DBSA

Development Bank of Southern Africa

Green Building: Rocket Science or Not?

Development Planning Division - Knowledge Week October 2010

CONTENTS

GREEN BUILDING AND REGENERATIVE DESIGN

Green Building

- A building which is energy efficient, resource efficient and environmentally responsible contributing to sustainability
- It incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants.
- Building green creates healthier environments for people to live and work in.

Regeneration:

- Beyond sustainability to regenerative systems

  - **Produce rather than Use**....

BEYOND SUSTAINABILITY
TOWARDS THE DESIGN OF REGENERATIVE SYSTEMS

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after: Bill Reed of Intergrative Design Collaborative & Regenesis

REGENERATIVE
LESS ENERGY REQUIRED

DEGENERATIVE
MORE ENERGY REQUIRED

Regenerating Systems

Synergism of Living Systems

Whole Systems thinking

Technologies & Techniques

Fragmented

Degenerating Systems

Regenerative
Humans participating as nature co evolution of the whole system

Reconciliatory
Humans are an integral part of nature

Restorative
Humans assisting the evolution of sub systems

Sustainable
Neutral Ecological Footprint

Green
Relative Improvement
Green Star SA, LEED, BREEAM etc

Conventional
Decreasing of Resources
Self Destructive

BASIC PRINCIPLES

Organisations show that they are Environmentally Accountable when they are:

- At the forefront of environmental technology knowledge
- Encourage environmental management and apply it in their own infrastructure
- When they promote energy friendly buildings that save energy (electricity) and proactively prevent peak demand.
- Save water
- Save money through reducing operational/ recurrent costs
- Prevent destruction of irreplacable natural resources
- Promote recycling – waste management
- Contribute to reducing air polution
- Contribute to enhancing the quality of air within buildings
- Contribute to improved user-friendly buildings that in turn increases productivity
- Provide individuals control of their indoor environment e.g. opening windows
- Raise awareness and serve as educational models.


Mixed
Plastic/paper/
foil blend
waste only
Get it...
SORTED!
MAKE THINGS HAPPEN
NEDBANK
Tin&
glass
waste only
Get it...
SORTED
MAKE THINGS HAPPEN
NEDBANK
Plastic
&
polystyrene
waste only
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Get it...
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Ink cartridges
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Batteries
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PASSIVE SOLAR BUILDING DESIGN

Reduces energy consumption and ensures comfortable accommodation.

Climate plays a major role in passive solar building design

Local climate conditions that vary from place to place and must be considered.

- **The sun's movements,**
- **The prevailing wind direction**
- **Changing temperatures**
- **Humidity**

ELEMENTS OF PSD continued…

Insulation:
Good insulation in the roof and walls help to keep the inside temperature warm in winter or cool in summer.

Orientation:
North orientation ensures that as many well-used spaces face north as possible.

Shading:
Suitable roof overhangs let in the lower winter sun but shade rooms from the higher hot summer sun.

Windows:
Sensible fenestration (windows) let in light and catches winter sun, while not allowing too much window area so that warm or cool air cannot be retained inside when needed.

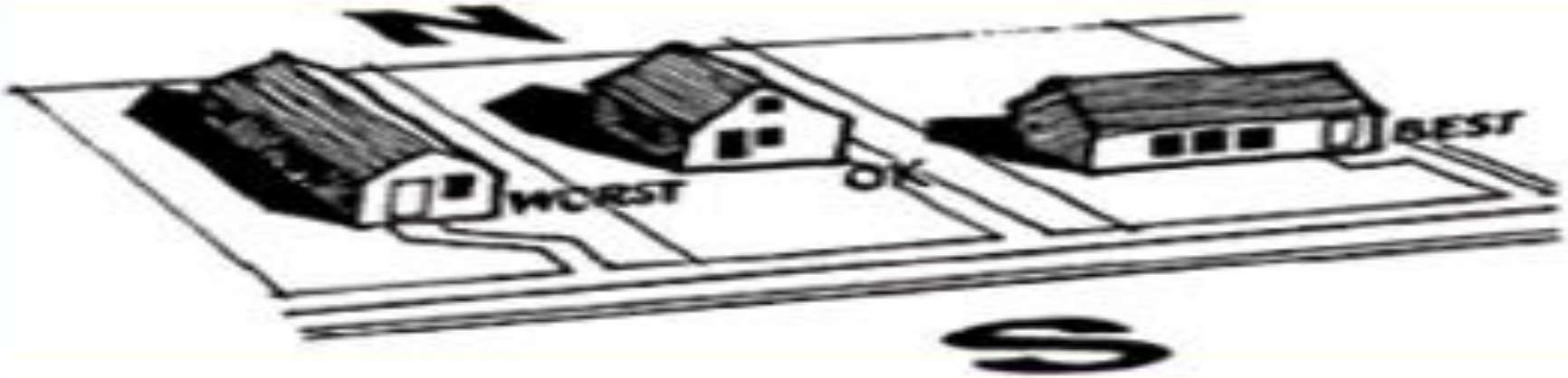
EXAMPLES OF PASSIVE SOLAR DESIGN

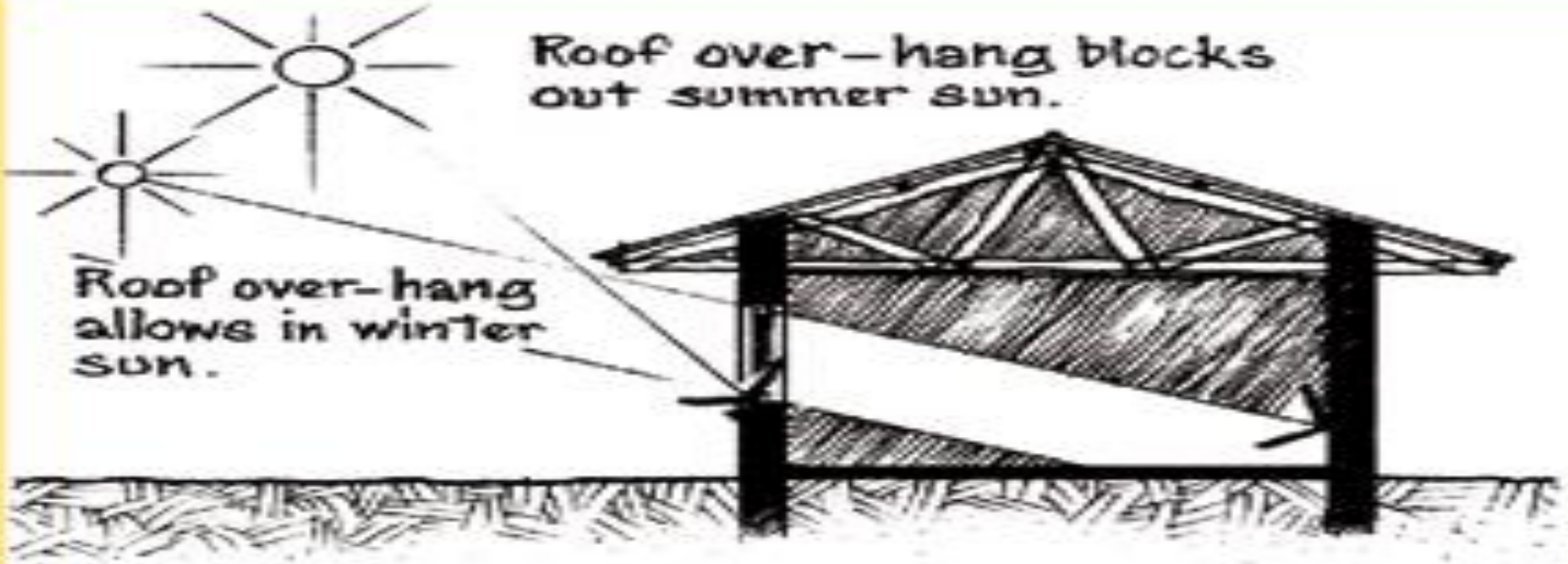
Ventilation:
Suitable ventilation provides fresh air and cool breezes, so rooms can be ventilated as needed using airbricks, forced ventilation or by opening windows.

Lighting:
Natural lighting through windows and light wells reduces the need for artificial lighting.

Building Materials:
Materials such as concrete floors and brick or clay walls absorb heat from direct sunlight and releases it again at night.

Landscaping:
Planting evergreen trees or shrubs to block strong winds in the winter, and deciduous trees to provide shade and reduce sunlight reflection in the summer, but let sun through during winter, helps to reduce the need for artificial heating and cooling.





A roof over-hang on the north side of the house should let in winter sun and shade rooms from summer sun.

WEATHER SEALING

- **A significant amount of energy is lost from homes and buildings if the structure is compromised**
- **Air leakage can result in 40% of the energy lost from an existing building**
- **Ensuring that the envelope is continuous and consistent is fundamental to minimise this loss**
- **Doors and windows are the most significant areas of concern and can be addressed at little cost and without the help of a contractor**
- **Any investment made in weather sealing is recovered within two and a half years time through reduced energy bills**

BUILDER'S TOOLKIT

- **Builder's Toolkit**

  An award winning SA software developed by University of Pretoria

- **Calculates energy benefits of orientation, ceilings, insulation, shading, wall and roof colour, window size, window type and ventilation on internal building temperatures for specific climatic conditions**

- **It calculates the energy required to maintain the building's internal temperature at an acceptable level throughout the year.**

- **That information can be used to conduct a life cycle analysis for each passive solar intervention**

CLAY AS A BUILDING MATERIAL

- There are clay buildings around the world that are hundreds of years old and still intact
- Thick clay walls are excellent insulators – far better than bricks
- It keeps a house cool in summer and warm in winter
- It also keeps air humidity at a comfortable level
- Construction techniques that use clay as a base for walls:
  - Clay bricks
  - Rammed earth
  - Cob
  - Light weight clay construction amongst others

- While the benefits of using clay wherever possible are clear there are regulator, financial and social barriers to it

CLAY AS A BUILDING MATERIAL

- A clay building is classified as an alternative building in SA. The National Home Builders Registration Council must approve a house before banks will finance it.
- The Council currently has no guidelines for alternative clay bricks – so no housing grants or subsidies available for those
- At a low income level, the perception is that clay is inferior and that only brick and mortar constitute a 'proper house'

A code of practice for clay based structures was developed for Namibia in 2007. This has enabled people to build safe and solid clay houses while serving as a base for construction approval by authorities. For a copy of this contact Sustainable Energy Africa.

INTERVENTION RESULTS FOR LOW INCOME HOUSING

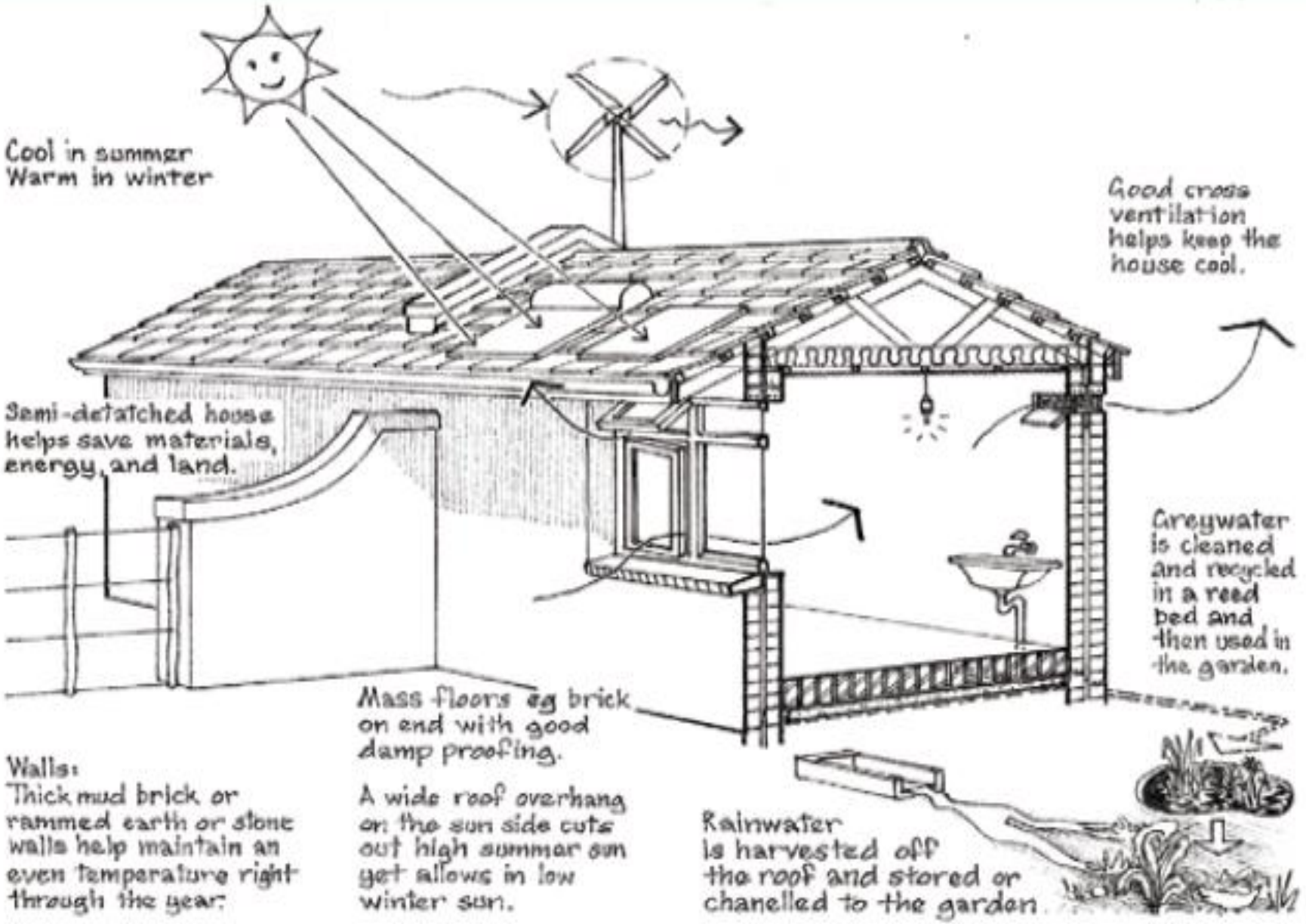
	Intervention	City		
		Cape Town	Durban	Pretoria
No-cost Interventions	Clay Walls	Yes	Yes	Yes
	North Orientation			
	Concrete Block Walls			
Immediately Beneficial Capital Cost Interventions	Aluminium Foil Roofing	Yes	Yes	Yes
	Insulated Ceiling			
	Ceiling			
No-value Interventions	2 Skin Walls with air gap	Yes	No	Yes
	Tile Roof			
	Window Shading	No	No	No
	Exterior Colour			

INTERVENTION RESULTS FOR LOW INCOME HOUSING

	Annual Energy Savings from Low Income Housing interventions (GWh)			
	Orientation	Ceiling	Additional insulation	Sisalation
Cape Town	29	296	231	310
South Africa	421	2,641	2,028	5,819

Findings for all projects regardless of source of funding:

- **The use of sisalation proved feasible**
- **The use of ceilings, and the use of insulated ceilings are publicly feasible**
- **Of these three interventions, the use of sisalation seems to be the most**
- **Efficient intervention as it returned the highest IRR across all project locations.**
- **The use of two skin walls with an air gap (cavity walls) be a feasible for use in Cape Town and Pretoria.**



GREEN HOUSE

SUPPORTS A LOW IMPACT LOCAL ECONOMY

GREEN BUILDING RATING SYSTEM
SETTING STANDARDS USING GREEN STAR SA

Green Star SA is a green building rating system that has being developed by the Green Building Council of South Africa based on the Australian Green Building Council's Green Star system. It has been customized for South African use, and is currently only applicable to commercial buildings. For more information go to **www.gbcsa.org.za.**

Similar to **Australia;** USA: Leadership in Energy and Environmental Design (**LEED)** building certification program run by the U.S. Green Building Council. UK Building Research Establishment Environmental Assessment Method (**BREEAM**)

Objectives are to:

- **Establish a common language and standard of measurement**
- **Promote integrated, whole-building design**
- **Raise awareness of green building benefits**
- **Recognise environmental leadership**
- **Reduce the environmental impact of development**

RELEVANT REGULATIONS

The South African Bureau of standards has developed energy efficiency standards (SANS 204) for residential and commercial buildings that were published in October 2008.

They are:

SANS 204-1:	**Energy Efficient Performance Parameters for Buildings**
SANS 204-2:	**Energy efficiency in Naturally Ventilated Buildings**
SANS 204-3:	**Energy Efficiency in Artificially Controlled Buildings**

SANS 204-1 could ultimately become part of the National Building Regulations and SANS 204-2&3 will become part of the Building Code of South Africa.

The aim is to encourage the implementation of passive solar design in the residential and commercial sectors

1-4 year timeframe for implementation

DBSA A PARTNER
THE GREEN HOUSE BUILDING 2004

Design interventions & the contractor

- Question needs
  - Is the need justified
  - Is there another way to provide the same service / functionality?
- Participation of end user & those affected & participating in manufacture in design decisions

- Substitution of unsustainable materials
- No toxics - ban bad materials

Design for:

- Least energy, water, materials over lifecycle
- sustainability interventions in later production, retail and use.
- Disassembly of product to enable recovery with least re-processing (highest use)
- 'Cradle to Cradle' responsibility
- Appropriate technology

- Green specifications

DBSA A PARTNER
THE GREEN HOUSE BUILDING 2004

SUSTAINABLE CONSTRUCTION SPECIFICATION

Construction Phase 1: Conversion of potting shed

Aim of specification: to ensure that construction activities are conducted in an environmentally and socially responsible manner by:

- stipulating measures against which the environmental performance of the Contractor will be measured,

- providing for capacity building processes for contractor and public

DBSA WELCOME CENTRE REGENERATIVE SYSTEM

Design Concept:

Continuation of the landscape, disguising itself as Highveld Savannah with its functions neatly tucked underneath and merging wall and roof into a single entity. Another noteworthy distinction of the building is that it is completely off-grid and CO_2 neutral

DBSA APPROACH

DBSA Energy Master Plan:

- Ensure energy security
- Reduce energy cost
- Promote responsible development

Earth excavation offers temperature control system opportunity

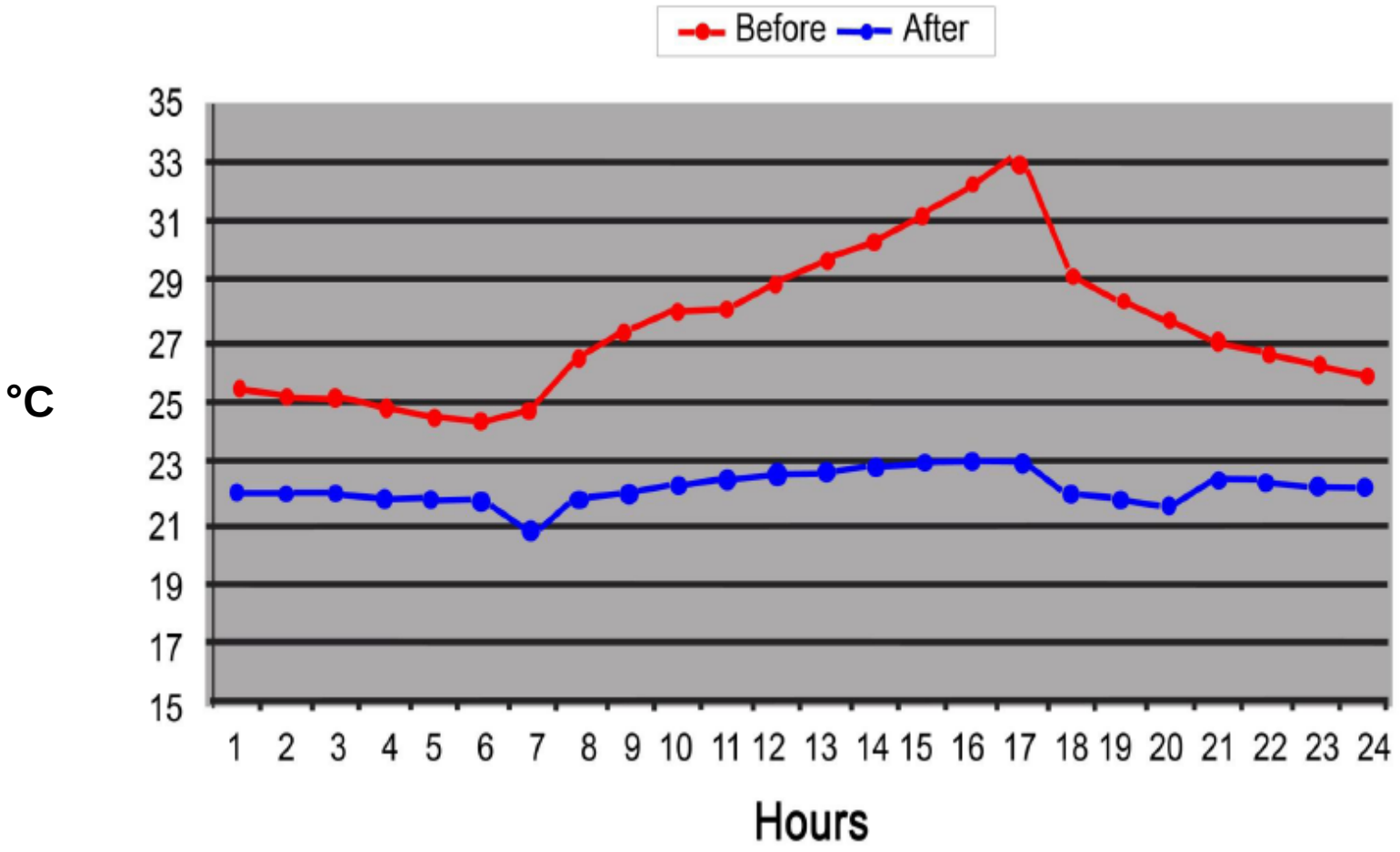
Collapsing soil conditions on site led to earth excavation of 3m replaced with suitable material. Excavated earth's constant temperature used cost-effectively as a control system

Fresh air supply is drawn into the building *via* underground pipes, thereby pre-heating the air in winter and pre-cooling it in summer.

Natural light permeates the building, while artificial high-efficiency lights further reduce energy demand and heat gain. A solar water heater provides warm water for under floor warmth in winter and all year domestic hot water.

The building further relies on photovoltaic energy from 30kWp panels. These churn out electricity from sunlight without polluting the air, soil or water. The Bank also intends to build a further 1 MW photovoltaic plant to ultimately service the whole campus.

INDOOR TEMPERATURE BEFORE AND AFTER THE ENVIRONMENTAL DESIGN



ENERGY EFFICIENCY AT THE WELCOMING CENTRE

Solar hot water plant:
34 m^2 solar vacuum collector
1 600-litre storage tank
240 m^2 under floor heating

Solar photovoltaic plant:
29.4 kW solar panels
Producing 54 248 kWh/annum
Battery storage = 217,7 kWh
Equals all electricity requirements for the building

Energy efficiency:
Demand has been reduced through efficiency from 38.4 kVA to 9.96 kVA

Architects Bentel Associates International

October 2010

Pick ‘n Pay SUPERMARKET HURLINGHAM JOHANNESBURG

The R160-million multi-level complex comprises a receiving basement, a level for staff facilities, trading and mezzanine levels ; 300-bay basement parking area.

5600 m^2 PnP supermarket, 750 m^2 of adjoining line shops, a Pick 'n Pay liquor store and a Pick 'n Pay Cooking School

Green Design features:

•Natural light from skylights and full length glass facades

•40% less energy than a comparable conventionally designed store due to the use of high performance refrigeration, lighting and Heating, Ventilation, & Air Conditioning (HVAC) systems.

•Renewable energy sources to help light, warm and cool the site. No VOC (Volatile Organic Compound) paints have been used and solar panels are used to power external signage at night.

GREEN DESIGN FEATURES

Pick 'n Pay is installing 100 kilowatts of photovoltaic capacity that will generate between 8-20% of the store's power when in operation.

The refrigeration plant incorporates a heat recovery system, which provides the entire store's hot water requirements.

An integrated energy-saving system also manages the store lighting, bakery equipment and staff facilities.

A single 1 600-litre hot water tank caters for the hot water reclaim system supplying domestic hot water to the building.

A rainwater harvesting system has been installed to be used as irrigation for the largely indigenous landscaping and back-up for the air conditioning system

Masdar, the world's first carbon-neutral, zero-waste city

CM2M HILL has been working with its client Masdar of the Abu Dhabi Future Energy Company since 2007 to develop sustainable built environment policies and procedures, pilot test and implement new sustainable technologies and assist in managing the design and construction of Masdar City


an Smith + Gordon Gill Architecture.

MASDAR HEADQUARTERS ABU DHABI UNITED ARAB EMIRATES

A collaborative, building information modeling (Autodesk BIM) approach enabled the team members to integrate architectural, structural, and building systems from the project outset, thereby increasing the efficiency and constructability of the entire system.

The world's first positive-energy building, producing more energy than it consumes and surpassing the standards for LEED Platinum™ sustainable design certification.

This groundbreaking building is a zero-waste, zero-carbon-emission development designed to showcase advanced energy and waste-efficiency technologies.

MASDAR HEADQUARTERS

ADRIAN SMITH + GORDON GILL MULTI DISCIPLINARY TEAM

AN AMBITIOUS, HIGH-PERFORMANCE BUILDING

The eight-story, 964,000-square-foot Masdar Headquarters building includes office and retail space, shaded public gardens, a prayer hall, and direct access to the city's transportation systems.

It consumes 70 percent less water than comparable buildings and incorporate numerous eco-friendly components, including a 7-acre roof canopy that will provide shade and serve as an armature for one of the world's largest photovoltaic panel arrays.

The building's signature architectural feature is a collection of 11 cones that support the massive rooftop trellis and facilitate natural ventilation and cooling by drawing warm air up to roof level, where it will dissipate in the wind.

The cones will also provide day-lighting for the building and form attractive, oasis-like interior courtyards.


NEDBANK PHASE II
135 RIVONIA ROAD
SANDTON
SOUTH AFRICA

CONCLUSIONS

Green Building: Rocket Science or Not?

No….. and Yes!

Simple principles implemented can effect huge savings in simple buildings

More complex buildings require the same principles but involve advanced thought processes enhanced by technological modeling

REFERENCES

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- CSIR
- DBSA ARCHIVES
- DEPARTMENT OF HOUSING
- DEPARTMENT OF MINERALS & ENERGY
- GREEN BUILDING COUNCIL E-JOURNALS
- HOLM & JORDAAN
- MBSA CONGRESS PRESENTATIONS SEPT 2010
- UNIVERSITY OF PRETORIA

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Thank You

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