropriate; the nominal and coverage area of the material in square metres; the nominal gross mass; the nominal thermal resistance R-Value of the material, in $m^2.K/W$; the fire performance classification and a warning, referring to precautions for health and safety during handling and installation of the insulation material. Ensure that the product is suitable for the intended application.

M – MOISTURE

There is a lot of confusion about insulation that's been soaked or damaged by flood waters or leaky plumbing. Is it still a good insulating material? Does it breed mold and mildew? Will it eventually damage other structures such as drywall or tile floors?

Insulation will lose its insulating efficiency or R-Value when exposed to moisture. Some insulation products are not absorbent and, if exposed to moisture, will not wick up or hold water. If allowed to dry out insulation may retain its original R-Value.

Clean-up and restoration after water damage is a comprehensive job. It requires skills, tools and experience in a variety of disciplines. Please contact the Associating for professional advice.

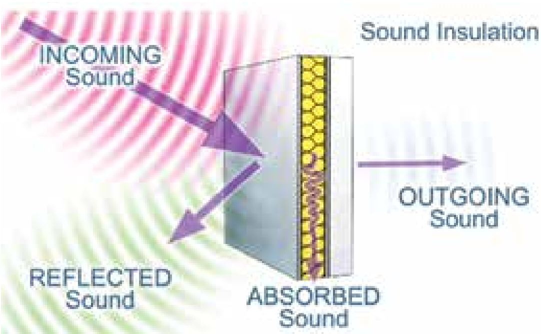
In wall applications certain insulation material may be applied as vapour retarders, or moisture barriers.

Example: Aluminium vapour barrier

N – NOISE REDUCTION

Noise Reduction Coefficient (NRC) measures the degree to which a product absorbs sound.

Soundproofing insulation is a special type of insulation product, designed to be an acoustic barrier. The insulation barrier absorbs sound and can greatly reduce noise leakage from one room to another.



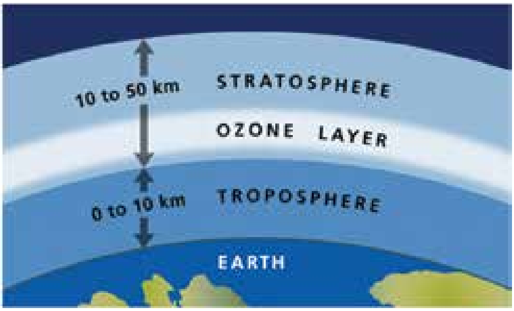
NRC is represented by a number between 0 and 1.00, which indicates the percentage of sound reaching it that will be absorbed. For example, an acoustical ceiling insulation panel with an NRC value of .60 will absorb 60% of the sound that strikes it and deflect 40% back into the space. A ceiling insulation panel with an NRC of .50 or higher is considered to offer significant sound absorbing properties. A higher score is better. A ceiling with an NRC of 1.00 absorbs all sound. A ceiling with a NRC of 0.00 absorbs no sound.

Sound Transmission Class (or STC) or Sound Reduction Index (SRI) is a numeral rating of how well a building partition reduces airborne sound. It is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations. The STC rating figure very roughly reflects the decibel reduction in noise that a partition can provide.

O – OZONE

The ozone layer is defined by meteorologists as an area/region of concentrated ozone just above the troposphere/lower layer of the stratosphere. It is important to note that ozone is not only confined to the stratosphere (about 90% of the atmosphere's ozone is in the stratosphere), but across the whole atmosphere. In big cities during the summertime, air quality at the surface can be an issue when ozone and other gases increase to dangerous levels.

Ozone gas is like a double edged sword. When ozone is at the earth's surface, it can be dangerous as it is corrosive and harmful to breathe in. However, when it is concentrated in the lower stratosphere, it actually protects us from the sun's harmful UV rays. Without ozone in the atmosphere, it would be too dangerous to walk outside without having to wear some sort of special suit.



During the mid-1980s, concerns grew over what appeared to be a 'hole' in the ozone layer over Antarctica in spring. Scientists determined that the 'hole' was caused by humans due to man-made chemicals such as CFCs (chlorofluorocarbons). The CFCs and other chemicals were interacting with the ozone and destroying the layer over Antarctica. A smaller hole was also seen over the Northern Hemisphere. Initially, it seemed impossible that CFCs could reach the stratosphere as they were heavier than air. However, weather phenomena like thunderstorms can produce updrafts and carry air (and other) particles to the top of the troposphere and even into the parts of the stratosphere. In 1987, the Montreal Protocol was put together by several nations with the goal of reducing and completely stopping the production of CFCs. While CFCs are still being produced today by smaller nations, the ozone 'hole' has begun to fill in, although it may be decades before it completely recovers.

Chlorofluorocarbons (CFCs) are nontoxic, non-flammable chemicals containing atoms of carbon, chlorine, and fluorine. They are used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants.

How does this relate to public health?

Exposure to ultraviolet (UV) rays from the sun (shortwave radiation) is said to cause 65% to 90% of melanoma of the skin, which accounts for three-fourths of all skin cancer deaths. Additionally, the sun's UV rays can also cause cataracts and other damage to the eye. On the other hand, exposure to UV rays impacts vitamin D circulation, which is said to be a protective factor against colon or rectum cancer. https://climate.ncsu.edu/edu/k12/.ozonelayer

Montreal Protocol

The **Montreal Protocol** on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion.

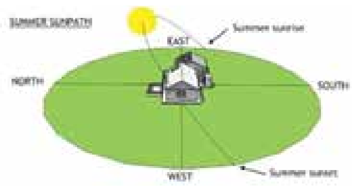
In terms of the Montreal protocol, and recent amendments, South Africa is a developing country, and it is not illegal to use HCFC blend as a blowing agent. There is a phase out plan to reduce the use of HCFC's in developing countries over time, as can be seen below, an extract from: Decision XIX/6, an adjustment to the Montreal Protocol:

For Article 5 Parties to have completed the accelerated phase-out of production and consumption in 2030, on the basis of the following reduction steps:

a) By 2015 of 10 per cent;
b) By 2020 of 35 per cent;
c) By 2025 of 67.5 per cent;
d) While allowing for servicing an annual average of 2.5 per cent during the period 2030–2040.

P – PASSIVE DESIGN

Passive design' is design that takes advantage of the climate, i.e. natural energy flows, to maintain a comfortable temperature range in the building. Passive design reduces or eliminates the need for auxiliary heating or cooling.



Passive design utilises natural sources of heating and cooling, such as the sun and cooling breezes. It is achieved by appropriately orientating your building on its site and carefully designing the building envelope (roof, walls, windows and floors of a home). Well-designed building envelopes minimise unwanted heat gain and loss.

Consider factors such as your climate, building design, and budget when selecting insulation.

Buildings and Trees - Natural Partners

Deciduous trees planted on the east and west sides will help keep your house/ building cool in the summer and allow sun to shine through the windows in the winter.

Cool Roofs

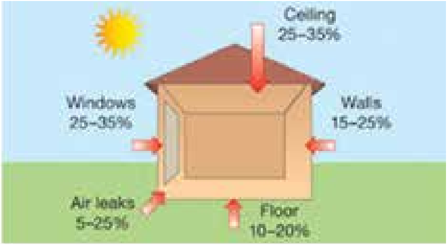
If you've ever stood on a roof on a hot summer day, you know how hot it can get. The heat from the roof makes an air conditioner work even harder to keep a building cool.

If you are building a new home/building, decide during planning whether you want a cool roof. A cool roof uses material that is designed to reflect more sunlight and absorb less heat than a standard roof resulting in reduced usage of air-conditioning. Cool roofs can be made of a highly reflective type of paint, a sheet covering, or highly reflective tiles or shingles.

If you want to convert an existing roof to a cool roof:

- Retrofit the roof with specialized heat-reflective coating
- Re-cover the roof with a new waterproofing surface.
- Replace the roof with a cool one.

Air Leaks



Inadequate thermal insulation and excessive air leakage are the main causes of heat loss in older domestic properties.

Improving your home's insulation and sealing air leaks are the fastest and most cost-effective ways to reduce energy waste and make the most of saving money. Be sure to seal air leaks before you insulate, because insulating materials won't block leaks.

Sealing Air Leaks

One of the quickest energy- and money-saving tasks you can do is caulk, seal, and weather strip all seams, cracks and openings to the outside.

Tips for Sealing Air Leaks

- Test your building for air tightness.
  On a windy day, carefully hold a lit incense stick or candle next to your windows, doors, electrical boxes, plumbing fixtures, electrical outlets, ceiling fixtures, attic hatches, and other places where air may leak. If the smoke stream travels horizontally, you have located an air leak that may need caulking, sealing, or weather stripping.
- Caulk and weather-strip doors and windows that leak air.
- Caulk and seal air leaks where plumbing, ducting, or electrical wiring comes through walls, floors, ceilings, and soffits over cabinets.
- Inspect dirty spots in your insulation for air leaks and mould. Seal leaks with low-expansion spray foam made for this purpose and install house flashing if needed.
- Look for dirty spots on your ceiling paint and carpet, which may indicate air leaks at interior wall/ceiling joints and wall/floor joists, and caulk them.
- Use foam sealant on larger gaps around windows, baseboards, and other places where air may leak out.
- Fit weather seals as a permanent fixture to the door or window frame.

Q – QUALITY

In accordance with the South African National Building Regulations a local authority may require a test report or evaluation certificate in respect of any construction system, method, material, article or product which is proposed to be used in the erection of any building, to ascertain the adequacy or safety in use thereof.

The test reports and certificates referred to are:

- An SABS test report; or
- A CSIR report; or
- An Agrément certificate (only acceptable in the absence of a South African National Standard – i.e. fit for purpose).

Accessibility to Standards ensures good quality products.

A standard is essentially a technical document that standardise generally in terms of quality and performance, and it serves as a form of a benchmark.

TIPSASA Members are required to comply with the relevant South African National Building Standards, applicable to their relevant products. Membership of TIPSASA will provide recognition that products and services meet the requirements of quality, performance and safety set by the Association in compliance with the South African National Building Regulations.

R – "R-VALUE"

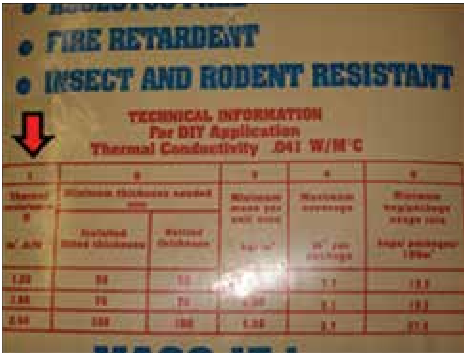
Insulation materials are rated for their performance in restricting heat transfer. This is expressed as the R-Value, also known as thermal resistance.

The R-Value is a guide to its performance as an insulator-the higher the

R-Value, the better the insulation (i.e., resistance to heat flow) it provides.

R-Values are expressed using the metric unit's m^2.K/W, where:

- m^2 refers to one metre squared of the material of a specified thickness;
- K refers to a one degree temperature difference (Kelvin or Celsius) across the material;
- W refers to the amount of heat flow across the material in watts.



Use the nominal R-Values as listed by the manufacturer on the packaging of the insulation to determine the performance.

Products which have the same R-Value will provide exactly the same insulating effect as each other, provided they are correctly installed. The higher the R-Value the more effective the insulation. Products must be installed in accordance with the manufacturer's installations specifications.

The information available on the product data sheet and/or label must include the R-Value and Fire Performance Classification. See example below. Ensure that the insulation suits your particular application. Ask if performance guarantees and/or test certificates are available.

R – "R-Value" Calculations

The R-value is a measure of resistance to heat flow through a given thickness of material. So the higher the R-value, the more thermal resistance the material has and therefore the better its insulating properties.

The R-value is calculated by using the formula $R = \frac{l}{\lambda}$

Where:

- l is the thickness of the material in metres and
- λ is the thermal conductivity in W/mK

The R-value is measured in metres squared Kelvin per Watt (m^2.K/W)

For example the thermal resistance of 135mm of fibre glass insulation (with thermal conductivity 0.040 W/mK) is 3.37 m^2.K/W

The R-value is therefore a relatively simple way to compare two insulating materials if you have the thermal conductivity for each material. It also allows you to see the impact of adding thicker layers of the same insulating material.

WARNING: Ensure products added together has been tested as such to determine their fire performance! Simply adding products together could cause a fire hazard. Only use composites tested with a fire performance rating.

When it comes to the building envelope the R-value of the individual insulation materials becomes just one of the performance parameters to be taken into consideration when determining the

To determine the insulation thickness required:

R-Value of Fibre glass blanket (1m) – 1/0.040 = 25 m^2.K/W

$$\text{Thickness} = \frac{\text{R-Value required}}{\text{R-Value of material}}$$

$$\frac{3.37\ m^2.K/W}{25\ m^2.K/W}$$

0.1348m (approx. 135mm) **SANS 204 Deemed-to-satisfy**

S – SYSTEM SOLUTIONS

ETICS - WHAT IS ETICS? (ALSO KNOWN AS EIFS)

ETICS is the abbreviation for External Thermal Insulation Composite System.

ETICS can be used to improve the energy efficiency of both new and existing buildings. A comprehensive range is available to meet the various demands of building structure and architecture.

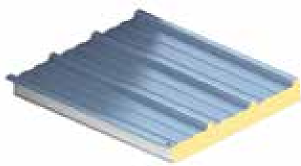
ETICS consist of an insulating core, like glass fibre or polystyrene, and the necessary components for fixing to the outside wall with adhesive, anchors or mechanically with rails. After that they are coated with plaster that has been reinforced with woven glass fibre mesh. The final layer consists of the finishing plaster or the desired surface material. ETICS can be used for a great variety of buildings.

THERMAL INSULATED PANELS

Insulated panels consist of two metal faced panels, bonded to an insulation core by means of an adhesive forming a double skin insulating sandwich panel. Sandwich panels belong to the generic group called "composite structures".

Thermal insulating sandwich panels can be used in the following applications:

a) roofs and roof cladding;
b) external walls and wall cladding; and
c) walls (including partitions) and ceilings within the building envelope.



For applications in the building sector, where high thermal performance and load bearing capacity is needed, insulated roof and wall systems are used as load-bearing components in the construction of roofs and walls.

Compared to conventional roof and wall systems, which are built up on site, sandwich panel systems are prefabricated off-site, and are quickly assembled to the structure when they arrive on site.

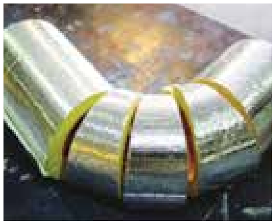
THERMAL PIPE INSULATION

In accordance with SANS 10400-XA Energy usage in buildings, all exposed pipes to and from the hot water cylinders and central heating systems shall be insulated with pipe insulation material.

Pipe insulation must be:

a) protected against the effects of weather and sunlight,
b) be able to withstand the temperatures within the piping,
c) be fire rated, and
d) achieve the minimum required total R-Value's.

Example: Snap on pipe insulation is a pre-formed, rigid, resin bonded Glasswool section of 1 metre in length. A single longitudinal slit allows the section to open to encompass the pipe and snap closed after placement. Standard finishing options are available in plain, canvas and reinforced foil.



Other insulation cores are:

- Polystyrene
- Polyurethane
- Polyisocyanurate

GEYSER INSULATION

A Geyser blanket consists of an insulating material and an outer reflective coating. The whole essence of fitting a geyser with a geyser blanket is to minimize thermal energy (heat) lost and thereby save energy.

T – THERMAL PERFORMANCE (INCLUDING THERMAL BRIDGING)

Thermal insulation refers to materials or a combination thereof which provide resistance to heat flow. The insulating capability of a material is measured for thermal conductivity (k). Low thermal conductivity is equivalent to high insulating capability (R-Value).

Insulation materials are rated for their performance in restricting heat transfer. This is expressed as the R-Value, also known as thermal resistance. The R-Value is a guide to its performance as an insulator-the higher the R-Value, the better the insulation (i.e., resistance to heat flow) it provides. R-Values are expressed using the metric unit's $m^2.K/W$.

R-Values can differ depending on the direction of heat flow through the product. The difference is generally marginal for bulk insulation but can be pronounced for reflective insulation.

- Up R-Values describe resistance to heat flow upwards (sometimes known as 'winter' R-Values).
- Down R-Values describe resistance to heat flow downwards (sometimes known as 'summer' R- values).

Insulation performance is influenced by many factors the most prominent of which include:

- Thermal conductivity ("k" or "λ" value)
- Surface emissivity ("ε" value)
- Insulation thickness
- Density
- Specific heat capacity
- Thermal bridging

It is important to note that the factors influencing performance may vary over time as material ages or environmental conditions change.

Thermal bridges occur, this can lead to lowered temperatures either on the internal surface or within the structure, with the subsequent risk of condensation and mould growth as well as a reduction in its energy efficiency capability. When working with existing buildings, the total elimination of thermal bridging is not always practical or even possible without extreme intervention.

U – USEFUL TERMS

Carbon tax: A tax on the emission of carbon dioxide into the atmosphere.

Flammability: The ability of a substance to burn or ignite, causing fire or combustion. The degree of difficulty required to cause the combustion of a substance is quantified through fire testing.

Flame spread: The surface burning characteristics rating is a ranking derived by laboratory standard test methodology of a material's propensity to burn rapidly and spread flames.

Fire Resistance: The shortest period for which a building insulation element or component will comply with the requirements for stability and integrity. A fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. Fire resistance is often confused with fire retardant abilities.

Life-cycle assessment (LCA, also known as life-cycle analysis or cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from cradle to grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).

Orientation: Direction that a building envelope element faces.

Solar heat gain: The increase in temperature in a space, object or structure that results from solar radiation.

Solar energy: Electromagnetic energy radiated from the sun

Thermal capacity (C-value): The ability of a material to store heat energy.

Thermal bridging: The transfer of heat across building elements, which have less thermal resistance than the added insulation. This decreases the overall R-Value. Wall frames and ceiling beams are examples of thermal bridges, having a lower R-Value than the insulating material placed between them. Because of this, the overall R-Value of a typical ceiling and/or wall is reduced.

Thermal mass: The ability of building materials to store heat. The basic characteristic of materials with thermal mass is their ability to absorb heat, store it, and at a later time release it at a slow pace.

U-Value: Measures the transfer of heat through a material, a building element or sandwich panel (thermal transmittance).

V – VAPOUR BARRIERS/ RETARDERS

Vapour barriers/retarders include polythene sheet, reflective foil, foil backed plasterboard and well maintained water resistant painted surfaces. Provide vapour and moisture barriers to the warm side of the thermal insulation to prevent condensation. Water resistant insulation such as polystyrene can also act as a vapour retarder. Tape or glue all joints in vapour barriers to keep out moisture and ensure that there are no tears or pinholes or damage in the membrane.

Use vapour barriers to protect from condensation:

- In hot humid (tropical) climates.
- In cool climates where the difference between indoor and outdoor temperature is significant.
- In roof spaces with a low ventilation rate, for example cathedral or raked ceilings.
- In situations where high amounts of vapour are generated and not exhausted.
- Use perforated reflective foil in walls when building with porous materials. The perforations prevent water droplets from penetrating but allow vapour through so that the insulation can dry if it does somehow get wet. This prevents rotting behind weatherboards, for example.
- On the underside of metal roofing, to minimize the likelihood of corrosion, surface mould, decay of wood based materials, sheet plastics, etc.

In cold climates place the vapour barrier on the warm inside of the insulation (directly above the ceiling lining and next to the internal wall lining).

In warm climates place the vapour barrier on the outside of the insulation. In hot humid climates it is ideal to have bulk insulation with a double sided vapour retarder. The top vapour barrier can be installed on site or a loose outlay.

Note: The above is a very wide rule of thumb approach and a general design guide, for more critical design each application must be considered on its own merits and may require professional advice.

Use perforated reflective foil in walls and under mezzanine floors when building with porous materials. The perforations prevent water droplets from penetrating but allow vapour through so that the insulation can dry if it does somehow get wet. This prevents rotting behind weatherboards or under timber floors, for example.

W – WALLS INSULATION

External walls are defined as the complete walling system, as measured from the outer skin exposed to the environment, to the inside of the inner skin exposed to the interior of the building, and does not include glazing.

Designers should consider that interstitial condensation occurs in walling systems which are not able to accommodate moisture migration. The selection of vapour retarder and appropriate construction materials, including insulation, is important for the thermal efficiency of walling in climate zones where damp and high relative humidity is experienced.

Thermal resistance that is added to external walling with high thermal capacity *(the ability of a material to store heat energy)*, should be placed in between layers e.g. in the cavity of a masonry wall.

Approximately 24% of heat from an average un-insulated home is lost through the walls. Wall insulation can act as a moisture retarder. External walls should be insulated to reduce radiant and conducted heat transfer.

Wall insulation can be installed:

- Within cavities
- On the outside surface of solid walls (ETICS or EIFS Systems)

Cavity brick walls have high thermal mass, but without insulation are usually too cold in winter and often too hot in summer if exposed to prolonged heat wave conditions. If the cavity is insulated, the internal thermal mass (i.e. the internal brick skin) is protected from external temperature changes, and becomes highly effective at regulating temperatures within the building. Thermal mass is the ability of building materials to store heat. The basic characteristic of materials with thermal mass is their ability to absorb heat, store it, and at a later time release it.

If using a framed construction system, insulation should be placed in the wall framing. Insulation can also be installed on the outside of the framing (but the insulation must be weatherproof to be effective).

The amount of insulation installed may depend on the thickness and thermal mass of the walls and the size of the framing.

If building a new home or renovation, consider increasing the thickness of the framing size to fit in more insulation.

If using a solid construction system such as concrete, insulation should be placed on the inside of the wall leaf and within the cavity.

Cavity wall insulation is used to reduce heat loss through a cavity wall by filling the air space with material that inhibits heat transfer. This immobilises the air within the cavity (air is still the actual insulator), preventing convection, and can substantially reduce space heating costs.

Cavity Wall Insulation can also reduce condensation which in time will help prevent damp problems within the home, can increase the value of a home whilst reducing the cost of energy bills and carbon emissions

During construction of new buildings, cavities are often filled with glass fibre wool or rock wool panels placed between the two leaves (sides) of the wall, but many other building insulation materials offer various advantages and many others are also widely used such as scarred polystyrene, polyurethane and Polyisocyanurate.

Cavity wall insulation also helps to prevent convection and can keep a house warm by making sure that less heat is lost through walls; this can also thus be a more cost-efficient way of heating one's house.

Building a cavity wall need not be cumbersome, new insulation products on the market makes this or the process fast and easy with the best thermal insulation performance to date.

Unlike conventional wall insulation which requires a space or "cavity" between the insulation and the wall, the new revolutionised cavity wall insulation system is built without a cavity as the insulation already provides a profiled cavity inside the sheet. It includes a 60 mm cavity between the two skins (walls) containing a 40/60mm profiled expanded polystyrene insulation panel.

A double-skin masonry with no cavity, plastered internally, or rendered externally achieves an R-Value of 0.35 m^2.K/W. A double masonry wall with a 50mm air cavity containing a 40mm EPS sheet only achieves an R-Value of 1.04 m^2.K/W whereas the new system performs the best on the market with a system R-Value of 1.36 m^2.K/W.

X – X-FACTOR

Has your building got the "X-Factor?

The X (EPC) Factor of homes/buildings is based on the energy performance of buildings based on measured energy consumption.

The energy performance is the net energy consumed in kilowatt hours per square metre per year (kWh/m2/a) to meet the different needs associated with the use of the building excluding measured or assessed energy consumed by garages, car parks and storage areas as well as energy consumed by outdoor services (for example landscape lighting and security), which may include, inter alia, heating, hot water heating, cooling, ventilation and lighting.

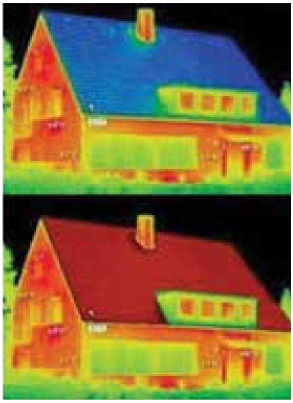
The measured energy performance is the operational energy performance, based on measured amounts of energy consumed.

SANS 1544 – Energy performance certificates (EPC) for buildings was published in December 2014 and specifies the requirements for producing energy performance certificates for buildings. It deals with energy performance based on measured energy consumption in existing buildings that have been in operation for two years or longer. The standard covers building occupancy classes given in SANS 10400-XA for which the maximum energy consumption is specified.

The EPC is the X-Factor that would determine the value of the property, based on energy performance, once legislated.

The EPC will play an essential role in the property market.

Y – YOUR WHOLE HOUSE/ BUILDING PLAN



A picture is worth…….in this case, lost money. This thermal image—taken by a professional energy auditor—shows cool and warm air escaping through roof, windows and cracks.

After you know where your home is losing energy, make a plan by asking yourself a few questions:

- How much money do you spend on energy?
- Where are your greatest energy losses?
- How long will it take for an investment in energy efficiency to pay for itself in energy cost savings?
- Do the energy-saving measures provide additional benefits that are important to you—for example, increased comfort from installing double-paned, efficient windows?
- How long do you plan to own your current home?
- How much time do you have for maintenance and repairs?
- Can you do the job yourself or do you need a contractor?
- What is your budget?

Planning smart purchases and home improvements will maximize your energy efficiency and save you the most money.

How much insulation does my house/building need?

Contact the Thermal Insulation Products and Systems Association SA (TIPSASA) to assist – the benchmark of the Industry.

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Z – ZERO CARBON BUILDING (ZCB) AND NEARLY ZERO ENERGY BUILDING

Most of the energy used today is produced from fossil fuels (coal, oil, natural gas), and a direct consequence of using these fuels is that greenhouse gasses are released into the atmosphere, with one of the most significant being CO2 (carbon dioxide). These gasses, by absorbing and emitting infrared radiation, contribute to global warming and climate change.

In response to this threat, governments across the world have committed to reducing their greenhouse gasses emissions and increasing renewable energy production.

The South African Government has legally committed to ensure that the net SA carbon account for the year 2050 is at least 80% lower than the 1990 baseline. In order for this target to be realised, emissions from all sectors will have to be reduced, while at the same time renewable energy production is expected to increase.

The usage of renewable energy will lead to zero carbon cities.

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- Kingspan Insulated Panels
- Spunchem Africa (Pty) Ltd
- Technopol SA (Pty) Ltd.
- Thermguard /Comfort Living

TIPS

TIPS ON HOW TO SELECT THERMAL INSULATION

When selecting insulation, ensure that the material:

1. is in compliance with relevant South African National Standard i.e. product standard;
2. is appropriate for the intended occupancy class in accordance with SANS 10400 Part A
3. complies with the fire safety requirements given in SANS 10400 Part T and SANS 428.
4. complies with the recommended R-value for the relevant climatic zones in accordance with SANS 10400 Part XA and SANS 204.

TIPS FOR FINDING A CONTRACTOR

- Look for licensed, insured, and certified contractors.
- Get three quotes with details in writing.
- Ask about previous experience.
- Check references.
- Ask neighbours and friends for recommendations.
- Focus on local companies.
- Ask for Certificate of Compliance – Product and Installation.

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