

**Are environmentally friendly buildings appropriate in South
Africa?**

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Declaration by student

I hereby confirm that the treatise is my own work and that any sources consulted are adequately acknowledged in the text and listed in the bibliography.

Signature of acceptance and confirmation by student

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Taking a look at how environmentally friendly buildings fit into South Africa's social, economical and cultural conditions, and examining whether the concept is appropriate or not. By focusing on economic viability together with the progress that green buildings have already made in South Africa, it is possible to draw to a conclusion that the concept is appropriate in South Africa and will be increasingly implemented in the Building Industry through the use of both statutory and voluntary regulations and guidelines.

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1. Background

The effect buildings have on the environment and how the two ideas relate to each other is a relatively new concept and has recently taken on considerable popularity among young and upcoming architects. The focus has shifted from aesthetic and profitability goals, to environmentally friendly goals. There are a few key issues at stake here while the world is “going green”, such as is it possible to focus on the environment and still generate a good return on investment? We are all responsible for our role on this planet, but has the construction industry taken it too far? Is it even our place to get involved? More specifically, how appropriate are environmentally friendly buildings in South Africa? The building industry is both determined by, and is a determinant of the state of our economy. It is therefore essential to ascertain just how economically viable these environmentally friendly buildings are. In this study issues will be addresses concerning green building regulations, functional implementation of environmentally friendly concepts in South Africa, return on investment, and overall practicality of environmentally friendly buildings.

With the world’s current economic crises, money is scarce and resources are needed in every sector of the business world. The problem of global warming is one we have known about for many years and one of the solutions is to create environmentally friendly buildings, or “green buildings” as they have become commonly known as in the industry. If these buildings are not economically viable then they will take a back seat, as there are many pressing issues that supersede the question of “saving our planet”. As

Maslow's hierarchy theory explains, the first level of human beings basic needs is physiological. If these can no longer be met, as is the case with many people currently living in South Africa, then the question of environmental impact and making our buildings "green" is the last thing on these people's minds. Vegter (2008) explains this in his article saying "With fewer people considering the environment as a top priority compared with other issues, such as health care, economy, education, terrorism and crime" . Therefore, for this environmentally friendly buildings idea to survive and continue in the building industry it needs to be economically viable, generate profits and offer costs savings over the life cycle of the building as well as other benefits that makes the idea attractive enough to implement. We in South Africa live in a developing country and as Vegtor states "In many developing nations, issues such as poverty, health care, housing and unemployment take precedence over high-minded concerns about the environment, especially when the industrialized rich world is widely viewed as the main culprit." This statement is more relevant today than ever. Investors are looking to make money, not save the planet. Is it realistic to believe that these two ideas can co-exist?

(Vegter, 2008)

It will be examined whether regulations are in place to ensure environmentally friendly buildings or not. And if not, what can be done to slowly introduce this concept to gradually become the norm in the built environment rather than the exception?

Taking specific examples of environmentally friendly buildings, studying the ideas and motivations behind these projects and finding out how financial viability played a role during design phase, will paint a clearer picture of how the concept fits into our world. Is it possible to design a building which is both economically viable and environmentally friendly? The general public perception is that Architects who design these buildings are not concerned about the buildings as economic return, but more as a component that

needs to compliment and be in harmony with its surroundings. The question then presents itself, when all is considered are we in South Africa ready for green buildings? How suitable is it in our country when we face so many other pressing issues that require attention?

2. Main Problem

2.1. Are environmentally friendly buildings appropriate in South Africa?

Environmentally friendly buildings are not appropriate in South Africa.

The reason the above hypothesis was concluded is due to the following assumptions:

1. It is the general perception that environmentally friendly buildings are not economically viable and therefore do no appeal to developers and other investors.
2. We do not have any regulations in place enforcing the concept; therefore it is assumed that there is no need for it.
3. The examples of environmentally friendly buildings do no qualify under any specific standard therefore cannot be called “green buildings”, they merely implement minor green concepts.
4. The technology needed to create a green building is too expensive and advanced for South Africa.

3. Sub-Problems and Hypotheses

3.1. Do South Africa's building regulations provide for environmentally Friendly Buildings?

There is a minimal amount of energy efficient policies implemented in South Africa and these that do in fact exist are out dated and have shifted down on the list of priorities.

3.2. Are there examples of environmentally friendly buildings in South Africa?

There are buildings that showcase minor green features, but these do not qualify as "green buildings" or environmentally friendly building.

3.3. How appropriate is the environmentally friendly strategy under South Africa's social, cultural and economic conditions?

Environmentally friendly strategies are more appropriate in highly-resourced wealthy countries than in our third world country.

3.4. Are environmentally friendly buildings economically viable?

Environmentally friendly are not economically viable. They are too expensive at both initial cost phase and during the life cycle of the building to be a practical, cost effective solution. Our knowledge and resources available are still too limited to produce a building that yields a positive return on investment.

4. Research Methodology

Research will be done using current construction magazines for example property news, built and construction world. Various relevant articles have been obtained. Journals will also be used as well as news papers, the World Wide Web, National Building Regulations and Building Standards Act, interviews, documentaries and site visits. Interviews with relevant professionals will be held who are involved with projects concerning environmentally friendly buildings .

CHAPTER 2

Does South Africa's building regulations provide for environmentally friendly buildings?

1. Introduction

As described by the Green Building Council of South Africa (2008), a green building is a building which is energy and resource efficient as well as environmentally friendly. The main focus is to design buildings which reduce the negative impact on its environment and its occupants by reducing energy and resource consumption. As Jeff Cole (15 April 2009, Johannesburg) explains "Buildings are 80% inefficient and form a huge part of our economy and by improving building efficiency we can make a big difference." Environmentally friendly buildings addresses the global warming issue while also looking after our health.

(www.gbcsa.org.za, 2008)

2. Definition

Environmentally friendly buildings, often also referred to as "green buildings", are buildings which are designed with more in mind than the traditional idea of a practical and aesthetically pleasing structure. Berman (2008:6) talks about the basic principles of traditional design which are functionality and beauty, and the movement occurring across the globe which aims to address another factor previously ignored namely safety. This safety encompasses both our health and that of our planet. What the school of thought behind environmentally friendly buildings aims to do is to create a

building which is in harmony with its surrounding environment, complementing rather than harming.

3. Energy Efficient Building Regulations

3.1. SANS 204

There are currently no building regulations which force anyone to design or build environmentally friendly buildings. Many buildings in South Africa are not at minimum standard and in an effort to change this, the SANS 204 series of standards are currently being developed in South Africa by the South African Bureau of Standards (SABS). Dr Geoff Visser stated in an article in Engineering News (October 2008) that "...new work is being done at the SABS on developing energy management systems standards, we are in the early stages, but welcome any and all participation..."

If this standard is implemented it will create a platform for the passing of an energy efficient building act. Plan approvals would then incorporate this act meaning that the design would have to meet statutory regulations. As explained by van der Merwe (2008) the first three parts of the standards are expected to be published in June 2009.

The SABS 204 draft consists of the following:

- **SANS 204-1 for energy efficiency in buildings with artificial or natural environmental control part 1: general provisions**
- **SANS 204-2 for energy efficiency in buildings with artificial or natural environmental control part 2: the applications of the general provisions for energy efficiency in buildings with natural environmental control**

- **SANS 204-3 for energy efficiency in buildings with artificial or natural environmental control part 2 : the applications of the general provisions for energy efficiency in buildings with artificial environmental control**

Rodney Milford commented on the standard saying that it would be the minimum requirement for buildings and not the best practice to strive for. (Vd Merwe, October 2008) (vd Merwe, June 2008)

For a higher standard of environmentally friendly buildings, a benchmark tool was created called the Green Star Rating Tool.

4. Green Building Council South Africa

4.1. Background

Global warming is a familiar concept, taught in schools, with the effects more present today than ever. Global warming is the average increase in temperature due to trapped energy in the atmosphere in the form of carbon gasses. Previously governments were still in denial about the climate change and what contribution we made to this problem. Today, this has changed to a small degree with new regulations being passed to promote greener architectural design. (Berman 2008:6)

The most seriously affected continent to date is Australia. Australia is the highest emitter of green house gasses per capita in the developed world. According to the Stern Review on the Economics of Climate Change released in 2006 by Nicholas Stern, Australia is one of the countries most at risk from climate change. This explains why they were the first to come together and realise that buildings have played a contributing role, thus forming the Green Building Council of Australia. They were the first to develop the “Green Star” which can be explained as a rating tool to evaluate the environmentally friendliness of a building. It is completely voluntary and just sets standard

parameters for measuring green buildings. The council was launched in 2002 and became the leaders in this field, encouraging the launch of the Green Building Council of South Africa.

(Stern, 2006)

4.2. Green Star Rating Tool

South Africa was the twentieth country to form a Green Building Council called the Green Building Council of South Africa, from which the Green Star SA Rating Tool was born. This rating tool was developed in 2008 by the council and is based, under licence, on the Australian Green Star. It is an objective measurement tool to allow individuals or developers to see just how 'green' their buildings really are. This rating tool is specifically designed for South Africa's harsh climate to assist in the design of sustainable architecture.

(www.gbcsa.org.za, 2009)

The Green Building Council states in their technical manual (2008:ix) that the Green star was created to change the built environment into one that reduces environmental impact of buildings, to identify building lifecycle impacts and raise awareness of green building benefits.

The Green Star SA has rating tools for each individual phase of the building lifecycle, namely design, construction, operations and refurbishments. As it is not possible to have one generic rating system for all types of buildings the Green Star Australia has a Green Star Rating tool for different types of building. However, South Africa is still in a very premature stage of this whole development and so far the only tool that has been developed is one that caters for both new and already developed office buildings. The tool incorporates local regulations as a guideline for improving the way our buildings are designed and built, as to consider the environment and help with factors such as energy and resource efficiency.

The Green Star SA consists of various categories which are assessed and consequently rated. The Green Star structure is displayed below.

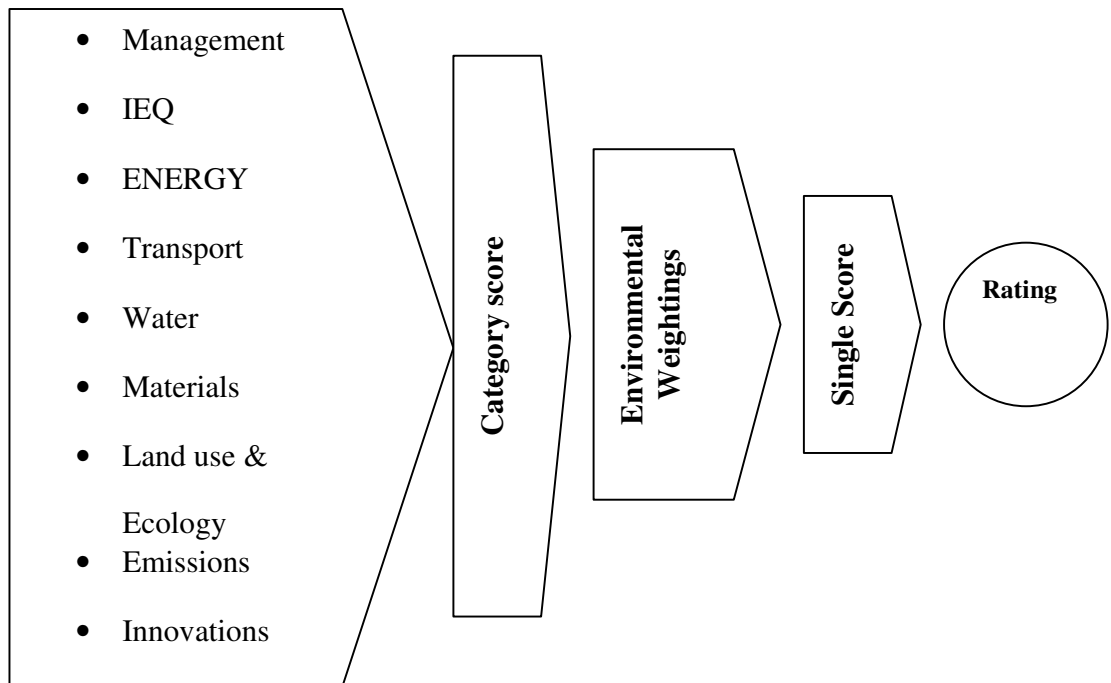


Figure 1 : Structure of the Green Star rating system (GBCSA 2008: x)

The tool rates nine separate categories which addresses nine areas of a development that has the potential to have an environmental impact. These are:

1. Management
2. Indoor Environmental Quality
3. Energy
4. Transport
5. Water
6. Materials
7. Land and Ecology
8. Emissions
9. Innovation

GBCSA (2008: x)

Credits in each category are awarded for actions that show that the building meets the objectives of the council. These credits are then added together to achieve an overall percentage for each category. This percentage is then multiplied by a weighting factor to reach a final score. This weighting factor ensures that the category is proportionately represented according to its impact on the environment and overall importance.

GBCSA (2008: x)

$$\text{Category score} = \frac{\text{Number of points achieved}}{\text{Number of points available}}$$

$$\text{Weighted Category Score} = \text{Category Score (\%)} \times \text{Weighting Factor (\%)} \times 100$$

Note : All category weightings are provided in Appendix A

The final score is calculated by adding all the Weighted Category Scores with a maximum score of 100, plus an extra five point for the Innovation category. This category is seen as an additional 'bonus point' category and is therefore not applied to a Weighting Factor.

In order for a building to receive a rating by the GBCSA it has to achieve a minimum four star rating by a Green Star SA accredited professional. This professional has to be engaged in the project prior to commencement of designs and contribute substantially throughout the project.

GBCSA (2008: xi)

Table 1 : Green Star SA rating tool scores
GBCSA (2008:xii)

| Overall Score | Rating | Outcome |
|----------------------|---------------|---|
| 10-19 | One Star | Not eligible for formal certification |
| 20-29 | Two Star | Not eligible for formal certification |
| 30-44 | Three Star | Not eligible for formal certification |
| 45-59 | Four Star | Eligible for Four Star Certified Rating that recognizes/rewards 'Best Practice' |
| 60-74 | Five Star | Eligible for Five Star Certified Rating that recognizes/rewards 'South Africa Excellence' |
| 75+ | Six Star | Eligible for Six Star Certified Rating that recognizes/rewards 'World Leadership' |

There are four eligibility factors that have to be met before a Green Star SA Certification can be obtained:

1. Spatial Differentiation

The building has to be distinct from its surrounding spaces in order to send a clear message to the public. This means that the relevant project has to have a clear street address and entry, and must be freestanding.

2. Space Use

A minimum of 80% of the gross floor area must be used for Commercial Office space.

3. Conditional Requirements

All conditional requirements must be met to be eligible for a Green Star SA Certification regardless of the overall rating of the building.

4. Timing of Certification

There are specific time frames wherein certification must take place in order to be valid.

GBCSA (2008:xii)

What the Green Star SA rating tool has done is created an opportunity for voluntary change and is considered to be a large stepping stone towards bringing about the necessary changes. The tool has however, not gone without criticism. Cole (15 April, 2009) explains that this rating tool sets an “impossible high standard”. Another comment noted by Cole is that the rating tool does not allow for human error. The building can be built with a six star rating, yet if not operated correctly, this would be in vain. The occupants of the building are not forced, and often not educated, to use the technologies implemented in these buildings. For example BP SA's Green Headquarters in Cape Town. As BP changed their vision from traditional petroleum company's values to focus on four new brand values, one of which is green, they decided to house their staff in an environmentally friendly building designed by Alex Robertson from Alex Roberson Associates. The R115-million building won the South African Property Association (SAPOA) 2005 award in the category of innovative developments. The award was won due to the innovative ‘Green thinking’ of the building. Yet according to Cole (15 April, 2009), once the building was occupied the technologies implemented into the building to make it more environmentally friendly were not used. This was due to a “lack of knowledge and understanding” says Cole. The way a building is operated contributes largely to how successful the green building will be in reducing its negative impact on the environment. The Green Star SA rating tool simply assesses the design and not the operation of the

building after completion. Cole suggests that another solution should be considered besides the Green Star SA Rating Tool in order to address this.

Koblitz (20 April, 2009)

The Green Building Council South Africa currently has a Green Star SA Accredited Professional course for professionals to attend and write an exam. Once this examination has been passed these professionals can be involved with the project team from the start and earn two points for the project as a result of their participation. Accredited professionals are valued because they have a comprehensive understanding of the Green Star SA rating system, and the practical application of this during the building design and construction process. These professionals can also assist in educating occupants in efficiently operating the building to gain maximum energy and cost savings.

(Lyn Tucket, 9 September 2009)

5. Summary

There are currently no building regulations governing the environmentally friendliness of buildings. The only mechanism currently available to measure and ensure that a building can be considered 'green' is the Green Star Rating Tool. This tool is not a statutory requirement and is completely voluntary. The only standard that is being considered is the SANS 204 series of standards and will only be final later this year.

6. Conclusion

South Africa's building regulations SANS 204 only provides for environmentally friendly buildings on a minimalist level, and the process of enforcing this series of standards is still pending. This standard should not be

seen as the benchmark to obtain for green buildings, but rather as a minimum requirement for all buildings in South Africa. The Green Star Rating Tool is a benchmark tool, used to set high standards when moving towards greener building practice in South Africa.

7. Testing the Hypothesis

Question

Does South Africa's building regulations provide for environmentally Friendly Buildings?

Hypothesis

There is a minimal amount of energy efficient policies implemented in South Africa and these that do in fact exist are out dated and have shifted down on the list of priorities.

The hypothesis has been proven wrong. There are currently no energy efficient policies and therefore they cannot be out dated. New standards are being developed, namely the SANS 204 series of standards, showing that the need for new green building regulations is very high on South Africa's list of priorities.

CHAPTER 3

Are there examples of Environmentally Friendly buildings in South Africa?

1. Introduction

It has become the unwritten law for businesses to reduce their environmental impact through minimizing its carbon footprint and conserving energy and water. There are currently 100 building in Johannesburg alone undergoing refurbishment to 'go green'.
(Cornish, 2009: 66)

2. BP Headquarters Cape Town

A prime example of how far South Africa has moved towards environmentally friendly buildings can be seen in the BP Headquarters in Cape Town which was completed in 2004 at a cost of R110m. Although British Petroleum (BP) is an oil company, they are at the forefront with green technology in their Headquarters in the Waterfront in Cape Town because the projects' objectives included reducing energy consumption, optimizing the use of natural light, passive heating and climate control to name but a few. The three storey, 18 000m², low-rise T-shaped headquarters is designed to use natural light, through the use of atrium roof lights and provision of light shelves, without direct sunlight to reduce energy required to cool and illuminate the building with artificial lights. The air-conditioning system uses passive and natural ventilation.
(Cornish, 2009: 68)



Figure 2 : BP Headquarters using natural light www.urbansprout.co.za

When designed, two primary goals were set to work around. The first being that the target annual energy consumption was set at 115kWh/m^2 , and the second that 10 percent of this energy had to come from renewable energy sources.

(Cornish, 2009: 66)

The way this was achieved is through the use of concepts such as solar water heaters, grey-water system and roof gardens. The solar water heaters function with hot-water cylinders and 68kW photovoltaic array cells on the roof and can generate 10 percent of the building's electricity demand. This solar system is the largest grid-connect system in South Africa. The roof garden retains heat energy from the sun and through evaporation helps to cool the air, resulting in a cost saving on air conditioning and heating. To further reduce energy consumption the lighting system uses movement and light-sensitive sensors.

Water consumption was reduced by 25 percent compared to conventional buildings through the use of a grey water system incorporating rainwater from the roof, condensed water from the air conditioning, shower and wash-hand water run-off which is stored in a 1350m² tank and used to flush toilets and for irrigation.

In addition to the above the building sports the following green features:

1. Sustainable material were used
2. Gabions and stone walls were formed from excavated rock
3. Timber flooring is FSC-certified
4. Carpets are made from 100% recycled materials and locally hand made

(www.urbansprout.co.za, 2008)
(Moodley : 2009, 60)

The BP Headquarters is not a GreenStar rated project. It encompasses many of the GreenStar principles but has not been given a rating by the Green Building Council of South Africa.

3. Menlyn Maine Development

3.1. Overview

Situated in the heart of Pretoria's Eastern business suburbs, Bowen (July 2009) describes the Menlyn Maine development as "a truly globally connected green city". He adds that the development is a modern mixed

use development comprising of Offices, Retail and Residential, boasting to be the 1st Green Precinct in South Africa.

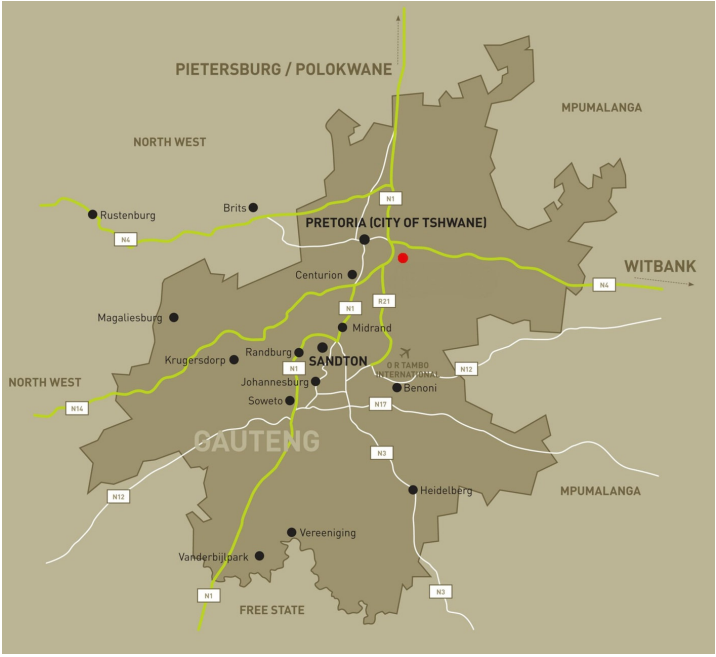
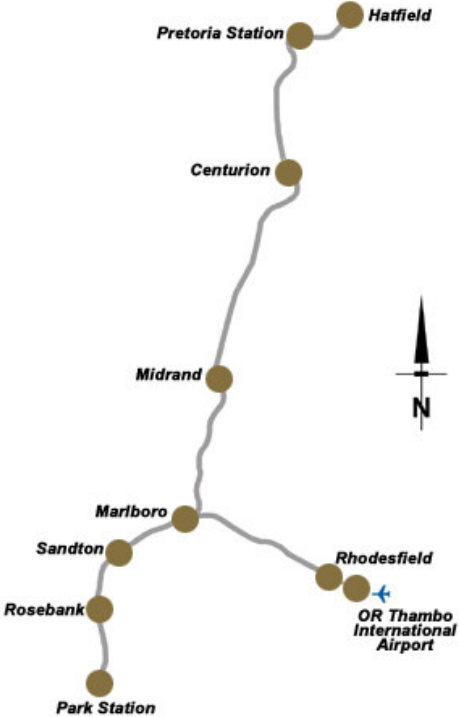


Figure 3 : Location (Menlyn Maine Presentation: 2009)

Figure 4 : Gautrain feeder network (Menlyn Maine Presentation: 2009)



Menlyn Maine will be linked to the Gautrain feeder network along Aramist Street via a Gautrain bus-link

from the Hatfield Station, reducing its Carbon footprint.

3.2. The Environment

According to Bowen (2009), Menlyn Maine is a truly Green City and is a member of the Green Building Council of South Africa. He adds that 3 of the first 5 GreenStar registered projects in South Africa form part of Menlyn Maine. All Menlyn Maine projects will have a minimum of a 4-Star GreenStar rating. A GreenStar rating, as discussed in Chapter 2, is a comprehensive rating system for evaluating design and performance of buildings based on: Energy, Water Efficiency, Indoor Environment Quality and Resource Conservation.

GBCSA (2008: x)

Menlyn Maine endeavours to achieve a minimum Four Star GreenStar rating by incorporating the following technologies into the precinct:

- Greywater Treatment Facilities
- Rainwater Attenuation & Harvesting
- Green Roofs on buildings
- Energy Efficiency via design and occupancy sensors
- Thermal Storage Water Cooled AC Systems

(Bowen: 2009)

Bowen (2009) claims that due to its Green Principles, occupants will experience improved employee productivity and efficiency, thereby saving on costs.

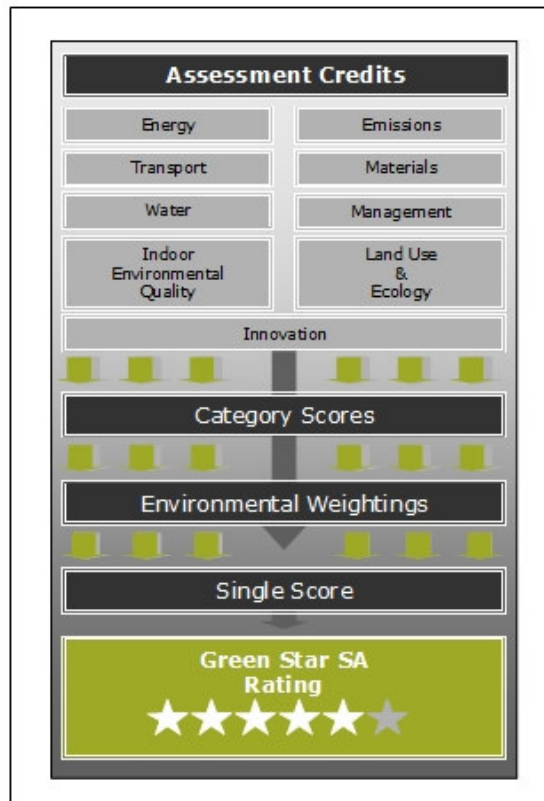


Figure 5 : Green Star Rating (Menlyn Maine Presentation: 2009)

Menlyn Maine has been selected to work together with the worldwide Clinton Climate Initiative. The CCI seeks to reduce CO₂ emissions in new developments and refurbishments. In conjunction with the C40 Cities Leadership Group Menlyn Maine endeavours to become a world class Green City.

(Bowen: 2009)

Media Maine was announced to be one of 16 projects to form part of the Climate Positive Development Programme. These projects aim to produce zero carbon omissions to move towards eliminating our carbon footprint on the planet. This is done by incorporating technologies that make use of clean energy sources, waste and water management, and specialized lighting and transport systems. www.engineeringnews.co.za (Creamer, May 2009)



16 Founding Projects in 10 Countries

© Copyright, 2009 Clinton Climate Initiative

Figure 6: Menlyn Maine forms part of the Climate Positive Development Programme

Menlyn Maine Development is a R7 billion project, catering for various markets and groups of people. There are currently 6 buildings in the design and costing phase.

(www.engineeringnews.co.za , February 2009)

- Bartholomew Building - Construction commencing first quarter 2009
- Falcon Building - Designed, Costed - ready to build
- Galileo Building - Designed, Costed - ready to build
- Pegasus Building - Designed, Costed - ready to build
- Building P - Under Design and Costing - ready to build
- Residential - Initial Design Concepts completed. Construction planned for 2011. (<http://www.menlynmaine.co.za/buildings>)



Figure 7 : An artist's impression of one of Menlyn Maine's eco-friendly buildings (www.sagoodnews.co.za, 2009)

What makes Menlyn Maine unique when compared to other developments is the focus on the environment and building “green”. Anton van Wyk, MD of Menlyn Maine says that the entire development will have a strong environmental feel to it, with an emphasis on saving energy. This has become vital as “buildings use a substantial portion of the world’s energy” says van Wyk. He goes on to explain that buildings are responsible for up to 40% of energy consumption, and 48% of greenhouse-gas emissions. It is easy then to understand why this development has caused such a media and public interest.

(www.engineeringnews.co.za February 2009)

Two of the buildings stand out from the rest the one being the Bartholomew Building and has been registered with the Green Building Council of South Africa. This project is the 4th registered

project in the country. The second significant building is the Pegasus Building which is the first GreenStar registered project in South Africa

http://www.menlynmaine.co.za/news/item/Bartholomew_Building_GBCSA_Registered (2 June 2009).

Environmentally friendly aspects of this development includes amongst others:

1. Living close to the work place will reduce the emission of green house gasses
2. The development houses a park which will help to clean the air referred to as a “green lung” by van Wyk.
3. Street lights will face downwards as not to disturb night birds
4. An estimated 22 MVA of electricity will be used, with the “green” features of Menlyn Maine saving an estimated 10 MVA
5. Building automation systems
6. High efficiency lighting
7. Centralized geysers
8. Water-efficient irrigation systems
9. Stormwater harvesting.
10. Carbon emission reduction

www.engineeringnews.co.za (Venter :2009)

www.medioclubsouthafrica.com, (Erasmus: 2009)

4. Conclusion

It is apparent when looking at the above examples that South Africa is shifting its focus to Environmentally Friendly Buildings. Van Wyk (2009) did however raise an interesting point concerning local suppliers of “green” products. He explained that these local suppliers placed a 20% premium on “green” products as opposed to 2-5% by international suppliers. Only once they started to import these products have the suppliers been more reasonable with their prices. This can be seen as a step in the right direction, for if these “green” products are more affordable they will most certainly become more popular, and even the norm.

(www.engineeringnews.co.za ,2009)

Menlyn Maine development has put South Africa on the “Green Building Map” and is disproving wide spread perceptions that South Africa is not ready to take on Environmentally Friendly Building projects. There are only 16 projects in the Climate Positive Development Programme, of which two are situated in South Africa. This is an outstanding achievement and proves that South Africa is ready and fully equipped for the “Green Movement”.

5. Test the Hypothesis

Are there examples of Environmentally Friendly buildings in South Africa?

There are buildings that showcase minor green features, but these do not qualify as “green buildings” or environmentally friendly building.

Through the use of various examples the above hypothesis can now be considered false as there are more than one example of Environmentally Friendly Buildings in South Africa.

CHAPTER 4

How appropriate is the environmentally friendly strategy under South Africa's social, cultural and economic conditions?

1. Introduction

In South Africa we are moving towards 'greener' buildings everyday leading to architects choosing environmentally friendly products and materials in their designs.

2. Energy Efficient Materials

South Africa has many natural resources available for the use in construction. The use of these materials cannot be denied and the impact on the environment needs to be evaluated to determine if this is beneficial or to the detriment of the environment.

2.1. Natural Materials

2.1.1. Mud and Clay

People have been constructing their dwellings from mud and clay in South Africa for centuries, and to this day rural communities are making use of this natural material as the main constituent to construct their homes. COB housing is one of the earliest forms of clay and mud construction and involves mixing straw, sand, clay and water, and shaping the mixture into round loaf shaped bricks. This material is exceptionally environmentally friendly as the material has no environmental impact and once the building's use had expired, the remains can return back to the earth's surface.

(www.urbansprout.co.za, 2009)

2.1.2. Stone

Natural Stone construction has been used since the early Bronze Age and is still widely used in South Africa. The problem with rock is that it required extensive heating to obtain optimum comfort levels. Natural Stone construction can be very aesthetically pleasing, shows exceptional compressive strength properties and has very little impact on the environment.

2.1.3. Thatch

Thatch is easily obtainable in South Africa and is a popular means of construction still today. It is a good insulator and is considered to be a "truly renewable material" (van Wyk, 2009)

2.1.4. Wood

The wide use of wood in construction is threatening the existence of certain tree species and is therefore not encouraged by environmentalists. The reason for its popularity is that it is flexible and strong under loads of compression as well as its aesthetic appeal.

In an effort to coming to a reasonable compromise between environmentalists and the construction industry, concerning the topic of the use of wood in construction, some solutions have been found. One of these being wood veneers. Tabu is a leading Italian manufacturer of veneers and has made its Green range of veneers, certified by the Forest Stewardship Council (FSC), available in South Africa. The advantage of using this product is that it already reduces the consumption of wood and all the raw material are sourced from environmentally friendly origins.

(Specifier, March 2009)

2.1.5. Brick

Clay brick is a common method of construction and is used consistently throughout South Africa. The material offers high thermal efficiency and is also considered to be a sustainable building material. The thermal efficiency regulated internal temperatures without the need for artificial cooling or heating. According to Specifier (2009) only 5% of energy consumption occurs during the material's manufacturing process, leaving 95% of consumption during the lifecycle of the building. This 95% can be reduced substantially by minimizing the need for energy consumption of

the HVAC through the use of clay bricks for construction. A comparative study was done by Structatherm Projects to determine the difference in energy usage between a clay brick cavity wall construction with insulation and a steel frame construction. The study showed a 40-60% reduction in energy consumption in the case of the clay brick house.

(Specifier, March 2009:13)

2.1.6. Concrete

Concrete is the predominant building material as stated by van Wyk, “due to its plasticity, longevity, formability and ease of transport.” (2009:3)

Where more environmentally friendly options exist in the place of of concrete, the option should be examined and considered. This material is not seen as environmentally friendly due to its high CO₂ omissions and its failure to complement and exist in harmony with its environment. This material has various applications, one of which is concrete roof tiles, for which an alternative does exist. Grant Wheeler explains that by replacing the use of concrete-based products with slate, 500kg of CO₂ omissions can be eliminated per house.

(Kopping, 2009)

3. Energy and Cost Saving with Technology

3.1. Water

Grey Water System

Grey water system uses grey water which includes shower, bath, wash hand basin water and washing machine water for irrigation purposes.

It is senseless if one considers it that for so long potable water was used for this purpose.

According to www.greywater.co.za (2009), an average household uses between 200 – 300 litres of reusable water per day. Grey water had useful amounts of sulphates and nitrates which some experts say is more beneficial to the garden than clean tap water. If converted back to a Rand value of R 0.38/litre, an average family can save up to R114 per month, not to mention the saving of scarce resource such as potable water.

([www. Greywater.co.za](http://www.Greywater.co.za), 2009)

Advantages of Grey water system

- Lower fresh water usage
- Less strain on septic tank
- Grey Water has effective nutrients for plant life
- Ground water recharge
- Cost effective, up to 80% of waste re-used
- Avoid penalties on water restrictions
- Connect to existing irrigation

(www. Greywater.co.za, 2009)

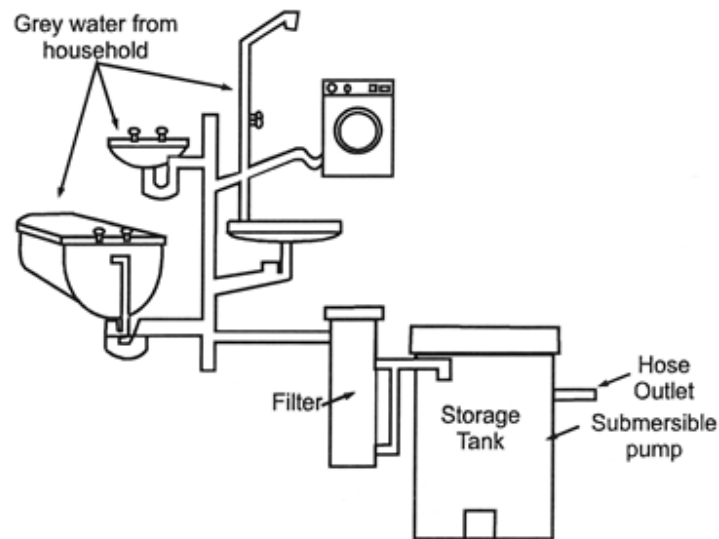


Figure 8: How a Grey Water System Works (www. Greywater.co.za)

Grey water systems available in South Africa:

- Below ground or above ground system
- Submersible or standard pump system
- Float switch or timer systems
- Storage tanks from 240 Litres up to 5000 Litres
- Built-in easy to clean filter for hair and body fat
- Durable non-corrosive Polyethylene containers
- Manual shut-off valves for rainy season
- Water pumped into irrigation systems for gardens
- Irrigation for gardens
- Rain water tanks supplied and installed
- DIY Kit

(www. Greywater.co.za, 2009)

Cost savings

| | 5.326 kl free | 5.326 kl @ R3.33 | 7.101 kl @ R7.10 | Excess usage @ R10.52 | Total | Difference |
|-------------------------------|---------------|------------------|------------------|-----------------------|---------|------------|
| Average usage with grey water | R0.00 | R17.57 | R50.41 | R139.36 | R207.33 | |
| Average usage with irrigation | R0.00 | R17.57 | R50.41 | R297.16 | R365.14 | R157.81 |

| | 3.728 kl free | 3.728 kl @ R4.01 | 4.971 kl @ R8.52 | Excess usage @ R9.32 | Total | Difference |
|------------------------------------|---------------|------------------|------------------|----------------------|----------------|------------|
| Disposal charge with grey water | R0.00 | R14.95 | R42.34 | R86.42 | R143.71 | |
| Disposal charge without grey water | R0.00 | R14.95 | R42.34 | R226.22 | R283.51 | R139.80 |
| Montly saving | | | | | R297.61 | |

Table 2 : Cost Savings (www. Greywater.co.za/costs.htm, 2009)

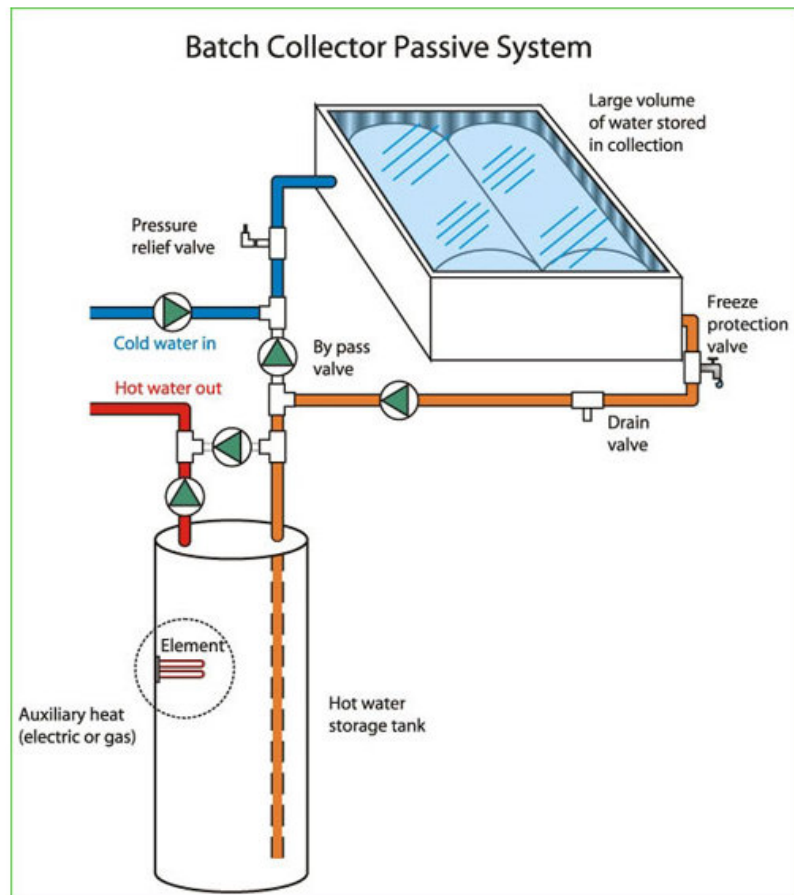
A household uses 31 000kl with a Grey water system compared to 46 000kl when watering using municipal water.

3.2. Temperature

Solar Water Heating

A typical solar heating system consists of a solar panel with heat transfer fluid. This fluid transfers the heat energy to where it is needed such as a water tank or radiator. The solar panel is positioned where it is exposed to maximum sunlight throughout the day. The heat transfer liquid is pushed through the solar panel using a pump, and then transfers the heat to the storage area.

(<http://www.solarwaterheating.co.za/how.html>, 2009)



(Source: <http://www.southface.org>)

Figure 9: How solar heating works

(<http://www.solarwaterheating.co.za/how.html>, 2009)

By using a solar water system in both residential and commercial buildings, major cost savings can be obtained. South Africa is also the perfect location for such a system, as there is ample of sunlight throughout the year.

3.3. Lighting

3.3.1. Natural light - the Sun

As the sun provides the earth with natural light, it also regulates its rhythm and pace, determining the seasons and separating night and day. It has also been shown that light affects human emotions and provides us with health benefits. South Africa's supply of natural light is substantially higher than countries in Europe and the rest of the world. The opportunity to maximize this source is available to us most of the year, throughout the four seasons. It seems then illogical to design a building that keeps out natural light, opting for artificial illumination instead. Yet, this has been happening for decades and only in recent developments, where architects have started to focus on the environment, has this aspect slowly started to move in the other direction. It is also necessary to note that the reason why designs are incorporating natural light is due to an effort in reducing energy consumption as power is one of South Africa's scarcest commodities. Sunlight is free, and us in South Africa are blessed with year round supply of sunlight. Through correct orientation of a building and the use of materials with high thermal mass, it is possible to use this resource to our advantage, and save on energy costs.

'Day lighting' is a method of achieving these lighting levels while creating a comfortable working environment. It uses light shelves, light tubes and top lighting. Light shelves are reflective surfaces that are placed strategically near windows to reflect light into the building, thus importing natural light and improving the light quality. Daylight is distributed evenly through the room and glare is reduced at windows.

(Kopping, 2008:23)

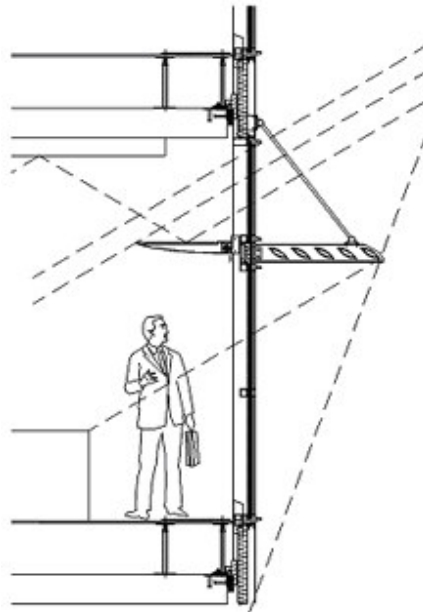


Figure 10 : Lighting Shelves

(<http://www1.hunterdouglascontract.com/HDWeb/Cultures/en-US/Products/SolarControl/LightShelves/SystemDescription.htm#top.>)

Light tubes are reflective chambers on the façade of the building which capture sunlight, and reflects it evenly back throughout the office. Top lighting works on a slightly different principal, using glazing on the top surface of the building. For optimum use if this technology and to ensure that direct sunlight doesn't penetrate the building and overload the HVAC the glazing should face in a southerly direction.

(Kopping, 2008:27)

3.3.2. Artificial light

Choosing fluorescent tubes over incandescent bulbs saves the consumer on 75% energy consumption, while producing the same

amount of light. Fluorescent tubes also produces less heat energy and thus relieves strain from the HVAC to maintain comfortable working temperatures.

(van Wyk, 2009)

The consumption of energy by lighting in commercial offices ranges somewhere between 29-35% and for residential buildings about 11%. The most basic technology available to curb energy consumption commercial office space is a time switch which is a timed circuit that switches lights on and off at regulated times to coincide with the working hours of the occupants. Only general areas should be governed by this technology and offices should still be provided with their own light switches. Movement sensors are an option available in areas which are seldom used, which automatically turn lights on when movement is detected in the room. These systems aim to eliminate human error such as forgetfulness and savings of up to 80% energy is claimed by its suppliers. Light sensors that measure the ambient light levels provided by the sun are also available; this together with conventional South African offices that are designed with large windows facades is available to ensure optimal lighting levels with minimum consumption, throughout the working day.

(Osborne, 2009) (Kopping, 2008:24)

The Green Star SA rating tool suggests that lighting levels in commercial offices should be kept below 400 lux and SANS 204 that a lighting level of 300 lux is sufficient to provide enough lighting for the working environment while not wasting energy consumption.

(Green Building Council of South Africa, 2008)

4. Conclusion

By simply implementing the environmentally friendly strategies during early planning phase it is highly possible to by correct orientation and design to create an environmentally friendly building without costing a cent more. South Africa has been implementing some environmentally friendly strategies for years, without realizing it, says Cole (2009)

5. Testing the Hypothesis

Question

How appropriate is the environmentally friendly strategy under South Africa's social, cultural and economic conditions?

Hypothesis

Environmentally friendly strategies are more appropriate in highly-resourced wealthy countries than in our third world country.

The hypothesis has been proven false, as South Africa is a perfect country to implement environmentally friendly strategies, many of which do not cost a cent.

CHAPTER 5

Are environmentally friendly buildings economically viable?

1. Introduction

The necessity for environmentally friendly buildings has been discussed in previous chapters and the benefits of using “green” concepts in building designs are widely recognized by professionals and environmentalist alike. However, whether it is economically viable to implement these concepts is so far an unexplored subject as there is still much debate regarding this. Although there is a lot more research material available internationally than locally, Kats (2003) confirms this when stating in his report that there seems to be consensus on the environmental and social benefits of green building, but consistent concern over the lack of financial and economic information.

In order to examine the economic viability of environmentally friendly buildings, one needs to look at the cost incurred at different stages of the project, from design up until final completion, as a direct result of the building’s environmentally friendliness and compare this to the costs saved over the lifecycle of the building.

As explained by Bowen (July 2009), South Africa currently only has two developments which are Green Star Accredited, namely Menlyn Maine and Zonk’izizwe Town Centre. It is therefore still going to take a number of years before research can be conducted here regarding the topic. Bowen says that this is because it will only be possible to do a conclusive study once the lifecycle of these buildings have lapsed. As they are currently still in design phase, the only cost analyses available is estimated additional costs of incorporating green concepts into the design.

2. Overall Cost Implications

Integrating environmentally friendly concepts into the design of projects is a solid investment, says Kats (2004:v). The most comprehensive study

done to date have found that with an additional 2% investment in construction costs can yield a life cycle saving of up to 20%.

The Financial Benefits of Green Buildings are:

- lower energy
- lower waste disposal
- decreased water costs
- lower environmental and emissions costs
- lower operations and maintenance costs
- savings from increased productivity and health

The saving in energy, waste and water costs can fairly accurately be measured, whereas increased productivity and health is difficult to predict with accuracy. (Kats, 2003:v)

The California Waste Management Board did a study showing cost savings over a 20 year period, as reflected in the table below. It shows that energy savings alone exceed the average increased cost of an environmentally friendly building. The impact on productivity and health is also shown, and when compared, forms a much larger part of the cost picture as one might think, compared to the cost of construction or energy. It is therefore proved, that although initial construction cost are higher, the cost savings gained if the building is maintained correctly in order to obtain an increase in productivity is significant and cannot be ignored. Drawing conclusion from the research, it can be said that building green is economically viable and makes financial sense. (Kats, 2003: ix)

Financial Benefits of Green Buildings Summary of Findings (per ft²)

| Category | 20-year NPV |
|--|----------------|
| Energy Value | \$5.79 |
| Emissions Value | \$1.18 |
| Water Value | \$0.51 |
| Waste Value (construction only) - 1 year | \$0.03 |
| Commissioning O&M Value | \$8.47 |
| Productivity and Health Value (Certified and Silver) | \$36.89 |
| Productivity and Health Value (Gold and Platinum) | \$55.33 |
| Less Green Cost Premium | (\$4.00) |
| Total 20-year NPV (Certified and Silver) | \$48.87 |
| Total 20-year NPV (Gold and Platinum) | \$67.31 |

Source: Capital E Analysis

Table 3 : Financial Benefits of Green Buildings (Kats, 2003: ix)

3. Tools used to conclude the study:

3. 1. Life Cycle Costing

Life cycle costing is used to assess and incorporate the benefits and costs associated with environmentally friendly buildings. This costing is used to obtain a reasonable net present value estimate of the future related costs and benefits of these buildings.

(Kats, 2003: 8)

3.2. Present Value (PV) and Net Present Value (NPV)

It is accurate to conclude that it initially costs more to build green, but in order to conduct an accurate study on the total cost implications, cost saving over time needs to be included. In order to do this the current value of the green building together with future cost savings needs to be calculated on a Present Value (PV) and Net Present Value (NPV) basis. Present Value (PV) is the present value of future stream of financial benefits and NPV shows the stream of current and future benefits and costs. This gives the value of the total costs in current monetary terms. In other words, the tool takes the time value of money into consideration in order to make all costs comparable on the same scale to account for inflation, interest and other monetary tools making your Rand today comparable to your Rand in the future.

The way this is calculated is by way of the following formula:

$$NPV = \sum_{i=1}^n \frac{values_i}{(1 + rate)^i}$$

Rate : Interest Rate per time period

n : The number of time periods

Pmt : Payments made each time period

This calculation provides the value of today's Rand value for a certain time period of financial benefits. By calculating the NPV of the initial green cost premium and the stream of future discounted benefits it is possible to determine the NPV of the entire investment.

(Kats, 2003: 9)

4. The Problems of Determining Cost

There is a large misconception that building green is more expensive, and some of the obstacles causing this misconception include incomplete integration within and between projects, lack of life cycle costing and insufficient technical information. This is causing developers to be resistant towards the idea of green building and this will take time to overcome.

(Kats, 2003: 12)

The problems with determining cost is that the few developers who do decide to go the “green” route keep cost information to themselves, and do not make it available for research use to change the perception of the rest. When developers are willing to share this information, it is still difficult to conclude on a precise “green premium” for the following reasons:

1. Cost information is project specific and does not form a basis for cost comparison
2. Some of the green projects include costly finishes that push up initial cost and do not add to the environmental friendliness of the building
3. When a construction firm first decides to go the “green” route, the cost are usually higher than normal as the company tends to experience a learning curve regarding the subject and fine polishing on their processes and methods still has to be done to optimize costs
4. Newness in technologies make professionals and clients resistant to using them. Some technologies are also oversized and not fully integrated.

(Kats, 2003: 13)

5. The Economical Viability Analysis

LEED is the Green Star Rating equivalent rating system used in America and ratings are as follow:

Level 1 – Certified

Level 2 – Silver

Level 3 – Gold

Level 4 – Platinum.

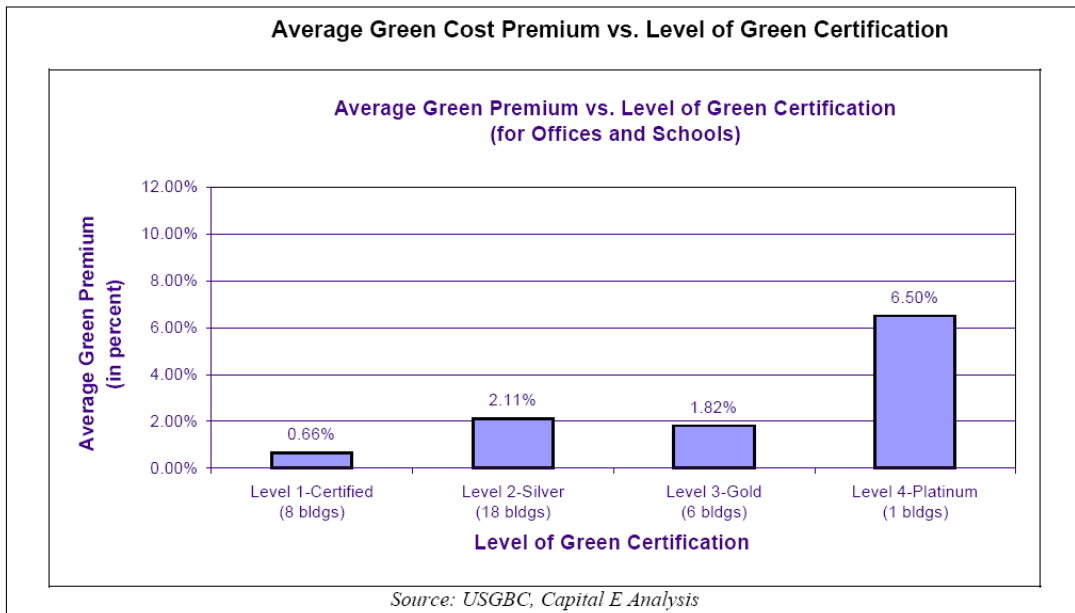
A study was done by California Waste Management Board on 33 individual LEED registered projects completed between 1995 and 2004. To conclude a useful study cost data must include both green building and conventional building design costs for the same building. Unsurprisingly, such solid data on additional costs associated with green design is scarce and somewhat almost impossible to come by. Therefore, for the purpose of the study, broad literature review was used from various professionals and sustainable building bodies to obtain the necessary information.

Although the sample size is small, the study gives meaningful insight into the cost premium of green buildings. The results of the study can be seen in the table below, showing an estimated green premium of approximately 2%.
(Kats, 2003: 14)

| Level of Green Standard and Average Green Cost Premium | |
|--|----------------------------|
| Level of Green Standard | Average Green Cost Premium |
| Level 1 – Certified | 0.66% |
| Level 2 – Silver | 2.11% |
| Level 3 – Gold | 1.82% |
| Level 4 – Platinum | 6.50% |
| Average of 33 Buildings | 1.84% |

Source: USGBC, Capital E Analysis

**Table 4 : Level of Green Standard and Average Green Cost Premium
(Kats, 2003: 14)**



**Figure 11 : Average Green Cost Premium vs. Level of Green Certification
(Kats, 2003: 16)**

| Year of Completion and Average Green Cost Premiums for Buildings with Silver Certification | |
|--|----------------------------|
| Year of Completion | Average Green Cost Premium |
| 1997-1998 | 2.20% |
| 1999-2000 | 2.49% |
| 2001-2002 | 1.40% |
| 2003-2004 | 2.21% |
| Avg. of 18 Silver buildings | 2.11% |

Table 5 : Year of Completion and Average Green Cost Premiums for Buildings with Silver Certification (Kats, 2003: 16)

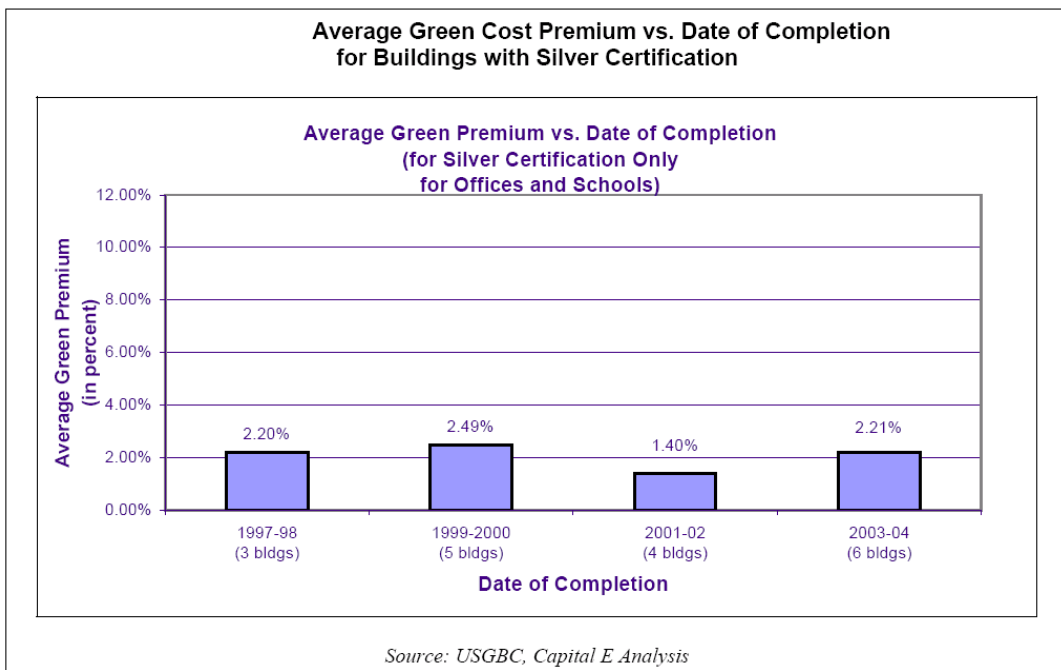


Figure 12 : Average Green Premium vs. Date of Completion (Kats, 2003: 17)

There is reason to think, by evidence and experience that building green gets less expensive over time. This trend is not reflected in the above data, however this has been experienced in Pennsylvania, Portland and Seattle.

Portland Study

3 LEED Silver Buildings

| Completed Date | Cost Premiums |
|-----------------------|----------------------|
| 1995 | 2% |
| 1997 | 1% |
| 2000 | 0% |

Table 6 : Cost Premiums vs. Completion dates – Portland Study
(Kats, 2003: 17)

6. Energy Use

Energy has become a scarce and expensive commodity in South Africa and across the globe. Saving on energy usage can substantially save on the operational life cycle cost of the building.

The impact that green buildings have on energy use:

1. Green building, on average, use 30% less energy than conventional buildings.
2. Characterized by lower electricity peak consumption
3. More likely to generate renewable energy on-site

(Kats, 2003: 19)

To decrease peak demands LEED encourages:

- *Integrated design*: Building systems are considered in total to optimize competing demands
- *High Performance Lighting*: Using more efficient lights, task lighting, use of sensors, use of daylight harvesting.
- *Increased Ventilation Effectiveness*: Cut air-conditioning load during peak through improved system optimization
- *Under floor Air Distribution Systems*: Use of plenum below a raised floor to deliver conditioning to cut fan and cooling loads, lowering air-conditioning load.

(Kats, 2003: 20)

| | Certified | Silver | Gold | Average |
|---|------------|------------|------------|------------|
| Energy Efficiency (above standard code) | 18% | 30% | 37% | 28% |
| On-Site Renewable Energy | 0% | 0% | 4% | 2% |
| Green Power | 10% | 0% | 7% | 6% |
| Total | 28% | 30% | 48% | 36% |

Source: USGBC, Capital E Analysis

Table 7 : Reduced Energy Use in Green Buildings as Compared with Conventional Buildings

(Kats, 2003: 24)

7. Water Conservation

Environmentally friendly building water conservation strategies fall into one of the following categories:

- ➔ Efficient potable water use through better technology/design
- ➔ Capture of grey water for irrigation use

- On site stormwater capture for use or groundwater recharge
- Recycled/reclaimed water use

(Kats, 2003: 40)

In the Pretoria East area the cost of water is R 0.38/litre. With the implementation of the above strategies, instead of using this R8/litre potable water for irrigation, which seems senseless now that these technologies are available, one could save on costs through the use of a grey water system and stormwater capture alone. The premium for these technologies can be saved in life cycle costing in less than one year.

8. Conclusion

Building costs can be minimized by integrating environmentally friendly, sustainable design concepts effectively into a project development and design. It is when green design is considered too late in the design process that overall costs can increase due to the need for “redesign”. The saving on life cycle costs of an environmentally friendly building dramatically exceeds additional initial investment costs. It is therefore accurate to conclude that environmentally friendly buildings are economically viable.

(Kats, 2003: vii)

(<http://www.ciwmb.ca.gov/greenbuilding/Design/costissues.htm>)

9. Test the Hypothesis

Question

Are environmentally friendly buildings economically viable?

Hypothesis

Environmentally friendly are not economically viable. They are too expensive at both initial cost phase and during the life cycle of the building to be a practical, cost effective solution. Our knowledge and resources available are still too limited to produce a building that yields a positive return on investment.

Environmentally friendly buildings are economically viable when considering the cost premium for a green building over a conventional building of similar type and size, compared to cost savings over the life cycle of the building. Therefore the hypothesis has been proven false.

CHAPTER 6

Are environmentally friendly buildings appropriate in South Africa?

Conclusion

1. Introduction

In examining whether environmentally friendly buildings are appropriate in South Africa, specific questions were asked. These questions look at the issue from different angles to see if South Africa is ready for the concept. In order to do this it is necessary to study firstly to what degree the concept has already been implemented in South Africa, what the concepts means for us in South Africa and what benefits we have in implementing the concept, and lastly what the financial implications are if one is to build a green development.

The question was asked *“Does South Africa’s building regulations provide for Environmentally Friendly Buildings?”* in order to form a benchmark from which one can measure the later chapter with the question *“Are there examples of Environmentally Friendly buildings in South Africa?”* If the findings were that there were strict regulations that had to be adhered to regarding environmentally friendly buildings, it would explain why there were environmentally friendly buildings in South Africa in the first place. The findings in Chapter 2 were however, that the statutory regulations, namely SANS 204, are very basic minimal standard only regulating a building’s energy usage. The Green Star Rating tool is a tool drawn up by the Green Building Council of South Africa and is a voluntary body, which indicated free choice. Where green buildings are being built, it is done out of the individual or group’s free choice. This shows that South Africa has not only accepted the concept, but recognised the need to implement as well.

The chapter titled *“How appropriate is the environmentally friendly strategy under South Africa’s social, cultural and economic conditions?”* took this concept a little further. It was established that many South African’s are choosing the green concept, but it is necessary to prove that the concept is suitable in South Africa. It was proven that the environmentally friendly building strategy is perfect under South Africa’s social, cultural and economic conditions through studying energy efficient materials as well as technologies that suites South African conditions. In the last chapter *“Are environmentally friendly buildings economically viable?”* the financial aspect of the concept was studied to examine how the concept could potentially affect the economics of the construction industry.

2. Summary

Question 1

Does South Africa’s building regulations provide for environmentally Friendly Buildings?

Hypothesis 1

There is a minimal amount of energy efficient policies implemented in South Africa and these that do in fact exist are out dated and have shifted down on the list of priorities.

The hypothesis has been proven wrong. There are currently no energy efficient policies and therefore they cannot be out dated. New standards are being developed, namely the SANS 204 series of standards, showing that the need for new green building regulations is very high on South Africa’s list of priorities.

Question 2

Are there examples of Environmentally Friendly buildings in South Africa?

Hypothesis 2

There are buildings that showcase minor green features, but these do not qualify as “green buildings” or environmentally friendly building.

Through the use of various examples the above hypothesis can now be considered false as there are more than one example of Environmentally Friendly Buildings in South Africa.

Question 3

How appropriate is the environmentally friendly strategy under South Africa’s social, cultural and economic conditions?

Hypothesis 3

Environmentally friendly strategies are more appropriate in highly-resourced wealthy countries than in our third world country.

The hypothesis has been proven false, as South Africa is a perfect country to implement environmentally friendly strategies, many of which do not cost a cent.

Question 4

Are environmentally friendly buildings economically viable?

Hypothesis 4

Environmentally friendly are not economically viable. They are too expensive at both initial cost phase and during the life cycle of the building to be a practical, cost effective solution. Our knowledge and resources available are still too limited to produce a building that yields a positive return on investment.

Environmentally friendly buildings are economically viable when considering the cost premium for a green building over a conventional building of similar type and size, compared to cost savings over the life cycle of the building. Therefore the hypothesis has been proven false.

3. Results of Study

It was unanimously proven in all four sub problems that environmentally friendly buildings are appropriate in South Africa.

South Africa has passed the new SANS 204 series setting minimum standards for energy usage in buildings. Over and above the new SANS 204, the voluntary Green Star Council has designed the Green Star Rating Tool as a green building measuring tool for their members. This tool rates just how “green” a building is at two stages. Firstly design stage and secondly completion stage. South Africa currently has 5 Green Star rated projects. It does this by measuring the energy and resource efficiency of a building. The above shows that South Africa has recognised the need and is ready to increasingly implement the environmentally friendly building concept in new development schemes. One of the green star registered projects currently in South Africa is Menlyn Maine Development. Menlyn Maine development is a benchmark development recognized by both the Green Star Council of South Africa and the international Clinton Climate Initiative. The development is also one of sixteen projects in the Climate Positive Development Programme. The development has paved the way for future similar developments by proving that there is both need and possibility in South Africa.

The green building concept suits South Africa because firstly, South Africa has many natural energy efficient materials available such as mud, clay, stone, thatch and wood, which is widely used for green construction. Secondly, South Africa’s high source of natural light proves helpful in

saving energy costs for both lighting and heating purposes. Lastly, it was shown how environmentally friendly technologies, such as grey water systems and solar water panels, are available and can easily be implemented in both South African homes and commercial developments

Another great concern of South African developers is cost. These developers are businessmen and their main aim is to make a profit. In order to convince them to adopt the green concept, they have to see the financial benefit. In the last sub problem it was shown that the additional cost to design green is minimal compared to the financial savings over the building life cycle. In a comprehensive study it was proven that the average additional cost for going green is 2% of the total construction cost, and saving over the lifecycle of the building yield around 20%. (Kats, 2009 :v)

4. Conclusion

It has been proven that environmentally friendly buildings are appropriate in South Africa as there are no stringent statutory regulations in place to force this on South Africans, yet the concept is widely accepted and implemented by the people. When considering energy efficient materials, South Africa is in abundance of these and in addition the over supply of natural sunlight makes South Africa the prime location for environmentally friendly buildings. It is also apparent that monetary reward does not have to be sacrificed for the survival of the environment, making the concept attractive to developers, hence suitable and appropriate as well.

5. Suggestions for further research

Further research should be done on the return on investment and economical viability of South African buildings as this was not available at the time this study was concluded.

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APPENDIX A – WEIGHTINGS

A rating tool that provides a single score must include some assumptions regarding the relative importance or environmental impact of different building features. Green Star SA uses the framework adopted by Green Star Australia which in turn is used by the United Kingdom's BREEAM (Building Research Establishment's Environmental Assessment Method) to provide more flexible in approach to weightings by providing a two-tiered weighting structure as follows:

- Each credit category (e.g. Energy, Indoor Environment Quality etc.) has an environmental weighting
- The number of points allocated to each issue (e.g. daylight and noise in IEQ category) is effectively a weighting among issues within the credit category.

The approach also means that if a credit is deemed to be 'not applicable' to a particular project the credit can simply be removed from the scoring.

CATEGORY WEIGHTINGS

The Green Building Council Australia (GBCA) investigated the weightings used by LEED and BREEAM and conducted their own national survey in the formulation of Green Star's initial weightings.

In South Africa, the weightings were derived through consultation with industry experts considering the Australian weightings and deliberating on the relative importance of issues in the South African context.

The following table summarizes the weightings for Australia and South Africa Office tools.

| | Australian Green Star- Office v3 | South African Green Star SA - Office v1 |
|---------------------------------|---|--|
| Management | 10 | 9 |
| Indoor Environmental Quality | 20 | 15 |
| Energy | 25 | 25 |
| Transport | 10 | 9 |
| Water | 12 | 14 |
| Materials | 10 | 13 |
| Ecology | 8 | 7 |
| Emissions | 5 | 8 |
| | 100 | 100 |

Table App-A. 1: Comparison of Weightings with different Environmental Rating tools