Technical Guidelines

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human settlements

Department:
Human Settlements
REPUBLIC OF SOUTH AFRICA

2 PART B: TECHNICAL PROVISIONS

2.1 NATIONAL NORMS AND STANDARDS FOR THE CONSTRUCTION OF STAND ALONE RESIDENTIAL DWELLINGS FINANCED THROUGH NATIONAL HOUSING PROGRAMMES

2.1.1 PURPOSE

This section contains the minimum National technical norms and standards for the creation of serviced residential stands and houses to be constructed through the application of the National Housing Programme. With effect from 1 April 2007, it replaced the National Norms and Standards contained in the National Housing Code, 2000. All residential developments that will be undertaken through the finance provided in terms of the National Housing Programmes must comply with the norms and standards contained in this section.

2.1.2 INTRODUCTION

In terms of the provisions of section 3(2)(a) of the Housing Act, 1997 (Act No. 107 of 1997), which came into effect on 1 April 1998, the Minister of Housing must determine national policy, including national norms and standards in respect of housing development. Section 3(3) furthermore provides that the national norms and standards referred to, includes norms and standards in respect of permanent residential structures but are not limited thereto.

The then Minister of Housing introduced such norms and standards in terms of the provisions of the Housing Act, 1997 (Act No.107 of 1997) in December 1998. The Comprehensive Plan for the Creation of Sustainable Human Settlements, approved by Cabinet on 1 September 2004, inter alia advocates the enhancement of the National Norms and Standards for housing products to be delivered through the National Housing Programme. The objective of creating sustainable housing developments through quality and durable products that comply to minimum standards and giving effect to the objectives of the Housing Act, 1997 (Act No. 107 of 1997) is also supported.

In terms of the provisions of section 1 (vi) of the Housing Act, 1997 (Act No. 107 of 1997) which came into effect on 1 April 1998, "housing development" means:

> "the establishment and maintenance of habitable, stable and sustainable public and private residential environments to ensure viable households and communities in areas allowing convenient

access to economic opportunities, and to health, educational and social amenities in which all citizens and permanent residents of the Republic will, on a progressive basis, have access to:

(a) permanent residential structures with secure tenure, ensuring internal and external privacy and providing adequate protection against the elements; and

(b) potable water, adequate sanitary facilities and domestic energy supply".

Against this background, the previous Minister of Housing introduced the revised National Norms and Standards, including prescripts regarding the housing typologies that will be financed through National Housing Programmes in future with effect from 1 April 2007.

2.1.3 GENERAL PRINCIPLES

Any specification or definition of norms and standards for affordable housing should ideally be performance based. This encourages innovation by allowing a variety of building systems, materials or techniques to be combined to meet the set performance requirements.

While there are many technologies that can be used to produce a house that will meet a performance specification, it is essential that the resulting structure is acceptable to the community members who are the potential "buyers" of the housing products. It is advisable that the acceptability of any proposed building system is tested in the earliest phase of project development and certainly, before the construction contract relating to the superstructure of the dwellings is officially approved and finalised.

2.1.4 RELEVANCE OF THE NATIONAL BUILDING REGULATIONS (NBR) TO AFFORDABLE HOUSING

The NBR as published in the Government Gazette from time to time apply equally to affordable housing and to luxurious housing developments. The NBR consist of performance standards for buildings, without prescribing how these are to be achieved.

The SABS 0400 publication, relating to the application of the building regulations contains both the NBR and a set of "deemed-to-satisfy rules". The rules are provided to assist designers to meet the performance requirements set out in the regulations. It deals with conventional construction only, is not regulations, nor does it have the force of law of the NBR. For example:

Deemed-to-satisfy rule HH2.4 requires that the width of any continuous strip foundation shall not be less than 600mm in the case of a foundation to a load-bearing or free standing masonry wall.

There is no need to comply with this rule if in the opinion of an engineer:

a) Ground conditions are so poor that more sophisticated foundations must be used, or

b) The combination of building load and founding conditions is such that the strip foundation can be reduced in width, or omitted altogether.

On presenting either alternative to the municipality, it will be accepted as complying with the relevant building regulation, if it is shown to be the result of a rational design by an appropriately qualified, competent person.

2.1.5 PROOF OF COMPLIANCE WITH THE NBR

There are several methods of persuading a municipality that a particular design complies with the requirements of the NBR, namely that the building will be constructed in accordance with:

a) A design that conforms in all respects with the Deemed-to-satisfy rules set out in SABS 0400;

b) A certificate issued by the Board of Agrément SA, that is,

  - an Agrément Certificate, or
  - a MANTAG Certificate; and

c) A rational design prepared by a competent person. Unconventional building methods, systems or components, are covered by an Agrément Certificate. This provides an assurance of fitness for purpose of non-standardised building and construction products and systems, by evaluating these against prescribed performance criteria.

A MANTAG Certificate is a distinct type of Agrément Certificate dealing with:

> "acceptable safety and health criteria for houses and related out-buildings, non-residential schools and primary health care centres in areas where the local authority is of the opinion that the type of construction is appropriate, given that in these areas it is of

paramount importance that the buildings be erected at the lowest possible cost."

"Rational designs" are normally presented in relation to the *structural strength and stability* of a dwelling and much less frequently, in relation to:

a) Resistance to rainwater penetration;

b) Damp proofing;

c) Fire protection;

d) Lighting and ventilation; and

e) Drainage.

However, there is a tendency for regulatory authorities that are presented with a rational design, to assume that it covers all aspects of the work. For this reason the National Department insists that the competent person must:

a) Clearly identify those aspects of the building that are the subject of the rational design;

b) Inspect for compliance with the rational design; and

c) Assume full professional responsibility for the subsequent performance of the subjects covered by the rational design.

All aspects of the work that are not the subject of the rational design, must comply with the Deemed-to-satisfy rules of SABS 0400 or be covered by a Certificate issued by the Board of Agrément SA.

2.1.6 THE ROLE OF THE NATIONAL HOME BUILDERS REGISTRATION COUNCIL (NHBRC)

The NHBRC was established in terms of Section 2 of the Housing Consumers Protections Measures Act, 1998 (Act No. 95 of 1998) as a statutory body with the prime objective to provide consumer protection through the regulation of the home building industry.

In terms of the provisions of the said Act, all home builders must be registered with the NHBRC and a home builder may not commence with the construction of a home unless the home is enrolled with the NHBRC. The NHBRC has also published Home Building Manuals and the technical requirements contained in the said manual are enforced by the NHBRC.

The Housing Subsidy Scheme was made subject to the provisions of the said Act with effect from 1 April 2002 and all houses that are to be constructed through the application of the housing subsidy amount only must be enrolled with the NHBRC and these houses will therefore be subject to the following technical specifications:

a) The NBR;

b) The Standards introduced by the NHBRC; and

c) The National Norms and Standards contained in this document.

The NHBRC requires the results of a geological survey of a particular stand or site and will evaluate the findings of the report and may require that specified precautionary measures be provided in respect of municipal engineering services and/or the dwelling to be constructed.

2.1.7 THE NATIONAL NORMS AND STANDARDS FOR STAND ALONE RESIDENTIAL DWELLINGS FINANCED THROUGH THE NATIONAL HOUSING PROGRAMMES

HOUSING LAND

It is confirmed that for purposes of this document, in accordance with the MINMEC decision, the cost of acquisition of land for housing development is not part of the funding provided through the Housing Subsidy Scheme. Housing land will be acquired in terms of a separate dedicated Housing Land Programme including a separate funding mechanism. The land price in respect of each individual stand will however be taken into account in determining the actual product price of the residential property created through the housing subsidy scheme. This will also be required in terms of the calculation of the NHBRC enrolment fees and to ensure that the subsidy beneficiary is informed regarding the total value of the housing product allocated to him/her.

NORMS AND STANDARDS IN RESPECT OF MUNICIPAL ENGINEERING SERVICES

General conditions

Bulk and connector services located outside the boundaries of project sites and which are provided by municipalities/service providers must be financed through internal sources of revenue of municipalities or other resources and may not be financed out of the Integrated Housing and Human Settlement Development Grant (IHAHSG).

A municipality may, in instances where it has the capacity, provide additional funds for the provision of municipal engineering services and/or the construction of houses, or a combination thereof, to enhance the end products to be delivered through the National Housing Programmes.

Standards for internal municipal engineering services

The internal reticulation services must be funded from alternative funding resources. However, as a last resort option in cases where no other funding resources are available the internal reticulation services may be funded from the provincial annual housing development funding allocated by the Minister.

The level of the engineering services to be provided is determined by the provisions of the relevant National Housing Programme. For instance, the Programme: Upgrading of Informal Settlements provides for considerable discretion regarding the township layout and infrastructure design and standards. This means that a particular informal settlement layout may be required to ensure higher densities and in achieving this objective, not every residential property may have a road access. However, in general, all residential properties created through the National Housing Programme must at least comply with the levels of services indicated in the following table:

Table 1: Minimum Level of Services permitted in terms of the National Norms and Standards

Type of Service	Minimum Level
Water	Single standpipe per stand (metered).
Sanitation	VIP or alternative system agreed to between the community, the municipality and the MEC.
Roads	Graded or gravel paved road access to each stand. This does not necessarily require a vehicle access to each property.
Stormwater	Lined open channels.
Street lighting	Highmast security lighting for residential purposes where this is feasible and practicable, on condition that such street lighting is not funded from the MIG initiative or from other resources.

NORMS AND STANDARDS IN RESPECT OF STAND ALONE PERMANENT RESIDENTIAL STRUCTURES (HOUSES)

Minimum size and facilities

The minimum size of permanent residential structures to be provided by means of the housing subsidy, is 40 square metres of gross floor area.

Each house as a minimum must be designed on the basis of:

a) Two bedrooms;

b) A separate bathroom with a toilet, a shower and hand basin;

c) A combined living area and kitchen with wash basin; and

d) A ready board electrical installation where electricity supply in the township is available.

Technical specifications

The minimum technical specifications indicated below will be applied to all stand alone houses constructed as part of Project Linked Subsidies, Individual Subsidies, Consolidation Subsidies, Institutional Housing Subsidies and People's Housing Process projects.

Assumptions used to determine the specifications:

a) Favourable soil conditions (NHBRC classification H, S, R, C);

b) Level Topography;

c) Maximum 10 meter connection to municipal water supply and sewer; and

d) The SCCCA is excluded (as a different dispensation is available to these areas).

A THE SITE PREPARATION

The finished ground levels must direct water away from the building.

In areas where termite infestation is known to be a problem, the soil within the site must be treated in accordance with the recommendations set out in SABS 0124 - *Application of certain soil insecticides for the protection of buildings.*

B FOUNDATIONS

B.1 Cement

The correct cement for the purpose intended must be clearly specified and it must comply with the requirements of *SABS ENV 197-1 common cements and SABS 413-1.*

Masonry Cements:

a) Masonry cement shall not be used in concrete;

b) Masonry cement MC 22,5X shall not be used in shell bedding mortar; and

c) Cement for use in concrete, mortar or plaster shall be chosen in accordance with Table 2.

B.2 Design

The foundation of any building must be designed to safely transmit all the loads from the building to the ground without causing or being subjected to excessive movements.

In favourable soil conditions the foundations must be designed to reduce as far as practically possible, the depth of excavation, the height of the foundation walls and the cost of unnecessarily large footings.

Any variation from the foundations required by the Deemed-to-satisfy rules of the NBR must be the subject of a rational design by a Professional Engineer.

In problematic soil conditions, a Professional Engineer must design the foundations and advise on the articulation of the superstructure and all additional prescribed requirements that are deemed necessary.

The minimum foundation specifications are:

a) External: 500 x200mm (10Mpa) concrete strip footings;

b) Internal: 400 x 200mm (10Mpa); and

c) Founding depth: 400mm.

C SUB-STRUCTURE: (MORTAR – CLASS II: 1:6 CEMENT SAND MIXTURE)

140mm cement masonary inuts (7Mpa) in compliance with SABS specification No.1215 at 4 x courses only.

D FILLING

Imported (house area x 300mm x 1.46).

E FLOOR SLAB

Any floor of any building shall be:

a) water resistant in the case of the floor of any kitchen, shower room, bathroom or room containing a Water Closet (WC);

b) provided with adequate under-floor ventilation in the case of a suspended timber floor;

c) so constructed that any moisture present in the ground or filling is prevented from penetrating the slab in the case of a concrete floor slab that is supported on ground or filling; and

d) 75mm (10Mpa) concrete steel hand or power floated without.

F SUPERSTRUCTURE (MORTAR- CLASS II) 1:6 CEMENT SAND MIXTURE

F.1 Walls

Any wall shall be:

a) so constructed that it will adequately resist the penetration of water into any part of the building where it would be detrimental to the health of the occupants or to the durability of the building;

b) provided with the means to fix any roof truss, rafter or beam to the wall in a secure manner that will ensure that any forces to which the roof may normally be subjected will be transmitted to the wall supporting it; and

c) of combustibility and fire resistance characteristics appropriate to the use of the wall.

The minimum specifications for walls are:

a) 140mm cement masonary units SABS specification No 1215;

c) Maximum 10mm bed joint and purpends;

d) Allow for gable;

e) Height of external walls: 2400mm (100 x 24); and

f) Height of internal walls to u/s of roof covering.

Note: Internal walls to be load bearing roof anchoring

Table 2: Cements and their use in concrete (C), mortar (M) and plaster (P)

SABS ENV. SPEC	DESCRIPTION	SABS ENV. NOTATION	APPROXIMATE EQUIVALENT CEMENTS			USE		
COMMON CEMENT			**DESCRIPTION**	**NOMEN-CLATURE**	**SABS**	**C**	**M**	**P**
197-1	Portland Cement	CEM	Ordinary Portland	OPC	471	yes	yes	yes
197-1	Portland Slag Cement	CEM II/A-S	Portland Slagment	PC 15 SL	831	yes	yes	yes
	Portland Silica Fume Cement	CEM II/A-D				yes		
	Portland Limestone Cement	CEM II/A-L				yes	yes	yes
	Portland Fly Ash Cement	CEM II/A-V CEM II/A-W	Portland Fly Ash Cement	PC 15 FA	1466	yes	yes	yes
		CEM II/B-V CEM II/B-W	Portland Fly Ash Cement	PC 25 FA		yes		
197-1	Blast Furnace Cement	CEM III/A	Blast Furnace Cement	PBFC	1491	yes		
MASONRY CEMENTS								
413-1	Masonry Cement	MC 12,5					yes	yes
413-1	Masonry Cement	MC 22,5X					yes	

G METALWORK

The minimum specifications for metalwork are:

a) 1.0mm pressed metal clisco doorframes (internal/ external);

b) Standard 3 mm steel window frames in 1.0mm clisco surrounds;

c) 2 level lockset internal; and

d) 3 level lockset external.

Note: **Use of clisco surrounds in window frames, excludes the needs for lintels, dpc and window cills.**

H GLAZING

Any glazing shall be of glass and be fixed in a manner and position that will ensure that it will:

a) safely sustain any wind loads to which it is likely to be subjected; and

b) not allow the penetration of water to the interior of the building.

In accordance with SABS 0173 allow for silicone bead around Clisco frames.

I CARPENTER

External door frames: External hardwood frames ledged braced batten doors (closed back)

Internal doors: Hollow core masonite clad:

Purlins: 152 x 50mm (S5) SAP purlin beams at maximum 1 m centre to centre tied with 30 x 1,2mm (galvanised) hoop iron straps to masonary (600mm deep) with the maximum span 3,5m/45m2 units.

J ROOF

The roof of any building shall:

a) be so constructed that it will resist any forces to which it is likely to be subjected;

b) be durable and waterproof;

c) not allow the accumulation of any rainwater upon its surface;

d) be constructed to provide adequate height in any room immediately beneath the roof/ceiling assembly; and

e) have a fire resistance appropriate to its use.

The minimum specification for the roof is:

f) 5mm full hard galvanised roof sheets, cranked at centre to eliminate ridge capping; and

g) Fixed with 75. El Toro drive screws to purlin beams.

Note: 1x ridge purlin beam.

K LIGHTING AND VENTILATION

Any habitable room, bathroom, shower-room and room containing a WC shall be provided with a means of lighting and ventilation which will enable such room to be used, without detriment to health and safety or causing any nuisance, for the purpose for which it is designed.

All dwellings shall be provided with the means of ventilation and natural lighting set out in Table 3.

Table 3: Criteria for ventilation and natural lighting

DESCRIPTION	FLOOR AREA OF DWELLING 40M²
Minimum window area (light area) for each habitable room, including kitchens.	5% of floor area.
Minimum area of openable windows or controllable ventilation openings for each habitable room, including kitchens.	5% of floor area with one opening having an area of at least 0,1m².

L FINISHING

The minimum specifications for finishing are:

a) External walls to receive Agrément Certified coating system;

b) Internal wall to be cement slurry-brushed (no paint);

c) Internal doors to be painted;

d) External doors to be treated with mixture of linseed oil and turpentine and to be finished with I (one) coat polyurethane varnish;

e) External ends of purlin beams to be treaded with cabolinium;

f) Allow for fascias and barge boards; and

g) Allow for 600mm aprons around perimeter of building.

M PLUMBING

Drainage installations shall be:

a) designed and constructed so that the installation is capable of carrying the hydraulic design load and of discharging it into a common drain, connecting sewer or sewer provided to accept such discharge;

b) watertight;

c) capable of sustaining the loads and forces that it may normally be subjected to;

d) protected against any damage wherever this is necessary; and

e) capable of being cleaned and maintained through the means of access provided.

Drains shall be laid strictly in accordance with the requirements of the municipality.

French drains and septic tanks shall be constructed to a size and design approved by the municipality.

Non waterborne means of sanitation must comply with the requirements of Section 7.4 of SABS 0252-2: *Water supply and drainage of buildings; Part 2: Drainage Installations for buildings,* all to the requirements of the municipality.

The following minimum facilities must be provided:

a) Allow for 1 x WC;

b) Allow for 1 x shower with elevated floor walls and standard trap with trap stop to facilitate washing of clothes;

c) Allow for 1 x hand basin properly installed; and

d) Allow for 1 x sink unit properly installed with supporting 25 x 25 x 2mm steel tube frame painted to standard.

N STORM WATER

The design shall provide for suitable means for the control and disposal of accumulated storm water.

Storm water drains shall comply with the requirements of the municipality.

O ENVIRONMENTALLY EFFICIENT HOUSING

Water Supply

The design of the water supply and the specification of devices such as taps, showers and toilets must be in accordance with the aims of the National Water Conservation Campaign.

Reference should be made to the document entitled A to Z of Water Saving Devices published by the SABS and JASWIC, for information on appropriate devices such as:

a) water conserving taps;

b) low flow rate shower-heads; and

c) dual flush toilet cisterns.

Special attention should be paid to the water saving potential of toilet suites that are designed as a unit, to operate efficiently and safely on a standard flush of 4,5 litres instead of the current norm of 9 litres. Those suites that are covered by an Agrément Certificate can be specified with confidence.

Before specifying water saving devices such as low-flow showerheads, the designer must satisfy himself that they will function satisfactorily with the available water pressure.

Water saving measures that are undertaken, must be compatible with imperatives that the water supply and the sewerage disposal systems must be safe and hygienic, and be capable of operating efficiently with only normal and reasonable maintenance.

Thermal efficiency

Designs for affordable housing must take cognisance of the need for the resultant dwellings to be thermally efficient.

The cost constraints imposed by the subsidy scheme make it difficult to meet this requirement. However, there are several principles that, if followed, will enhance the thermal efficiency of the dwelling at minimal cost. These are:

a) The longer axis of the dwelling should be orientated so that it runs as near east/west as possible;

b) The dwelling should be compact in plan with the rooms that are used most and the major areas of glazing placed on the northern side of the building to allow solar heat to penetrate the glazing during the winter months;

c) The roof overhang to the northern wall should be sufficient to shade the windows from midday summer sunshine; and

d) Windows facing east and west should be limited in number and confined in area to the minimum required for daylight and ventilation.

2.1.8 EXCEPTIONS IN THE APPLICATION OF THE NORMS AND STANDARDS

The exceptions are:

a) The National Norms and Standards will not be mandatory in respect of dwellings and or projects that are developed in terms of the Rural Housing Subsidy Instrument. Rural subsidies may be used for any purpose which, in the discretion of the MEC amount to housing purposes; and

b) The National Norms and Standards must be applied in respect of dwellings and or projects that are developed in terms of the People's Housing Process with the required discretion to ensure that durable products are developed. For instance, where beneficiaries provide material recovered from previous buildings or obtained in the so called "second hand market", the application thereof must be considered against the objectives of the programme but also in view of the consumer protection objectives of the Government.

The Environmental Guidelines in the following section should also be considered.

2.2 BROADER ENVIRONMENTAL GUIDELINES

Environmental issues are inherently linked with the quality of life. Settlements are often strongly influenced by access to resources in the environment. Settlements and the activities that take place in them alter the environment in which they are set. Environmentally sound human settlements are characterised by good air quality, energy and water efficient homes, with planting that provides green ' lungs' or even food security. These may be seen as healthy, sustainable settlements which provide quality living environments. The promotion of settlements with these attributes would bring social, economic and environmental benefits to South Africa.

2.2.1 RATIONALE FOR ENVIRONMENTALLY SOUND HOUSING

Although South Africa has introduced a wide range of policies, strategies, programmes and plans to address housing challenges, so far not much has been done to encourage any consideration of environmentally sound practices. The result is that many of the country's residential habitats are smoggy, barren wastelands, which detract from the quality of life of the residents. The South African housing programmes address the housing backlog and demand through various subsidy schemes. Through these, hundreds of low cost houses are being built every day, but most of these are built without any consideration of environmentally sound principles. If these interventions are taken into account at the inception phase of each project, it would ensure that quality of life is attained.

2.2.2 PURPOSE AND STRUCTURE OF THE ENVIRONMENTAL GUIDELINES

This section aims to recommend energy and water efficiency initiatives in the housing sector. It focuses on the product being delivered through the National Housing Programme. Therefore, emphasis has been placed on no-cost and very low-cost options throughout this document. Recommended interventions have also been limited to the individual housing sites and structures, as communal services are generally beyond the scope of the housing developers.

2.3 COMPONENTS OF ENVIRONMENTALLY SOUND HOUSING

This guideline proposes interventions in the housing product through two major aspects to the development of environmentally sound low cost housing namely sustainable energy and sustainable water.

2.3.1 SUSTAINABLE ENERGY

Sustainable Energy Efficient Housing has two components:

Energy Efficiency

More often than not, in the rush to deliver housing in large numbers in view of the immense backlog, a unique opportunity to provide environmentally sustainable and energy efficient units is being overlooked. The relatively gentle climate that South Africa enjoys has also resulted in a fairly complacent attitude to energy efficient building construction amongst housing developers. The result is that low cost housing is not designed to take advantage of the climate. Houses tend to be cold in winter and hot in summer, and require significant energy consumption and household expenditure in winter to achieve some level of comfort.

As a result, the energy consumption patterns of low income households in South Africa have emerged as one of the most important factors influencing the national electricity demand and the high levels of air pollution (mainly due to coal used for space heating) experienced in urban areas. If sound energy principles are not incorporated into the design of low cost housing, beneficiaries are condemned to a future of high energy consumption. This situation is exacerbated by local air quality problems, compromised family health and worker productivity, and increased greenhouse gas concentrations.

Energy efficiency can be defined as the realisation of a higher energy service per given unit of energy input. This results in energy conservation which ensures that households can improve their standard of living without necessarily consuming more energy. An energy efficient house is naturally thermally comfortable, makes the best use of available energy and does not require large amounts of energy in its day-to-day running, while minimising negative environmental impact. For housing to be truly energy efficient, the climatic conditions of the particular area in which it is located should be taken into consideration.

Energy efficient housing can be enhanced by two aspects, design considerations for thermally efficient housing and materials and technologies for the construction of energy efficient housing. These are discussed in detail below:

Design Considerations

Energy efficient housing is largely informed by natural elements such as the sun, wind and rain. Therefore, in order to optimise these natural forces' influence on the buildings, the planning, location and orientation of the housing is a critical concern. At a micro-level, the layout of the house also needs to maximise climatic forces.

Orientation

Passive solar design involves applying energy flow principles and climate characteristics of a region in the design, construction and management of houses, so as to achieve thermal comfort with minimal conventional energy input. The basic components of passive solar design incorporate the orientation of the house, optimising the use of direct natural sunlight, and utilising thermally efficient building materials. Applying these principles provides a low cost or no cost intervention and is applicable in all climatic regions.

Passive solar design can reduce the energy requirements to keep the house comfortable. It implies that houses in the Southern Hemisphere should face towards geographic north in order to obtain optimal solar benefit. Houses which point north have most windows facing north, and as a result they would have the least heat gain in summer and the least heat loss in winter, keeping the indoor air temperature comfortable. The orientation of houses should be an integral part of planning and design.

House Plan and Layout

While the housing unit should face north, the internal arrangement of the living spaces is equally important. The plan should be designed to maximise interior space while minimising exterior wall area, from which heat loss will occur in winter. In other words, housing units should be designed so that the smallest wall area is exposed to the outside and the units should be as close to a square shape as possible. Windows and doors should be placed in the north side of the house to ensure that sunlight enters the house and warms the floor. A roof overhang must be built on the northern side of the house to shade the windows in summer.

Living spaces should be arranged so that the rooms where people spend most of their hours are located on the northern side of the unit. Uninhabited rooms such as bathrooms and storerooms can be used to screen unwanted western sun or to prevent heat loss on south-facing facades. Living rooms and kitchens should ideally be placed on the northern side.

Energy Efficient Materials and Technology

Energy efficiency in housing is not only informed by natural elements like the sun, wind and rain but also by the kinds of building material used, hence the concept of 'passive thermal design'. Passive thermal design entails using appropriate building materials which are able to store heat during the day and release this heat slowly at night. Building materials have properties which influence their performance in terms of energy efficiency. All of these properties affect the flow of heat through the materials and therefore affect the temperatures indoors. Some of these properties include:

a) The degree to which a material reflects heat;

b) The capacity of a material to store heat (thermal mass); and

c) The degree to which a material conducts heat.

Insulation

Insulation is a key method for ensuring energy efficiency in housing by reducing heat flow into or out of the unit. Insulation effectively keeps a house cooler on a hot day, and warmer on a cold one. Insulation can be achieved by using any number of materials which have very poor conductive properties, or very high reflective properties.

In houses, most heat is lost and gained through the roof. Using a reflective roofing material on the outside is useful, but the installation of a ceiling is generally regarded as a cost-effective solution. A roof without ceiling allows heat to be lost easily in cold weather and may result in overheating in summer. By placing insulation material (such as fibreglass wool, layers of paper or paper pulp, polystyrene sheets or old blankets) directly above the ceiling, households can save almost half of the energy used for space heating in winter.

Walls can also be insulated. There are various methods to insulate a wall. Building a cavity wall (two parallel walls with an air gap between) is seen as the most effective method of insulation, but it is also the most expensive method and therefore not widely applied. Another method is to plaster walls, or to use panels (also called construction boards). These panels are either used as an add-on to the walls and thus function as an insulation layer or to fulfil the wall function themselves and have a structural function.

Flooring

Floors are an important component to achieve thermal efficiency in houses. Flooring material should be of high thermal mass, such as concrete, bricks or clay, to trap heat and solar radiation coming in through the windows. The heat is slowly released at night. Single storey residential units can basically use the high thermal mass floor slabs and the soil underneath it as thermal mass. Multi-storey residential blocks have the disadvantage that they only have the ground floor with this thermal advantage. Adding thermal mass to upper storeys by adding heavyweight material beyond constructional requirements involves high costs and is often considered to be too expensive.

Windows

Another prime example of regulating heat flow in low cost housing is through the windows. Big-sized windows should be north oriented to allow maximum heating. Windows can be shaded by a deciduous tree in the summer, which will lose its leaves in winter to allow the sunshine through. A roof overhang can be built which shades the window in summer, and allows the sunshine in during winter.

Table 4: Summary of Recommendations and Cost Implications:

RECOMMENDATION	BENEFIT	COST	RESPONSIBILITY
The longer axis of dwelling units should be orientated as near to East-West as possible, and the most window surface should be on the North side.	Energy Savings to Beneficiaries	No direct cost	ND - Incentives Planners - Concept Developers- Implementation
North walls and roofs of new housing units must not be shaded by neighbouring buildings or landforms.	Energy Savings to Beneficiaries	No direct cost	ND - Incentives Planners - Concept Developers- Implementation
Local climatic conditions such as prevailing winds should be considered when planning a housing development.	Energy Savings to Beneficiaries	Possible marginal Design costs	ND - Incentives Planners - Concept Developers- Implementation
Housing units should be designed, so that the smallest area is exposed to the outside. In other words, units should be as close to square as possible, with rooms where people spend most of their waking hours located on the Northern side of the unit.	Energy Savings to Beneficiaries	No direct cost	ND - Incentives Designers - Concept Developers- Implementation
All housing units should be well insulated in order to ensure energy efficiency.	Significant Energy Savings to Beneficiaries	Cost of material and installation	ND - Incentive Designers - Concept Contractors - Implementation
North-facing windows should be shaded in Summer and sunny in Winter.	Energy Savings to Beneficiaries	Additional building cost (overhang)	ND - Incentive Designers - Concept Contractors- Implementation
Designers should ensure that housing is able to safely accommodate the use of fuels and appliances, and advise households on appropriate and safe fuel use.	Health benefits and reduced cost of fuel	None	DME - Incentives and Awareness

2.3.2 SUSTAINABLE WATER

Sustainable water has the following components:

Water efficient low cost housing

South Africa has limited and erratic rainfall, and is essentially a dry, drought-prone country. Evaporation rates are exceptionally high, and the ground-water reserves in South Africa are small and increasingly fragile. Year by year, additional sources of water are becoming both more difficult to find and more expensive to develop.

Through the increasing demand resulting from population growth and urbanisation, industrial development and agricultural needs, water is becoming an increasingly scarce commodity. If this increasing demand exceeds the potential supply, we will be faced with a permanent water crisis. In the current policy environment water is now regarded as a national resource. The effective management of this scarce resource, not only in South Africa but also in other Southern African countries, is critical to the continued development of the region in general and the country in particular. It is, therefore, essential that everyone, including housing developers and designers; plays a part in conserving water.

The following components of water efficient low cost housing will be discussed: Design Considerations for Efficient Water Systems in Low Cost Housing; and the use of Water Saving Devices and Technologies.

DESIGN CONSIDERATIONS

Layout

In small buildings, such as low cost houses, very little consideration is given to the layout of plumbing systems. This is mainly due to the fact that building design is often completed and construction started before the plumbing contractor is employed. In such cases, optimal layout is difficult to achieve.

One of the primary causes of persistent water wastage in domestic dwellings is the "dead leg" in the hot water system, a long pipe run from the water heater to a supply point. This causes much cooled water to be drawn off before hot water is discharged. Energy waste is also of concern in this scenario.

Pipe Sizing

The optimum pipe sizing is essential to the performance of many of the water saving devices.

Water Pressure

The pressure at which water is distributed within a building can have an effect on water consumption for a number of reasons. Water supplied to a point of use at a higher pressure than necessary causes wastage because more water is discharged from the tap or other fitting in a given period of time than is necessary to perform the function (such as rinsing a cup or washing hands). A lower pressure will, in most cases, not detract from the utility of the supply. Higher pressures also increase the amount of water lost due to leakage. While adequate maintenance should be done to prevent leaks, high pressures do make the problem worse when they occur.

The plumbing designer is able to determine what the pressure should be as pressure is controlled by the installation of a pressure reducing valve (PRV). Ideally installed at a point close to where the supply enters the building, the PRV will also ensure that all water supplies in the building are 'balanced' (i.e. both hot and cold water are supplied at the same pressure). This is necessary to avoid problems with the use of mixing devices (such as showers and taps) which, if used with unbalanced supplies, can result in continuous discharge of water from the pressure relief valve of the hot water system. If a balanced system in not used, then the use of mixing fittings should be avoided and the selection of appropriate water-saving devices must be handled with care.

Plumbing Fittings

It is pertinent that the Engineer/Designer for plumbing fittings understand all the various guidelines, policies, standards and best management practices for water supply systems design and plumbing.

SECONDARY WATER USE (GREY WATER) AND RAINWATER HARVESTING

Grey water refers to the reuse of water drained from baths, showers, washing machines, and sinks (household wastewater excluding toilet wastes) for irrigation and other water conservation applications. Contrary to common belief, grey water is not an entirely "safe" product, as it contains bacteria and other potential pathogens. It should therefore be used with caution.

Rainwater harvesting is the process of intercepting storm-water runoff and putting it to beneficial use. Rainwater is usually collected or harvested from rooftops, concrete patios, driveways and other impervious surfaces. Buildings and landscapes can be designed to maximize the amount of catchment area, thereby increasing rainwater harvesting possibilities. Intercepted water then can be collected, detained, retained and routed for use in evaporative coolers, toilet flushing, pet and car washing, indoor plant watering, pet and livestock watering, and for lawn and garden irrigation.

WATER SAVING DEVICES

Advances in technology mean that water-saving devices are continuously being updated and new ones appear on the market on a regular basis. These include the following:

Toilet Systems

With the severe affordability constraints in the subsidised housing sector, developers often provide on site sanitation. VIPs and composting toilets are generally regarded as being environmentally sound. However, care must be taken in the design of on site sanitation, as improper design may lead to ground water contamination.

In the case of waterborne sewerage, the most common toilet system in domestic use is one which uses a cistern, usually either low-level or close-coupled. For optimum water conservation a low-volume or dual-flush type should be used. These cisterns should be used with a pan designed to be used with low flush volumes.

Taps

Water conserving taps with a lower flow rate than previously accepted as the norm should preferably be selected for all new installations. These are designed to give comparable levels of utility while using less water. Taps fitted over wash basins do not need to provide a high rate of flow. Another option which is suitable in certain situations is the metering tap, which delivers a pre-determined, but adjustable, quantity of water when operated.

Table 5: Summary of Recommendations and Cost Implications:

RECOMMENDATION	BENEFIT	COST	RESPONSIBILITY
All plumbing layout and design in low cost housing should be determined in conjunction with the design of the structure	Savings on materials and construction; water & energy conservation	Contractor's fees	ND - Incentives Designers & Contractors - Concept Contractors - Implementation
	Water conservation	Communication costs	DWEA - Awareness and Incentives
"Dead Legs" should be avoided by careful siting of the components of the hot water system	Savings in materials and construction; and water and energy conservation	Possible additional material costs	ND - Incentives Designers - Concept Contractors - Implementation

RECOMMENDATION	BENEFIT	COST	RESPONSIBILITY
Reduce water pressure to an optimal level according to the specifications for the devices used in the plumbing system.	Water savings	Cost of Pressure Reducing Valve (PRV)	DWEA & ND - Incentives Designers & Contractors - Concept Contractors - Implementation
Consideration should be given to the use of secondary (grey) water when designing any new water installation.	Significant water savings	Cost of Devices or additional materials	DWEA & ND - IncentivesDesigners & Contractors - Concept Contractors - Implementation
It is important to specify the use of a low-volume or dual-flush toilet system.	Water savings	Cost of fitting	DWEA & ND - Incentives Designer - Specification Contractor - Implementation
Choose a low flow tap fitted with a ventilator / flow controller or spray nozzle.	Water savings	Cost of fitting	DWEA & ND - Incentives Designer - Specification Contractor - Implementation
Low flow rate shower heads should be specified for all new installations.	Water savings	Cost of fitting	DWEA & ND - Incentives Designer - Specification Contractor - Implementation

2.4 GENERAL CONSIDERATIONS

2.4.1 THE SITE

Location and siting are important in terms of energy-efficiency. The following recommendations relate to the site:

a) Topographic conditions can affect solar radiation. Therefore steep south-facing slopes should be avoided in areas with cold winters;

b) Existing landforms, trees and buildings cast shadows which should be taken into account when locating a housing development;

c) Local climatic conditions such as rainfall patterns and prevailing winds should be considered when planning a housing development; and

d) Site planning needs to be sensitive to the principles of both energy and water-efficiency.

Recommendations which apply include:

a) Housing units should (as far as possible) face in a Northerly direction, i.e. the longer axis of the dwelling should be orientated as near to East-West as possible, and the most window surface should be on the North side;

b) Appropriate indigenous, deciduous trees should be planted to shade the Northern facade of all housing units; and

c) Reasonable measures must be taken to prevent groundwater contamination by poorly designed sanitation systems.

2.4.2 INFRASTRUCTURE PROVISION

The following considerations should be taken into account:

a) Water pressure to the site should be reduced to an optimal level according to the specifications for the devices used in the plumbing system; and

b) Serious consideration should be given to the use of secondary (grey) water when designing any new water installation.

2.4.3 THE HOUSE

HOUSING PLAN

All plumbing layout and design in low cost housing should be determined in conjunction with the design of the structure.

“Dead Legs” should be avoided by careful siting of the components of the hot water system. All exposed pipe work, particularly in roof spaces or on outside walls should also be suitably lagged.

HOUSING ELEMENTS

a) All housing units should be well insulated in order to ensure energy efficiency;

b) Low flow taps fitted with ventilator/ flow controllers or spray nozzles should be used;

c) A low volume or dual-flush toilet system should be used;

d) Low flow rate shower heads should be specified for all new installations; and

e) Appropriate, indigenous, deciduous trees should be planted to shade the North-facing windows and walls of all housing units.

2.4.4 RETROFITTING

While the retrofitting of energy and water efficient devices and materials has not been discussed within the document, it should be pointed out that there are ways in which certain cost effective retrofitting can be implemented. For instance, an insulating ceiling can be fitted at any time after the housing unit has been completed.

2.4.5 DANGEROUS PRACTICES

There are certain housing construction practices that pose a risk to human health. These include:

The use of asbestos building materials

Asbestos is a dangerous building material. Studies have shown that the inhalation of asbestos dust can cause severe health problems. As there are a number of alternative products which are easily available that do not cost more than asbestos products, and conform to the Standards and Guidelines of the National Home Builders Registration Council (NHBRC), the use of asbestos building products has been totally banned in the construction of houses in South Africa.

2.4.6 DAMP

Damp in housing is often linked to a higher incidence of respiratory diseases. It is therefore very important that all new housing is adequately damp-proofed, and that the quality of concrete blocks is controlled to ensure that they do not absorb water.

2.4.7 INDOOR AIR QUALITY

Poor air quality has been linked to a raised incidence of respiratory disease. Dangerous levels of carbon monoxide and smoke have been measured in poorly ventilated new housing where coal, wood and/or paraffin are being used.

2.4.8 EMISSION OF DANGEROUS CHEMICALS

There are many other building materials and services which can have a detrimental effect on human health and well-being because of harmful emissions. Concrete and granite can emit radon gas, synthetic materials, paints and adhesives release volatile organic compounds, PVC used for pipes, fittings and vinyl floor coverings releases dioxins during manufacturing, use and disposal. These harmful properties should be kept in mind when specifications are drawn up.

2.4.9 SITING OF HOUSING DEVELOPMENTS

Care must be taken when siting housing in relation to other land-uses such as landfills, noxious industry or offensive trade. There is environmental health risks associated with such locational issues.