



SUSTAINABILITY
INSTITUTE



SANS 10400-XA
ENERGY USAGE
IN BUILDINGS:

A developer's **guide to compliance** in home design

see money differently

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A developer's guide to compliance in home design

A Nedbank 'greener buildings' initiative

Nedbank is committed to doing its part to preserve and protect the environment. This also involves assisting and enabling other South Africans – be they individuals or organisations – to achieve and contribute to environmental sustainability in their home and work environments. Through this document, Nedbank hopes to support government's efforts to encourage energy efficiency in buildings by simplifying and explaining the new South African National Standard (SANS) 10400–XA Regulations for the benefit of homeowners, architects and property developers.

Introduction

South Africa's national electricity grid is under pressure, as the limited supply struggles to keep up with growing demand. The costs of generating electricity predominantly from coal and nuclear energy are rising, as the resource inputs they require become increasingly expensive. At the same time polluting mining processes, the impact of power plants on freshwater supplies and the production of greenhouse gases and harmful wastes pose significant challenges to the environmental sustainability of the country's base power supply.

Nearly 60% of the world's electricity is consumed by residential and commercial buildings, and the building sector is the single largest contributor to greenhouse gas emissions. Concerns about climate change and energy costs have resulted in energy becoming an increasingly important consideration in the design of buildings, and energy-efficient buildings are

now the norm in many parts of the developed world. The bulk of South Africa's buildings were designed and constructed when electricity was cheap, but rising costs are making them more and more expensive to run, and less affordable to their occupants.

The South African Constitution requires the protection of the environment for the benefit of all, and government is mandated to put rules and regulations in place to promote a more sustainable future. Following trends in other countries, our government is now focusing on improving the energy efficiency of existing buildings by retrofitting them for energy efficiency, and ensuring that new buildings are designed to be as energy efficient as possible. In 2011 the SANS 10400–XA 'Energy Usage in Buildings' Regulations were added to the National Building Regulations for Energy Usage in Buildings to improve the energy efficiency of our country's buildings.

Because developers are often involved in the construction of large numbers of housing units at any one time, they have a significant role to play in saving energy, by shifting towards more energy-efficient designs and materials. Although some of these interventions may negatively affect their profits, the regulations are designed so as to allow a degree of flexibility in the manner in which energy efficiency is achieved. Developers should work closely with their professional teams to explore their options and improve their building models to comply with SANS 10400–XA in a cost-effective manner. Incorporating energy efficiency principles into the design of homes not only helps to reduce their operating costs, but can also make them more comfortable to live in, as they provide greater protection from extreme temperatures.

Developers need to choose the most practical and cost-effective route, depending on their target market and the financial resources available.

The SANS 10400–XA Regulations

The amended South African National Building Regulations require the following:

- **XA1** – buildings are to use energy efficiently and reduce greenhouse gas emissions in accordance with a set of requirements.
- **XA2** – not more than 50% of the annual volume of domestic hot water should be supplied by means of electrical resistance heating, ie 50% or more of the volume of hot water used must be heated by energy sources other than electricity.
- **XA3** – compliance with the XA1 Regulations must be achieved by one of three methods. If practitioners build in accordance with SANS 10400–XA, the buildings will be 'deemed to comply' with National Building Regulation XA1.

The South African government is bound to promote and defend the implementation of these regulations through the mechanisms and procedures used to control new buildings. This responsibility lies with municipalities and, more specifically, with Building Control Officers.

Which buildings are affected?

Buildings that consume energy as a result of human occupancy are the main target of the new regulations. All new buildings must comply with the regulations, as must any additions and extensions to existing buildings. If the existing building is unaffected by an addition, only the addition will have to comply with the regulations. Renovations must comply with the regulations if they require planning approval from a local authority.

Garages and storage areas that are not within the building envelope and do not form part of the habitable area, do not have to comply with the SANS 10400–XA Regulations,

and this also holds true for factories and the operational aspects of businesses.

How is compliance achieved?

To avoid delays in achieving planning approval and receiving occupancy certificates, developers should communicate to their architects and the professional teams that the buildings must be designed in accordance with the SANS 10400–XA Regulations. According to the wording of Regulation XA3, SANS 10400–XA is 'deemed to satisfy' the regulations. Those who want to comply with the regulations should therefore start with this document, which can be purchased and downloaded from the 'Buy a Standard' section of the SABS website (www.sabs.co.za).

Compliance with the SANS 10400–XA Regulations requires that the design of new buildings satisfy certain conditions.

There are three routes to compliance, namely:

- **The Prescriptive Route** as in paragraph 4.2.1 (b).
- **The Reference Building Route** as in paragraph 4.2.1 (c).
- **The Performance Route** as in paragraph 4.2.1 (a).

The **Prescriptive Route** is generally available to all persons, and will commonly be used for houses and smaller buildings. This route requires that a set of rules is adhered to for water heating, insulation and glazed areas, ie windows, glass doors and roof lights.

Compliance through the Reference Building Route or Performance Route can be achieved by means of a Rational Design by a Competent Person – Energy.

Hotels are, however, the only residential buildings to which the Performance Route is applicable; it cannot be used for residential homes.

The owner of the property is typically considered to be the Responsible Person for ensuring compliance with the SANS 10400–XA Regulations, unless he or she appoints a professional.

What is a Rational Design?

A **Rational Design** is a document prepared by a Competent Person – Energy, and submitted along with the plans for approval. This document typically contains:

- The credentials of the Competent Person – Energy.
- The methodology used to model energy usage.
- The choice of energy modelling software and its suitability – energy modelling software must be accredited by Agrément South Africa, for example Bsimac and Design Builder.
- The results of energy modelling.
- The opinion of the Competent Person – Energy on the building's compliance.

Who is responsible?

The owner of the property is typically considered to be the **Responsible Person** for ensuring compliance with the SANS 10400–XA Regulations, unless he or she appoints a professional, eg an architect, draughtsperson or engineer, who is then deemed to be the **Appointed Person**. By the time the plans are submitted to council, a decision must be made as to which of the three routes to compliance with the SANS 10400–XA Regulations will be followed. If either the Performance Route or Reference Building Route is pursued, a **Competent Person – Energy** must also be appointed.

What is a Competent Person – Energy?

A Competent Person is defined as 'a person who has the necessary

education, training, experience and contextual knowledge to make a determination in terms of a functional regulation'. In this case a Competent Person – Energy will typically be a mechanical engineer or architect, who has been on appropriate courses pertaining to the SANS 10400–XA 'Energy Usage in Buildings' Regulations. Most multidisciplinary engineering consultancies should offer this service.

What documentation must be completed?

Once the plans are ready for submission, the Appointed Person (or Responsible Person, if a professional has not been appointed) must inform the local authority and Building Control Officer as to which of the 3 compliance routes has been chosen, by completing a set of four documents (Forms 1 to 4). These are standardised SABS forms that include a checklist indicating the client's choice of compliance route, and must be submitted to the local authority. The forms can be downloaded from the SABS website (www.sabs.co.za). The property owner must sign Form 1 for the Prescriptive Route, or Form 1 and 2 for the Reference Building Route.

Form 1: 'Declaration by person responsible for preparing an application for approval of the erection of the building in terms of section 4 of the act'

The Appointed Person (or Responsible Person if a professional has not been appointed) is required to make a declaration as to the means by which

the SANS 10400–XA Regulations will be satisfied under the 'XA: Energy Efficiency in Buildings' section of Schedule A. If the Performance Route or Reference Building Route is followed, he or she must provide the name of the Competent Person – Energy on Schedule B. The owner and Appointed Person must sign this form and it must be submitted to the Building Control Officer, along with the plans.

Form 2: 'Application for acceptance as an approved Competent Person in terms of Regulation A19'

If a Competent Person – Energy is required, he or she must indicate acceptance of responsibility for energy-related duties, by completing and signing Form 2. This includes a declaration that he or she has the qualifications, experience and contextual knowledge necessary to undertake such work. Based on this declaration, the local authority has to approve the Competent Person – Energy as fit to prepare the application. It is the local authority's prerogative to require that applicants undergo some form of training; and some, eg the City of Cape Town, require that the professional be listed on the Building Control website (www.buildingcontrol.co.za) as having attended an appropriate training course. The property owner and Competent Person must sign this form and it must be submitted to the Building Control Officer, along with the plans.

Option 1: Compliance through the Prescriptive Route

As compliance through the Prescriptive Route does not require the appointment of a Competent Person – Energy, it is likely to be the route most widely used in cases where the developer would prefer the simplicity of following the prescribed rules, rather than trying a more innovative approach to achieving energy performance standards.

Who can use the Prescriptive Route?

The Prescriptive Route – otherwise known as the ‘Building Envelope and Services Route’ – is generally available to all persons. It requires that the design and materials follow all relevant provisions of SANS 10400–XA and certain provisions of SANS 204. This is the simplest of the three compliance routes, as a Competent Person – Energy is not required – but take into account that the energy efficiency interventions may prove costly when replicated across multiple similar units in a larger development.

What does the Prescriptive Route entail?

In following the Prescriptive Route, the building must be designed and built in accordance with paragraph 4.2.1 (b) of the SANS 10400–XA standard.

The requirements of paragraph 4.2.1 (b) have the following implications:

- At least 50% of hot–water demand must be met by means other than electric resistance heating.
- Roof or ceiling insulation is required, and must meet minimum requirements, depending on the climatic zone and roof material.
- Insulation is required for exposed hot–water pipes.
- Wall insulation is required for non–masonry external walls.
- Floor insulation is required if there is in–slab heating.
- Shading devices or performance glazing is required where glass areas are greater than 15% of net floor area.
- Other building services that use energy or control the use of energy must be provided in accordance with SANS 204.
- Orientation requirements in accordance with SANS 204 are non–mandatory, as the fenestration design can compensate for sub–optimal orientation.

This method of compliance must be chosen by the Appointed Person at the outset of the project.

Why should buildings face north?

Although it is not a mandatory requirement of the SANS 10400–XA regulations, it is highly advisable (according to SANS 204) that buildings face north where possible. This means that the rooms that are used most, eg bedrooms and living rooms, and the largest areas of glazing should be placed on the northern side of the building to make the best use of the heat of the sun in winter. Combined with the prescribed window and shading specifications to block the sun in summer, this can significantly enhance the thermal comfort of a home, without using electricity. In some cases suboptimal orientation may cost the developer more, as extra money must be spent on shading devices and performance glazing in order to comply with SANS 10400–XA. The orientation of buildings on the site should be taken into account from the very start of the project, as this will influence the layout of roads and other infrastructure in multi–unit developments.

What must be done to follow the Prescriptive Route?

To meet the minimum requirements of the Prescriptive Route, Schedule A of Form I must indicate that this route has been chosen, and the design must adhere to certain rules. This requires that decisions be made on the following:

- 1 **Water heating:** The location, capacity and type of hot–water installations must be planned to ensure that at least 50% of the water will be heated by means other than electrical resistance heating.
- 2 **Insulation:** Insulation must be specified as follows –
 - Roof and ceiling insulation type and thickness.
 - Hot–water pipe insulation thickness (only on exposed pipes).
 - External–wall insulation (only where external walls are non–masonry).
 - Under–slab insulation (only where in–slab heating is installed).
- 3 **Glazed areas:** The total glazed area as a percentage of the net floor area must be indicated –
 - If it is **more than 15%**, the glazed area must be designed to comply with SANS 204. This may require the additional specification of performance glazing or shading over glazed areas.
 - If it is **less than 15%**, no additional requirements have to be met.

If the Prescriptive Route requirements pose technical difficulties or are unaffordable, the developer may wish to pursue compliance through the Reference Building route.

Which water-heating options should be used?

Conventional approaches to water heating use electricity to heat an element that heats water inside a geyser tank – this is known as ‘electrical resistance heating’. Approximately 50% of the average energy consumed by middle-to-upper-income households is used to heat water, so heating water using alternative sources is one of the most significant ways in which homeowners can save on electricity. Compliance with SANS 10400–XA requires consideration of the following options:

1 Solar water heaters

With South Africa’s abundant sunshine, using a device that harnesses the heat of the sun can save 25% to 40% on the electricity used by a conventional geyser. Solar water heaters are available in a variety of shapes and forms that impact on their cost, aesthetics and energy efficiency.

The main options are –

- Passive or active? Passive systems take advantage of hot water’s tendency to rise above cold water, allowing natural circulation of water without an electric pump. These systems require that the tank be placed above the collector plate, typically on the roof. Active systems use a little more electricity to circulate the water, but allow for the tank to be concealed under the roof. Both systems can have an electrical element as a backup for times when the sun is not strong enough to reach the required water temperature.



Installed ‘active’ flat-plate solar collectors

- Flat plate or evacuated tube? A flat-plate system collects the sun’s heat through a weatherproof box with a glass cover, whereas an evacuated-tube system does so through a series of parallel glass tubes. Evacuated-tube systems are designed for colder climates and typically reach higher water temperatures than flat-plate systems.



‘Passive’ evacuated-tube solar collector

2 Heat pumps

Water can be heated by extracting heat from the air using a heat pump, which uses 50% to 70% less electricity than an electrical resistance water heater. A heat pump resembles a small air-conditioner unit attached to the exterior of the building, and is typically connected to a geyser inside. As heat pumps do not require roof space or direct sunlight, they are easier to incorporate into the design of multi-storey apartment blocks than solar water heaters are.

3 Other options

The wording of the SANS 10400–XA water-heating requirements is not prescriptive, and leaves the choice of technology open to innovation. Other options that could be considered are those that recover heat from household systems, eg from fireplaces or stoves, or make use of combustible fuels such as gas, sawdust pellets or wood.

Option 2: Compliance through the Reference Building Route

If the Prescriptive Route requirements pose technical difficulties or are unaffordable, the developer may wish to pursue compliance through the Reference Building route. This option permits a greater degree of flexibility and creativity, allowing the professional team to introduce innovative energy-efficient solutions to achieve an energy performance that is the same or better than that which would have been achieved by the strict application of the Prescriptive Route.

The factors influencing the choice of this compliance route are:

- The type of project (this route is better suited to multi-unit residential buildings or larger property developments).
- The scale of the project.
- The skill set in the professional team.
- The developer's preferences and willingness to pay for energy modelling.

If the Competent Person – Energy is working with a team with the requisite energy modelling expertise, or is skilled in performing energy modelling, design options can be checked for compliance at an early stage to ensure a cost-effective design.

Who may perform Rational Designs?

Pursuing the Reference Building Route requires the appointment of a Competent Person – Energy. If appropriately qualified, the architect may take on this role.

What does the Reference Building Route entail?

A Reference Building is initially designed according to the developer's vision and needs, with all the elements required to comply with the Prescriptive Route being included. The energy performance of this design is then calculated and used as a base case with which the energy performance of the improved design can be compared.

Thereafter, the design can be modified with recommendations from the

professional team. The annual energy usage and demand is calculated and compared with the performance of the Reference Building (the base case). If the modified design shows an equivalent, or improved energy usage compared with the Reference Building, it complies with the regulations.

What must be done to follow the Reference Building Route?

To meet the requirements of the Reference Building Route, the developer must appoint a Competent Person – Energy who, along with the architect, will ensure that the required documents are submitted to the local authority timeously.

The developer must also sign the following two SABS forms before the plans can be submitted for approval:

- **Form 1:** 'Declaration by person responsible for preparing an application for approval of the erection of the building in terms of section 4 of the act'.
- **Form 2:** 'Application for acceptance as an approved Competent Person in terms of Regulation A19'.

Nedbank: Leading by example

When Nedbank became the first African financial institution to achieve carbon neutrality in 2009, it committed itself to leveraging this achievement to promote, encourage and enable greater energy efficiency across all areas of South African industry and society. A significant component of this commitment is Nedbank's strong belief in leading by example, which is why, over the past three years, the group has made significant contributions to the country's energy efficiency and carbon-reduction efforts.

In 2012, Nedbank completed construction of its third 4-star Green Star SA-rated building. All of these Nedbank buildings are designed, constructed and operated in an environmentally sustainable and energy-efficient manner. In addition to recycled materials being used for their construction, the buildings use the latest in energy-efficient lighting and air-conditioning technology, various water-saving and storage systems, and effective waste limitation and management processes. Nedbank has also been actively involved in the

financing, planning and development of six of the seven Green Star SA-rated buildings we currently have in South Africa.

Nedbank was the first African signatory to the Equator Principles and is one of only 25 banks worldwide to be included in the Dow Jones Sustainability Index. In 2010, we were recognised at the *Financial Times* Sustainability Awards as the 'Emerging Markets Sustainable Bank of the Year for Middle East and Africa'.

This document was researched and compiled by the Sustainability Institute (SI) in collaboration with Structatherm Projects on behalf of Nedbank Limited.

The SI was established in 1999 to promote learning about sustainable living in South Africa. Located in the Lynedoch EcoVillage near Stellenbosch, the SI focuses on combining practice with theory in a way that integrates ecology and equity in support of a sustainable South Africa, with special reference to reducing and eradicating poverty. The SI has built a name for itself through its Masters Programme in Sustainable Development Planning and Management, which comprises a Postgraduate Diploma in Sustainable Development and a Master of Philosophy degree in Sustainable Development, in partnership with the School of Public Leadership at Stellenbosch University.

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