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# A building developer adopting minimal impact materials for low to middle income housing in South Africa

**Fihlani, Thulani Nicholas**

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# A building developer adopting minimal impact materials for low to middle income housing in South Africa

**Thulani Nicholas Fihlani**

**9706501F**

**A business venture proposal submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration**

**Johannesburg, 2017**

DECLARATION

I, Thulani Nicholas Fihlani, declare that this business venture proposal is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Thulani Nicholas Fihlani

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Signed at ……

On the …….. day of …… 2018

# DEDICATION

This document is dedicated to my family both living and departed. My three children; Yanga, Amyoli Aaliyah and Thulani Jr. you continue to inspire me and represent the best achievements of my life, I love you unconditionally and equally. It is also dedicated to my mother, Xoliswa Christine Fihlani, you have always been and continue to be my rock, you raised me to be inquisitive and aspire to better myself.

This document is also dedicated to my departed grandmother, Rosey Fihlani, who passed away before seeing me become the first university graduate in the family and making a family of my own. My uncle, Lindile Cwati, who passed away in January 2017, you were my mentor, father figure and confidant. Lastly, it is dedicated to my unborn twins, Skylar and Bryson, who fell victim to a miscarriage the night before my MBA GMAT exams. Losing you was one of the darkest moments in my life, but it also inspired me to pursue and complete my MBA in your memory.

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# SUPPLEMENTARY INFORMATION

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# EXECUTIVE SUMMARY

I have identified a need for a coordinated approach to green building, minimal impact and modular residential building construction company in the South African low-middle income property development market. There lies immense potential to industrialise and bring to mainstream the new methods of using recyclable materials in home construction in a country facing rapid declines in natural resources, increasing industrial waste build-up and burgeoning rural-to-urban migration, to populations that face inhumane living conditions in makeshift shelters. The business opportunity is anchored in building fast, with reduced easy to manage resources and lowered operational costs.

The anticipated outcomes include high quality affordable housing, increased property value, high turnout and turnaround times on building efficiency, safer leaving conditions, well planned residential neighbourhoods, efficient reuse of waste and recyclable by products and making a good profit for potential investors in the business.

Greenbuild technology has been around for over a decade and in that time, the start-up costs have lowered, and product innovations has rapidly developed to industrial production levels in major economies around the world, such as US, Europe and China. Africa has been slow in adopting the technology. In South Africa, the use of green and minimal impact materials has been in experimental stage by innovative corporate developers looking to get Green Star ratings and bragging points. The number of informal settlements continue to increase throughout South Africa, mainly constructed using industrial waste materials to build unsafe structures for shelter, under worsening extreme weather conditions and fire dangers. Government struggles to meet production of the low-cost state provided and subsidised housing, at a rate fast enough to curb formation of these informal settlements, in the face of rapidly dangerous and destructive service delivery protest across the country.

The proposed business is aimed at taking advantage of high-quality alternative building products, produced using recycled materials, to build structurally rigid,

safer structures that will have an appreciating property value to financially empower the owner, and present them with economical leverage to participate in the country's economy. Critical success factors will reveal themselves in the number of reskilled and employed young, technically skilled labour from FET colleges and training centres; the reduction in informal settlements over the next decade; the increase in formalised residential communities with higher or increasing property value; the economical participation of the previously disadvantaged population in the residential property market; the formal adoption of green building and use of alternative minimal impact materials in housing construction; and a profitable business venture the in mass production of such products.

# 1 INTRODUCTION

## 1.1 The Proposition (Purpose of the study)

The purpose of this research is to study the viability in the use of minimal impact and alternative/green building material for low-to-middle income residential housing developments in South Africa. It looks at the best option for implementation in SA, comparing a hybrid method (mixing conventional building materials with pre-fab materials) and fully pre-fabricated walls made from recycled materials. The study will produce a Business Case for establishing and successfully operating a new business venture to implement the project.

On a preliminary basis, the author proposes that a minimum of two methods should be studied and simulated for possible implementation in the South African market.

1. The first is a hybrid method which combines the standard methods of constructing a house/building structure made of an external walls envelope with normal brick and mortar walls, combining this with a new method that uses pre-fabricated full standard height (2.4m) and standard size (1.2m/width) walls produced from alternative materials, to subdivide the section/rooms of the house.
2. The second is a total application method, to construct the entire building structure using prefabricated walls. The external wall finishes for this method could either be rhinolite rendering and applying oil-based paint, or cladding using wood or stone tiles.
3. The third and control method, would be the traditional and prevalent construction method of brick and mortar (alternatively, cinder block and mortar), which would be used to compare against both the hybrid and total prefabrication methods, to demonstrate the advantages and disadvantages; efficiencies and innovation in implementing the recommended or most viable option.

The next step would be to compare these two methods against each other and compare them against the current and conventional building methods in SA, with

the distinct purpose of establishing a benchmark for a formalised process, before a final solution is implemented for the business venture. This new venture will seek to identify an opportunity to partner with local suppliers or economically viable importers of finished products, with a long-term view to locally manufacture (through R&D innovation) and supplying products in SA and the rest of Africa.

The proposed use of safer and lightweight prefabricated materials will greatly improve working conditions and minimise exposure to potential danger on a construction site, by improving efficiency in the entire process. Reducing resource handling and improving project management using the 'just-in-time' work management principle, will in turn improve quality of the product while benefiting the owner by increasing the property's value in line with trends in property market.

## 1.2 Context of the study

On their mid-year population estimates StatsSA (2017) claims that the official population of South Africa is estimated at over 56,5 million people as of August 2017. According to the General Household Survey (GHS) (2002 – 2014), in 2002 the number of households living in informal settlements, better known as shacks or squatter camps, stood at 76%, and by 2014 it had grown to 80% of households across the country. One could conclude that as numbers of people in households increase, people turn to informal shelter to alleviate congestion. Violent destructive service delivery protests are a regular occurrence across the country, highlighting the dire living conditions and inadequacy of housing amongst the poor and vulnerable communities. Natural and man-made disasters often worsen the plight of informal settlements inhabitants during extreme winter and summer seasons. After disaster recovery efforts are put into action, the communities that are rescued and destitute, often spend weeks and months in temporary shelters (tents, community hall and schools), while the brave amongst them try to recover their livelihood after total loss of assets and belongings, by rebuilding in the same informal settlements using similar materials.

It is quicker to build informal shelters than conventional brick and mortar structures. Government is often too slow to react and misses the opportunity to relocate these informal settlements households to better areas or build more secure structures for the people. A solution lies in faster building construction with modular materials that are easier to transport and assemble, to rival and eventually replace the convenience of informal shelter, when people have the urgency to put a roof over their heads.

This study presents alternative solutions to classic building methodologies using green and recyclable materials for minimal impact residential building construction. Determination of the suitability of alternate methods would be expected, to provide practical solutions to the problems of low-to-middle income housing. Other benefits that may arise are likely to be improved turnaround on construction efficiency, and improved industrial waste recycling to produce green minimal impact sustainable structures.

## 1.3 Problem statement

### *1.3.1 Green and Sustainable Residential Building Construction: Main problem*

In their paper, 'Housing conditions, sanitation status and associated health risks in selected subsidized low-cost housing settlements in Cape Town, South Africa', Govender, Barnes, and Pieper (2011) found that a large number of the houses 'had two (38%) or three (48%) structural problems and 99% of the home owners could not afford repairs to the home, …walls…showing large visible cracks…causing rain water to penetrate during rainstorms'. This is not only a Western Cape or urban problem, it plays itself out daily throughout the post 1994 South African low-cost residential development areas, rural and urban. Things were supposed to be different, a government elected by the people with an inherent expectation to improve the quality of life for the poor and previously marginalised. This raises the question; were the good intentions of the newly formed government's reconstruction and development program (RDP), low-cost

housing provisions started on an unsustainable age-old building methodology, in a country that was depleting its natural resources (like water) at an alarming rate?

After 10 years in the construction industry, specialising in commercial property development within the Banking environment, where the author and partners were actively adapting alternative and innovative ways in building methods and materials. Combined with professional observations of the current residential construction industry, its inefficiency, minimal functionality, excessive costs and inferior quality, the author has identified a potential opportunity for innovative solutions in this industry.

In recent travels to China, as part of the WBS MBA Global Tour, observations were made on advances in the production and use of alternative green and recycled materials in residential building construction. These observations strengthen the belief that focused changes are needed in the low-cost housing sector in SA. An opportunity has been identified to service an unmet need, one that both the consumer and current suppliers have not yet fully grasped, relating to an undeniable necessity in the face of growing population levels, dwindling global natural resources and the potential to improve life and environment.

The objectives of this paper are to investigate and provide persuasive evidence in identifying success criteria relating to a business venture, that has a key objective to provide technologically improved low-cost housing construction methods; the use of locally sourced or produced alternative green and recycled materials; and improved project and resource management techniques to fit the South African market.

The use of wood, steel/metal, cardboard, plastic and fibre glass in dwellings found in informal settlements around SA has been in existence for a few decades, with most of these materials scavenged in massive industrial waste dumping sites. These waste materials are now being re-used, internationally, to produce new alternative and environmentally friendly partitioning walls to high quality, safety and environmental standards.

The total utilisation of recycled materials may not be a viable option initially in the South African market due to the entrenched perceptions within the population

and industry, that building strength equates to rigid, inflexible structures and materials. South Africa's strong National Building Regulations (NBR) do not prohibit the use of alternative materials, however, there is a lack of proper oversight and capability to assess deviations from the internationally adopted norm, when referencing against existing building standards and regulations. Lobbying for amendments may be needed in the medium to long term to ensure adoption of regulations that are in line with technology development and assimilation.

### *1.3.2 Sub-problems*

The first sub-problem is: Requirements for improvements in project and resources management and principles

Peterson, Peterson, and Liu (2013, p. 15) sum it up best when they say, "*Houses start absorbing resources long before they come into existence*". Home construction and its associated infrastructure play a primary role in the consumption of natural resources (e.g., oil, timber, copper, aluminium, iron for making steel, and the components in concrete). Adding to that, is the time and costs in scheduling deliveries at the right time, in the right quantities, handling and proper storage (i.e., cement in right humidity levels and weather conditions); having the right skills (labour) onsite; and meeting required production safely and in the best quality.

In my opinion and experience, a well-managed project is one where future 'minor' changes in the final products, either by the owner/customer or original project manager, do not require all the specialist services (e.g. structural engineering, architecture, civil engineering, etc.) to be involved repeatedly. A simple change such as moving the dividing wall to re-organising the layout and positioning of the 'kid's bedroom' should be easier and less costly than building the room from scratch. To get to this level of simplicity, a project should be managed and planned efficiently from the inception and most importantly executed smartly. The middle to the end of the construction project is the most stressful, costly, critical and slowest part of the project, where there are often too many resources

(people, materials) and services (plumbing, electrical) in a limited space, causing bottlenecks, damages and costly re-work.

In our project budgeting and planning in my previous job, we allowed for 3-5% extra costs on variations and snags (re-works), but at the end of the project that cost area ballooned to 10% of the total project cost. The proposal is a housing construction where, instead of having 4 people, taking 4 days to build 4 walls, an extra 3 days to render plaster and allow to dry properly, all excluding re-works; you instead have 2 people construct 1 wall in 30 minutes with electrical and plumbing first fixes (conduit and plumb-lines) already built onto the wall and the wall is ready to accept the first coat of paint immediately. Managing such a project and resources will take a fraction of the time it currently takes to manage a conventional residential construction project. The skills required will be slightly different from what already exists in the market, but since drywalling is an industry standard in commercial property development, it is not impossible to get those skills or re-skill the labour market.

Further Education and Training (FET) colleges would need to adjust their programmes to produce required talent, but the trade-off is highly efficient, skilled and competitive labour, combined with alternative materials use, which will contribute to lower cost (over-all) of labour and resources compared to operational costs, something that is not easily achieved in special projects.

The second sub-problem is: The use of alternative building materials and associated Cost Benefits

**Functional Requirements**



Fig. 1. A shack attached to a low-cost house in Masipumelela.



Fig. 2. Backyard shacks in Driftsands – waterlogged after brief rain spell.

Photos by (Govender et al., 2011)

Sahu and Jena (2015) believe that when planning a building in terms of practical performance measures, emphasis should be on maximum comfort, security and privacy, and convenience to occupants with basic functional requirements focusing on:

1. **Strength and Sustainability**: "*the building should be safe and sound against dead load, live (or superimposed) load, and wind load. Earthquake forces in seismic regions are a matter of concern" (Sahu & Jena, 2015, p. 47)*. In many areas, around SA there is increased danger and reported incidents of tornadoes (rural EC, KZN, NW and parts of GP), seismic events (earthquakes and aftershock in NW, GP and FS), gale-force winds, heavy rains (WC, EC, KZN) and fires (WC) that determine the required strength of our buildings. The devastating results of the shack fires in and around Cape Town provide a sobering example of the dangers of informal housing in the country. The government's low-cost housing developments are plagued with structural instability that often renders these unsafe to occupy or otherwise uninhabitable.

2. **Dimensional Stability**: "*this refers to the elastic or plastic deformation under load, expansion and contraction due to temperature change, and chemical reaction between the materials used in the construction" (Sahu & Jena, 2015, p. 47)*. Concrete is by its nature rigid and inflexible which makes it more resistant to changes in shape brought on by fluctuations in temperature, this contributes to the phenomena of cracking walls and structural integrity degradation, evident in many conventional buildings over time. The problem is made worse by inferior quality of concrete or mortar mixtures on many RDP housing developments. Recycled materials by design and intention are flexible and therefore would be expected to perform better and last longer when exposed to similar conditions.

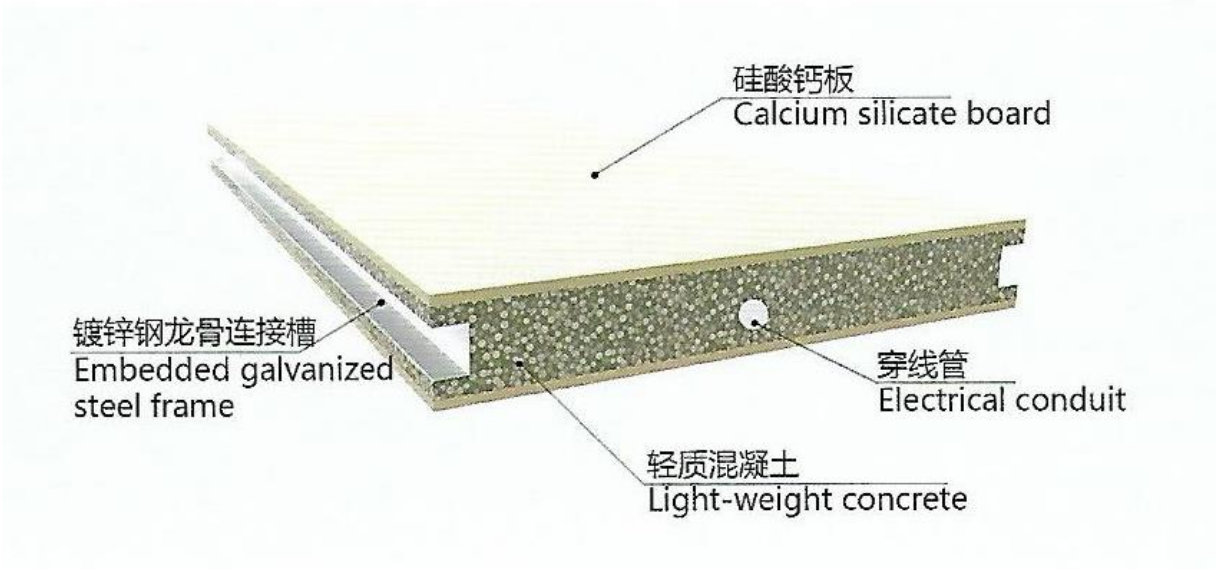
3. **Comfort**: "*this is one of the most basic requirements of planning. A plan which is suitable to the user is by far the best plan" (Sahu & Jena, 2015, p. 47)*. The size and layout of RDP houses has proven to be less functional

than might have been originally intended and many a sight of shacks (informal wooden structure) extensions, attached to these houses attests to this fact. In some rural areas across EC and KZN, it is observed that these government provided structures are so inadequate in size, that families often use them as tool sheds and opt to construct more functional and spacious traditional (e.g., rondavel) houses for themselves.

The proposal, for the hybrid method, seeks to employ the standard bricks quantity used in a conventional RDP house in SA today, use the bricks allocated to subdividing the house, during designing, on the external 'envelope structure' to increase the floor area of the house. In doing this, we can now build bigger, more functional rooms (e.g., bedrooms, living rooms) using the alternative prefabricated walls. There is an inherent financial risk associated with the costs of implementing the prefabricated walls, due to foreign exchange rate as the walls will initially be imported. This could negatively affect the cost of the final product, but there will be immediate benefits and improvements in construction period and quality of the proposed product.

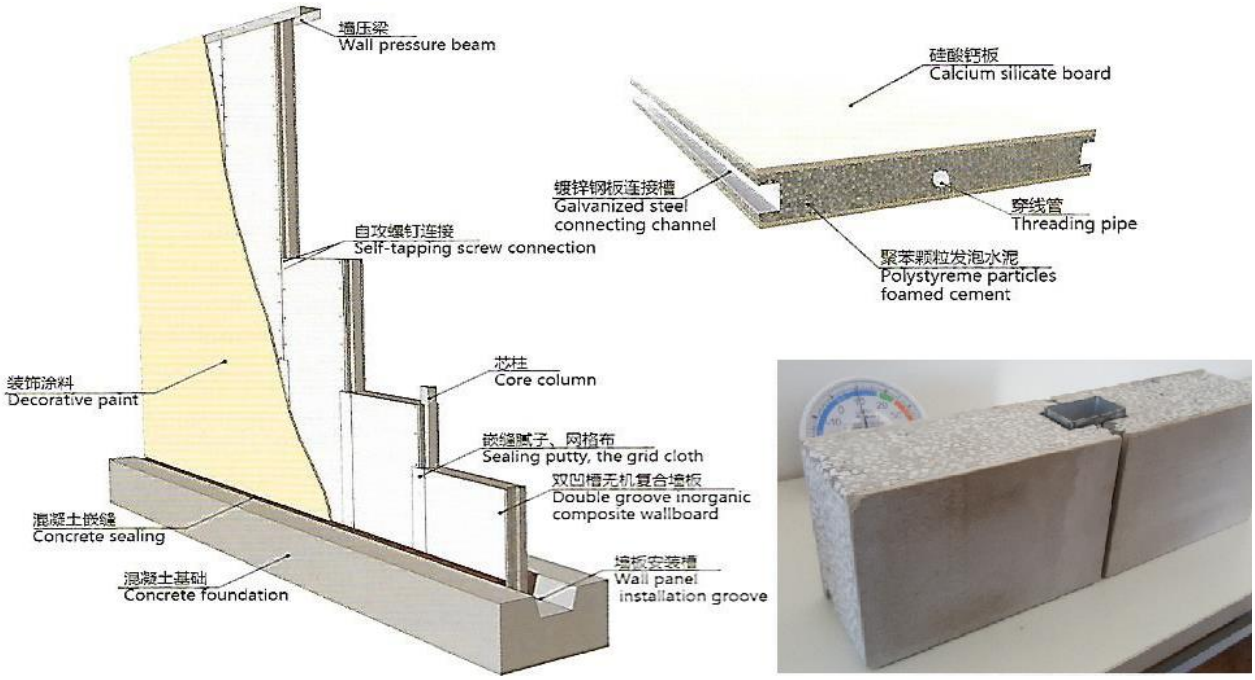
A Shanghai based, Chinese company called Poly Solar is successfully implementing the use of alternative materials in housing construction, a product they have termed the 'Poly Smart House'. The building material is manufactured using inorganic fibre reinforced Calcium Silicate boards as surface material of the wall panels, in which an embedded galvanised steel plate is used as the edge and to join two wall panels together when forming the wall. This is expected to be an economically viable and easy to replicate solution in SA as the materials used are in abundance, as by-products of industries such as coal fired power stations (that is; gypsum) and others. The diagrams below show the structural formation of these wall panels.

**Figure 1 – Poly-Smart Prefabricated Wall Panel**




Source: Poly Solar, 2017

**Figure 2 - Poly-Smart House Wall Construction Demonstration**




Source: Poly Solar, 2017

The thickness of the wall is 120mm, the standard size of an internal brick wall in conventional building, made with an internal core of Polyphyly (Styrofoam)

granules with foaming cement. The wall can be spontaneously breathing, and adjusting to humidity, with electrical conduit and plumbing first fixes pre-embedded during manufacturing (Poly Solar, 2017). The wall is fit for interior and exterior panelling, and in China they can fully construct a housing structure in seven days using only these panels as walls. South Africa is not yet ready to apply full implementation at this stage as the technology will need to prove its usefulness and strengths before extensive adaptation.

The main components used in manufacturing the wall panels are cement, plant fibre, silica-sand (without any asbestos, fiberglass or formaldehyde), which are the best physicochemical characteristic ingredients in eliminating shrinkage and deformation, while providing high strength and reliability (Poly Solar, 2017). These wall panels are green, environmentally friendly, durable, combining heat, thermal and sound insulation, are 2hr fire rated, water resistant, anti-termite and provide excellent comfort (Poly Solar, 2017). The walls are pre-fabricated to standard drywall size (2.4m Height, 1.2m Width), easy to assemble/install and ready to paint on installation, with no plastering required.

## 1.4 Significance of the study

This study will provide a clearer view of the abundant opportunities and advantages in establishing and managing an environmentally sustainable and friendly business, in an era where both individuals and communities including governments, have become conscious of limited and dwindling natural resources. It will be of most value to individuals and businesses that trade on recyclable materials and waste disposal efforts from industrial manufacturing. It is anticipated that this will also highlight the urgent need for new skills required to position the building trade, and by association the training institutions in the country, in good standing as we enter 4$^{th}$ Industrial Revolution.

It is further anticipated and intended that use of the most viable method from this study, will benefit low-to-middle income prospective home owners, and first-time buyers including recipients of government provided housing, previously known as

RDP houses, all of whom are beneficiaries from the country's previously disadvantage communities, by providing high quality low-cost housing.

## 1.5 Delimitations of the study

The study will only focus on low-middle income single dwelling residential building structures for urban households, where high informal settlements presents high risk to human wellbeing and space shortages. The study will only focus on very limited and alternative material use, and not the wider scope of green building materials available in the global market. The proposed solution will be presented and tested in the form of computer aided simulations using national contractor building rates and quantities, with no physical manifestation of a working prototype model, due to excessive cost of implementing such a model.

The simulation model chosen for this study is the Monte Carlo simulation using the @Risk software program from Palisade. This was chosen for its ease of setup and use, and accurate results dependent on inputs and assumptions made. The model, values and assumptions applied in the simulation are for a minimal detailed and academic demonstration purpose, to illustrate the viable opportunity identified in the proposed business venture. It will not include any business plan, marketing plan or business canvas model or precise accounting value, mainly to protect the author's intellectual property, business opportunity, and minimise the risk of an unintended disclosure of a potentially lucrative business idea.

## 1.6 Assumptions

In the construction industry, like any other industry, demonstrating the viability of any business proposal is dependent on the proof of concept. This can be done either by designing and constructing a working prototype or by using a quantity surveying mechanism to cost estimate the building project or design. The former method can be an expensive and fruitless exercise, should the business idea not be accepted or approved. The latter provides a less risky option. Additionally, one could use it to compare the proposed solution based on available information, against the classic approach, by bringing in variables such as time – impacting

labour costs and differences in raw materials, foreign exchange risks and all kinds of things.

Other critical assumptions on this proposal are as follows:

1. The foundations for all the building iterations and implementations will be made of the same materials, to the same layout, quality and strength
2. The roof structure for all the iterations to be tested is also completely identical
3. The windows, doors and frames for all walls will be chosen from the same materials, prefabricated walls will include aluminium angles on edges around frames.

# 2 LITERATURE REVIEW

## 2.1 Introduction

Humanity continues to make impressive advances in industry, health, mobility and architecture with extraordinary innovation from every generation(Sirvaitis, 2010). Building construction is as old as humanity itself and modern trends are shifting towards environmentally friendly construction methods (Sirvaitis, 2010)..

The latter part of the last century has seen stronger focus on the negative environmental impact of the excessive use of natural resources in the prevalent conventional building methods, to the point where in recent times, communities and organisations are attracted by the option of using sustainable building materials to reduce damage to the eco system (Nunan, 2010). The ideal situation is a zero waste scheme, where one process's waste is combined or re-used as input or resource in another process, a combination of energy technologies and efficiency to deconstruct the laws and schemes assumed to be the only solutions to our needs (Khan & Islam, 2012).

Nunan (2010) further argues that this is more sustainable than the conventional way with wider choice of sustainable materials with less impact of footprint on natural environment. He also holds the view that our choice of alternative methods must carefully consider the diverse techniques and the variety of building methods suitable to each specific environment.

## 2.2 Definition of topic or background discussion.

Green and Sustainable Residential Building Construction

In citing McBean et al (1995) and their own earlier works (Khan and Islam, 2007a), Khan and Islam (2012) reaffirm that the industrial age goes hand-in-hand with waste generation, and shows direct correlation in the standard of life and resulting waste. They note that this lifestyle is clearly not sustainable in the face of *'global warming'* and toxic shock, they champion alternative technologies that reduce, reuse and recycle (Khan & Islam, 2012). Innovative entrepreneurs in the

alternative and sustainable products space, are no longer hiding in the '*green ghetto*', but are becoming accepted into mainstream building industry (Woolley, 2013).

A number of prevalent technologies currently in commission present little benefit to life on the planet, after huge strides were made in innovation over the years. Evidently the world is turning into a toxic container, with a continuously depleting atmosphere and pushing the urgency to implement truly sustainable technology (Khan & Islam, 2012). The challenge associated with introducing these materials appear insurmountable, from residential property development; nature and range of available material; supply and sourcing problems; to legislation, regulation and environmental policies (Woolley, 2013).

The table reproduced below, developed by Khan and Islam (2012) illustrates the actual differences defining sustainable from unsustainable methods:

| **Sustainable (Natural)** | **Unsustainable (Artificial)** |
|---|---|
| Progressive/youth measured by the rate of change | Non-progressive/resist change |
| Unlimited adaptability and flexibility | Zero adaptability and inflexible |
| Increasingly self-evident with time | Increasingly difficult to cover up a phenomenal source |
| 100% efficient | Efficiency approaches zero as processing is increased |
| Can never be proven to be unsustainable | Unsustainability unravels itself with time |

Table taken from (Khan & Islam, 2012, p. 20)

Advocates for renewable products include entrepreneurs, who have seized opportunities on an unserved market with customers embracing the Tony Watkins' holistic philosophy (Woolley, 2013). Woolley (2013) acknowledges that even green advocates occasionally resist ecological innovation towards natural materials when failing to recognise the importance of their use in minimal impact solutions.

## 2.3 Project Management and Resources Management Principles

On a typical construction site, anywhere in South Africa today, one of the greatest problems facing project managers are wasted resources which include materials, labour, time and money. The main culprits include:

- A wall that has to be demolished and rebuilt because of incorrect mixture on mortar, not being built straight, damaged and cracked brick
- cement that stayed exposed to moisture for long periods before use
- time lost due to unfavourable weather conditions
- injuries, deliveries and structural support equipment (scaffolding)
- too many single skilled labour (e.g. brick masons) on a site with too many critical paths that are finish-to-start, resulting in other professions waiting around or being constantly moved between sites.

There is improved efficiency on the use of valuable resources like water, energy, materials and land in constructing sustainable buildings, compared to conventional methods, combining sustainable strategies and materials in design stages improves the potential market value of the project (Kubba, 2010). Kubba (2010) further contends that highly successful projects are dependent on an integrated design and construction execution. Conventional home building produces large amounts of waste, approximately 1.8kg per square foot, with expectations of housing boom exceeding all previous human endeavour, in the next 50 years , there is potential for increased waste generation (Nunan, 2010).

Prefabrication and modular assembly offer affordable ways of building even though at times, focus is mostly on environmental benefits of sustainable

construction, these new materials also present improved performance in safety, durability and material strength. According to Kubba (2010, pp. 37, 38, 39), a collaboration between the Partnership for Achieving Construction Excellence ( PACE) and the Pentagon Renovation and Construction Program Office (PRCPO) resulted in the publication of the Field Guide for Sustainable Construction that can assist project teams to meet sustainable project goals, the major rated topics on the guide are:

- *'Ensure that sustainable construction requirements are met by addressing specific procurement strategies'.*
- *'Identify methods and means to reduce the environmental impact of construction on the project site and surrounding environment'.*
- *'Identify and employ environmentally friendly building materials and avoid use of harmful and toxic materials'.*
- *'Identify ways and means to minimize or eliminate waste on construction projects'.*
- *'Identify materials that can be recycled at each phase of construction as well as approaches to support onsite recycling efforts'.*
- *'Employ techniques that improve a building's energy performance and reduce energy consumed during construction, as well as determine available opportunities to use renewable energy sources'.*
- *'Identify reusable materials and methods that will facilitate potential future reuse of a facility, system, equipment, products, and materials'.*
- *'Identify the latest construction technologies that can be utilised during the construction process to promote efficiency and reduce waste (e.g., paper)'.*
- *'Identify ways and means to improve health, safety, and quality of life for construction workers'.*

*'Delineate methods that ensure the during construction indoor environmental quality measures are managed and correctly implemented'.*

### *2.3.1 Just-in-Time for Construction*

Started in the latter part of the 1908's, by Taichi Ohno and colleagues at Toyota, to adopt 'Lean Production', JIT which is an acronym for Just-in-Time, is a process "*of pulling work forward from one process to the next 'just-in-time' when the successor process needs it, ultimately producing throughput"* giving the advantage to reduce inventory for '*work-in-process'* and '*working capital*' (Ballard & Howell, 1995, p. 1). This process reduces operational, resources and project management costs, but most benefits are found time, workflow and continuous improvements in production. The production directives stem from Kanban, which continuously aims for stable output quantities combined with accurate production targets to achieve 2-6 week production schedules (Ballard & Howell, 1995), by replenishing "*the right inventory at the right time and in the right amount*" (Tommelein & Li, 1999, p. 97). Tommelein and Li (1999) contend that, this manufacturing process can be applicable to ready-mixed concrete.

**Figure 3 - Kanban System (after Rother and Shook 1998 p.42)**

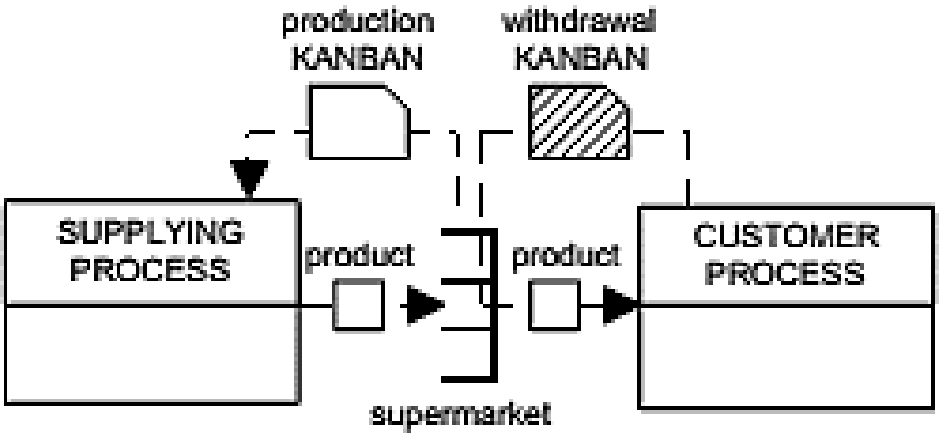



Figure 3 above, illustrates the upstream product pulling process, where a '***withdrawal kanban***' is implemented by the customer from a '***supermarket***' with a limited capacity storage centre, for storing products from the '***supplying process'***. Replenishments for the '***supermarket'*** are achieved by issuing a '***production kanban***' once inventory gets below threshold, instructing supplier to produce more products, but only enough to replace withdrawals (Tommelein & Li, 1999, p. 98). This process is ideal for modular prefabricated building materials

and the specialist resources, labour and services that will need to be managed during each project. In SA there is inherent risk to using JIT, such as unpredictable and prolonged strikes is transport sector, which could be managed by localised high inventory levels storage facilities within a 10km radius of construction development sites

### *2.3.2 Proposition 1 – The Smart Space House*

The first proposition is a hybrid method to combine the standard conventional methods of constructing a house/building structure, made of an external brick and mortar wall envelope, combining this with prefabricated full height (2.4m) and standard size (1.2m/width) walls, made from alternative materials, to be used to subdivide the section/rooms of the house.

## 2.4 Alternative Building Materials use and Associated Cost Benefits

Petkute (2015) defines "*Material"* as a substance that something new/else is produced from, which "*automatically"* implies that recycled material refers to a substance that maybe re-used for another purpose. The global increase in human population continues to increase demand for supplies, depletes natural resources and escalating material production costs (Petkute, 2015). The prospective home owner's budget needs to be strongly considered to enable him/her to afford a good home with low maintenance (Sahu & Jena, 2015). A conventional residential building's standard finish costs, for material and labour, are estimated to be 65-70% and 30-35% respectively, bricks and cement make up a combined 40% of the material costs (Sahu & Jena, 2015).

"*Low cost housing has become synonymous with low-quality housing, but low-cost does not mean cheap or inferior housing which compromise on the quality, strength, or durability of a building…the mistrust that exists between the prospective owner and the builder needs to be eliminated*" (Sahu & Jena, 2015, p. 54). Sahu and Jena (2015, p. 55) further emphasise that in constructing low-

cost buildings, consideration should be focused on seven critically important aspects:

1. *'Strength and durability'*
2. *'Resistance to moisture penetration'*
3. *'Protection from ravages of natural elements'*
4. *'Safety against fire hazard'*
5. *'Thermal insulation'*
6. *'Protection against vermin'*
7. *'Convenience and comfort'*

Kubba (2010) mentions that with years of substantial numbers of '*green building*' construction in existence today, convincing evidence has shown that '*improved comfort levels*', '*aesthetics*', including '*energy and resource efficiency*' could be enhanced, using alternative materials in building construction.

He lists a few of the 'primary benefits' as:

- *'Reducing energy consumption'*
- *'Protection of ecosystems'*
- *'Improved health of occupants'*
- *'Increased productivity'*

Studies show that organizations spend a maximum of 10% of operational cost on building maintenance and the rest on staff salaries (Kubba 2010). He concludes that a small improvement in employee comfort has the potential to improve performance and productivity, with increasing evidence that linking efficiency in construction while simultaneously improving working conditions, reduced turnover and absenteeism with other unforeseen but positive benefits. Kubba (2010) argues that these benefits are '*a major contributing factor*' in building efficiency growth, more particularly for the occupants living and working in these structures, a fact demonstrated by a purported 65% of owners living in '*green buildings*', claiming a positive return on investment, from Turner's "Green Building barometer".

The poor built quality of many low-income houses in South Africa deprives the owners of future earnings growth. These houses immediately begin to fall apart from cracks, leaking roofs, uneven wall surfaces, location and collective residential area upkeep, and unaffordable maintenance all contributing to low property resale prices. Kubba's (2010) findings talk to the poor working conditions of low income, mostly migrant, labour in many construction sites around SA, that are often not adequately equipped (safety equipment), spending many days lifting heavy bricks whilst standing on make shift elevated platforms (125ltr oil drums with wooden planks), whilst breathing in hazardous concrete mixture dust.

### *2.4.1 Proposition 2 – The Smart Plus House*

The second proposition is a total application method, to build the complete residential structure using totally prefabricated walls. Built on a concrete foundation, like that used with conventional brick building, and The Smart Space House, but with the distinct exception that all standing walls are constructed using prefabricated "PolySmart" walls.

## 2.5 Conclusion of Literature Review

The use of recyclable materials as an alternative in building construction, has been around for a few decades now. The concept initially started as a hobby environmentalist and a brave step into the unknown, over the years it has grown in leaps and bounds mainly due to rapid innovations in industrial production of critical components. The technology and its advocates are no longer operating on the fringes of mainstream industry, and many successful manufacturing organisations are operating around the world.

There is unfortunately not enough academic research and literature on the impact, advantages and potential gains to be achieved in mass adoption of the aforementioned types of environmental methodologies and materials as used in the construction industry. The little research available must not however be used as a reason to simply write off this technology as the hobby of the rich and adventurous few, who possess financial means and time to experiment with

unpopular (fringe) innovation. It is with these facts in mind that the author pleads for an open mind from the consumer of this review, as the expectation is that there are significant opportunities presented in a venture proposal of this nature.

The construction industry has been stagnant in significant technological innovation for hundreds of years, however, more recently, plummeting natural resources and increasing waste generation, have necessitated a re-imagining of the processes and inputs needed to bring the profession into the 22nd century. Lean production principles are now possible to implement, not just in the construction process itself, but also through the supply chain, which will make it possible to streamline the entire process end-to-end.

# 3 RESEARCH METHODOLOGY

## 3.1 Research Design

The data research will include current construction rates used in commercial industry for a detailed bill of quantities (BOQ), a detailed standard design for the proposed product including dimensions, and manufacturer supplied dimensions for the raw materials and products to be used. The cost associated with producing a working model (prototype) of the proposed design implementations, have limited the opportunity to truly demonstrate the viability of this business venture. The next best alternative identified was the use of a simulation software program that would assist to overcome this limitation, and still be able to demonstrate these proposals in principle. There are numerous software products on the market that would have helped achieve this function, but the one that was identified as being specifically suitable and chosen in this research, is the Monte Carlo simulation, implemented using the @Risk software program from Palisade.

The construction BOQ rates, are based on the JBCC contract, compiled by David Langdon Quantity Surveyors (QS) and Standard Bank Group Real Estate QS for use in commercial property construction (2016), will be adopted and a 10% price escalation applied for 2017 and 2018 as part of input data collection. These rates were selected mainly because they are 40% above residential construction rate,

to account for the above normal labour and materials rate anticipated for the proposed construction methods. The conventional construction industry in the low-cost residential construction market, uses either clay bricks or cinder blocks to construct the standing walls of the house, it is therefore crucial that both these iterations are represented in the hybrid (proposition 1) implementation, as well as the conventional method to be used for control and comparison in this study. This will therefore require 5 possible iterations to be simulated, that is;

1. The Smart Space with Bricks
2. The Smart Space with Cinder Blocks
3. The Smart Plus
4. The Conventional Brick
5. The Conventional Cinder Block houses.

The collected data will then be used to design and run a Monte Carlo simulation for 5000 iterations of the 5 possible iterations of the proposed business venture producing and selling the newly designed house. Statistical (manufacturers, suppliers, oversight bodies) and regulatory data will also be reviewed, and summarily included as supporting evidence, to demonstrate what advantages and opportunities had been identified within the industry and field, including awareness of what existing regulations and laws state, that may hinder or enable implementation.

The advantage of simulating the 5 possible implementations using real world and current materials and labour rates, is that, the best possible and most viable methods may be accurately compared against each other, and against the current conventional methods. The disadvantage is that the simulation process takes a long time to run and produces an incredibly substantial amount of raw data.

## 3.2 The research instruments

### *3.2.1 Simulation*

The research makes use of proposed software program, @Risk, to demonstrate the proof of concept and viability of this Business Venture proposal, for preliminary proof of implementing a successful green residential construction project on a large-scale industrialised development business concept for the SA market. The simulations will be focused on a business entity producing a complete product, and not on the production/assembly of the product itself, the product is completely build/manufactured with all inputs and costs executed by the business, and the business needs to sell it to the market. Effectively, @Risk allows one to develop a simulation model with all known or even unknown factors and probabilities.

A professional Quantity Surveying program (e.g. Vector, WinQS, QSPlus, PriMus) would be required should the proposed preliminary results be favourable, but there would be cost, and IP implications associated with this venture. The simulation's internal data is made up of intensively compiled tables of raw materials dimensions, component quantities, supply and installation rates, a standard design of the proposed product and a (BOQ) for all different implementations to be compared. This data is made up of current supplier data for materials productions and current contractor rates for commercial building construction including labour rates. The commercial rates have been adapted because they a higher than residential rates, mainly because the proposed use of selected alternative building materials requires skills similar to those used in commercial building construction, for example drywall installations, and therefore present a more realistic pricing strategy.

The BOQ is made up of robust and universally applied Excel formulae to give accurate calculations of final costs using rates and quantities. It was selected specifically to compile and present a detailed itemised bill of materials and associated costs for a clear view of all resources required to produce the product. The quantities were measured, and triple checked for each line item and diagram

to be used in the final product. The BOQ summaries for each iteration and implementation represent above 90% accuracy for the final cost of the product, whilst the raw material dimensions are as provided by manufactures and used globally in the building industry.

**Table 1 - Raw materials and dimensions**

| Description of block/Material | Size of block (mm) – w x h x l (incl. 10mm mortar) | Thickness of wall (mm) – double/single (incl. 10mm plaster) | Std. area of wall panel surface (1.2m w x 2.4m h) ($m^2$) - Z | Std. area of block surface ($m^2$). (incl. 10mm mortar) (h x l) - Y | No. of block/bricks/panels in std. wall panel - i.e. Std. block (area) in Std. wall area (Z/Y) |
|---|---|---|---|---|---|
| Single Brick | 102.5 x 75 x 225 | 112.5 | 2.88 | 0.016875 | 171 |
| Double Brick | 225 x 75 x 225 | 225 | 5.76 | 0.016875 | 341 |
| Concrete Block – external perimeter | 210 x 210 x 430 | 210 | 2.88 | 0.0903 | 32 |
| Concrete Block - internal | 110 x 210 x 430 | 110 | 2.88 | 0.0903 | 32 |
| Poly Smart wall – single | 110 x 2400 x 1200 | 110 | 2.88 | 2.88 | 1 |
| Poly Smart wall - double | 110 x 2400 x 1200 | 220 | 5.76 | 2.88 | 2 |

**Table 2 - Raw materials quantities and rates**

| Type of wall | No. of std. wall panels in 3m x 2.4m wall | No. of bricks in 3m wall | Rate to supply and install /m² brick, incl. brick and mortar |
|---|---|---|---|
| Single brick | 2.5 | 427.5 | R534 |

| Type of wall | No. of std. wall panels in 4m x 2.4m wall | No. of bricks in 4m wall | Rate to supply and install /m² brick, incl. brick and mortar |
|---|---|---|---|
| Single brick | 3.3 | 564.3 | R534 |

| Type of wall | No. of std. wall panels in 3m x 2.4m wall | No. of blocks in 3m wall | Rate to supply and install /m² block, incl. block and mortar |
|---|---|---|---|
| Concrete block - external | 2.5 | 80 | R715 |

| Type of wall | No. of std. wall panels in 4m x 2.4m wall | No. of blocks in 4m wall | Rate to supply and install /m² block, incl. block and mortar |
|---|---|---|---|
| Concrete block - external | 3.3 | 105.6 | R715 |

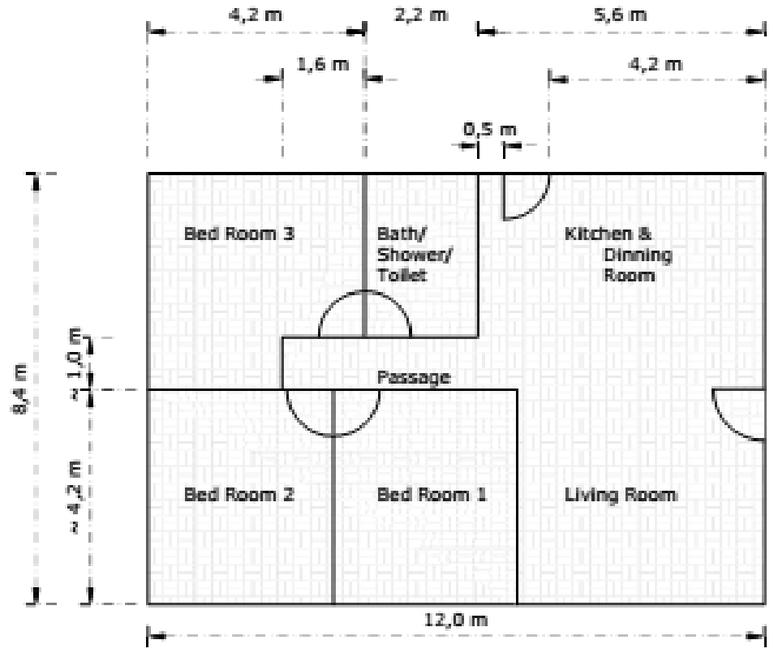
| Type of wall | No. of std. wall panels in 3m x 2.4m wall | No. of blocks in 3m wall | Rate to supply and install /m² block, incl. blocks and mortar |
|---|---|---|---|
| Concrete block - internal | 2.5 | 80 | R704 |

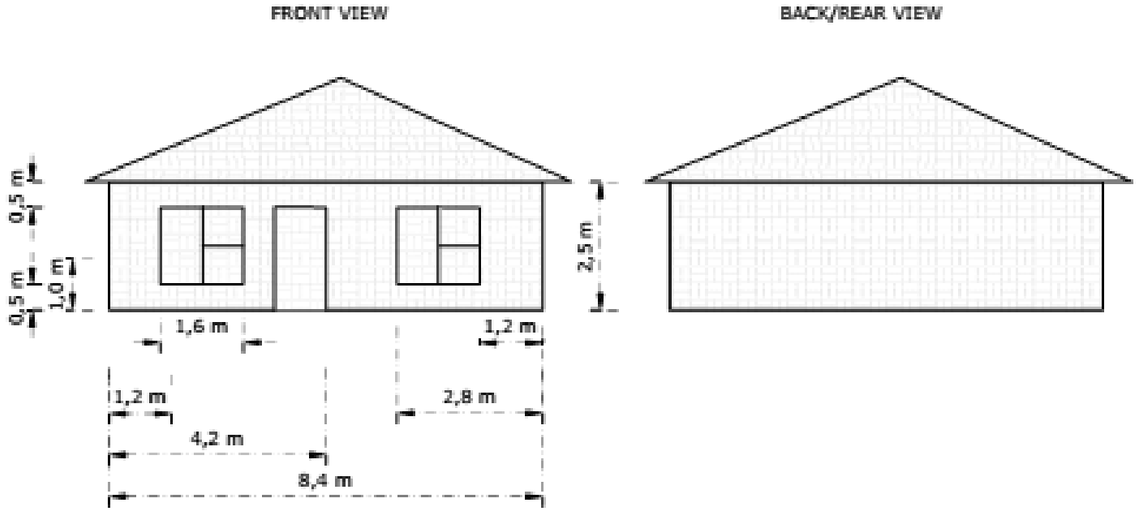
| Type of wall | No. of std. wall panels in 4m x 2.4m wall | No. of blocks in 4m wall | Rate to supply and install /m² block, incl. blocks and mortar |
|---|---|---|---|
| Concrete block - internal | 3.3 | 105.6 | R704 |

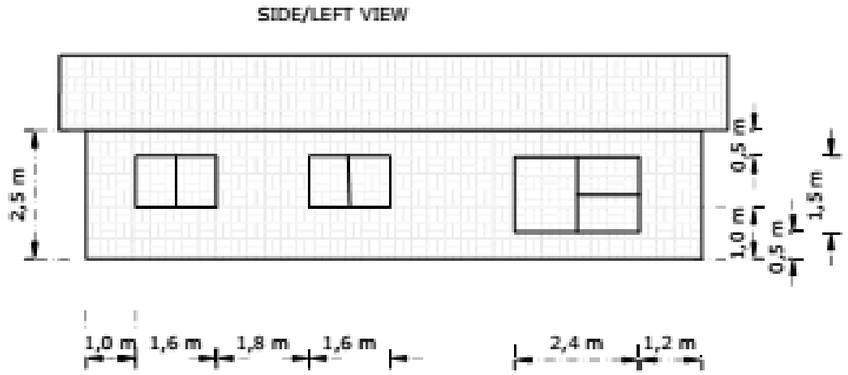
| Type of wall | No. of std. wall panels in 3m x 2.4m wall | No. of panels in 3m wall | Rate to supply and install /m² panel, incl. panels and mortar |
|---|---|---|---|
| Poly smart panel | 2.5 | 3 | R1250 |

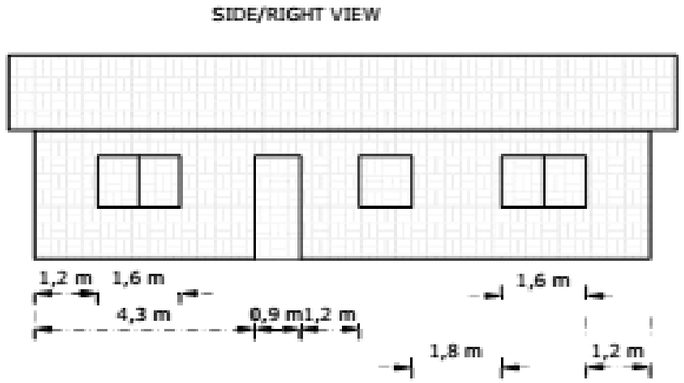
| Type of wall | No. of std. wall panels in 4m x 2.4m wall | No. of panels in 4m wall | Rate to supply and install /m panel, incl. panels and mortar |
|---|---|---|---|
| Poly smart panel | 3.3 | 4 | R1250 |

**Figure 4 - Proposed standard design of the house**

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DESIGNED BY: THULANI NICHOLAS FIHLANI
Student No. : 9706501F

DATE: 01 SEPTEMBER 2017

**Table 3 - Summary of BOQ for a Conventional Brick Building implementation**

| | |
|---|---|
| **Site Name** | Conventional Brick |
| **Site Size ($m^2$)** | 101 |
| **Expected Construction Period in weeks** | 8 |
| **Number of Bricks to be used to build house** | 12474 |
| **Number of Blocks to be used to build house** | 0 |
| **Number of Polysmart prefabs to be used to build house** | 0,0 |
| **Number of Bricks to be used on foundation** | 5973 |
| | |
| | |
| | |
| e-Mail Address | |
| Telephone Number | |
| Cellular Phone Number | |

0

**BILL OF QUANTITIES SUMMARY** 0

| BILL NO. | DESCRIPTION | Land & Building | Electrical | Mechanical | Energy / Water Metering | Amount |
|---|---|---|---|---|---|---|
| | | Asset Classification | | | | |
| | **Preliminaries - See below** | | | | | |
| BILL NO. 1 | MASONRY | R 125 817,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | R - | | | | R - |
| BILL NO. 3 | VINYL | R - | | | | R - |
| BILL NO. 4 | TILING | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | R 97 092,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | R - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | **R 464 623,40** | **R 3 868,00** | **R -** | **R -** | **R 468 491,40** |
| | **PRELIMINARIES** **(Main Contractor/Electrical/HVAC)** | **R -** | **R -** | **R -** | | **R -** |
| | ***TOTAL:*** | **R 464 623,40** | **R 3 868,00** | **R -** | **R -** | **R 468 491,40** |
| | | | | | ***VAT @ 14%*** | **R 65 588,80** |
| | | | | | ***TOTAL*** | **R 534 080,20** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 4 600,23** | **R 38,30** | **R -** | **R -** | **R 4 638,53** |
| ***Rand/m2 (Including Preliminaries)*** | **R 4 600,23** | **R 38,30** | **R -** | | **R 4 638,53** |

**Table 4 - Summary of BOQ for a Conventional Cinder Block Building implementation**

| | |
|---|---|
| **Site Name** | Conventional Cinder Block |
| **Site Size ($m^2$)** | 101 |
| **Expected Construction Period in weeks** | 6 |
| **Number of Bricks to be used to build house** | 0 |
| **Number of Blocks to be used to build house** | 1484 |
| **Number of Polysmart prefabs to be used to build house** | 0,00 |
| **Number of Bricks to be used on foundation** | 5973 |
| | |
| | |
| | |
| e-Mail Address | |
| Telephone Number | |
| Cellular Phone Number | |

0

**BILL OF QUANTITIES SUMMARY** — 0

| BILL NO. | DESCRIPTION | | Asset Classification: Land & Building | Electrical | Mechanical | Energy / Water Metering | Amount |
|---|---|---|---|---|---|---|---|
| | **Preliminaries - See below** | | | | | | |
| BILL NO. 1 | MASONRY | | R 108 593,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | | R - | | | | R - |
| BILL NO. 3 | VINYL | | R - | | | | R - |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | | R 97 092,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | | - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | | **R 447 399,40** | **R 3 868,00** | **R -** | **R -** | **R 451 267,40** |
| | **PRELIMINARIES** (Main Contractor/Electrical/HVAC | | **R -** | **R -** | **R -** | | **R -** |
| | ***TOTAL:*** | | **R 447 399,40** | **R 3 868,00** | **R -** | **R -** | **R 451 267,40** |
| | | | | | | ***VAT @ 14%*** | **R 63 177,44** |
| | | | | | | ***TOTAL*** | **R 514 444,84** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 4 429,70** | **R 38,30** | **R -** | **R -** | **R 4 467,99** |

**Table 5 - Summary of BOQ for a Hybrid (Brick + Pre-fab) Building implementation: Proposal 1**

| | |
|---|---|
| **Site Name** | Hybrid Method |
| **Site Size ($m^2$)** | **101** |
| **Expected Construction Period in weeks** | **3** |
| **Number of Bricks to be used to build house** | **9126** |
| **Number of Blocks to be used to build house** | **0** |
| **Number of Polysmart prefabs to be used to build house** | **24,00** |
| **Number of Bricks to be used on foundation** | **5973** |
| | |
| | |
| | |
| e-Mail Address | |
| Telephone Number | |
| Cellular Phone Number | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **0** |
| **BILL OF QUANTITIES SUMMARY** | | | | | | | | | **0** |
| | | | **Asset Classification** | | | | | | |
| | | | **Land & Building** | **Electrical** | **Mechanical** | **Energy / Water Metering** | | **Amount** | |
| **BILL NO.** | **DESCRIPTION** | | | | | | | | |
| | **Preliminaries - See below** | | | | | | | | |
| BILL NO. 1 | MASONRY | | R 95 646,00 | | | | R | - | |
| BILL NO. 2 | PARTITIONS ETC | | R 31 710,00 | | | | R | - | |
| BILL NO. 3 | VINYL | | R - | | | | R | - | |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R | - | |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R | - | |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R | - | |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R | - | |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R | - | |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R | - | |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R | - | |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R | - | |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R | - | |
| BILL NO. 13 | ROUGH FORMWORK | | R 79 422,00 | | | | R | - | |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R | - | |
| BILL NO. 17 | ELECTRICAL WORK | | R - | R 3 868,00 | | | R | - | |
| | ***SUB-TOTAL:*** | | **R 448 492,40** | **R 3 868,00** | **R -** | **R -** | **R** | **452 360,40** | |
| | **PRELIMINARIES**<br>**(Main Contractor/Electrical/HVAC)** | | **R -** | **R -** | **R -** | | **R** | **-** | |
| | ***TOTAL:*** | | **R 448 492,40** | **R 3 868,00** | **R -** | **R -** | **R** | **452 360,40** | |
| | | | | | | ***VAT @ 14%*** | **R** | **63 330,46** | |
| | | | | | | ***TOTAL*** | **R** | **515 690,86** | |

| | ***PC*** | ***EC*** | ***HVAC*** | ***FIRE DETECTION*** | ***Total TK Boq*** |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 4 440,52** | **R 38,30** | **R -** | **R -** | **R 4 478,82** |
| ***Rand/m2 (Including Preliminaries)*** | **R 4 440,52** | **R 38,30** | **R -** | | **R 4 478,82** |

**Table 6 - Summary of BOQ for a Hybrid (Cinder Block + Pre-fab) Building implementation: Proposal 1**

| | | |
|---|---|---|
| **Site Name** | Hybrid Method | |
| **Site Size ($m^2$)** | **101** | |
| **Expected Construction Period in weeks** | **3** | |
| **Number of Bricks to be used to build house** | **0** | |
| **Number of Blocks to be used to build house** | **853** | |
| **Number of Polysmart prefabs to be used to build house** | **24,00** | |
| **Number of Bricks to be used on foundation** | **5973** | |
| | | |
| | | |
| | | |
| e-Mail Address | | |
| Telephone Number | | |
| Cellular Phone Number | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | **0** | |
| **BILL OF QUANTITIES SUMMARY** | | | | | | **0** | |
| | | | **Asset Classification** | | | | |
| | | | **Land & Building** | **Electrical** | **Mechanical** | **Energy / Water Metering** | **Amount** |
| **BILL NO.** | **DESCRIPTION** | | | | | | |
| | **Preliminaries - See below** | | | | | | |
| BILL NO. 1 | MASONRY | | R 68 465,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | | R 31 710,00 | | | | R - |
| BILL NO. 3 | VINYL | | R - | | | | R - |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | | R 79 422,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | | - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | | **R 421 311,40** | **R 3 868,00** | **R -** | **R -** | **R 425 179,40** |
| | **PRELIMINARIES (Main Contractor/Electrical/HVAC)** | | **R -** | **R -** | **R -** | | **R -** |
| | ***TOTAL:*** | | **R 421 311,40** | **R 3 868,00** | **R -** | **R -** | **R 425 179,40** |
| | | | | | | ***VAT @ 14%*** | **R 59 525,12** |
| | | | | | | ***TOTAL*** | **R 484 704,52** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 4 171,40** | **R 38,30** | **R -** | **R -** | **R 4 209,70** |
| ***Rand/m2 (Including Preliminaries)*** | **R 4 171,40** | **R 38,30** | **R -** | | **R 4 209,70** |

**Table 7 - Summary of BOQ for a Total Prefabricated Polysmart Walls Building implementation: Proposal 2**

| | |
|---|---|
| **Site Name** | Total Fabrication |
| **Site Size ($m^2$)** | **101** |
| **Expected Construction Period in weeks** | **2** |
| **Number of Bricks to be used to build house** | **0** |
| **Number of Blocks to be used to build house** | **0** |
| **Number of Polysmart prefabs to be used to build house** | **57,00** |
| **Number of Bricks to be used on foundation** | **5973** |
| | |
| | |
| | |
| e-Mail Address | |
| Telephone Number | |
| Cellular Phone Number | |

**0**

**BILL OF QUANTITIES SUMMARY** — **0**

| BILL NO. | DESCRIPTION | | Asset Classification: Land & Building | Electrical | Mechanical | Energy / Water Metering | Amount |
|---|---|---|---|---|---|---|---|
| | **Preliminaries - See below** | | | | | | |
| BILL NO. 1 | MASONRY | | R 1 050,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | | R 72 210,00 | | | | R - |
| BILL NO. 3 | VINYL | | R - | | | | R - |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | | R 39 928,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | | R - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | | **R 354 902,40** | **R 3 868,00** | **R -** | **R -** | **R 358 770,40** |
| | **PRELIMINARIES** **(Main Contractor/Electrical/HVAC)** | | **R -** | **R -** | **R -** | | **R -** |
| | ***TOTAL:*** | | **R 354 902,40** | **R 3 868,00** | **R -** | **R -** | **R 358 770,40** |
| | | | | | | ***VAT @ 14%*** | **R 50 227,86** |
| | | | | | | ***TOTAL*** | **R 408 998,26** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 3 513,89** | **R 38,30** | **R -** | **R -** | **R 3 552,18** |
| ***Rand/m2 (Including Preliminaries)*** | **R 3 513,89** | **R 38,30** | **R -** | | **R 3 552,18** |

### *3.2.2 Statistics South Africa Construction Industry Survey 2014*

This was used to obtain and analyse *"industrial classification, details of employment, trading income, expenditure, profit or loss, inventories, capital expenditure on new assets, details of services rendered, details of purchases, information and communication technology usage, client base and the breakdown of income from services by province" (Lehohla & StatSA, 2016, p. 1),* in the construction industry with regards to opportunities for the proposed business venture

The report uses estimates that contain both sampling and non-sampling errors inherent in the relevant industry because only a fraction of the industry enterprises were used, "...relative standard error (RSE) provides an indication of percentage error likely to have occurred due to sampling…the larger the RSE, the less reliable the estimate is" (Lehohla & StatSA, 2016, p. 6).

Some of the likely non-sampling error sources were: sampling frame not up to date, wrong definitions and classification, phrasing of questions, non-response, processing and estimation (Lehohla & StatSA, 2016). Efforts were made to limit errors by careful design of questionnaires, testing with sampled respondents, editing and implementing efficient operating procedures on the reported data, because there were likely inherent on-sampling errors in survey and censuses (Lehohla & StatSA, 2016).

**Table 8 - Income in the construction industry, 2004 - 2014**

| Type of service | 2004 | | 2007 | | 2011 | | 2014 | |
|---|---|---|---|---|---|---|---|---|
| | R million | % contribution | R million | % contribution | R million | % contribution | R million | % contribution |
| Site preparation | 2 306 | 2,3 | 3 130 | 1,8 | 6 376 | 2,4 | 6 118 | 1,6 |
| Construction of buildings | 33 117 | 32,9 | 60 199 | 35,6 | 61 860 | 23,0 | 88 519 | 22,6 |
| Construction of civil engineering structures | 27 478 | 27,4 | 46 386 | 27,4 | 116 651 | 43,2 | 163 476 | 41,7 |
| Construction of other structures | 1 515 | 1,5 | 3 079 | 1,8 | 3 146 | 1,2 | 6 374 | 1,6 |
| Construction by specialist trade contractors | 4 079 | 4,1 | 8 294 | 4,9 | 10 131 | 3,8 | 19 836 | 5,1 |
| Plumbing | 2 112 | 2,1 | 3 055 | 1,8 | 3 419 | 1,3 | 5 906 | 1,5 |
| Electrical contractors | 5 642 | 5,6 | 10 252 | 6,1 | 18 272 | 6,8 | 24 471 | 6,2 |
| Shopfitting | 825 | 0,8 | 1 290 | 0,8 | 1 320 | 0,5 | 1 982 | 0,5 |
| Other building installation | 8 992 | 9,0 | 12 010 | 7,1 | 19 799 | 7,4 | 28 338 | 7,2 |
| Painting and decorating | 1 611 | 1,6 | 1 937 | 1,1 | 2 464 | 0,9 | 3 241 | 0,8 |
| Other building completion | 10 625 | 10,6 | 15 943 | 9,4 | 14 432 | 5,4 | 26 290 | 6,7 |
| Renting of construction or demolition equipment with operators | 2 140 | 2,1 | 3 674 | 2,2 | 11 096 | 4,1 | 17 741 | 4,5 |
| **Total** | **100 442** | **100,0** | **169 249** | **100,0** | **268 966** | **100,0** | **392 292** | **100,0** |

(Sources: Report No. 50-02-01)

The Income table by Lehohla and StatSA (2016, p. 7), shows that "*The total income for the construction industry in 2014 was R 392,3 billion. The total income represents an increase of 13.4% per annum over the income reported in the corresponding survey of 2011 (R 269,0 billion). Comparing 2011 and 2014, large increases were reported for 'construction of civil engineering structures' (+R 46,8 billion), 'construction of buildings' (+ R 26,6 billion) and 'other building completion' (+ R 11,8 billion). Since 2004, 'construction of buildings' service lost the biggest percentage share (10.3 percentage points) in the same period (from 32.9% in 2004 to 22.6% in 2014".*

**Table 9 - Profit margin in the construction industry, 2004 - 2014**

| Type of service | Net profit/loss after tax | | | | Turnover | | | | Profit margin | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2007 | 2011 | 2014 | 2004 | 2007 | 2011 | 2014 | 2004 | 2007 | 2011 | 2014 |
| | R million | | | | R million | | | | % | | | |
| Site preparation | 149 | 124 | 378 | 489 | 2 187 | 3 066 | 6 365 | 6 035 | 6,8 | 4,0 | 5,9 | 8,1 |
| Construction of buildings | 853 | 2 395 | 2 525 | 3 013 | 31 982 | 59 282 | 66 817 | 86 210 | 2,7 | 4,0 | 3,8 | 3,5 |
| Construction of civil engineering structures | 623 | 1 274 | 2 484 | 2 175 | 26 219 | 44 922 | 103 689 | 157 244 | 2,4 | 2,8 | 2,4 | 1,4 |
| Construction of other structures | 54 | 148 | 34 | 614 | 1 474 | 3 031 | 2 858 | 6 121 | 3,7 | 4,9 | 1,2 | 10,0 |
| Construction by specialist trade contractors | 97 | 411 | 355 | 85 | 4 010 | 8 164 | 13 655 | 19 510 | 2,4 | 5,0 | 2,6 | 0,4 |
| Plumbing | 96 | 146 | 50 | 315 | 2 082 | 3 036 | 3 490 | 5 822 | 4,6 | 4,8 | 1,4 | 5,4 |
| Electrical contractors | 196 | 533 | 815 | 1 128 | 5 563 | 10 082 | 16 882 | 24 029 | 3,5 | 5,3 | 4,8 | 4,7 |
| Shopfitting | 46 | 74 | 33 | 169 | 818 | 1 255 | 1 272 | 1 945 | 5,6 | 5,9 | 2,6 | 8,7 |
| Other building installation | 500 | 677 | 1 007 | 1 035 | 8 651 | 11 664 | 19 412 | 27 532 | 5,8 | 5,8 | 5,2 | 3,8 |
| Painting and decorating | 23 | 142 | -36 | 91 | 1 596 | 1 835 | 2 445 | 3 191 | 1,4 | 7,7 | -1,5 | 2,9 |
| Other building completion | 347 | 348 | 381 | 950 | 10 452 | 15 629 | 14 211 | 26 021 | 3,3 | 2,2 | 2,7 | 3,7 |
| Renting of construction or demolition equipment with operators | 127 | 330 | -400 | 992 | 1 995 | 3 505 | 10 552 | 17 137 | 6,4 | 9,4 | -3,8 | 5,8 |
| **Total** | **3 111** | **6 602** | **7 626** | **11 056** | **97 029** | **165 471** | **261 648** | **380 797** | **3,2** | **4,0** | **2,9** | **2,9** |

(Sources: Report No. 50-02-01)

Table 9 (above) shows *"The total profit margin for the construction industry was, 2.9% in 2014. 'Construction of other structures' had the highest profit margin at 10.0%, followed by 'shopfitting' at 8.7% and 'site preparation' at 8.1%. 'Construction by specialist trade contractors' had the lowest profit margin of 0.4%. Between 2004 and 2014, the construction industry recorded the highest profit margin of 4.0% in 2007" (Lehohla & StatSA, 2016, p. 9)*. This was at the peak of infrastructure development projects in preparations for FIFA World Cup 2010.

**Table 10 - Employment as at the end of June in the construction industry, 2004 - 2014**

| Type of service | 2004 | | 2007 | | 2011 | | 2014 | |
|---|---|---|---|---|---|---|---|---|
| | Number of employees | | | | | | | |
| | '000 | % contribution | '000 | % contribution to total | '000 | % contribution to total | '000 | % contribution to total |
| Site preparation | 10 | 2,5 | 16 | 2,9 | 10 | 2,1 | 9 | 1,8 |
| Construction of buildings | 126 | 31,2 | 171 | 31,8 | 111 | 22,9 | 110 | 21,9 |
| Construction of civil engineering structures | 89 | 22,1 | 121 | 22,3 | 170 | 35,1 | 166 | 32,9 |
| Construction of other structures | 10 | 2,5 | 14 | 2,6 | 9 | 1,9 | 13 | 2,6 |
| Construction by specialist trade contractors | 17 | 4,2 | 33 | 6,0 | 23 | 4,7 | 27 | 5,4 |
| Plumbing | 16 | 4,0 | 15 | 2,8 | 14 | 2,9 | 17 | 3,4 |
| Electrical contractors | 29 | 7,2 | 45 | 8,4 | 39 | 8,0 | 44 | 8,8 |
| Shopfitting | 3 | 0,7 | 4 | 0,7 | 3 | 0,6 | 3 | 0,6 |
| Other building installation | 27 | 6,7 | 23 | 4,3 | 29 | 6,0 | 27 | 5,4 |
| Painting and decorating | 12 | 3,0 | 10 | 1,9 | 17 | 3,5 | 10 | 2,0 |
| Other building completion | 56 | 13,9 | 74 | 13,6 | 40 | 8,2 | 55 | 11,0 |
| Renting of construction or demolition equipment with operators | 8 | 2,0 | 15 | 2,7 | 20 | 4,1 | 21 | 4,2 |
| **Total** | **403** | **100,0** | **541** | **100,0** | **485** | **100,0** | **502** | **100,0** |

(Sources: Report No. 50-02-01)

Lehohla and StatSA (2016, p. 10), further shows that "*the total number of persons employed in the construction industry as at end of June 2014 was 502 000…'construction of buildings' (110 000 or 21.9%)…declined…the biggest loss since 2007 was (-61 000)…highest growth in employment was in 'construction of civil engineering structures' (+45 000 jobs)"*

In Figure 5 below, taking a further look at proportional contribution in income and employment based on service type, shows "…*highest proportion of employment compared with its proportion of income was 'painting and decorating' (contributing 2.0% of employment and 0.8% of income), followed by 'plumbing' (3.45 of employment and 1.5 of income) and 'other building completion' (11.0% of employment and 6.7% of income)*" (Lehohla & StatSA, 2016, p. 11).

**Figure 5 - Income and employment by type of service (% contribution) in the construction industry, 2004 - 2014**

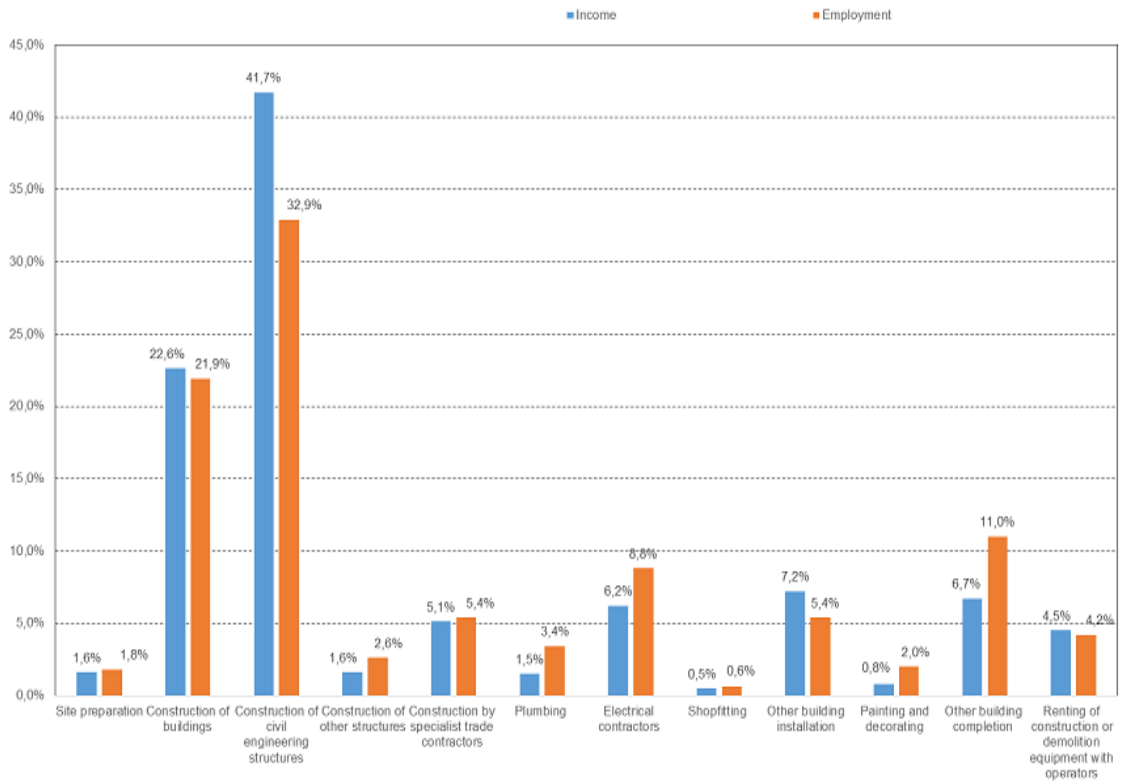



**Figure 6 - Income and employment by enterprise size (%contribution) in the construction industry, 2004 - 2014**

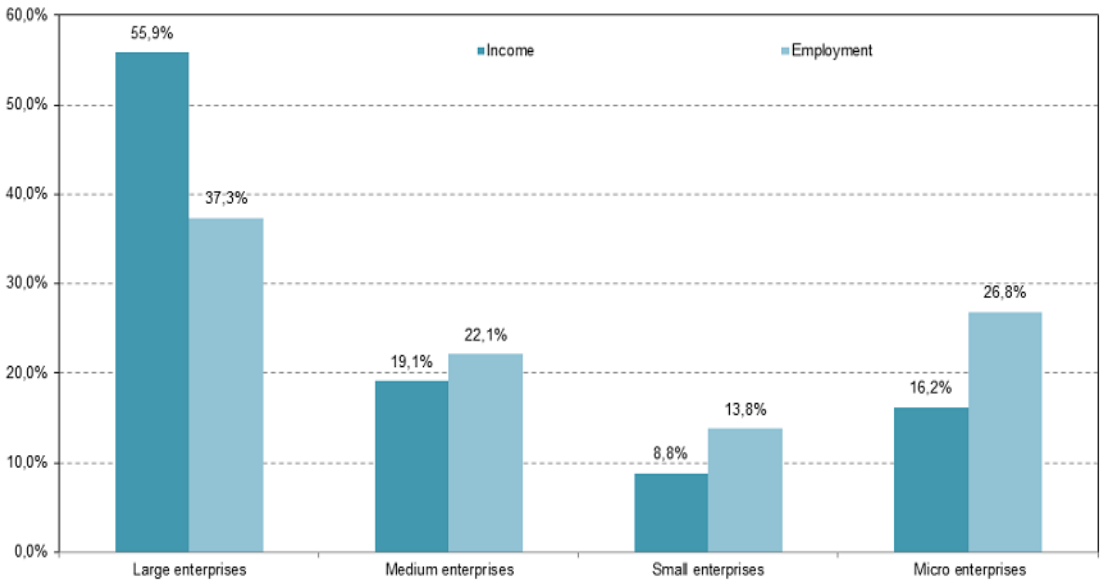



Figure 6 shows that "*whereas large enterprises (those with turnover equal to or greater than R 117 million) contributed 55,9% of the total income of the construction industry in 2014, their contribution to employment was only 37,3%.*

*Most (62,7%) of the employment in the industry was created by small, medium and micro enterprises (SMMEs)*" (Lehohla & StatSA, 2016, p. 12).

**Table 11 - Capital expenditure on new asset in the construction industry, 2004 - 214**

| Type of service | 2004 | | 2007 | | 2011 | | 2014 | |
|---|---|---|---|---|---|---|---|---|
| | R million | % contribution | R million | % contribution | R million | % contribution | R million | % contribution |
| Site preparation | 205 | 9,1 | 381 | 6,2 | 771 | 6,8 | 2 008 | 15,6 |
| Construction of buildings | 567 | 25,4 | 1 346 | 21,9 | 1 564 | 13,9 | 1 643 | 12,7 |
| Construction of civil engineering structures | 509 | 22,6 | 2 163 | 35,2 | 5 066 | 45,0 | 3 641 | 28,2 |
| Construction of other structures | 48 | 2,1 | 168 | 2,7 | 86 | 0,8 | 134 | 1,0 |
| Construction by specialist trade contractors | 58 | 2,6 | 170 | 2,8 | 338 | 3,0 | 710 | 5,5 |
| Plumbing | 37 | 1,6 | 44 | 0,7 | 142 | 1,3 | 228 | 1,8 |
| Electrical contractors | 85 | 3,8 | 312 | 5,1 | 829 | 7,4 | 1 120 | 8,7 |
| Shopfitting | 11 | 0,5 | 30 | 0,5 | 30 | 0,3 | 36 | 0,3 |
| Other building installation | 74 | 3,3 | 188 | 3,1 | 423 | 3,8 | 553 | 4,3 |
| Painting and decorating | 18 | 0,8 | 63 | 1,0 | 65 | 0,6 | 97 | 0,8 |
| Other building completion | 264 | 11,7 | 366 | 6,0 | 251 | 2,2 | 364 | 2,8 |
| Renting of construction or demolition equipment with operators | 372 | 16,5 | 907 | 14,8 | 1 699 | 15,1 | 2 374 | 18,4 |
| **Total** | **2 248** | **100,0** | **6 138** | **100,0** | **11 264** | **100,0** | **12 908** | **100,0** |

(Sources: Report No. 50-02-01)

Table 11, above, shows that "*The total capital expenditure on new assets in the construction industry in 2014 was R 12,9 billion. The largest contributor…was 'construction of civil engineering structures' (R 3,6 billion or 28,2%), followed by 'renting of construction or demolition equipment with operators' (R 2,4 billion or 18,4%), 'construction of buildings' (R 1,6 billion or 12,7%) and 'electrical contractors' (R 1,1 billion or 8,7%)…expenditure on new assets represents an increase of 4,6% per annum over the expenditure reported in the corresponding survey of 2011 (r 11,3 billion). Comparing 2011 and 2014, the largest increase was reported for 'site preparation' (+R 1,2 billion). The largest decrease was reported for 'construction of civil engineering structures' (-R 1,4 billion) …'Construction of buildings' service lost the biggest percentage share (-12,7 percentage points) in the same period (from 25,4% in 2004 to 12,7% in 2014)*" (Lehohla & StatSA, 2016, p. 15).

### *3.2.3 National Building Regulations and Building Standards – NBR ACT NO. 103 OF 1977*

The NBR act data is to be used as it is regulatory intended, to be a guide to contextualise the SA housing landscape and provide an overview of legislation, impacting prescribed roles and responsibilities of pieces of legislation, governing home design and construction; application of compliance methods; and identifying extraordinary development conditions (Keuter, 2008).

Included in the NBR act are:

1. Standards Act 30 of 1982
2. National Building Regulations and Building Standards Amendment Act 36 of 1984,
3. National Building Regulations and Building Standards Amendment Act 62 of 1989,
4. National Building Regulations and Building Standards Amendment Act 49 of 1995, and
5. Mine Health and Safety Act 29 of 996 (Keuter, 2008).

**Application of the Act**

1) *Subject to the provisions of any notice published in terms of subsection (2), the provisions of this Act shall apply in the area of jurisdiction of any local authority* (NBR Act No. 103, p7) (Keuter, 2008).

*2)* (a) *The Minister may, on such conditions as he may think fit and after consultation with the council and the Administrator of the province in question, of his own accord or at the request of a local authority or any other person, by notice in the Gazette exempt the area of jurisdiction, or any part thereof, of any local authority from the application of this Act, or of any provision thereof which are mentioned in the notice.*

*(b) Different notices may in terms of paragraph (a) be published in respect of different local authorities or different categories of local authorities* (NBR Act No. 103, p7) (Keuter, 2008).

## 18 Deviation and Exemption from National Building Regulations

1) *A local authority may, at the request in writing of the owner of any building or any person having an interest therein, in respect of the erection of such building or the land on which it is being or is to be erected, in writing permit a deviation or grant an exemption from any applicable national building regulation except a national building regulation regarding the strength and stability of the buildings* (NBR Act No. 103) (Keuter, 2008).

2) The Council may, at the request in writing of the owner of any building or any person having an interest therein and after consultation with the local authority in question, in respect of the erection of such building or the land on which it is being or is to be erected, in writing permit a deviation or grant an exemption from any applicable national building regulation relating to the strength and stability of buildings (NBR Act No. 103) (Keuter, 2008).

## 19 Prohibition on Use of Certain Methods or Materials

1) *If the Minister, after consultation with the council with and notwithstanding anything to the contrary contained in any law, is satisfied that any method or material used or to be used in the erection of any building will not be in the public interest or will be dangerous to life or property, the Minister may, having in writing notified the local authority in question, by notice in the Gazette or by notice sent by post or delivered, prohibit the owner of the land on which such building is being or to be erected from using such method or material in such erection* (NBR Act No. 103) (Keuter, 2008).

2) *Any person who contravenes or fails to comply with the provisions of a notice referred to in subsection (1) shall be guilty of an offence and liable on conviction to a fine not exceeding R100 for each day on which he so contravened of failed* (NBR Act No. 103) (Keuter, 2008).

### *3.2.4 National Home Builders Registration Council (NHBRC) – A Guide to the Home Building Manual*

The NHBRC data is to be used as a guide to contextualise the SA housing landscape and provide an overview of legislation impacting prescribed roles and responsibilities of pieces of legislation governing home design and construction; application of compliance methods; identifying extraordinary development conditions (NHBRC, 2014).

Drafted for primary use by home owners and builders, the guide also shares important insights into various aspects of housing for an even wider audience (NHBRC, 2014). This guide:

- *contextualises the Home Building Manual within the wider South African housing landscape and provided an overview of legislation which impacts upon housing";*

- *describes the roles and responsibilities of the different role players assigned in terms of the primary pieces of legislation governing the design and construction of home, namely the National Building Regulations and Building Standards Act 1977 (Act No. 103 of 1977), the Housing Consumer Protection Measures Act of 1998 (Act No. 95 of 1998) and the Occupational Health and Safety Act of 1993 (Act No. 85 of 1993);*

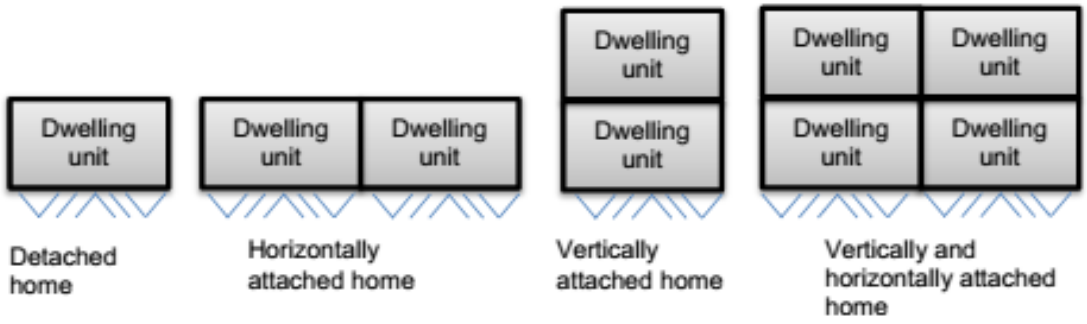
- *provides an overview of the requirements of the Home Building Manual and illustrates how the compliance methods may be applied in order to satisfy the NHBRC's Technical Requirements for a basic house;*

- *highlights the differences and commonalities between the satisfying of National Building Regulations and the NHBRC technical requirements for homes;*

- *identifies and discusses extraordinary development conditions which necessitate regional adjustments to single storey homes having concrete foundations and floors, masonry walls and timber roof trusses; and*

*provides a comprehensive overview of the warranty scheme* (NHBRC, 2014 – p2).

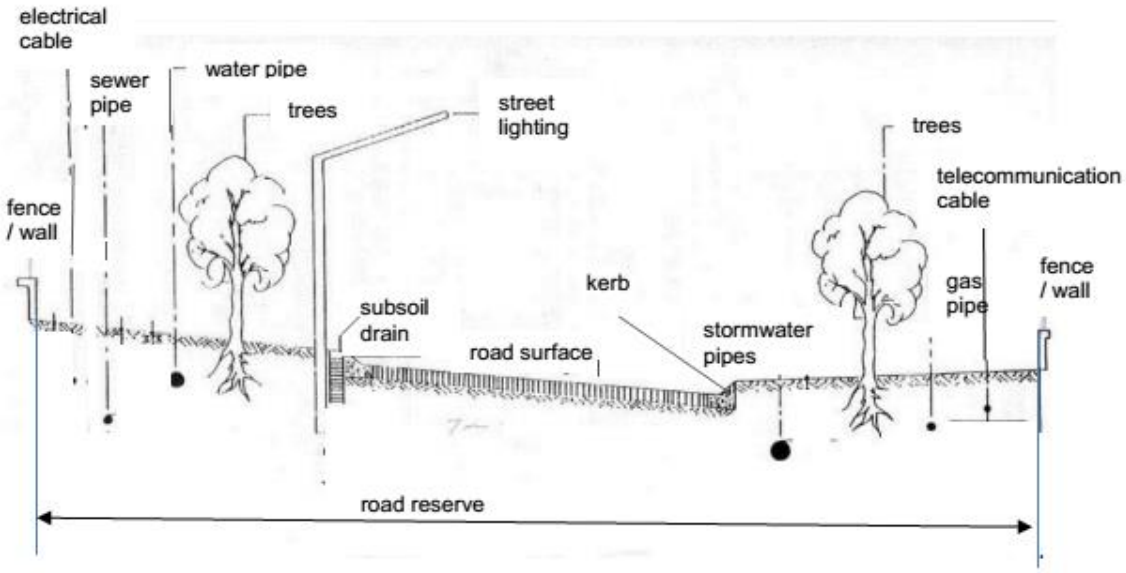
**Figure 7 - Detached and attached homes**




Source: NHBRC, 2014

Homes or dwelling units may be separated from (detached) or linked horizontally or vertically (attached) to each other as shown on figure 11 (NHBRC, 2014). Section 26(1) of Bill of Rights, embedded in the Constitution of the Republic of South Africa, states that "*Everyone has the right to have access to adequate housing*" (NHBRC, 2014 – p5).

**Figure 8 - The legislative landscape for housing**




Source: NHBRC, 2014

Section 24 of the Bill of Rights (Act No. 108 of 1996) state that:

*Everyone has the right:*

a) *to an environment that is not harmful to their health or well-being; and*
b) *to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:*
    I. *prevent pollution and ecological degradation;*
    II. *promote conservation; and*
    III. *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development* (NHBRC, 2014 – p6)

The preamble to the National Housing Act of 1997 (Act No. 107 of 1997) states that parliament "*recognises that*

- *housing as adequate shelter fulfils a basic human need;*
- *housing is both a product and a process;*
- *housing is a product of human endeavour and enterprise;*
- *housing is a vital part of integrated developmental planning;*
- *housing is a key sector of the national economy;*
- *housing is vital to socio-economic well-being of the nation*…" (NHBRC, 2014 – p6).

**Table 12 - Acts which impact upon housing**

| Regulated aspect of housing | Acts |
|---|---|
| Planning of housing developments | Environmental Conservation Act of 1989 (Act No. 73 of 1989)<br>Geoscience Act of 1993 (Act No. 100 of 1993)<br>National Environmental Management Act of 1998 (Act No. 107 of 1998)<br>National Heritage Resources Act of 1999 (Act No. 25 of 1999)<br>National Environmental Management: Protected Areas Act of 2003 (Act No.15 of 2003)<br>National Environmental Management: Biodiversity Act of 2004 (Act No.10 of 2004)<br>National Environmental Management: Integrated Coastal Management Act of 2008 (Act No.24 of 2008)<br>National Environmental Management: Waste Act of 2008 (Act No. 59 of 2008)<br>Spatial Planning and Land Use Management Act of 2013 (Act No. 16 of 2013) |
| Design and construction of homes | National Building Regulations and Building Standards Act of 1977 (Act No. 103 of 1977)<br>Housing Consumers Protection Measure Act of 1998 (Act No. 95 0f 1998)<br>Occupational Health and Safety Act of 1993 (Act No. 85 of 1993)<br>Construction Industry Development Board Act of 2000 (Act No. 38 of 2000)<br>Consumer Protection Act of 2008 (Act No. 68 of 2008)<br>National Regulator for Compulsory Specifications Act of 2008 (Act No. 5 of 2008) |
| Management of established housing developments | Sectional Titles Act of 1986 (Act No. 95 of 1986)<br>Share Blocks Control Act of 1980 (Act No. 59 of 1980) |
| Safety of constructed homes | Occupational Health and Safety Act of 1993 (Act No. 85 of 1993)<br>• Pressure Equipment Regulations of 2009<br>• Electrical Installation Regulations of 2011<br>• Electrical Machinery Regulations of 2011<br>• Construction Regulations 2004<br>National Building Regulations and Building Standards Act of 1977 (Act No. 103 of 1977)<br>• National Building Regulations |
| Legislation which relates to the rental and sale of homes | Rental Housing Act of 1999 (Act No. 50 of 1999)<br>Property Time Sharing Control Act of 1983 (Act No. 765 of 1983)<br>Housing Development Schemes for Retired Persons Act of 1988 (Act No. 65 of 1988)<br>Estate Agency Affairs Act of 1976 (Act No. 112 of 1976) |
| Provision by the state of housing | Housing Act of 1997 (Act No. 107 of 1997) |

Source: NHBRC, 2014

The three-primary design and home construction governing legislations (NHBRC, 2014), are:

1) National Building Regulations and Building Standards Act of 1977 (Act No. 103 0f 1977)
2) Housing Consumers Protection Measure Act of 1998 (Act No. 95 of 1988)
3) Occupational Health and Safety Act of 1993 (Act No. 85 of 1993)

The identified roles and responsibilities of the participants in these legislations, (NHBRC, 2014 – p8), are in essence:

1) *The owner (person in whose name the land on which a building was or is erected is registered in the deed office) is responsible for ensuring compliance with the requirements of the National Building Regulations and Building Standards Act of 1977;*
2) *The home builder is responsible for compliance with the NHBRC Technical Requirements established in terms of the Housing Consumer Protection Measure Act of 1998; and*
3) *The client (any person for whom construction work is being performed) and the contractor are responsible for ensuring compliance with the provisions of the Occupational Health and Safety Act of 1993*.

**Planning and design of housing developments**

The Guideline for Human Settlement Planning and Design for (Red Book), from CSIR, makes provisions for performance-based guidelines to inform decision making and appropriate practices and technology (NHBRC, 2014), as such it:

- *Provides a framework for both "human-centred" and "nature-centred" settlement-making;*
- *establishes spatial and structural principles for achieving well performing settlement-making;*
- *describes planning methods and participative processes;*
- *provides planning guidelines for movement networks, public transport, hard open spaces, soft open spaces, public facilities, land subdivision, public utilities and cross-cutting issues including fire safety; and*
- *provides guidelines for stormwater management, roads, water supply, sanitation, solid waste management and energy.*

In terms of the Constitution, housing is a national and provincial competence, and priority areas for government objectives of improving quality of life (NHBRC, 2014 – p10), are:

- *accelerated delivery of housing opportunities;*

- *access to basic services;*
- *more efficient land use; and*
- *an improved property market*.

All buildings including homes are required to be erected according to the provisions of the NBR and building control officers are appointed locally (NHBRC, 2014), responsible for:

1) *making the relevant recommendations for approval by Local Authority of building plans, specifications, certificates, etc.;*
2) *ensuring that the requirements of the Local Authority regarding approvals are carried out; and*
3) *inspecting buildings under construction or completed to confirm compliance with approved plans and specifications and conditions of approval including usage, location on site, etc.*

"*It should be borne in mind that the local authorities who administer these regulations have been exempted from any liability for failures of buildings or structures erected in accordance with the National Building Regulations which have been approved by a local authority. This means that owners have no recourse to these bodies in the event of failure or poor-quality work"* (NHBRC, 2014 – p10).

**SABS**

The South African Bureau of Standards (SABS), a statutory body in terms of the Standards Act of 2008 (Act No. 8 of 2008) (NHBRC, 2014), mandated to:

1) *develop, promote and maintain South African national standards;*
2) *promote quality in connection with commodities, products and services; and*
3) *render conformity assessment services and assist in matters connected therewith*.

"*The SBSA develops…national standards on a consensus basis together with representatives of valid national interests such as organs of state, industry*

*associations, consumer organisations or associations, non-governmental organisations, organised labour and professional and technical and trade organisations*" (NHBRC, 2014 – p13).

**Agrement South Africa**

"*Agrement South Africa is an independent body operating under a ministerial delegation of authority from the Minister of Public Works…assesses and certifies the fitness for purpose of systems, elements and components intended for use in the construction of buildings or infrastructure which fall outside of the scope of existing standards established by the SABS…the ability of a system, element or component to be consistently developed, manufactured, applied and installed such that it fulfils its intended purpose*" (NHBRC, 2014 – p13). The product cycle starts with research and development, followed by fit for purpose certification from Agrement SA, and once well-known, national standards, testing protocols and compliance requirements are developed (NHBRC, 2014).

**Table 13 - Attributes and considerations in the design and construction of a home**

| Attribute | Typical considerations | Regulator's requirements for attribute | |
|---|---|---|---|
| | | National Building Regulations | NHBRC Technical Requirements |
| Accessibility | Access and ease of movement for a range of users e.g. the elderly and people with disabilities or obesity | Part M: Stairways<br>Part S: Facilities for people with disabilities | Not regulated |
| Adaptability | Inherent ability of a home to be altered or extended or have its use changed | Not regulated | Not regulated |
| Acoustics | Control of external and internal noise (continuous and intermittent)<br>Intelligibility of sound | Not regulated | Not regulated |
| Aesthetics | Appearance of a home | Not regulated | Not regulated |
| Air purity | Ventilation of spaces<br>Control of odours | Part O: Lighting and ventilation | Not regulated |
| Contributions to sustainable development | • Usage of resources such as energy and water e.g. greenhouse gas emissions, use of renewable and non-renewable resources and consumption of fresh water)<br>• Choice of building materials e.g. use of renewable and non-renewable resources, use of harmful substances, potential to generate business and employment opportunities for targeted groups and formation of waste hazards)<br>• Choice of construction methods and resources e.g. potential to generate business and employment opportunities for targeted groups and health and safety during construction<br>• Methods of waste disposal .e.g. recycling and disposal of hazardous waste<br>• Resilience (ability to recover / bounce back from extreme hazards / disasters) | Not regulated save for Part XA: Energy usage | Not regulated |
| Constructability | Transportation to site and erection and health safety considerations.. | Not regulated | Not regulated |
| Durability | Retention of performance of components and elements over required service life subject to regular maintenance | A15 Maintenance and operation<br>Part B: Structural design | Part 2.1 Structural strength and serviceability (2.1.1.3)<br>Part 2.2 Dampness and weatherproofing (2.2.1.1) |
| Economics | Initial capital and running and maintenance costs | Not regulated | Not regulated |

Source: NHBRC, 2014

### *3.2.5 Eighty20 – Centre for Affordable Housing in Africa (CAHF)*

A study that looks at financial "…*data pertaining to the so-called FSC market in South Africa. It explores some initial thoughts as to what data we might want to see in order to support the development of an 'inclusive' housing finance sector*…" as it pertains to the South African Financial Charter (Melzer, Eighty20, 2015).

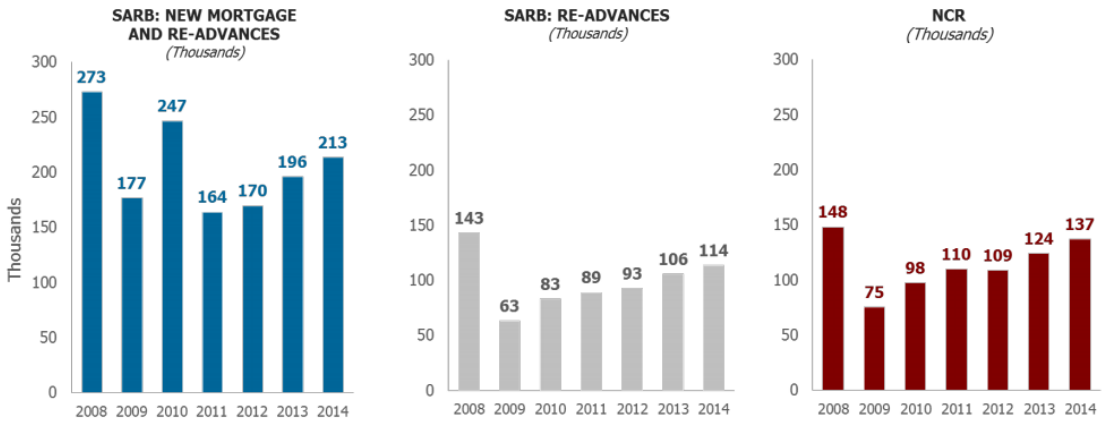
The Financial Sector Charter (FSC) was a voluntary initiative signed by "5 Big" Banking institutions of SA, to amongst other things provide financial support to lower income consumers in home loans by availing R42 billion in housing finance, for both developers and households earning between R 1500 and R 7500, from 2004 to 2008, valued in 2004 Rand terms (Melzer, Eighty20, 2015). The household earnings were too high to receive a free government house, on the "*RDP Housing*" skim, and too low to qualify for a normal Bank mortgage, but were qualifying for a government subsidy, which would be used with the FSC funded loan. The Bank agreed to regulate and hold to account lending practises, but the reporting only monitored achievements in origination without looking at factors supporting or preventing broader inclusion (Melzer, Eighty20, 2015).

According to Melzer et al (2015), the South African Reserve Bank (SARB) historically published an aggregated value of mortgage origination data for the entire market, but this data did not show the funding to the intended FSC target market. There are inherent data limitations regarding the FSC target market analysis, because the "*data is segmented by fixed personal income bands that do not change over time, unlike the thresholds used to earmark the FSC target market*" (Melzer, Eighty20, 2015 – p3). There is also a "light discrepancy" between SARB data and National Credit Regulator (NCR) data regarding yearly originated mortgages, mainly because SARB only monitors Banks while NCR includes all lenders (Melzer, Eighty20, 2015). SARB refers to approved loans as 'granted' regardless of whether paid out or taken up, but to the NCR 'granted' only refers to paid out loans (Melzer, Eighty20, 2015).

Comparing lending incomes by NCR and Banking Association of South Africa (BASA) further shows differing thresholds for highest incomes, NCR remains

static at R 15 000 per month whereas FSC adjust by inflation, which reached R 18 600 in 2014 (Melzer, Eighty20, 2015). NCR refers to personal income with highest paid borrower's income used in joint applications, while BASA combined household income in joint applications (Melzer, Eighty20, 2015).

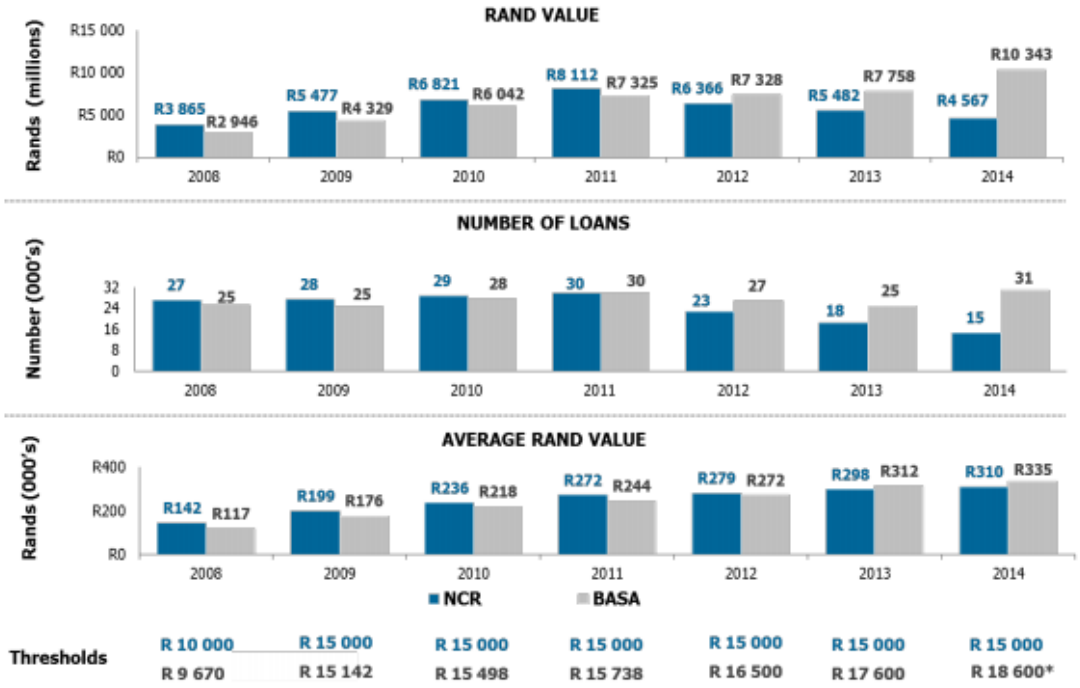
**Figure 9 - Mortgage origination: Total market - SARB vs NCR**




The chart above compares data published on granted and paid out mortgages form NCR to those from SARB, showing that lending totalled approximately R 137 billion in 2014 according to NCR, about R 23 billion deference to the SARB figures of the same period, but both show increased rand value of close to 12,5% per annum after 2009 lows (Melzer, Eighty20, 2015).

Looking at figure 10 (below) the evidence on this data from NCR 2011, shows that for every 40 households, from an estimate of 850 000, earning in the R 10 000 to R 15 000 per month segment, only one mortgage is approved compared to the one in every 15 households, in an estimated 2 million, earning above R 15 000 per month segment (Melzer, Eighty20, 2015). The main reason for this is affordability or lack thereof, as low incomes are strained by high debt levels and expensive houses (Melzer, Eighty20, 2015).

**Figure 10 - Mortgages granted: NCR vs. BASA**




Source: BASA, NCR
Notes: NCR data incorporates the top 40 registered credit providers * BASA income thresholds from 2008-2014

Data from the big four banks, ABSA, Standard Bank, FNB and Nedbank on home loan applications in 2012 is shown in the following charts:

**Figure 11 - Status of home loan applications: ABSA, 2012**

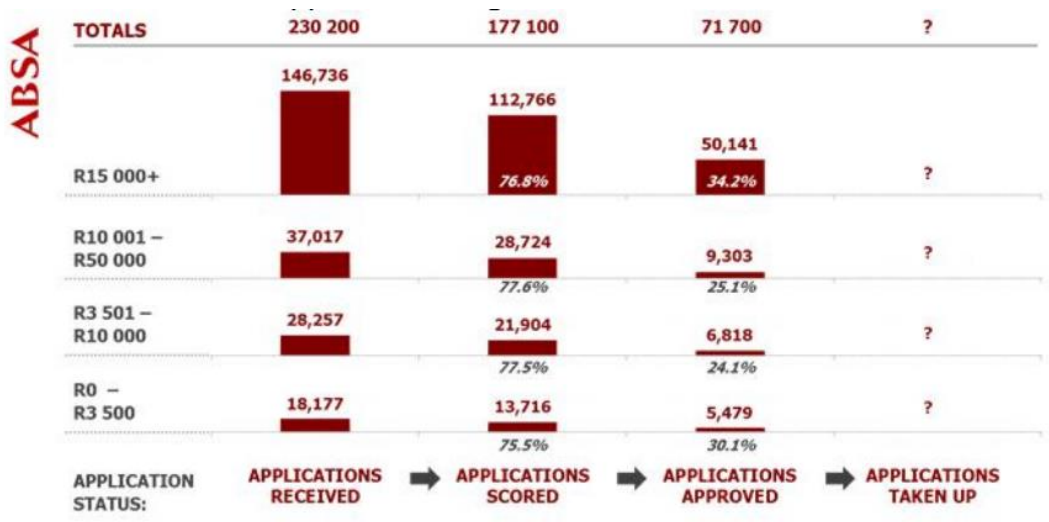


**Figure 12 - Status of home loan applications: Standard Bank, 2012**




**Figure 13 - Status of home loan applications: FNB, 2012**

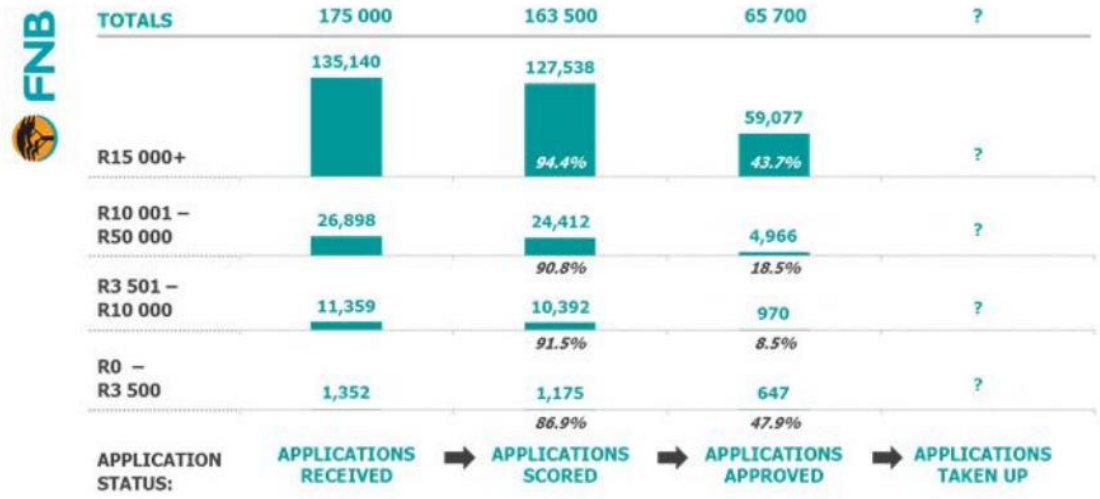
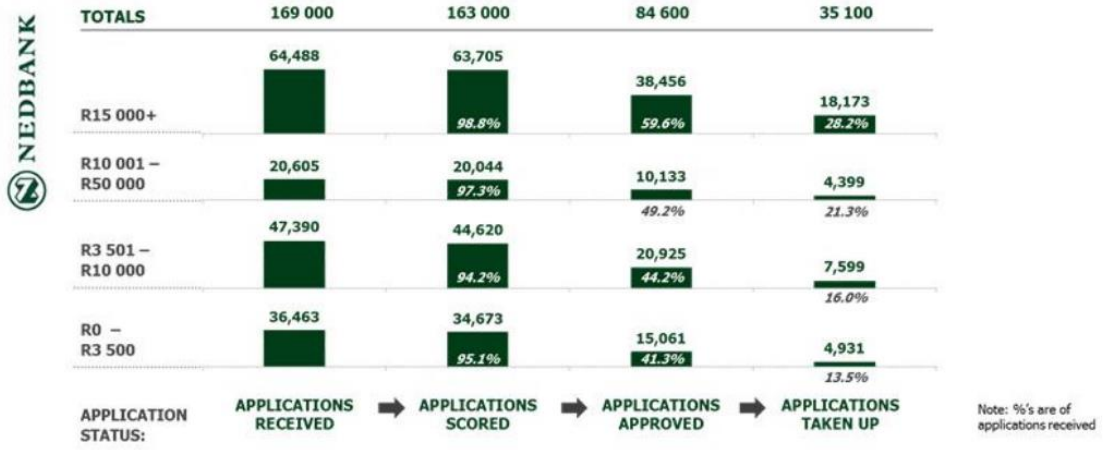


**Figure 14 - Status of home loan applications: Nedbank, 2012**




Melzer et al (2015, p7-8), argues that these *"…numbers require further investigation as they are…implausible; Absa and Nedbank…report surprisingly high numbers of applications and approvals in the lowest income segment…a simple comparison with NCR data for that year confirms that something is amiss…of a total of 16 256 home loans…approved or taken up…earning below R 3 500 per month…corresponding number of mortgages…published by the NCR is just 24*".

Data is also collected on the reason for rejection of home loans (Section6, Decline reason) by The Office of Disclosure, on all market segments, to isolate key barriers to access (Melzer, Eighty20, 2015). The following data is a summary of 2012 data for the four banks:

**Table 14 - Decline reason: All home loans, 2012**

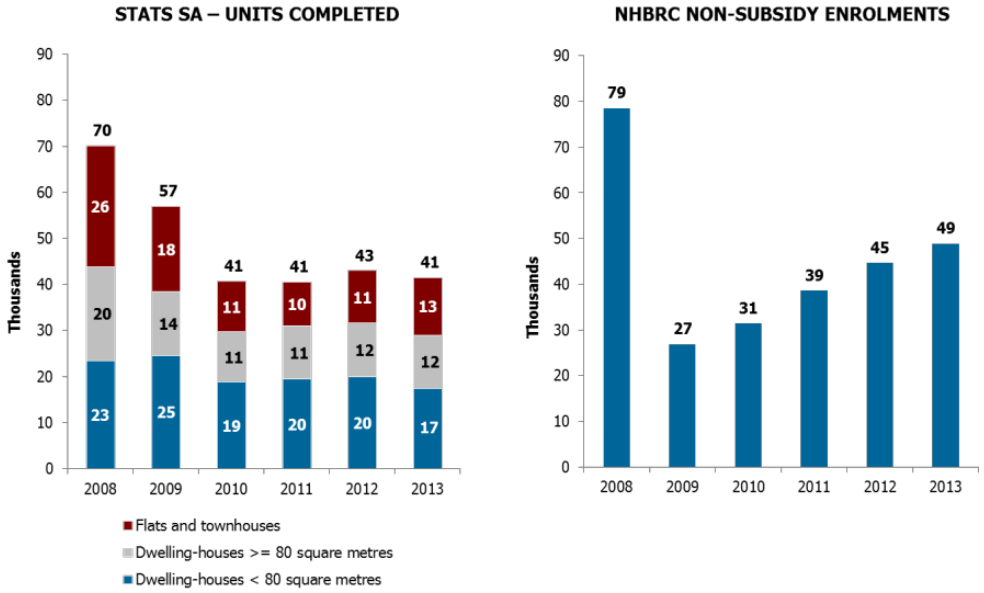
| | Absa | Standard Bank | First Rand Bank | Nedbank |
|---|---|---|---|---|
| **Lack of Affordability** | 10% | 18% | 45% | 39% |
| **Unacceptable credit track record** | 49% | 48% | 24% | 40% |
| **Insufficient information/ documents provided** | 5% | 20% | 10% | 0% |
| **Unacceptable security** | 2% | 4% | 10% | 3% |
| **Ineligible applicant** | 3% | n/a | 6% | 15% |
| **Unacceptable exposure (town)** | 0% | 1% | 0% | 0% |
| **Adverse credit record** | 3% | 4% | 5% | |
| **Other / blank data** | 28% | | | 2% |
| **Not target market** | | | | |

Source: Office of Disclosure

There are several reasons for declining an application at each bank, Absa, Standard Bank and Nedbank cited poor or adverse credit records as reason, and FNB looked at affordability (Melzer, Eighty20, 2015).

On the housing supply side, the only data on new builds relates to developer finance provided by the same four banks, reported as part of FSC process (Melzer, Eighty20, 2015), but it excludes significant contribution by private funded affordable housing developments. The BASA's developer finance data focuses on Rand value instead of new affordable unit developed (Melzer, Eighty20, 2015). NHBRC requires builders to submit data on type and estimate selling price of all houses built while StatsSA gathers data from municipalities on private builds less than or greater than 80m$^2$ flats or townhouses, excluding state subsidised housing developments (Melzer, Eighty20, 2015). "*Assuming that half of all dwellings under 80m$^2$ and half of all flats and townhouses are affordable to the FSC market, the market is delivering at most 15 000 units per year*" (Melzer, Eighty20, 2015). See figure 13, below.

**Figure 15 - Housing supply: 2008 to 2013**




Source: Statistics South Africa and NHBRC

# 4 PRESENTATION OF RESULTS

## 4.1 Introduction

The results are presented in table of summary simulation output reports for the two proposed methods. The simulation is run on a spreadsheet containing know inputs (discount rate, bonus limit); uncertain inputs (investment cost, revenue, fixed cost, growth rate, variable cost percentage); discounted cashflows calculations for a 10-year forecast; and outputs (NPV, bonus). The Simulation uses the known inputs and defined distribution parameters to calculate possible outputs for each of the 5000 iterations. The results are presented as output graphs and related numerical statistics for the NVP and Bonus for each of the proposed methods. A detailed discussion/explanation of the results will be found in the Business Case (chapter 5), partly due to the context and relevance to this section of the report, but mainly due to the total word count limitations stipulated for this body of work.

## 4.2 @Risk Model Inputs, Outputs and Definitions

The modelling Spreadsheet makes use of some familiar terms, extensively used in accounting, however for this study, these terms may have differing and special, definitions that are explained in the table below:

**Table 15 - Model Calculations Formulae & Definitions**

| Risk Model Item | Model Calculation Formulae | Model Specific Definition |
|---|---|---|
| **Inputs** | | |
| Discount Rate | = 12% | This is the interest rate used in discounted cash flow, to determine the present value of future cash flow (NPV) |
| Bonus Limit | = 60% of Investment costs | Should the annual revenue generated be above 60% of capital investment, the management team will be entitled to bonuses. However, should the revenue fall below 50% of capital investment, penalties will be imposed. |
| **Uncertain Inputs** | | |
| Investment Cost | Triangular Distribution = RiskTriang(min;midrange;max;RiskStatic(midrange)) | How much capital is required to operate the business, annually |
| Year 1 Revenue | Triangular Distribution = RiskTriang(min;midrange;max;RiskStatic(midrange)) | The revenue generated on the 1st year of business |

| | | |
|---|---|---|
| Annual Fixed Cost | Triangular Distribution = RiskTriang(min;midrange;max;RiskStatic(midrange)) | These are the cost incurred per unit for the total number of units produced per year, which in this study has been fixed at 200 units. *{Please note that the terminology used here is model specific especially the term "fixed" and does not necessarily equate to the account definition of "fixed costs" but instead is as defined above}.* |
| Annual Revenue Growth Rate | Normal Distribution = RiskNormal(0,025;0,04;RiskStatic(0,025)) | The percentage increase between equivalent financial periods to determine or show how fast the business can potentially grow |
| Annual Variable Cost Percentage | Normal Distribution = RiskNormal(0,5;0,02; RiskStatic(0,5)) | The risk associated with variable production cost measured against the total income/revenue for the sale of units. The percentage used is a broad-based percentage based on the author's conservative estimate to cover all variability in costs; outside the "direct" building costs. |
| **Discounted Cash Flows Calculation** | | |
| Investment Cost | = Uncertain Inputs Investment Cost | |
| Revenue | = Previous Year's Revenue * (1+$C$Annual Revenue Growth Rate) | The real/cash value of money the company needs/receives for that specific period to operate and generate an income |

| | | |
|---|---|---|
| Fixed Cost | = 200 units x specific model's building cost per unit | These are the direct building costs for the total **fixed** number of units produced per year. For this venture it is proposed that 200 units are produced every year for the first 10 years of operation, market conditions permitting |
| Variable Cost | = Administration (consultants, project office) costs + Project Management costs + Set-up costs (geographical/provincial bases) + Operational costs + Marketing costs + Import costs (materials) etc. | These are all the business operation costs over and above the building costs. These need to be managed at or below 50% of annual generated revenue or earnings, for the business to be profitable, and are calculated from EBITDA. |
| Cash Flow | = Revenue – Fixed (Building) Costs – Variable (Admirations costs + Project Management costs + Set-up costs) costs | The net amount of cash and or equivalents moving in and out of the business |
| **Outputs** | | |
| NPV | = RiskOutput("NPV") +Investment Cost+NPV(Discount Rate; Combined Annual Cash Flows from 1st to 10th year) | The Net Present Value showing the projected and potential profitability of investing in the proposed business |
| Bonus | = RiskOutput("Bonus") +MAX (NPV-Bonus Limit;0) | The bonus to be paid out to Managers |

## 4.3 Results pertaining to Proposition 1

**Table 16 - Proposal 1 (Hybrid + Brick): Investment Inputs and Outputs**

Hybrid Method - Proposal 1

| Known Inputs | |
|---|---|
| Discount Rate | 12,00% |
| Bonus Limit | R120 000 000,00 |

| | |
|---|---|
| Number of units per year | 200 |
| Fixed Cost per unit | R515 690,86 |
| Annual Fixed Cost | R103 138 172,00 |

| Uncertain Inputs | | Parameters of Distribution | | | |
|---|---|---|---|---|---|
| | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 |
| Investment Cost | R200 000 000,00 | Triangular | R160 000 000,00 | R200 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | R400 000 000,00 | Triangular | R320 000 000,00 | R400 000 000,00 | R440 000 000,00 |
| Annual Fixed Cost | R103 138 172,00 | Triangular | R94 297 757,26 | R103 138 172,00 | R111 978 586,70 |
| Annual Revenue Growth Rate | 2,50% | Normal | 2,50% | 4,00% | 0,00% |
| Annual Variable Cost Percentage | 50,00% | Normal | 50,00% | 2,00% | 0,00% |

**Discounted Cash Flows Calculation**

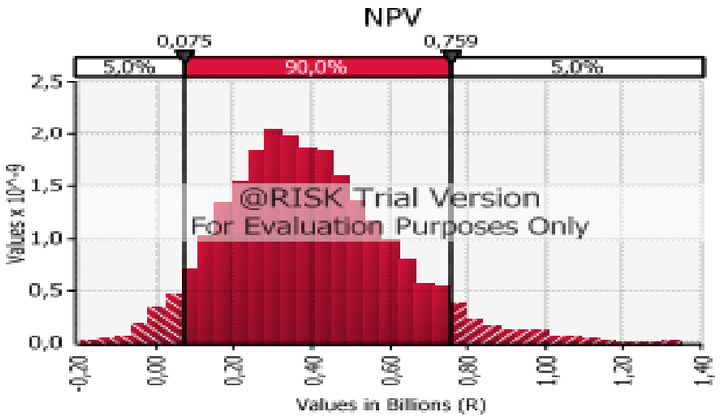
| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Investment Cost | -R200 000 000,00 | | | | | | | | | | |
| Revenue | | R400 000 000,00 | R410 000 000,00 | R420 250 000,00 | R430 756 250,00 | R441 525 156,25 | R452 563 285,16 | R463 877 367,29 | R475 474 301,47 | R487 361 159,00 | R499 545 187,98 |
| Fixed Cost | | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 | R103 138 172,00 |
| Variable Cost | | R200 000 000,00 | R205 000 000,00 | R210 125 000,00 | R215 378 125,00 | R220 762 578,13 | R226 281 642,58 | R231 938 683,64 | R237 737 150,73 | R243 680 579,50 | R249 772 593,99 |
| Cash Flow | -R200 000 000,00 | R96 861 828,00 | R101 861 828,00 | R106 986 828,00 | R112 239 953,00 | R117 624 406,13 | R123 143 470,58 | R128 800 511,64 | R134 598 978,73 | R140 542 407,50 | R146 634 421,99 |

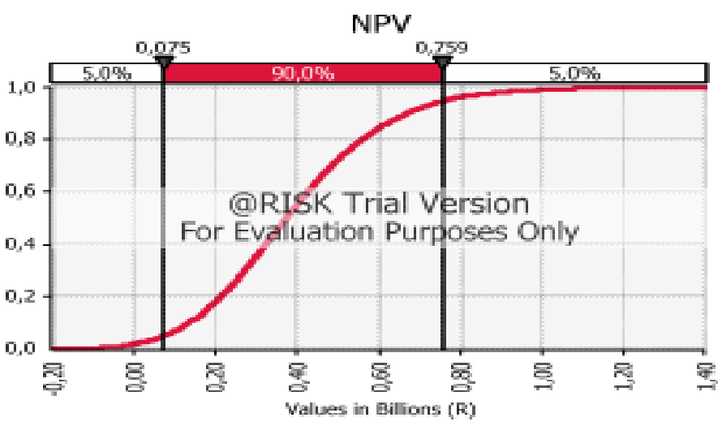
| Outputs | |
|---|---|
| NPV | R454 819 033,24 |
| Bonus | R334 819 033,24 |

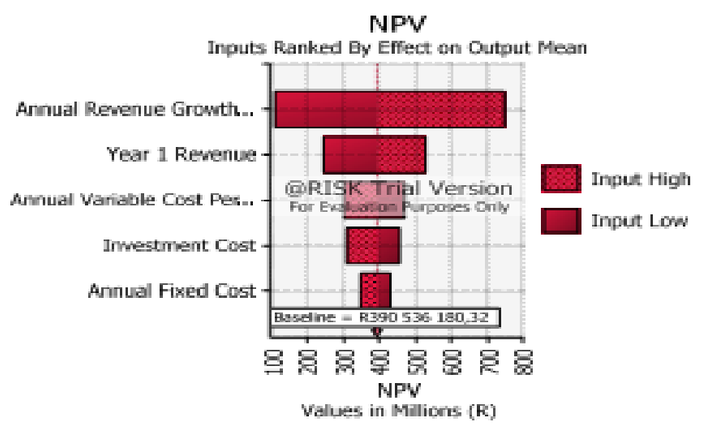
Table 17 - Proposal 1 (Hybrid + Brick): NPV simulated results for 5000 iterations

# @RISK Output Report for NPV C26

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:42:11




| Simulation Summary Information | |
|---|---|
| **Workbook Name** | Fihlani TN - 9706S01F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| **Number of Simulations** | 1 |
| **Number of Iterations** | 5000 |
| **Number of Inputs** | 25 |
| **Number of Outputs** | 10 |
| **Sampling Type** | Latin Hypercube |
| **Simulation Start Time** | 2017/09/06 10:09 |
| **Simulation Stop Time** | 2017/09/06 10:09 |
| **Simulation Duration** | 00:00:27 |
| **Random # Generator** | Mersenne Twister |
| **Random Seed** | 1545759779 |
| **Total Errors** | 0 |
| **Collect Distribution Samples** | All |
| **Convergence Testing** | Disabled |
| **Smart Sensitivity Analysis** | Enabled |

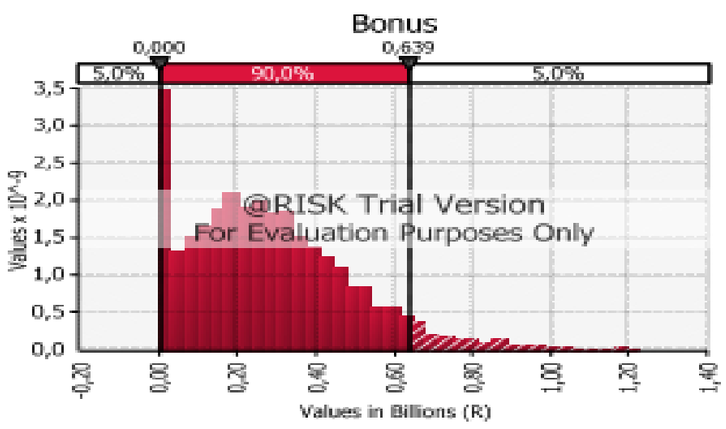
| Summary Statistics for NPV | | | |
|---|---|---|---|
| **Statistics** | | **Percentile** | |
| **Minimum** | -R187 983 069,55 | **1,0%** | -R26 497 483,50 |
| **Maximum** | R1 349 336 415,49 | **2,5%** | R22 829 836,67 |
| **Mean** | R390 536 180,32 | **5,0%** | R75 175 361,34 |
| **Std Dev** | R210 487 008,74 | **10,0%** | R134 287 877,36 |
| **Variance** | 4,43048E+16 | **20,0%** | R213 652 468,57 |
| **Skewness** | 0,507283853 | **25,0%** | R244 648 218,64 |
| **Kurtosis** | 3,464595724 | **50,0%** | R372 685 644,39 |
| **Median** | R372 685 644,39 | **75,0%** | R519 439 607,49 |
| **Mode** | R305 042 401,65 | **80,0%** | R559 075 366,30 |
| **Left X** | R75 175 361,34 | **90,0%** | R665 869 733,88 |
| **Left P** | 5% | **95,0%** | R758 949 618,24 |
| **Right X** | R758 949 618,24 | **97,5%** | R847 906 988,98 |
| **Right P** | 95% | **99,0%** | R980 425 552,95 |
| **#Errors** | 0 | | |

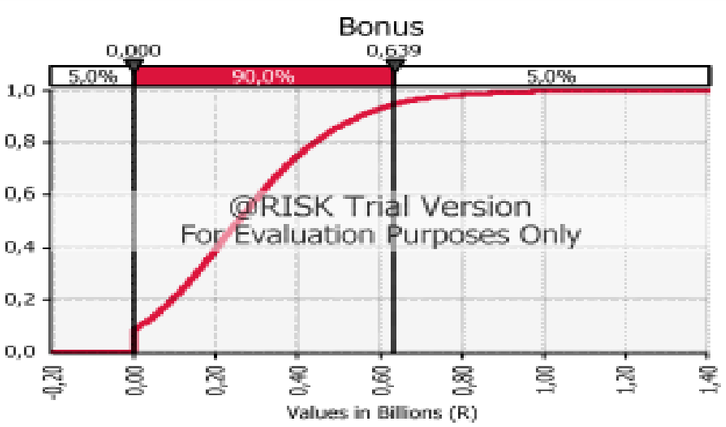
| Change in Output Statistic for NPV | | | |
|---|---|---|---|
| **Rank** | **Name** | **Lower** | **Upper** |
| 1 | Annual Revenue Growth Rate | R108 173 151,61 | R747 941 766,20 |
| 2 | Year 1 Revenue | R240 382 140,84 | R524 969 990,84 |
| 3 | Annual Variable Cost Percentage | R299 019 494,70 | R470 959 683,45 |
| 4 | Investment Cost | R308 152 448,34 | R458 803 022,95 |
| 5 | Annual Fixed Cost | R348 412 275,41 | R428 396 064,93 |

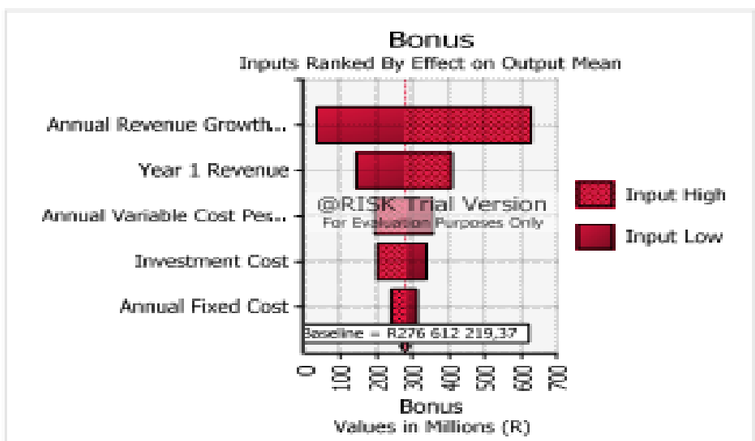
Table 18 - Proposal 1 (Hybrid + Brick): Bonus simulated results for 5000 iterations

# @RISK Output Report for Bonus C27

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:42:24




| Simulation Summary Information | |
|---|---|
| Workbook Name | Fihlani TN - 9706S01F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| Number of Simulations | 1 |
| Number of Iterations | 5000 |
| Number of Inputs | 25 |
| Number of Outputs | 10 |
| Sampling Type | Latin Hypercube |
| Simulation Start Time | 2017/09/06 10:09 |
| Simulation Stop Time | 2017/09/06 10:09 |
| Simulation Duration | 00:00:27 |
| Random # Generator | Mersenne Twister |
| Random Seed | 1545759779 |
| Total Errors | 0 |
| Collect Distribution Samples | All |
| Convergence Testing | Disabled |
| Smart Sensitivity Analysis | Enabled |

| Summary Statistics for Bonus | | | |
|---|---|---|---|
| Statistics | | Percentile | |
| Minimum | R0,00 | 1,0% | R0,00 |
| Maximum | R1 229 336 415,49 | 2,5% | R0,00 |
| Mean | R276 612 219,37 | 5,0% | R0,00 |
| Std Dev | R200 570 445,29 | 10,0% | R14 287 877,36 |
| Variance | 4,0228SE+16 | 20,0% | R93 652 468,57 |
| Skewness | 0,751420171 | 25,0% | R124 648 218,64 |
| Kurtosis | 3,508740705 | 50,0% | R252 685 644,39 |
| Median | R252 685 644,39 | 75,0% | R399 439 607,49 |
| Mode | R0,00 | 80,0% | R439 075 366,30 |
| Left X | R0,00 | 90,0% | R545 869 733,88 |
| Left P | 5% | 95,0% | R638 949 618,24 |
| Right X | R638 949 618,24 | 97,5% | R727 906 988,98 |
| Right P | 95% | 99,0% | R860 425 552,95 |
| #Errors | 0 | | |

| Change in Output Statistic for Bonus | | | |
|---|---|---|---|
| Rank | Name | Lower | Upper |
| 1 | Annual Revenue Growth Rate | R34 857 620,38 | R627 941 766,20 |
| 2 | Year 1 Revenue | R142 356 706,35 | R405 400 509,63 |
| 3 | Annual Variable Cost Percentage | R192 414 152,75 | R353 805 436,90 |
| 4 | Investment Cost | R202 025 644,67 | R339 585 878,42 |
| 5 | Annual Fixed Cost | R237 263 170,39 | R311 253 386,43 |

**Table 19 - Proposal 1 (Hybrid + Cinder Block): Investment Inputs and Outputs**

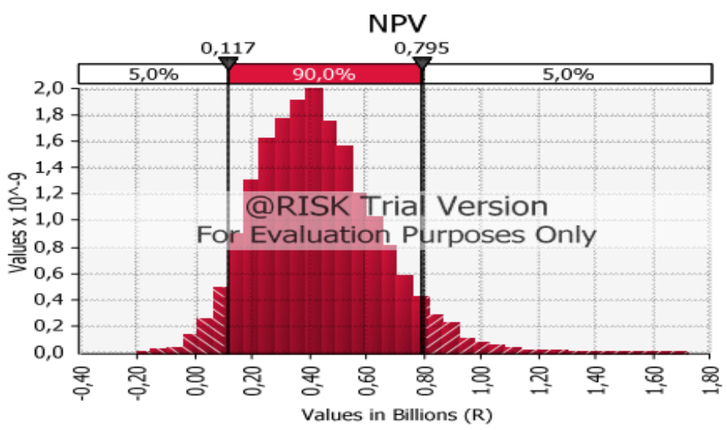
Hybrid Method - Proposal 1

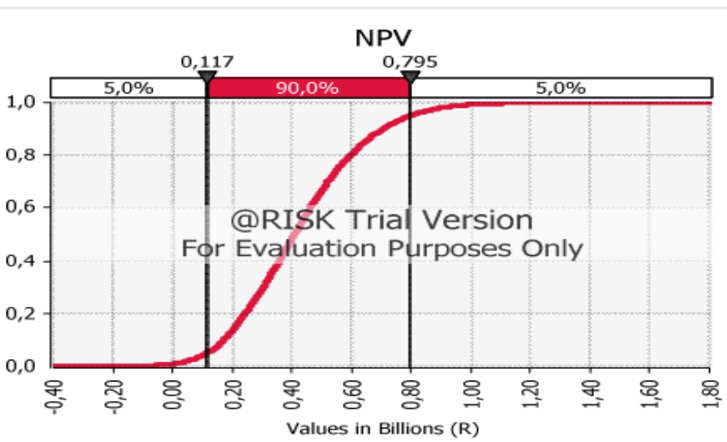
| **Known Inputs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount Rate | 12,00% | | | | | | | | | **Number of units per year** | 200 | |
| Bonus Limit | R120 000 000,00 | | | | | | | | | **Fixed Cost per unit** | R484 704,52 | |
| | | | | | | | | | | **Annual Fixed Cost** | R96 940 904,00 | |
| | | | **Parameters of Distribution** | | | | | | | | | |
| **Uncertain Inputs** | | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 | | | | | | |
| Investment Cost | R200 000 000,00 | | Triangular | R160 000 000,00 | R200 000 000,00 | R360 000 000,00 | | | | | | |
| Year 1 Revenue | R400 000 000,00 | | Triangular | R320 000 000,00 | R400 000 000,00 | R440 000 000,00 | | | | | | |
| Annual Fixed Cost | R96 940 904,00 | | Triangular | R88 631 683,66 | R96 940 904,00 | R105 250 124,30 | | | | | | |
| Annual Revenue Growth Rate | 2,50% | | Normal | 2,50% | 4,00% | 0,00% | | | | | | |
| Annual Variable Cost Percentage | 50,00% | | Normal | 50,00% | 2,00% | 0,00% | | | | | | |
| **Discounted Cash Flows Calculation** | | | | | | | | | | | | |
| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | |
| Investment Cost | -R200 000 000,00 | | | | | | | | | | | |
| Revenue | | R400 000 000,00 | R410 000 000,00 | R420 250 000,00 | R430 756 250,00 | R441 525 156,25 | R452 563 285,16 | R463 877 367,29 | R475 474 301,47 | R487 361 159,00 | R499 545 187,98 | |
| Fixed Cost | | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | R96 940 904,00 | |
| Variable Cost | | R200 000 000,00 | R205 000 000,00 | R210 125 000,00 | R215 378 125,00 | R220 762 578,13 | R226 281 642,58 | R231 938 683,64 | R237 737 150,73 | R243 680 579,50 | R249 772 593,99 | |
| Cash Flow | -R200 000 000,00 | R103 059 096,00 | R108 059 096,00 | R113 184 096,00 | R118 437 221,00 | R123 821 674,13 | R129 340 738,58 | R134 997 779,64 | R140 796 246,73 | R146 739 675,50 | R152 831 689,99 | |
| Outputs | | | | | | | | | | | | |
| NPV | R489 834 979,60 | | | | | | | | | | | |
| Bonus | R369 834 979,60 | | | | | | | | | | | |

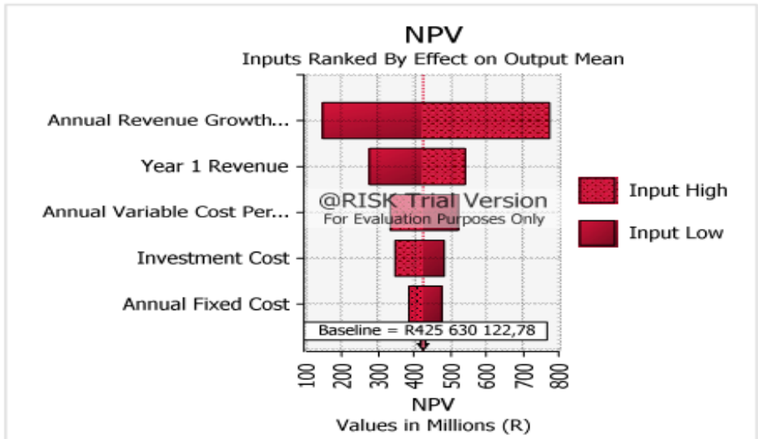
Table 20 - Proposal 1 (Hybrid + Block): NPV simulated results for 5000 iterations

# @RISK Output Report for NPV C26

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:42:35




## Simulation Summary Information

| | |
|---|---|
| **Workbook Name** | Fihlani TN - 9706501F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| **Number of Simulations** | 1 |
| **Number of Iterations** | 5000 |
| **Number of Inputs** | 25 |
| **Number of Outputs** | 10 |
| **Sampling Type** | Latin Hypercube |
| **Simulation Start Time** | 2017/09/06 10:09 |
| **Simulation Stop Time** | 2017/09/06 10:09 |
| **Simulation Duration** | 00:00:27 |
| **Random # Generator** | Mersenne Twister |
| **Random Seed** | 1545759779 |
| **Total Errors** | 0 |
| **Collect Distribution Samples** | All |
| **Convergence Testing** | Disabled |
| **Smart Sensitivity Analysis** | Enabled |

## Summary Statistics for NPV

| **Statistics** | | **Percentile** | |
|---|---|---|---|
| **Minimum** | -R205 167 019,90 | **1,0%** | R4 652 977,52 |
| **Maximum** | R1 728 767 691,60 | **2,5%** | R69 046 084,52 |
| **Mean** | R425 630 122,78 | **5,0%** | R116 669 878,59 |
| **Std Dev** | R209 696 596,02 | **10,0%** | R172 423 969,98 |
| **Variance** | 4,39727E+16 | **20,0%** | R242 914 472,28 |
| **Skewness** | 0,504692234 | **25,0%** | R275 260 354,39 |
| **Kurtosis** | 3,545387174 | **50,0%** | R409 094 635,33 |
| **Median** | R409 094 635,33 | **75,0%** | R554 869 067,69 |
| **Mode** | R313 199 223,21 | **80,0%** | R595 894 839,65 |
| **Left X** | R116 669 878,59 | **90,0%** | R702 629 898,36 |
| **Left P** | 5% | **95,0%** | R795 251 424,16 |
| **Right X** | R795 251 424,16 | **97,5%** | R877 352 861,03 |
| **Right P** | 95% | **99,0%** | R980 338 588,15 |
| **#Errors** | 0 | | |

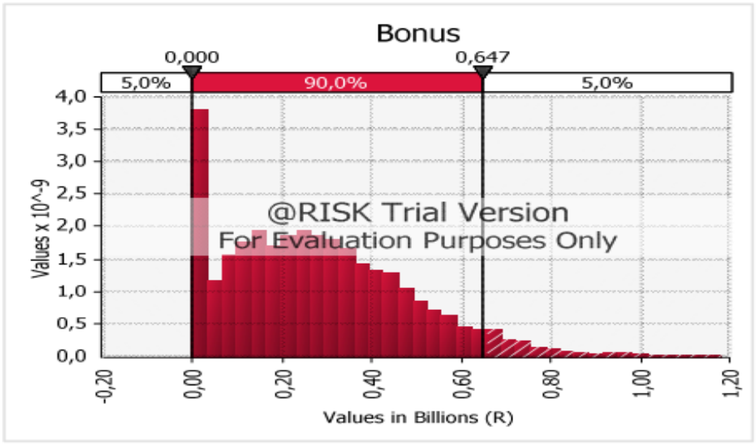
## Change in Output Statistic for NPV

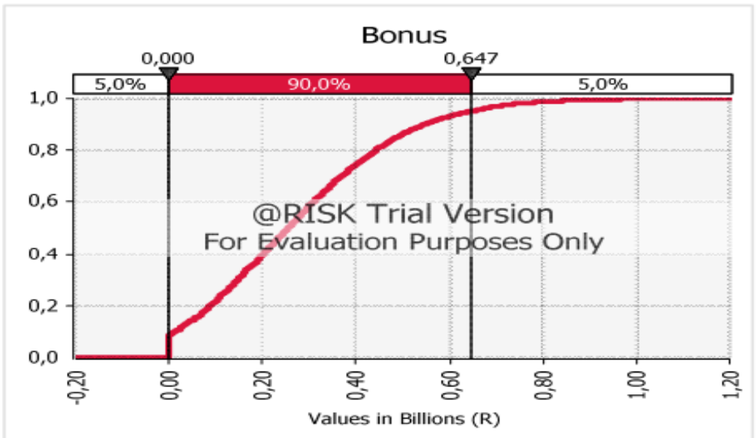
| **Rank** | **Name** | **Lower** | **Upper** |
|---|---|---|---|
| 1 | Annual Revenue Growth Rate | R142 990 060,21 | R775 421 539,46 |
| 2 | Year 1 Revenue | R277 502 013,91 | R540 101 126,57 |
| 3 | Annual Variable Cost Percentage | R332 971 377,50 | R522 142 418,77 |
| 4 | Investment Cost | R347 029 237,86 | R483 337 589,75 |
| 5 | Annual Fixed Cost | R385 908 609,23 | R473 704 435,00 |

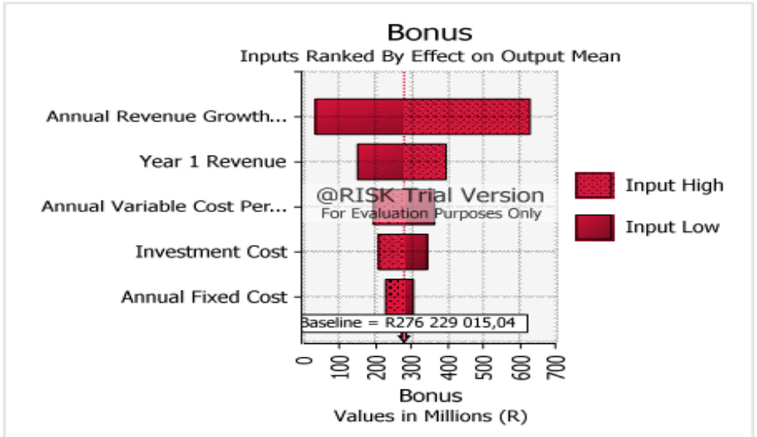
Table 21 - Proposal 1 (Hybrid + Block): Bonus simulated results for 5000 iterations

# @RISK Output Report for Bonus C27

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:43:51




| Simulation Summary Information | |
|---|---|
| **Workbook Name** | Fihlani TN - 9706501F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| **Number of Simulations** | 1 |
| **Number of Iterations** | 5000 |
| **Number of Inputs** | 25 |
| **Number of Outputs** | 10 |
| **Sampling Type** | Latin Hypercube |
| **Simulation Start Time** | 2017/09/06 10:09 |
| **Simulation Stop Time** | 2017/09/06 10:09 |
| **Simulation Duration** | 00:00:27 |
| **Random # Generator** | Mersenne Twister |
| **Random Seed** | 1545759779 |
| **Total Errors** | 0 |
| **Collect Distribution Samples** | All |
| **Convergence Testing** | Disabled |
| **Smart Sensitivity Analysis** | Enabled |

| Summary Statistics for Bonus | | | |
|---|---|---|---|
| **Statistics** | | **Percentile** | |
| **Minimum** | R0,00 | **1,0%** | R0,00 |
| **Maximum** | R1 179 678 506,96 | **2,5%** | R0,00 |
| **Mean** | R276 229 015,04 | **5,0%** | R0,00 |
| **Std Dev** | R200 903 770,58 | **10,0%** | R13 507 961,72 |
| **Variance** | 4,03623E+16 | **20,0%** | R89 886 316,74 |
| **Skewness** | 0,69266663 | **25,0%** | R118 129 662,96 |
| **Kurtosis** | 3,294855065 | **50,0%** | R254 031 544,56 |
| **Median** | R254 031 544,56 | **75,0%** | R403 444 854,55 |
| **Mode** | R0,00 | **80,0%** | R442 521 850,87 |
| **Left X** | R0,00 | **90,0%** | R547 687 120,69 |
| **Left P** | 5% | **95,0%** | R647 066 288,70 |
| **Right X** | R647 066 288,70 | **97,5%** | R721 908 721,39 |
| **Right P** | 95% | **99,0%** | R829 085 934,93 |
| **#Errors** | 0 | | |

| Change in Output Statistic for Bonus | | | |
|---|---|---|---|
| **Rank** | **Name** | **Lower** | **Upper** |
| 1 | Annual Revenue Growth Rate | R32 604 533,20 | R626 433 134,19 |
| 2 | Year 1 Revenue | R148 384 018,74 | R397 852 806,80 |
| 3 | Annual Variable Cost Percentage | R191 487 134,69 | R365 460 528,95 |
| 4 | Investment Cost | R205 027 823,37 | R341 041 096,38 |
| 5 | Annual Fixed Cost | R226 997 967,97 | R302 806 191,41 |

## 4.4 Results pertaining to Proposition 2

**Table 22 - Proposal 2 (Total Prefabricated Walls): Investment Inputs and Outputs**

Total Pre-Fabricated Walls - Proposal 2

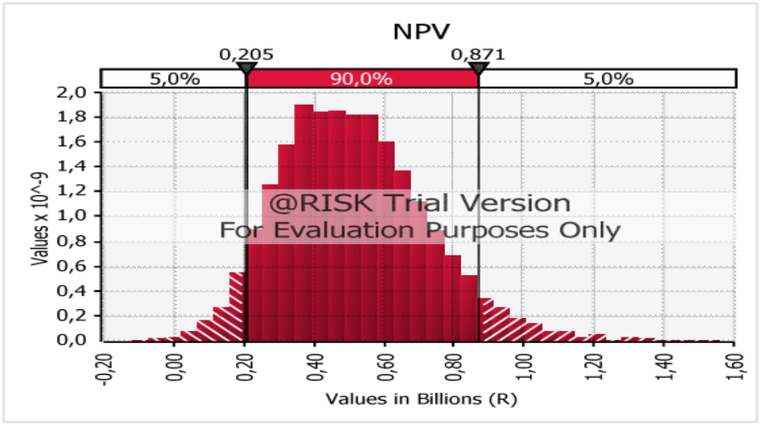
| **Known Inputs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount Rate | 12,00% | | | | | | | | | | | |
| Bonus Limit | R120 000 000,00 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | **Parameters of Distribution** | | | | | | | | |
| **Uncertain Inputs** | | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 | | | | | | |
| Investment Cost | R200 000 000,00 | | Triangular | R160 000 000,00 | R200 000 000,00 | R360 000 000,00 | | | | | | |
| Year 1 Revenue | R400 000 000,00 | | Triangular | R320 000 000,00 | R400 000 000,00 | R440 000 000,00 | | | | | | |
| Annual Fixed Cost | R81 799 652,00 | | Triangular | R74 788 253,26 | R81 799 652,00 | R88 811 050,74 | | | | | | |
| Annual Revenue Growth Rate | 2,50% | | Normal | 2,50% | 4,00% | 0,00% | | | | | | |
| Annual Variable Cost Percentage | 50,00% | | Normal | 50,00% | 2,00% | 0,00% | | | | | | |
| | | | | | | | | | | | | |
| **Discounted Cash Flows Calculation** | | | | | | | | | | | | |
| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | |
| Investment Cost | -R200 000 000,00 | | | | | | | | | | | |
| Revenue | | R400 000 000,00 | R410 000 000,00 | R420 250 000,00 | R430 756 250,00 | R441 525 156,25 | R452 563 285,16 | R463 877 367,29 | R475 474 301,47 | R487 361 159,00 | R499 545 187,98 | |
| Fixed Cost | | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | R81 799 652,00 | |
| Variable Cost | | R200 000 000,00 | R205 000 000,00 | R210 125 000,00 | R215 378 125,00 | R220 762 578,13 | R226 281 642,58 | R231 938 683,64 | R237 737 150,73 | R243 680 579,50 | R249 772 593,99 | |
| Cash Flow | -R200 000 000,00 | R118 200 348,00 | R123 200 348,00 | R128 325 348,00 | R133 578 473,00 | R138 962 926,13 | R144 481 990,58 | R150 139 031,64 | R155 937 498,73 | R161 880 927,50 | R167 972 941,99 | |
| | | | | | | | | | | | | |
| Outputs | | | | | | | | | | | | |
| NPV | R575 386 430,33 | | | | | | | | | | | |
| Bonus | R455 386 430,33 | | | | | | | | | | | |

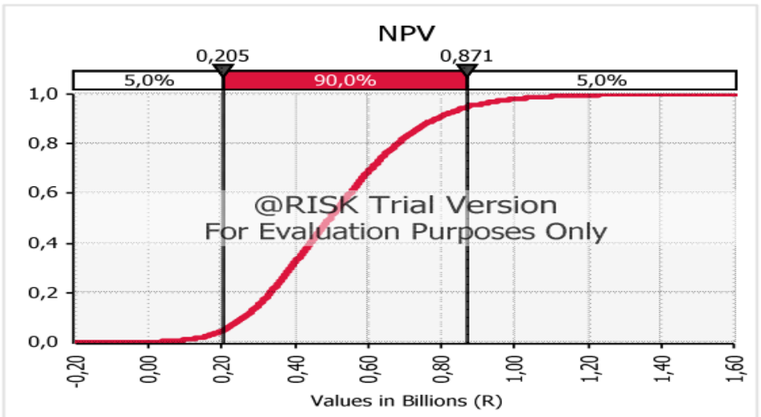
| | |
|---|---|
| **Number of units per year** | 200 |
| **Fixed Cost per unit** | R408 998,26 |
| **Annual Fixed Cost** | R81 799 652,00 |

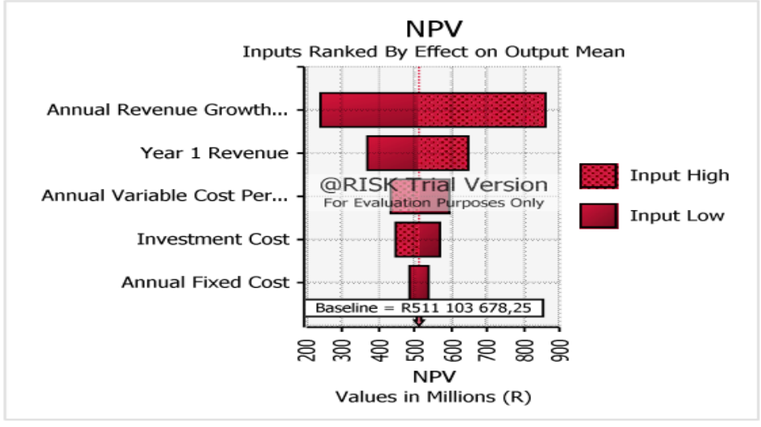
Table 23 - Proposal 2 (Total Prefabricated Walls): NPV simulated results for 5000 iterations

# @RISK Output Report for NPV C26

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:42:58




| Simulation Summary Information | |
|---|---|
| **Workbook Name** | Fihlani TN - 9706501F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| **Number of Simulations** | 1 |
| **Number of Iterations** | 5000 |
| **Number of Inputs** | 25 |
| **Number of Outputs** | 10 |
| **Sampling Type** | Latin Hypercube |
| **Simulation Start Time** | 2017/09/06 10:09 |
| **Simulation Stop Time** | 2017/09/06 10:09 |
| **Simulation Duration** | 00:00:27 |
| **Random # Generator** | Mersenne Twister |
| **Random Seed** | 1545759779 |
| **Total Errors** | 0 |
| **Collect Distribution Samples** | All |
| **Convergence Testing** | Disabled |
| **Smart Sensitivity Analysis** | Enabled |

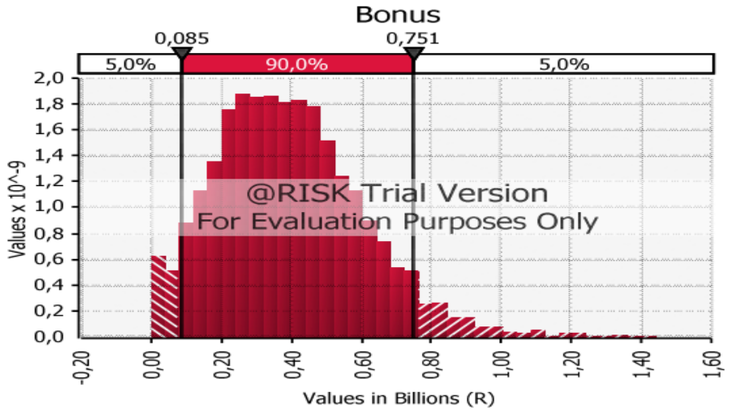
| Summary Statistics for NPV | | | |
|---|---|---|---|
| **Statistics** | | **Percentile** | |
| **Minimum** | -R120 342 451,74 | **1,0%** | R95 626 833,82 |
| **Maximum** | R1 562 316 916,45 | **2,5%** | R159 846 221,08 |
| **Mean** | R511 103 678,25 | **5,0%** | R204 947 449,48 |
| **Std Dev** | R208 830 422,74 | **10,0%** | R259 303 101,65 |
| **Variance** | 4,36101E+16 | **20,0%** | R333 298 026,18 |
| **Skewness** | 0,543232172 | **25,0%** | R360 100 975,14 |
| **Kurtosis** | 3,593987092 | **50,0%** | R495 176 246,13 |
| **Median** | R495 176 246,13 | **75,0%** | R640 106 138,02 |
| **Mode** | R448 425 086,60 | **80,0%** | R678 929 517,95 |
| **Left X** | R204 947 449,48 | **90,0%** | R785 379 961,48 |
| **Left P** | 5% | **95,0%** | R871 243 097,89 |
| **Right X** | R871 243 097,89 | **97,5%** | R963 671 801,34 |
| **Right P** | 95% | **99,0%** | R1 087 368 763,80 |
| **#Errors** | 0 | | |

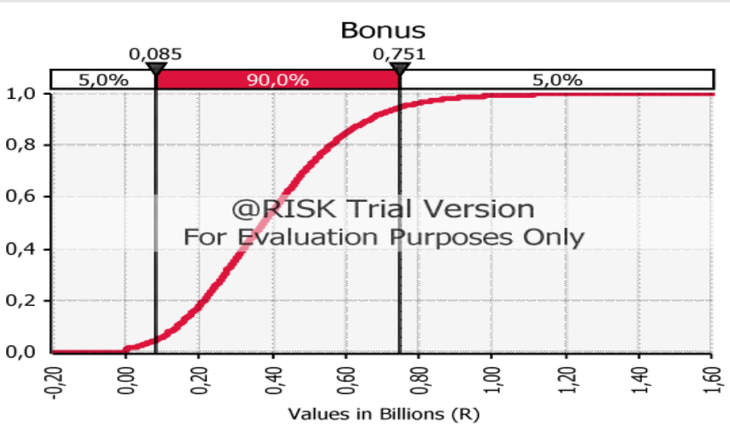
| Change in Output Statistic for NPV | | | |
|---|---|---|---|
| **Rank** | **Name** | **Lower** | **Upper** |
| 1 | Annual Revenue Growth Rate | R237 745 776,38 | R862 228 159,65 |
| 2 | Year 1 Revenue | R369 078 206,18 | R647 247 108,03 |
| 3 | Annual Variable Cost Percentage | R430 392 628,36 | R594 301 268,95 |
| 4 | Investment Cost | R448 858 013,36 | R569 145 040,10 |
| 5 | Annual Fixed Cost | R488 127 475,89 | R537 912 788,07 |

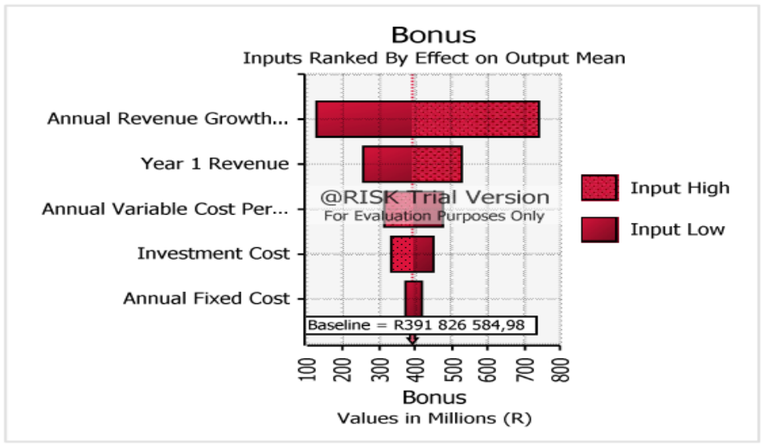
Table 24 - Proposal 2 (Total Prefabricated Walls): Bonus simulated results for 5000 iterations

# @RISK Output Report for Bonus C27

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:43:09




| Simulation Summary Information | |
|---|---|
| **Workbook Name** | Fihlani TN - 9706501F - WBS MBA PTSAT 2016_17 - ARP BUSA - Business Venture Proposal.xlsx |
| **Number of Simulations** | 1 |
| **Number of Iterations** | 5000 |
| **Number of Inputs** | 25 |
| **Number of Outputs** | 10 |
| **Sampling Type** | Latin Hypercube |
| **Simulation Start Time** | 2017/09/06 10:09 |
| **Simulation Stop Time** | 2017/09/06 10:09 |
| **Simulation Duration** | 00:00:27 |
| **Random # Generator** | Mersenne Twister |
| **Random Seed** | 1545759779 |
| **Total Errors** | 0 |
| **Collect Distribution Samples** | All |
| **Convergence Testing** | Disabled |
| **Smart Sensitivity Analysis** | Enabled |

| Summary Statistics for Bonus | | | |
|---|---|---|---|
| **Statistics** | | **Percentile** | |
| **Minimum** | R0,00 | **1,0%** | R0,00 |
| **Maximum** | R1 442 316 916,45 | **2,5%** | R39 846 221,08 |
| **Mean** | R391 826 584,98 | **5,0%** | R84 947 449,48 |
| **Std Dev** | R207 309 133,66 | **10,0%** | R139 303 101,65 |
| **Variance** | 4,29771E+16 | **20,0%** | R213 298 026,18 |
| **Skewness** | 0,591880163 | **25,0%** | R240 100 975,14 |
| **Kurtosis** | 3,557018598 | **50,0%** | R375 176 246,13 |
| **Median** | R375 176 246,13 | **75,0%** | R520 106 138,02 |
| **Mode** | R0,00 | **80,0%** | R558 929 517,95 |
| **Left X** | R84 947 449,48 | **90,0%** | R665 379 961,48 |
| **Left P** | 5% | **95,0%** | R751 243 097,89 |
| **Right X** | R751 243 097,89 | **97,5%** | R843 671 801,34 |
| **Right P** | 95% | **99,0%** | R967 368 763,80 |
| **#Errors** | 0 | | |

| Change in Output Statistic for Bonus | | | |
|---|---|---|---|
| **Rank** | **Name** | **Lower** | **Upper** |
| 1 | Annual Revenue Growth Rate | R124 560 409,32 | R742 228 159,65 |
| 2 | Year 1 Revenue | R252 800 453,41 | R527 300 661,47 |
| 3 | Annual Variable Cost Percentage | R312 061 394,73 | R474 473 875,25 |
| 4 | Investment Cost | R331 215 975,37 | R449 178 016,66 |
| 5 | Annual Fixed Cost | R369 039 667,97 | R418 218 250,96 |

# 5 BUSINESS CASE

## 5.1 Introduction

### 5.1.1 Purpose of this Document

The purpose of this document is to pull together the researched literature, proposed design and simulated implementation results, to show that a viable business opportunity exists, in a previously and currently underserved market within the population of South Africa. It describes an overview of the design, the proposed product/service, the current position of the industry, the future process as proposed, the expected risks, the expected benefits, change analysis, the proposed system, action plan, management approach, discusses results of the simulations, cost estimates, and the cost/benefit analysis.

### 5.1.2 Objectives

The objective of this document is to provide compelling evidence in support of the business need for a company that produces affordable low-middle income residential housing developments, constructed using alternative recyclable and/or green buildings, and minimal impact materials in both hybrid and total fabrication models in South Africa. The second objective is to show that there is opportunity to make profits and operate sustainable business that will create value for shareholders, employment for skilled youth and high-quality product for the consumer.

## 5.2 Design Overview

### 5.2.1 Background Information

In coming up with this design, practical experience and observation of modular design implementation, the advantages of its cost, time and ease of implementation within the commercial construction space, were of critical consideration. These were then incorporated into the process required to

implement a similar streamlined design adopted for residential property construction using the Poly-Smart wall from Shanghai based ploy Solar, in SA.

### 5.2.2 System Evolution Description

The design sees changes and standardisation in the wall panels to enable modular construction, easy repairs or replacements to damaged units and sections of the house, and low redesign or changes post production for the owner, with less dependence or requirements for specialist professionals required in initial production phase. The recycled materials are easy to handle and implement (it takes two people 30 minutes to fully assemble a standard dividing wall) and are ready to receive wall finishes on assembly. The walls are flexible (will not develop cracks), structurally sound, thermal and sound insulated, are 2-hour fire rated and have electrical and plumbing first fixes imbedded during manufacture.

### 5.2.3 Current Process

The construction industry has conventionally been focused on the use of rigid concrete-based structures that are inflexible and brittle, are prone to cracking walls, are natural resource (e.g., water, steel, cement) and labour intensive, and highly susceptible to climate conditions during construction. The current process has high escalating operational costs and slow production turnaround times, averaging 6 weeks per unit.

### 5.2.4 Proposed Process

The proposed process will produce both hybrid productions, combining conventional brick and mortar (external wall envelope) with prefabricated Poly-Smart (recycled material based) internal walls, and total adaptation with prefabricated walls, to build residential buildings. The process uses significantly reduced natural resources, improved resources and project management principles based on J-I-T method for construction, and standard size modular wall panels for faster assembly. The process also reduces operational and production costs, improves quality of the product, and increases the turnaround time per unit, with an anticipated average of 1.5 weeks per unit and with minimal dependency on climate conditions in construction phase.

## 5.3 Current Position

### 5.3.1 Current process and Services

The conventional building process involves numerous parallel processes and services that combine their trades to form the final product and most of these precede others which may not start until the preceding process is completed. The simplest example is that of electrical and plumbing first fixes, which may not start until the masonry is either complete or near completion. The other progress dependent services are wall finishes, which may not proceed until all other preceding processes including related curing times are completed, such as masonry; reticulation; plastering. The entire house is not just built one wall at a time, but also one brick per wall, a time, labour and resource consuming process.

### 5.3.2 Current Technology Environment

There is not much technology innovation in the conventional building environment, mainly because the processes have been in use for hundreds of years with little differentiation in the art of masonry and raw material used. The bulk of technology innovation is in the industrial sourcing and manufacturing of the end-user raw materials, such as mining and producing cement and producing bricks and cinder blocks. Technological improvements and innovation mainly present themselves in finishing/cosmetic products such as ceramic tiles, cabinets and electrical fittings.

### 5.3.3 Current Raw Materials

Raw materials at the core of the current process are lime, stone/rock, cement, water, sand, steel, fuel (coal, wood, gas), fibre cement, ceramic and heat.

### 5.3.4 Current Manufacturing Process

The manufacturing process is a well-developed and industrialised process with decades of proven success and experience. It consumes massive natural resources and produces millions of tons in waste generation globally. The manufacturing process also faces dire shortages and rapid depletion of critical

natural resources and increasing operational costs, which render it unsustainable going forward.

## 5.4 Future Process

### 5.4.1 Process Description

The future process is based on recyclable, minimal impact, fast implementation, low cost, sustainable and environmentally friendly technologies and products. The process requires different skills and training, is safe for both supplier and consumer, uses minimal natural resource relying on reuse of abundant waste products. The process can be safely implemented in areas that would not have been viable, safe or possible to implement with current methodologies.

### 5.4.2 Performance Measures

Performance to be measured include stress test and structural integrity test on the prefabricated walls. This aims to determine breaking point and deformation characteristics of the wall panels, compared to a conventional brick wall and current informal settlement structures. Tests will also be performed on water absorption (e.g., rainwater) and water proofing, sound attenuation and thermal insulation of the final product to protect the inhabitants against sound pollution, heat loss and build-up.

### 5.4.3 Customer Demographics

The target market and customer are in the low-to-middle income private or Bank funded, state subsidised and partially Bank funded, and fully state provided (previously RDP recipient) ranges. These will expectedly be in the majority, previously disadvantaged, sector of the country’s populations of Black, Coloured, Indian and Asian population groups. The majority of these will also be in urban and presently informal settlements.

## 5.5 Expected Risk

The Poly-Smart wall panels will initially be fully imported from China, until local production is patented (with partnership from Chines manufacturer) and a manufacturing plant commissioned. The inherent and expected risk in importing the product is the volatility of the Rand exchange rate compared to the Dollar and Chinese Yuan, the import tariffs and shipping times. The skills required to implement this alternative building solution are vastly different from those in conventional construction labour, currently in need of employment in the SA residential construction market. There will be required re-skilling of potential labour at FET or artisan training centres. This will exclude a lot of the older less educated labour which will increase the risk of opposition from current unions.

## 5.6 Expected Benefits

The expected benefits are; improved project management and resource management practices; improved product development and production rate; improved product quality and affordability; efficient use of minimal impact recyclable and modular alternative materials; and positive NPV with good return on investments and high profit margins. Providing a highly sort after and constitutionally enshrined and required need for shelter to underserved population. The most important benefits however, are in the reduced dependence or dwindling natural resources, improved industrial waste management and recycling efforts, and improved technology adoption and labour skills development for the next ‘fourth industrial revolution’.

## 5.7 Change Analysis

Changes are envisaged in skills acquisition for labour and manufacturing. Changes in design and construction products methods, resource management and distribution. The design must consider the modular shape and installation/assembly of the core components in the structure of the final product and how to effectively manage each project efficiently.

## 5.8 Proposed System

### 5.8.1 Background, Objectives and Scope

The proposed system is currently being implemented on a national scale in China, who in turn are also exporting their knowledge, skills and product in Central African countries such as Ethiopia, Rwanda and Somalia. It has been proven to work efficiently and rate of adoption is predicted to continuously rise over the next decade. The objectives of implementing this system in South Africa are to provide alternative methods to residential property construction; evolve the labour skills in the construction industry to align with the fourth industrial revolution.

The scope of this proposed project is to create jobs/employment opportunities for young technically skilled graduates; implement improved project and resource management; streamline and mainstream the use of green building or alternative material use in construction; and produce high quality affordable and functional low-to-middle income houses for the massive underserved population, living in informal shelter out of the main economy.

### 5.8.2 Description of the New System

The new system is modular, minimal impact, green built, alternative recyclable materials-based implementation in residential building construction.

## 5.9 Action Plan

### 5.9.1 Implications for Newly Skilled Labour Involvement

The proposed initial adoption of the design does not entirely rid the construction methods that are used in conventional building processes. The two proposed solutions, Hybrid method and Total fabrication method, will still need a solid brick and concrete foundation. The newly skilled labour will therefore require some knowledge and skill in masonry combined with the new skills in prefabricated modular building methods.

This however will reduce, and over time remove the need for old/current labour who only specialise in the masonry trade. The newly skilled labour will increase the labour rates per hour whilst reducing the cumulative time taken, and number of people needed to produce a single unit. This will reduce the production cost including resources and project management costs.

### 5.9.2 Enhancement Practices

There are inherent enhancement practices in skills acquisitions and use; enhancements in project management; enhanced resource management; and enhancements in the end-to-end production process from design to implementation.

### 5.9.3 Evidence of Success

The Monte Carlo simulation results presented below, show the viability of this proposed business and the expected revenue over an initial ten-year forecast. The initial cost to produce a working prototype present a financial limitation and investment requirement that could not be completed at this stage.

## 5.10 Management Approach

### 5.12.1 Priorities

Management priorities include:

1) Raising/acquiring the capital and investment required
2) Getting final building council approval of the proposed standard modular design
3) Skills acquisition and training for labour, in partnership with training centres, that is, Further Education and Training (FET) centres
4) Acquiring sole local supplier license of Poly-Smart walls with manufacturer, Poly Solar
5) Registering the company and getting ready to trade
6) Setting up accounts and relationships with suppliers
7) Producing demonstration/prototype units and engaging target customers

### 5.12.2 Schedule

| **January - March 2018** | **April – June 2018** | **July – September 2018** |
|---|---|---|
| Raise Initial Capital, from shareholders and prospective partners | Register Company, Banking accounts, Tax clearance, import documentation | Acquire talent and labour, for administrative business functions and production respectively |
| Approach Investors & acquire investment funding for the business | Acquire supplier license, Poly Solar's only approved supplier in SA | Skills training and acquisitions for labour force, at partner training |
| Get Approval of Design, from national, provincial and municipal authorities | Open accounts with supplier, initiate relations with partner training centres (FET) | Build first demo units to showcase proof of concept and engage customers. Start large scale production |

### 5.14.1 Discussion pertaining to Proposition 1 Description

The results are a summary, statistic and change in output statistics for the NPV and Bonus of a business producing hybrid-built units, based on brick walls, looking over a 10-year cashflow forecast.

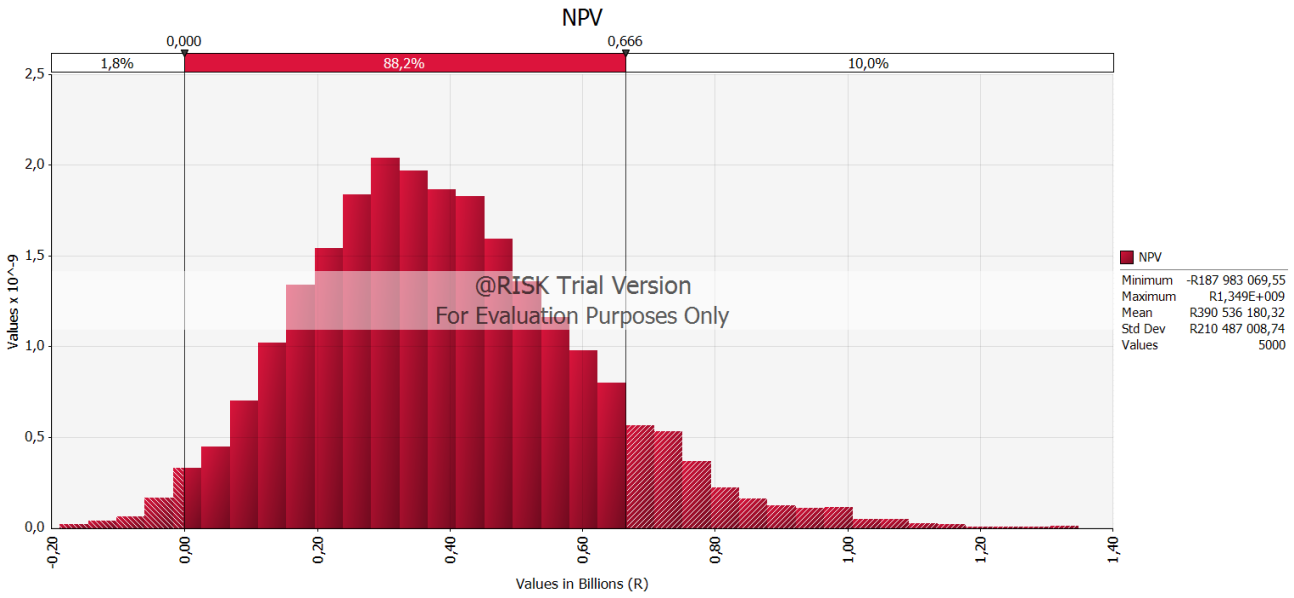
#### 5.14.2 Assessment

The assessment looks at the performance in outputs of the organisation, looking at possible maximums and minimums in NPV and Bonus for the 25 different inputs over 5000 possible random iterations with the Latin Hypercube sampling type.

#### 5.14.3 Results

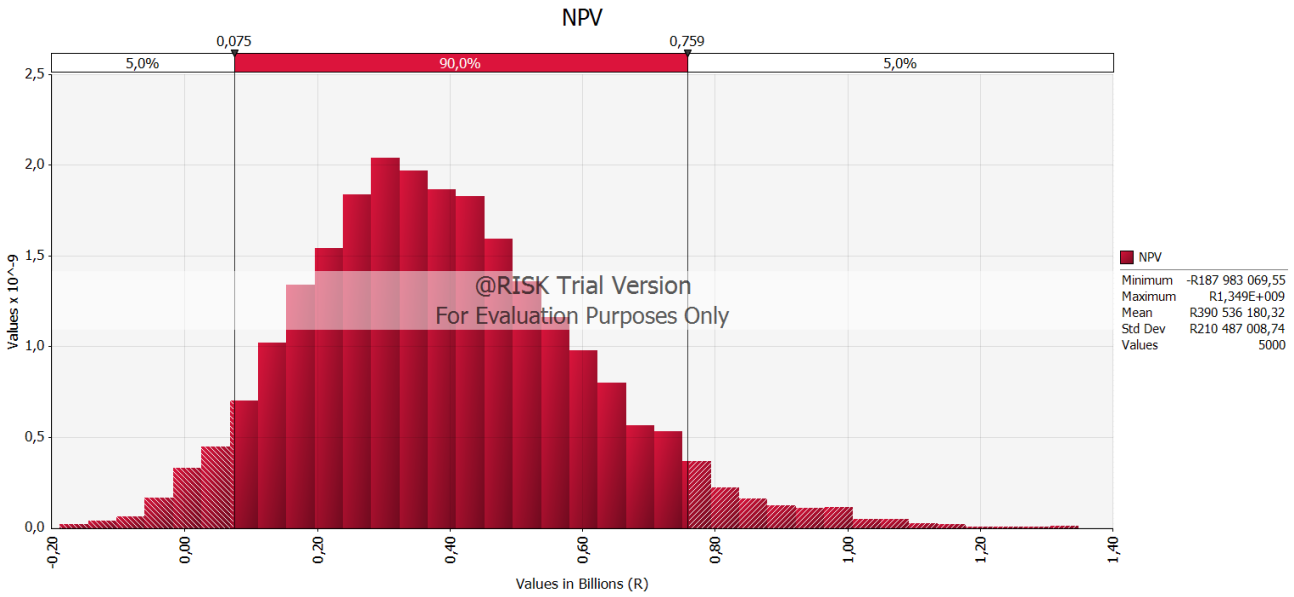
1. Proposal 1 (Brick and Poly-Smart Wall Panels)

**Figure 16 - Proposal 1_Brick – NPV: Graph 1**



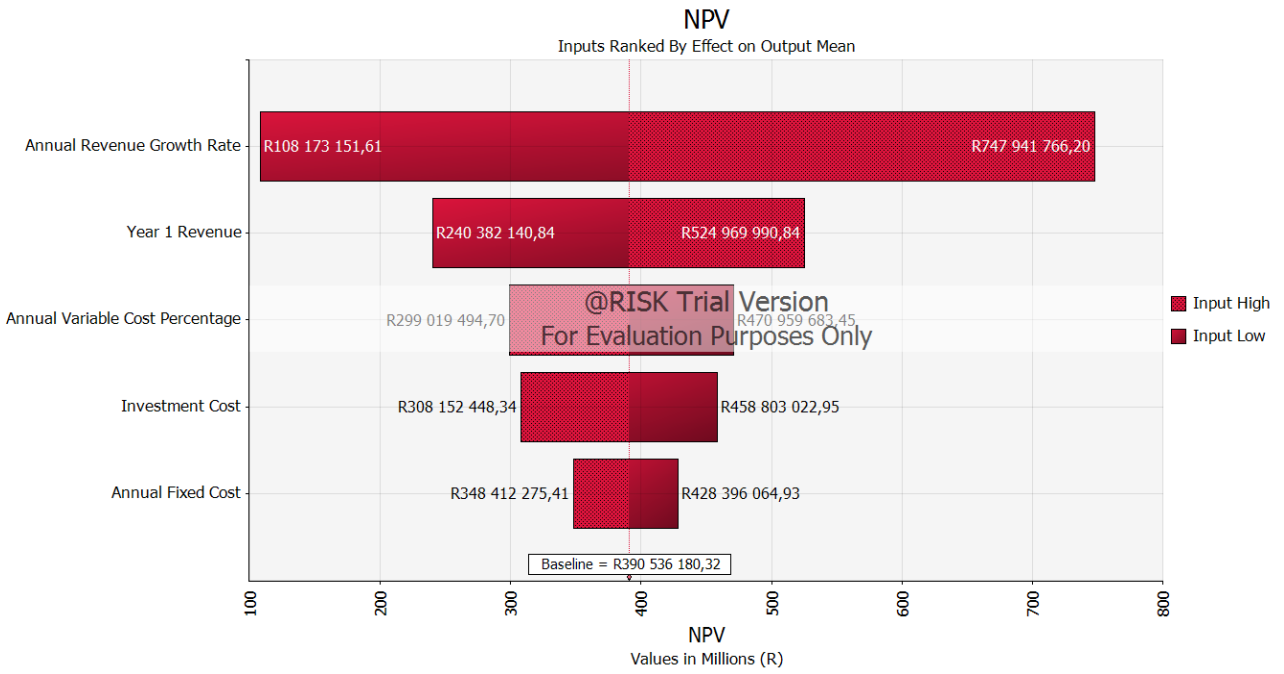

The graph 1 (above) shows that the probability of a zero NPV are 1.8% whilst the ninety percentile is over half a billion Rands, at R 666 million, with only a 10% chance for NPV greater than this value.

**Figure 17 - Proposal 1_Brick - NPV: Graph 2**




The second graph (above) show a more realistic and favourable business opportunity of 90% probability of a positive NPV at both minimum (R 75 million) and maximum (R 759 million) for this business venture.

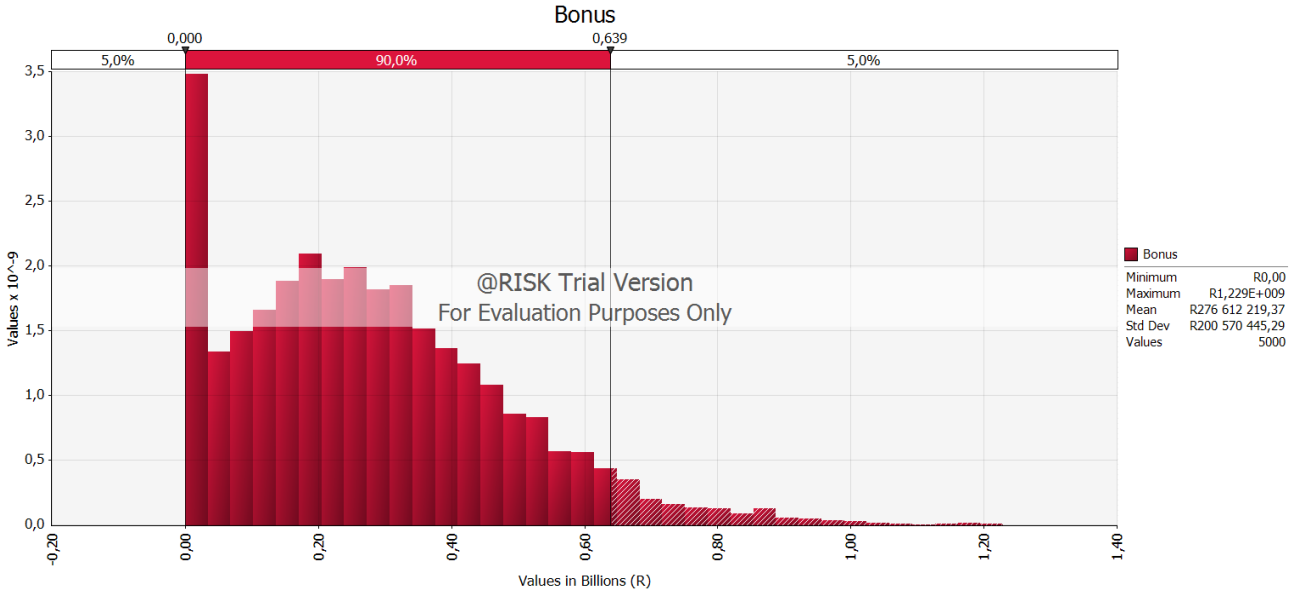
**Figure 18 - Proposal 1_Brick - NPV: Graph 3**




The third graph (above) shows that the annual revenue growth rate has the largest effect on the NVP, compared to the other four inputs, which affects how

much the NPV mean output changes, as this input varies over its range. As the annual revenue growth rate varies over its range and the other inputs remain at their static values, the mean NPV varies from about R106 million to about R 748 million.

**Figure 19 - Proposal 1_Brick - Bonus: Graph 4**




The Bonus graph 4 (above) shows that there is a large probability the bonus could be zero, but positive bonuses are possible, and some are very large, with the highest probable bonus valued at R 639 million. For more detailed view of the results, refer to Table 16 (p63), Table 17 (p64) and Table 18 (p65).

## 2. Proposal 2 (Cinder Blocks and Poly-Smart Wall Panels)

The graph 5 (below) show that the probability of a zero NPV is 0.8% whilst the ninety-fifth percentile is over half a billion Rands, at R 703 million, with only a 10% chance for NPV greater this value, which is the best of the proposed hybrid methods. As we move closer to the ninety-ninth percentile range the NPV nears a billion Rands, at R 980 million.

**Figure 20 - Proposal 1_Block – NPV: Graph 5**

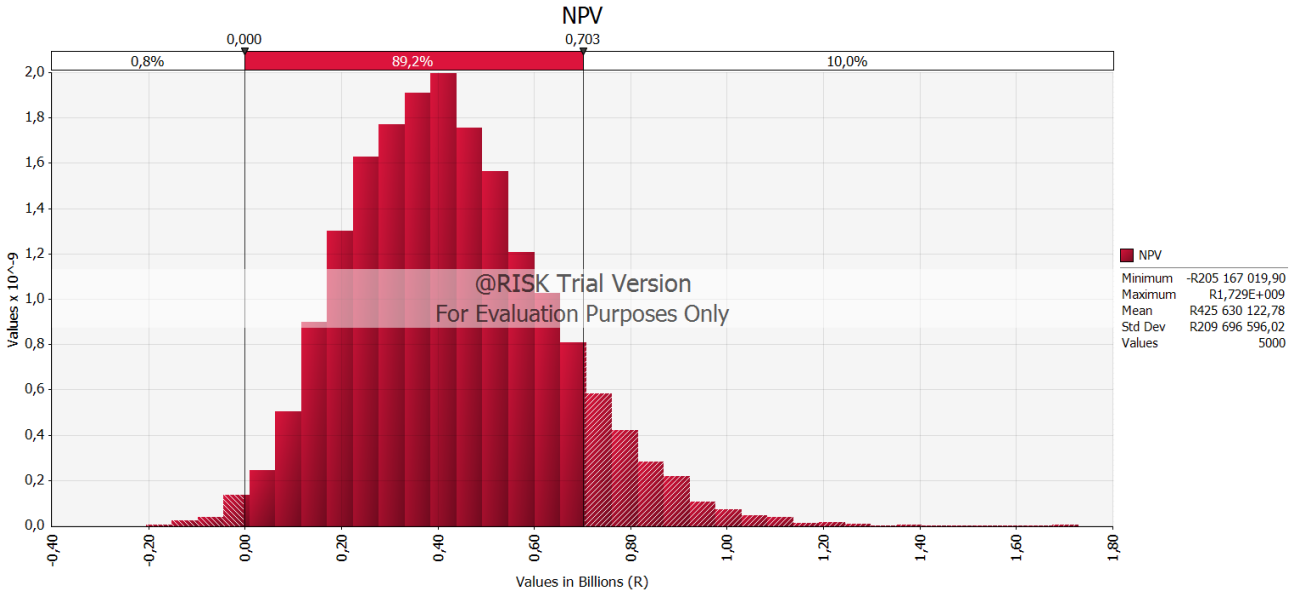
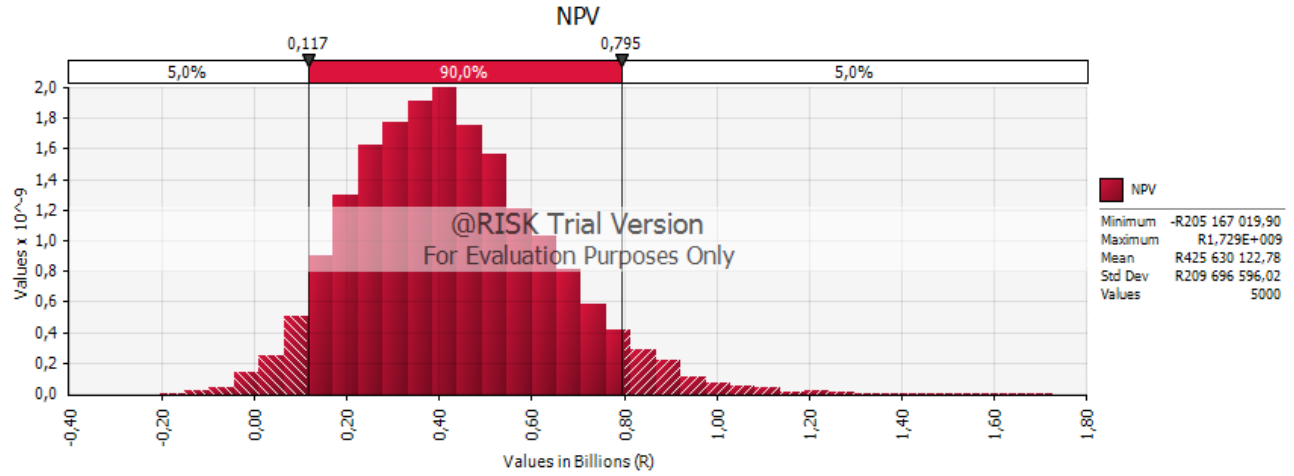



**Figure 21 - Proposal 1_Block – NPV: Graph 6**




Graph 6 (above) shows a more realistic and favourable business opportunity of 90% probability of a positive NPV at both minimum (R 117 million) and maximum (R 795 million) for this business venture, implementing the second hybrid method with cinder blocks.

Graph 7 (below), shows that the annual revenue growth rate has the largest effect on the NVP, compared to the other four inputs, which affects how much the NPV mean output changes as this input varies over its range. As the annual revenue growth rate varies over its range and the other inputs remain at their static values, the mean NPV varies from about R142 million to about R 775 million.

**Figure 22 - Proposal 1_Block – NPV: Graph 7**

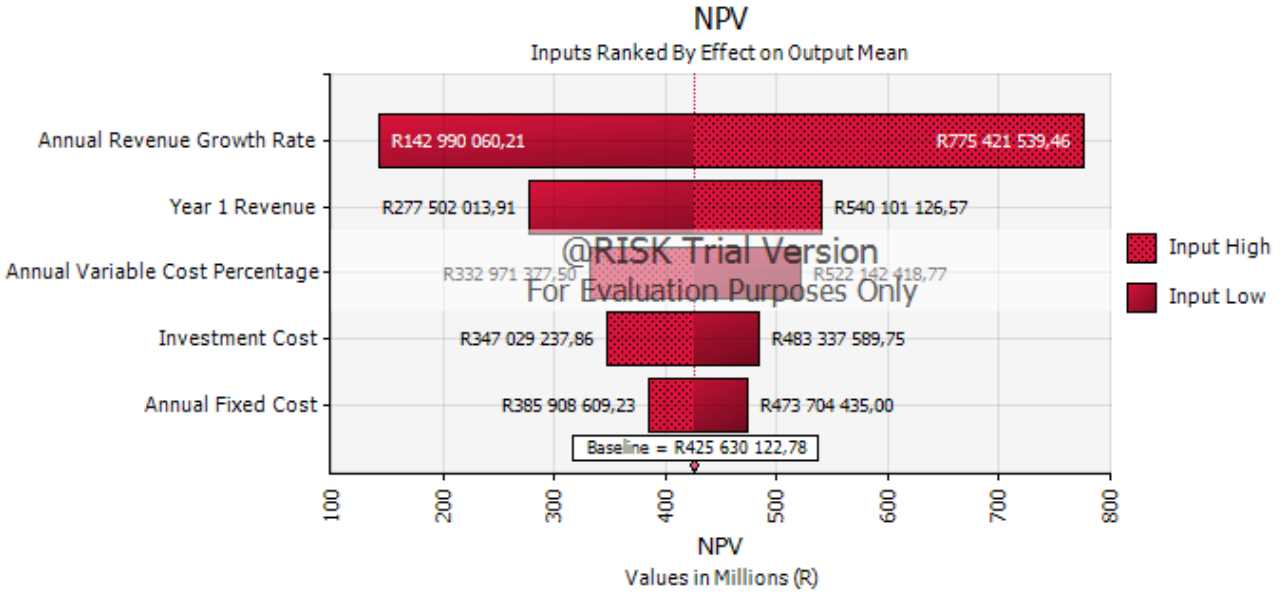
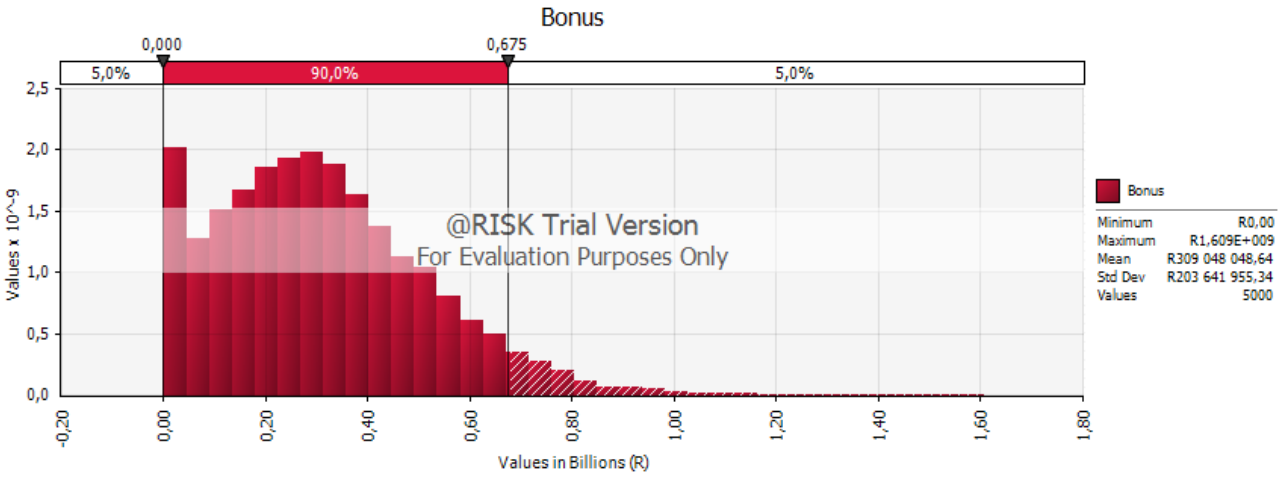



**Figure 23 - Proposal 1_Block – Bonus: Graph 8**




The Bonus graph (above) shows that there is an average probability that the bonus could be zero, but positive bonuses are possible, and some are very large, with the highest probable bonus valued at R 675 million. For more detailed view of the results, refer to Table 19 (p66), Table 20 (p67) and Table 21 (p68).

## 5.15 Discussion pertaining to Proposition 2

### 5.15.1 Description

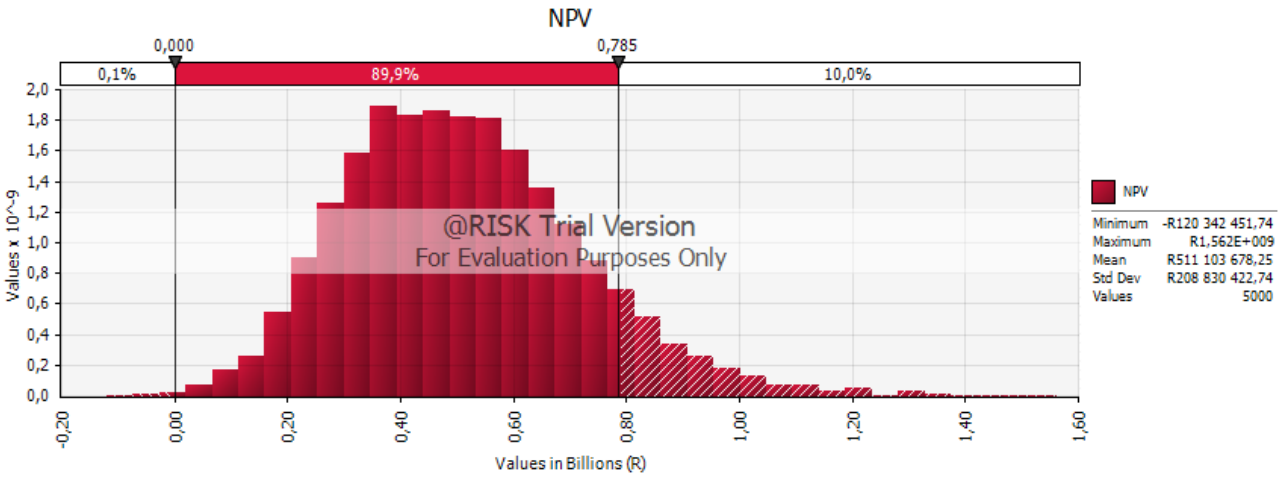
The results are a summary statistic and change in output statistics for the NPV and Bonus for a business producing hybrid method, based on brick walls, looking over a 10-year cashflow forecast.

### 5.15.2 Assessment

The assessment looks at the performance in outputs of the organisation, looking the possible maximums and minimums in NPV and Bonus for the 25 different inputs over 5000 possible random iterations, using the Latin Hypercube sampling type.

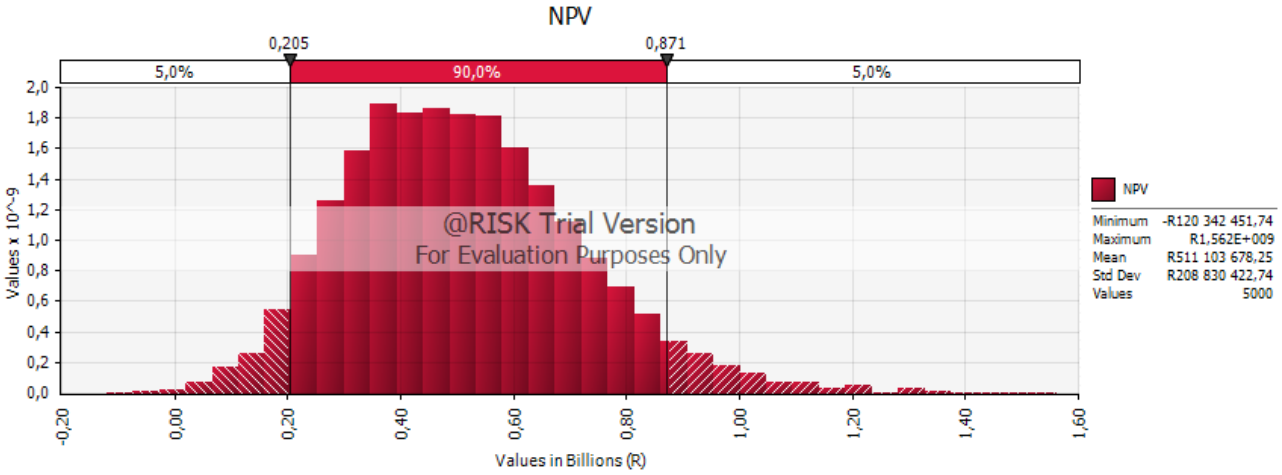
### 5.15.3 Results

**Figure 24 - Proposal 2 – NPV: Graph 9**




Graph 9 (above) shows that the probability of a zero NPV are 0.1% whilst the ninetieth percentile is over half a billion Rands, at R 785 million, with only a 10% chance for NPV greater than this value which is the best of the proposed methods. As we move closer to the ninety-ninth percentile range the NPV is above a billion Rands, at R 1087 million, but there is also a 1% chance of this happening like the hybrid proposals. This NPV probability range is the best of all the proposals and is the most recommended proposal, that will yield the best returns on investments.

**Figure 25 - Proposal 2 – NPV: Graph 10**




The second graph show a more realistic and favourable business opportunity of 90% probability of a positive NPV at both minimum (R 205 million) and maximum (R 871 million) for this business venture, implementing the total prefabricated Poly-Smart wall panel method. This method will however need to pass stringent and rigorous safety and structural integrity standards tests to exceed/meet SABS and NBR requirements, combined with marketing campaigns to win over consumers of alternative material products.

Graph 11 (below), also shows that, for total adaptation of prefabs, the annual revenue growth rate has the largest effect on the NVP, compared to the other four inputs, which also affects how much the NPV mean changes as the annual revenue growth rate input varies over its range. As the ARG rate varies over its range and the other inputs remain at their static values, the mean NPV varies from about R 238 million to about R 862 million, the best of all the possible construction methods.

**Figure 26 - Proposal 2 – NPV: Graph 11**

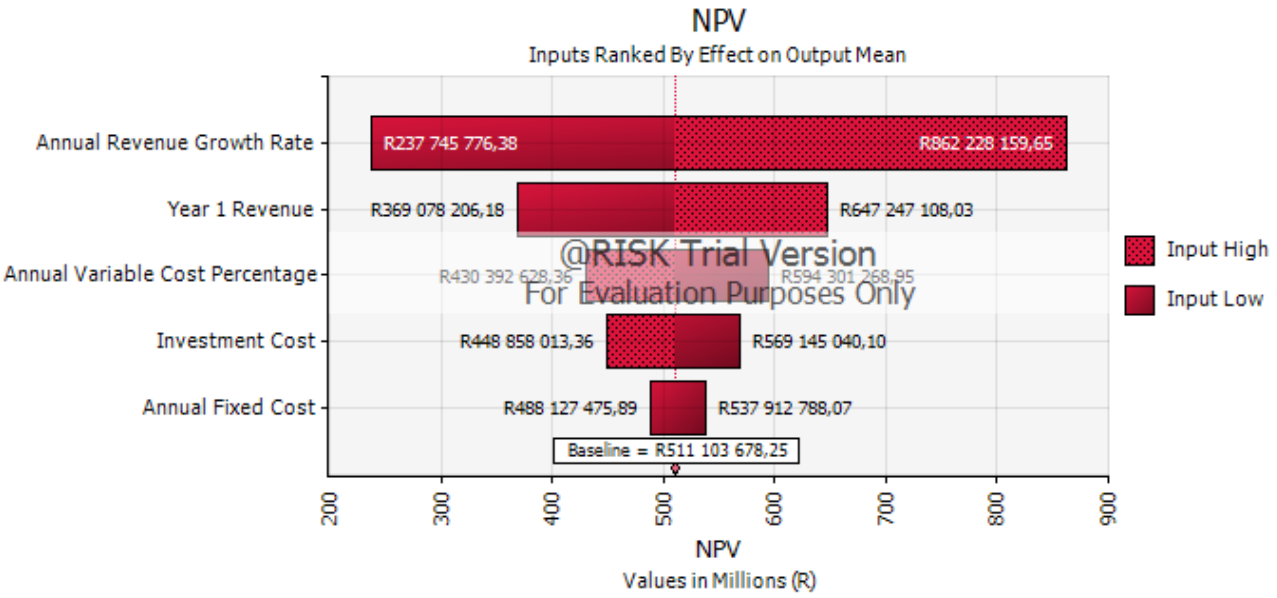
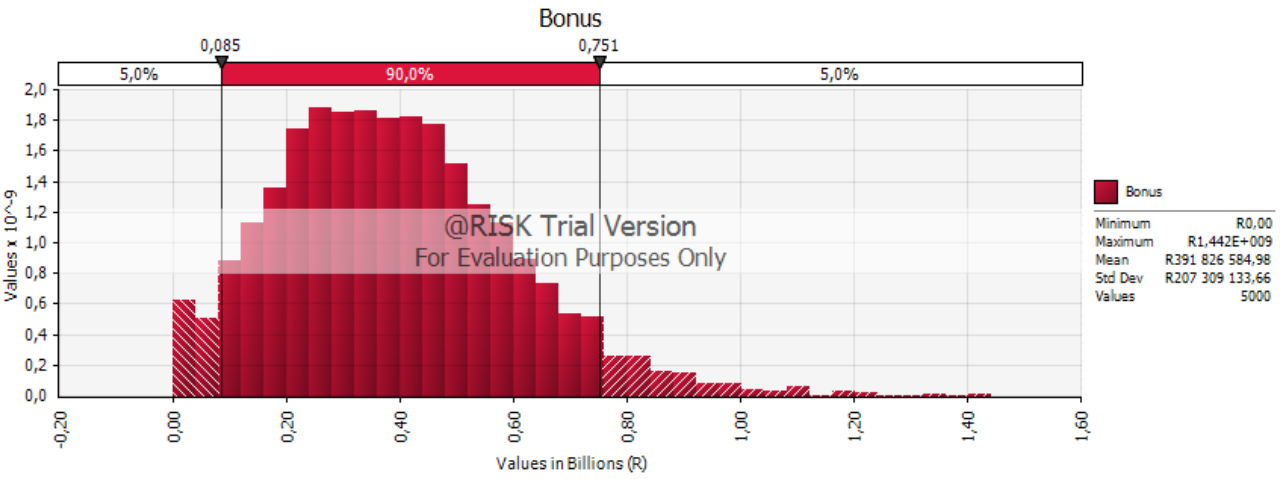



**Figure 27 - Proposal 2 – Bonus: Graph 12**




The Bonus graph 4 (above) shows that there is no probability that the bonus could be zero, and that positive bonuses will be achieved, some very large and at a high average, with the highest probable bonus valued at R 751 million in the ninetieth percentile. The bonus approaches a billion Rands at the ninety-nine-percentile range. For more detailed view of the results, refer to Table 22 (p69), Table 23 (p70) and Table 24 (p71).

## 5.16 Cost Estimate

The best and closest to real estimated costs per unit are:

1. R 408 998.26 including VAT for the best recommended Proposal 2, a total adaption of prefabricated panels. Refer to Table 8 (p38). This equates to construction cost of R 3 513.89 per $m^2$ and electrical cost of R 38.30 per $m^2$.
2. R 484 704.52 including VAT, for the 2nd best recommended Proposal 1_Block, a hybrid method combining a conventional cinder block external wall envelope with prefabricated internal dividing walls. Refer to Table7 (p37). This equates to construction cost of R 4 171.40 per $m^2$ and electrical cost of R 38.30 per $m^2$.

## 5.17 Cost/Benefit Analysis

| **Construction Method adopted** | **Unit Construction Cost per square $m^2$** | **Unit Electrical Reticulation cost per $m^2$** | **Time needed to complete 1 unit** |
|---|---|---|---|
| Conventional – Brick Building | R 4 600.23 | R 38.30 | 8 weeks |
| Conventional Cinder Block Building | R 4 429.70 | R 38.30 | 6 weeks |
| Proposal 1 - Hybrid (Brick & Poly-Smart wall panels) Building | R 4 440.52 | R 38.30 | 3 weeks |

| | | | |
|---|---|---|---|
| Proposal 1 - Hybrid (Cinder Block & Poly-Smart wall panels) Building | R 4 171.40 | R 38.30 | 3 weeks |
| Proposal 2 – (Total Poly-Smart wall panels) Building | R 3 513.89 | R 38.30 | 2 weeks |

The implementation of both hybrid and total prefabricated alternative material use in residential building construction has both cost and time reduction benefits over and above improved project and resources management and enhanced skills development for the labour market.

## 5.18 SWOT Analysis

Any existing business must have a strategy in place to succeed, but this is even more important for a new venture, as assessing or identifying possible strength and weaknesses and their effect (Scholes, Regner, Johnson, Whittington, & Angwin, 2014) on the planned business and its environment will help identify and properly plan for opportunities and threats to the success or failure of the new venture. A SWOT analysis is a tried, tested and recommended tool to use in testing the strategic position and capabilities (Scholes et al., 2014)

| | **Opportunities** (external, positive) | **Threats** (external, negative) |
|---|---|---|
| | High rate of informal settlement<br><br>Increasing population & property needs i.e., 1st time buyers, state recipients<br><br>Decline building raw materials, e.g. water<br><br>Opportunity for long term alternative and cheaper building options to counter ever increasing, prohibitive conventional property cost<br><br>New manufacturing process using abundant and cheap resources, i.e. industrial waste | High entry costs (currency exchange)<br><br>Un-evolving building regulation<br><br>Stringent labour laws<br><br>Union control and power<br><br>National Building Regulation standards |
| **Strengths** (internal, positive)<br><br>Construction industry experience<br><br>Commercial development green build<br><br>Faster, safer and high-quality residential building<br><br>Use of recyclable materials and improved material handling<br><br>Application of J-I-T project management principles within better suited the modular construction model | **Strength-Opportunity strategies**<br><br>Leverage lowered cost and rapid development as a solution to Government backlog in delivering low-cost housing<br><br>Develop programmes in collaboration with FTEs to provide training and new skills development<br><br>Build and donate prototypes to alleviate suffering in disaster-stricken communities<br><br>Manufacture core resource (PolySmart wall) locally | **Strength-Threats strategies**<br><br>Mitigate fight back from outdated labour skills market<br><br>Attract newly skilled labour ahead of existing conventional developers to discourage changing strategy to adopt green building<br><br>File extensive lateral patents to guard against competitors duplicating product (design and implementations)<br><br>Encourage changes and amendments to regulation, in line with innovation |
| **Weakness** (internal, negative)<br><br>Limited residential construction development experience<br><br>No physical proof of concept/prototype<br><br>Raising sufficient capital to start business | **Weakness-Opportunity strategies**<br><br>Hands-on involvement in initial developments and construction within first year<br><br>Producing a scaled model using minimal financial resources and comparable material<br><br>Request raw material sponsor for demo model from preferred/partner supplier | **Weakness-Threats strategies**<br><br>Involve local communities, NGOs and unions during initial implementation phase<br><br>Give opportunities to and attract informal Stokvel's saving schemes to invest in this new potentially viable option<br><br>Establish an R&D and renovations lab to manufacture all critical resources locally |

# 6 CONCLUSIONS & RECOMMENDATIONS

## 6.1 Introduction

This chapter brings forward the conclusions drawn from the presented research and business case results, gives recommendations for all identified and potential stakeholders, and suggest future research on improved implantation of this product and potential opportunities for raw material suppliers.

## 6.2 Conclusions of the study

The conclusions from this research and business case confirm that alternative use of environmentally friendly, minimal impact and recyclable material have both an economical and environmental potential value. They have become a necessary solution as the earth is starting to reveal the catastrophic impacts of the waste generation and depletion of natural resources that were the backbone of the industrial revolution, on our natural environment. The use of green building materials is not new to the world nor is it difficult to implement in a developing economy like South Africa and Africa, to mainstream and revolutionise the age-old construction profession.

The results on the business case shows that a hybrid model would be suitable for the SA market with phased transition towards total prefabrication in time, as the consumer and suppliers eventually accept the technology. The is inherent advantage in lowered cost, skills development and rapid deployment that could be used to persuade government to adopt minimal impact materials as a viable solution to reducing the housing backlog. An innovative and easy to implement solution like that proposed in this research will go a long way in alleviating the housing backlog, affordability, high quality and accumulative value to property, while creating employment opportunities for a younger and highly skilled youth.

## 6.3 Recommendations

It is recommended that an industrial standard for the production or reproduction of recycled building materials from the by-products of industrial waste production in mining and power generation is produced and funding provided for potential entrepreneurs in this new industry. That the consumers are made aware of the advantages, environmental and personal health benefits in residential building constructions, the strengths and safe implementation, and the speed at which affordable high-quality services could be delivered to improve their lives and communities. It is also recommended that a new skills curriculum is developed, compiled and incorporated into basic skills training centres (artisans) and FET colleges around the country to produce a new generation of builders skilled in use of alternative green building materials. It is recommended that potential investors, private and state funding institutions, are thoroughly informed and convince of this proven business opportunity and its potential for improved service delivery, customer satisfaction and wealth generation, and the chance for them to put their money where it is needed the most, our fledgling economy.

## 6.4 Suggestions for further research

It is suggested that further research is conducted on the use of steel and timber or combination, foundations to replace the use of concrete foundations on totally prefabricated residential structures, to even lessen the impact of the building structure on delicate ecosystems and environments, so that we may heal or attempt to remedy the negative impacts on our planet. Research the impact of this change on our economy, including the steel and timber production industries.

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# APPENDIX A

**Table 25 - Expenditure in construction industry, 2011 and 2014**

| Type of expenditure | 2011 | 2014 | Annualised % change |
|---|---|---|---|
| | R million | | |
| Purchases | 110 787 | 172 922 | 16,0 |
| Salaries and wages | 49 797 | 61 317 | 7,2 |
| Payments to sub-contractors and labour brokers | 52 843 | 85 696 | 17,5 |
| Vehicle running costs | 3 522 | 4 957 | 12,1 |
| Rental of plant, machinery and equipment | 5 659 | 6 891 | 6,8 |
| Repair and maintenance | 2 280 | 3 160 | 11,5 |
| Interest paid | 2 495 | 3 286 | 9,6 |
| Rental of land, buildings and other structures | 1 672 | 1 998 | 6,1 |
| Other expenditure | 28 444 | 38 673 | 10,8 |
| **Total** | **257 499** | **378 900** | **13,7** |

**Table 26 - Expenditure in the construction industry, 2014**

| Type of service | Purchases | Salaries and wages | Payments to construction sub-contractors and labour brokers | Vehicle running costs | Rental of plant, machinery and equipment | Repairs and maintenance | Interest paid | Rental of land, buildings and other structures | Other expenditure | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | R million | | | | | | | | | |
| Site preparation | 1 677 | 1 288 | 866 | 210 | 635 | 163 | 123 | 16 | 563 | 5 541 |
| Construction of buildings | 41 840 | 9 378 | 24 697 | 804 | 914 | 312 | 1 088 | 300 | 5 358 | 84 691 |
| Construction of civil engineering structures | 63 549 | 27 098 | 45 814 | 1 307 | 2 957 | 1 203 | 1 036 | 549 | 18 385 | 161 898 |
| Construction of other structures | 2 660 | 1 694 | 245 | 112 | 198 | 43 | 28 | 68 | 645 | 5 693 |
| Construction by specialist trade contractors | 10 546 | 2 251 | 3 251 | 278 | 435 | 81 | 145 | 152 | 2 333 | 19 472 |
| Plumbing | 2 975 | 1 274 | 247 | 210 | 53 | 43 | 31 | 60 | 637 | 5 530 |
| Electrical contractors | 13 877 | 4 328 | 1 609 | 643 | 140 | 115 | 120 | 176 | 1 949 | 22 957 |
| Shopfitting | 892 | 417 | 90 | 66 | 16 | 14 | 4 | 43 | 237 | 1 779 |
| Other building installation | 13 134 | 4 895 | 3 706 | 448 | 237 | 164 | 211 | 254 | 3 618 | 26 667 |
| Painting and decorating | 1 819 | 692 | 85 | 94 | 24 | 30 | 14 | 39 | 336 | 3 133 |
| Other building completion | 14 382 | 4 224 | 3 654 | 485 | 258 | 127 | 82 | 179 | 1 733 | 25 124 |
| Renting of construction or demolition equipment with operators | 5 571 | 3 778 | 1 432 | 300 | 1 024 | 865 | 404 | 162 | 2 879 | 16 415 |
| **Total** | **172 922** | **61 317** | **85 696** | **4 957** | **6 891** | **3 160** | **3 286** | **1 998** | **38 673** | **378 900** |

**Table 27 - Capital expenditure on new assets in the construction industry, 2011 and 2014**

| Type of asset | 2011 | 2014 | Annualised % change |
|---|---|---|---|
| | R million | | |
| Land, buildings and construction | 789 | 975 | 7,3 |
| Vehicles | 3 193 | 2 914 | -3,0 |
| Plant, machinery and equipment | 6 276 | 8 037 | 8,6 |
| Other | 1 006 | 982 | -0,8 |
| **Total** | **11 264** | **12 908** | **4,6** |

**Table 28 - Capital expenditure on new assets in the construction industry, 2014**

| Type of service | Vehicles | Plant, machinery and equipment | Other assets | Total capital expenditure on new assets |
|---|---|---|---|---|
| | R million | | | |
| Site preparation | 51 | 1 948 | 9 | 2 008 |
| Construction of buildings | 528 | 832 | 283 | 1 643 |
| Construction of civil engineering structures | 466 | 2 206 | 969 | 3 641 |
| Construction of other structures | 57 | 58 | 19 | 134 |
| Construction by specialist trade contractors | 68 | 536 | 106 | 710 |
| Plumbing | 127 | 71 | 30 | 228 |
| Electrical contractors | 831 | 176 | 113 | 1 120 |
| Shopfitting | 11 | 24 | 1 | 36 |
| Other building installation | 241 | 212 | 100 | 553 |
| Painting and decorating | 46 | 43 | 8 | 97 |
| Other building completion | 187 | 157 | 20 | 364 |
| Renting of construction or demolition equipment with operators | 301 | 1 774 | 299 | 2 374 |
| **Total** | **2 914** | **8 037** | **1 957** | **12 908** |

**Table 29 - Details of income from services rendered for construction industry, 2011 and 2014**

| Type of construction activity | R million | | % contribution to total income from services | | Annualised % change |
|---|---|---|---|---|---|
| | 2011 | 2014 | 2011 | 2014 | |
| Site preparation | 5 973 | 5 846 | 2,4 | 1,6 | -0,7 |
| Rental of construction equipment with driver/operator | 9 227 | 15 238 | 3,7 | 4,2 | 18,2 |
| Construction of residential buildings | 20 771 | 27 908 | 8,3 | 7,8 | 10,3 |
| Construction of commercial and industrial buildings | 21 475 | 30 231 | 8,5 | 8,4 | 12,1 |
| Construction of other non-residential buildings | 9 962 | 12 687 | 4,0 | 3,5 | 8,4 |
| Construction, alterations and repair of highways, streets, bridges, tunnels and railways | 32 645 | 36 052 | 13,0 | 10,0 | 3,4 |
| Other civil engineering | 37 547 | 50 943 | 14,9 | 14,4 | 10,7 |
| Construction of other structures | 3 124 | 3 049 | 1,2 | 0,8 | -0,8 |
| Construction by specialist trade contractors | 8 363 | 15 717 | 3,3 | 4,4 | 23,4 |
| Plumbing | 3 329 | 7 425 | 1,3 | 2,1 | 30,7 |
| Electrical contracting | 14 259 | 21 620 | 5,7 | 6,0 | 14,9 |
| Shopfitting | 1 495 | 1 926 | 0,6 | 0,5 | 8,8 |
| Other building installations | 15 227 | 20 342 | 6,0 | 5,7 | 10,1 |
| Painting and decorating | 4 104 | 4 698 | 1,6 | 1,3 | 4,6 |
| Other building completion | 5 796 | 13 927 | 2,3 | 3,9 | 33,9 |
| Architectural services | 44 | 76 | 0,0 | 0,0 | 20,0 |
| Engineering services | 4 629 | 5 006 | 1,8 | 1,4 | 2,6 |
| Other activities | 897 | 438 | 0,4 | 0,1 | -21,3 |
| **Total income from services rendered (excluding work subcontracted out)** | **198 867** | **273 129** | **79,0** | **76,1** | **11,2** |
| Income from services for work subcontracted out | 52 843 | 85 696 | 21,0 | 23,9 | 17,5 |
| **Total income from services rendered** | **251 710** | **358 825** | **100,0** | **100,0** | **12,5** |

Table **30 - Details of purchases for construction industry, 2011 and 2014**

| Details of purchases | R million | | % contribution to total purchases | | Annualised % change |
|---|---|---|---|---|---|
| | 2011 | 2014 | 2011 | 2014 | |
| Cement | 8 301 | 10 276 | 7,5 | 5,9 | 7,4 |
| Sand and aggregate | 5 934 | 8 650 | 5,4 | 5,0 | 13,4 |
| Ready-mix concrete | 8 044 | 13 064 | 7,3 | 7,6 | 17,5 |
| Walling , roofing and flooring material (including bricks and blocks) | 20 989 | 39 297 | 19,0 | 22,8 | 23,3 |
| Reinforcing and structural steel | 11 243 | 20 116 | 10,1 | 11,6 | 21,4 |
| Electrical fittings, equipment and supplies | 19 669 | 33 321 | 17,8 | 19,3 | 19,2 |
| Paint and limewashes (including pigments, binders and thinners) | 3 353 | 4 220 | 3,0 | 2,4 | 8,0 |
| Asphalt and bitumen products | 7 132 | 9 950 | 6,4 | 5,8 | 11,7 |
| Fuel for off-road vehicles, machinery and trucks used in construction | 5 469 | 7 864 | 4,9 | 4,5 | 12,9 |
| Other purchases | 20 656 | 26 164 | 18,6 | 15,1 | 8,2 |
| **Total purchases** | **110 790** | **172 922** | **100,0** | **100,0** | **16,0** |

# Actual Research Instrument

**Table 31 - Simulation: Input Results**

## @RISK Input Results

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:44:02

| Name | Worksheet | Cell | Graph | Min | Mean | Max | 5% | 95% | Errors |
|---|---|---|---|---|---|---|---|---|---|
| Investment Cost | Proposal 1 | C11 | 350m 400m | R160 971 300,00 | R239 999 600,00 | R357 819 400,00 | R179 996 500,00 | R319 957 200,00 | 0 |
| Year 1 Revenue | Proposal 1 | C12 | 300m 460m | R320 803 300,00 | R386 666 900,00 | R439 450 400,00 | R341 886 300,00 | R424 501 600,00 | 0 |
| Annual Fixed Cost | Proposal 1 | C13 | 94m 112m | R94 421 590,00 | R103 138 200,00 | R111 833 700,00 | R97 092 530,00 | R109 181 900,00 | 0 |
| Annual Revenue Growth Rate | Proposal 1 | C14 | -15% 20% | -12,15% | 2,50% | 17,20% | -4,08% | 9,07% | 0 |
| Annual Variable Cost Percentage | Proposal 1 | C15 | 43% 58% | 42,92% | 50,00% | 57,54% | 46,71% | 53,29% | 0 |
| Investment Cost | Proposal 1_Block | C11 | 350m 400m | R160 614 100,00 | R240 000 100,00 | R357 554 600,00 | R179 997 400,00 | R319 962 400,00 | 0 |
| Year 1 Revenue | Proposal 1_Block | C12 | 300m 460m | R321 090 400,00 | R386 666 800,00 | R439 462 700,00 | R341 879 900,00 | R424 499 200,00 | 0 |
| Annual Fixed Cost | Proposal 1_Block | C13 | 88m 106m | R88 693 770,00 | R96 940 900,00 | R105 099 500,00 | R91 255 060,00 | R102 620 900,00 | 0 |
| Annual Revenue Growth Rate | Proposal 1_Block | C14 | -15% 20% | -12,19% | 2,50% | 17,77% | -4,08% | 9,07% | 0 |
| Annual Variable Cost Percentage | Proposal 1_Block | C15 | 42% 58% | 42,82% | 50,00% | 57,27% | 46,71% | 53,29% | 0 |
| Investment Cost | Proposal 2 | C11 | 350m 400m | R161 203 200,00 | R240 000 100,00 | R358 032 300,00 | R179 970 600,00 | R319 953 700,00 | 0 |
| Year 1 Revenue | Proposal 2 | C12 | 300m 460m | R320 737 800,00 | R386 666 700,00 | R439 294 700,00 | R341 875 300,00 | R424 498 100,00 | 0 |
| Annual Fixed Cost | Proposal 2 | C13 | 74m 90m | R74 854 110,00 | R81 799 660,00 | R88 681 340,00 | R77 001 780,00 | R86 589 990,00 | 0 |
| Annual Revenue Growth Rate | Proposal 2 | C14 | -15% 20% | -14,93% | 2,50% | 16,94% | -4,09% | 9,07% | 0 |
| Annual Variable Cost Percentage | Proposal 2 | C15 | 42% 58% | 42,76% | 50,00% | 57,14% | 46,71% | 53,29% | 0 |
| Investment Cost | Conventional | C11 | 350m 400m | R160 520 100,00 | R239 999 800,00 | R358 654 100,00 | R179 963 900,00 | R319 920 900,00 | 0 |
| Year 1 Revenue | Conventional | C12 | 300m 460m | R320 929 500,00 | R386 666 700,00 | R439 121 200,00 | R341 891 000,00 | R424 505 500,00 | 0 |
| Annual Fixed Cost | Conventional | C13 | 96m 116m | R97 811 540,00 | R106 816 100,00 | R115 798 000,00 | R100 554 800,00 | R113 070 900,00 | 0 |
| Annual Revenue Growth Rate | Conventional | C14 | -15% 20% | -12,36% | 2,50% | 17,98% | -4,08% | 9,07% | 0 |
| Annual Variable Cost Percentage | Conventional | C15 | 42% 58% | 42,74% | 50,00% | 57,47% | 46,71% | 53,29% | 0 |
| Investment Cost | Conventional - Block | C11 | 350m 400m | R161 024 100,00 | R239 999 800,00 | R358 192 200,00 | R179 984 500,00 | R319 997 300,00 | 0 |
| Year 1 Revenue | Conventional - Block | C12 | 300m 460m | R321 266 000,00 | R386 666 600,00 | R439 175 200,00 | R341 867 700,00 | R424 504 700,00 | 0 |
| Annual Fixed Cost | Conventional - Block | C13 | 94m 114m | R94 125 110,00 | R103 164 500,00 | R112 460 200,00 | R96 921 180,00 | R109 546 100,00 | 0 |
| Annual Revenue Growth Rate | Conventional - Block | C14 | -15% 20% | -11,94% | 2,50% | 18,57% | -4,08% | 9,07% | 0 |
| Annual Variable Cost Percentage | Conventional - Block | C15 | 40% 58% | 41,53% | 50,00% | 57,42% | 46,71% | 53,29% | 0 |

**Table 32 - Simulation: Output Results**

## @RISK Output Results

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:44:14

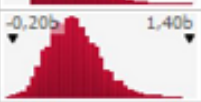
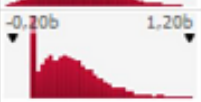
| Name | Worksheet | Cell | Graph | Min | Mean | Max | 5% | 95% | Errors |
|---|---|---|---|---|---|---|---|---|---|
| NPV | Proposal 1 | C26 |   | -R187 983 100,00 | R390 536 200,00 | R1 349 336 000,00 | R75 175 360,00 | R758 949 600,00 | 0 |
| Bonus | Proposal 1 | C27 |   | R0,00 | R276 612 200,00 | R1 229 336 000,00 | R0,00 | R638 949 600,00 | 0 |
| NPV | Proposal 1_Block | C26 |   | -R205 167 000,00 | R425 630 100,00 | R1 728 768 000,00 | R116 669 900,00 | R795 251 500,00 | 0 |
| Bonus | Proposal 1_Block | C27 |   | R0,00 | R309 048 100,00 | R1 608 768 000,00 | R0,00 | R675 251 500,00 | 0 |
| NPV | Proposal 2 | C26 |   | -R120 342 400,00 | R511 103 700,00 | R1 562 317 000,00 | R204 947 500,00 | R871 243 100,00 | 0 |
| Bonus | Proposal 2 | C27 |   | R0,00 | R391 826 600,00 | R1 442 317 000,00 | R84 947 450,00 | R751 243 100,00 | 0 |
| NPV | Conventional | C26 |   | -R231 357 800,00 | R369 687 900,00 | R1 309 863 000,00 | R60 938 350,00 | R738 041 000,00 | 0 |
| Bonus | Conventional | C27 |   | R0,00 | R257 634 500,00 | R1 189 863 000,00 | R0,00 | R618 041 000,00 | 0 |
| NPV | Conventional - Block | C26 |   | -R184 505 100,00 | R390 510 400,00 | R1 299 678 000,00 | R76 665 070,00 | R767 066 300,00 | 0 |
| Bonus | Conventional - Block | C27 |   | R0,00 | R276 229 000,00 | R1 179 678 000,00 | R0,00 | R647 066 300,00 | 0 |

**Table 33 - Simulation: Model Inputs**

# @RISK Model Inputs

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:44:29

| Name | Worksheet | Cell | Graph | Function | Min | Mean | Max |
|---|---|---|---|---|---|---|---|
| Investment Cost | Proposal 1 | C11 |  | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R160 000 000,00 | R240 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | Proposal 1 | C12 |  | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R320 000 000,00 | R386 666 700,00 | R440 000 000,00 |
| Annual Fixed Cost | Proposal 1 | C13 |  | RiskTriang(94297757,26;103138172;111978586,7;RiskStatic(103138172)) | R94 297 760,00 | R103 138 200,00 | R111 978 600,00 |
| Annual Revenue Growth Rate | Proposal 1 | C14 |  | RiskNormal(0,025;0,04;RiskStatic(0,025)) | -∞ | 2,50% | +∞ |
| Annual Variable Cost Percentage | Proposal 1 | C15 |  | RiskNormal(0,5;0,02;RiskStatic(0,5)) | -∞ | 50,00% | +∞ |
| Investment Cost | Proposal 1_Block | C11 |  | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R160 000 000,00 | R240 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | Proposal 1_Block | C12 |  | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R320 000 000,00 | R386 666 700,00 | R440 000 000,00 |
| Annual Fixed Cost | Proposal 1_Block | C13 |  | RiskTriang(88631683,66;96940904;105250124,3;RiskStatic(96940904)) | R88 631 680,00 | R96 940 900,00 | R105 250 100,00 |
| Annual Revenue Growth Rate | Proposal 1_Block | C14 |  | RiskNormal(0,025;0,04;RiskStatic(0,025)) | -∞ | 2,50% | +∞ |
| Annual Variable Cost Percentage | Proposal 1_Block | C15 |  | RiskNormal(0,5;0,02;RiskStatic(0,5)) | -∞ | 50,00% | +∞ |
| Investment Cost | Proposal 2 | C11 |  | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R160 000 000,00 | R240 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | Proposal 2 | C12 |  | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R320 000 000,00 | R386 666 700,00 | R440 000 000,00 |
| Annual Fixed Cost | Proposal 2 | C13 |  | RiskTriang(74788253,26;81799652;88811050,74;RiskStatic(81799652)) | R74 788 260,00 | R81 799 650,00 | R88 811 050,00 |
| Annual Revenue Growth Rate | Proposal 2 | C14 |  | RiskNormal(0,025;0,04;RiskStatic(0,025)) | -∞ | 2,50% | +∞ |
| Annual Variable Cost Percentage | Proposal 2 | C15 |  | RiskNormal(0,5;0,02;RiskStatic(0,5)) | -∞ | 50,00% | +∞ |
| Investment Cost | Conventional | C11 |  | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R160 000 000,00 | R240 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | Conventional | C12 |  | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R320 000 000,00 | R386 666 700,00 | R440 000 000,00 |
| Annual Fixed Cost | Conventional | C13 |  | RiskTriang(97660379,43;106816040;115971700,6;RiskStatic(106816040)) | R97 660 380,00 | R106 816 000,00 | R115 971 700,00 |
| Annual Revenue Growth Rate | Conventional | C14 |  | RiskNormal(0,025;0,04;RiskStatic(0,025)) | -∞ | 2,50% | +∞ |
| Annual Variable Cost Percentage | Conventional | C15 |  | RiskNormal(0,5;0,02;RiskStatic(0,5)) | -∞ | 50,00% | +∞ |
| Investment Cost | Conventional - Block | C11 |  | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R160 000 000,00 | R240 000 000,00 | R360 000 000,00 |
| Year 1 Revenue | Conventional - Block | C12 |  | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R320 000 000,00 | R386 666 700,00 | R440 000 000,00 |
| Annual Fixed Cost | Conventional - Block | C13 |  | RiskTriang(94069913,6;102888968;112534808,8;RiskStatic(102888968)) | R94 069 910,00 | R103 164 600,00 | R112 534 800,00 |
| Annual Revenue Growth Rate | Conventional - Block | C14 |  | RiskNormal(0,025;0,04;RiskStatic(0,025)) | -∞ | 2,50% | +∞ |
| Annual Variable Cost Percentage | Conventional - Block | C15 |  | RiskNormal(0,5;0,02;RiskStatic(0,5)) | -∞ | 50,00% | +∞ |

**Table 34 - Simulation: Model Outputs**

# @RISK Model Outputs

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 14:44:46

| Name | Worksheet | Cell | Function |
|---|---|---|---|
| NPV | Proposal 1 | C26 | RiskOutput("NPV") |
| Bonus | Proposal 1 | C27 | RiskOutput("Bonus") |
| NPV | Proposal 1_Block | C26 | RiskOutput("NPV") |
| Bonus | Proposal 1_Block | C27 | RiskOutput("Bonus") |
| NPV | Proposal 2 | C26 | RiskOutput("NPV") |
| Bonus | Proposal 2 | C27 | RiskOutput("Bonus") |
| NPV | Conventional | C26 | RiskOutput("NPV") |
| Bonus | Conventional | C27 | RiskOutput("Bonus") |
| NPV | Conventional - Block | C26 | RiskOutput("NPV") |
| Bonus | Conventional - Block | C27 | RiskOutput("Bonus") |

**Table 35 – Simulation: Sensitivity Analysis**

## @RISK Sensitivity Analysis

**Performed By:** Thulani Nicholas Fihlani
**Date:** Wednesday, 06 September 2017 16:00:15

| Rank For C26 | Sheet | Cell | Name | Description | Proposal 1!C26 NPV Range of Mean | Proposal 1!C27 Bonus Range of Mean | Proposal 1_Block!C26 NPV Range of Mean | Proposal 1_Block!C27 Bonus Range of Mean | Proposal 2!C26 NPV Range of Mean | Proposal 2!C27 Bonus Range of Mean | Conventional!C26 NPV Range of Mean | Conventional!C27 Bonus Range of Mean | Conventional - Block!C26 NPV Range of Mean | Conventional - Block!C27 Bonus Range of Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | Proposal 1 | C14 | Annual Revenue Growth Rate | RiskNormal(0,025;0,04;RiskStatic(0,025)) | R639 768 614,59 | R593 084 145,82 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| #2 | Proposal 1 | C12 | Year 1 Revenue | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | R284 587 850,00 | R263 043 803,28 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| #3 | Proposal 1 | C15 | Annual Variable Cost Percentage | RiskNormal(0,5;0,02;RiskStatic(0,5)) | R171 940 188,76 | R161 391 284,14 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| #4 | Proposal 1 | C11 | Investment Cost | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | R150 650 574,61 | R137 560 233,75 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| #5 | Proposal 1 | C13 | Annual Fixed Cost | RiskTriang(94297757,26;103138172;111978586,7;RiskStatic(103138172)) | R79 983 789,52 | R73 990 216,04 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| - | Conventional - Block | C15 | Annual Variable Cost Percentage | RiskNormal(0,5;0,02;RiskStatic(0,5)) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | R185 659 306,36 | R173 973 394,26 |
| - | Conventional - Block | C14 | Annual Revenue Growth Rate | RiskNormal(0,025;0,04;RiskStatic(0,025)) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | R637 385 746,64 | R593 828 601,00 |
| - | Conventional - Block | C13 | Annual Fixed Cost | RiskTriang(94069913,6;102888968;112534808,8;RiskStatic(102888968)) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | R79 898 696,93 | R75 808 223,44 |
| - | Conventional - Block | C12 | Year 1 Revenue | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | R268 558 764,90 | R249 468 788,06 |
| - | Conventional - Block | C11 | Investment Cost | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | R148 625 157,70 | R136 013 273,01 |
| - | Conventional | C15 | Annual Variable Cost Percentage | RiskNormal(0,5;0,02;RiskStatic(0,5)) | n/a | n/a | n/a | n/a | n/a | n/a | R177 968 099,62 | R164 057 939,28 | n/a | n/a |
| - | Conventional | C14 | Annual Revenue Growth Rate | RiskNormal(0,025;0,04;RiskStatic(0,025)) | n/a | n/a | n/a | n/a | n/a | n/a | R628 299 876,95 | R569 837 261,56 | n/a | n/a |
| - | Conventional | C13 | Annual Fixed Cost | RiskTriang(97660379,43;106816040;115971700,6;RiskStatic(106816040)) | n/a | n/a | n/a | n/a | n/a | n/a | R87 238 129,22 | R76 522 895,34 | n/a | n/a |
| - | Conventional | C12 | Year 1 Revenue | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | n/a | n/a | n/a | n/a | n/a | n/a | R248 611 142,06 | R219 632 466,54 | n/a | n/a |
| - | Conventional | C11 | Investment Cost | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | n/a | n/a | n/a | n/a | n/a | n/a | R136 197 578,41 | R119 680 174,08 | n/a | n/a |
| - | Proposal 2 | C15 | Annual Variable Cost Percentage | RiskNormal(0,5;0,02;RiskStatic(0,5)) | n/a | n/a | n/a | n/a | R163 908 640,59 | R162 412 480,51 | n/a | n/a | n/a | n/a |
| - | Proposal 2 | C14 | Annual Revenue Growth Rate | RiskNormal(0,025;0,04;RiskStatic(0,025)) | n/a | n/a | n/a | n/a | R624 482 383,27 | R617 667 750,33 | n/a | n/a | n/a | n/a |
| - | Proposal 2 | C13 | Annual Fixed Cost | RiskTriang(74788253,26;81799652;88811050,74;RiskStatic(81799652)) | n/a | n/a | n/a | n/a | R49 785 312,19 | R49 178 582,99 | n/a | n/a | n/a | n/a |
| - | Proposal 2 | C12 | Year 1 Revenue | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | n/a | n/a | n/a | n/a | R278 168 901,86 | R274 500 208,06 | n/a | n/a | n/a | n/a |
| - | Proposal 2 | C11 | Investment Cost | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | n/a | n/a | n/a | n/a | R120 287 026,73 | R117 962 041,29 | n/a | n/a | n/a | n/a |
| - | Proposal 1_Block | C15 | Annual Variable Cost Percentage | RiskNormal(0,5;0,02;RiskStatic(0,5)) | n/a | n/a | R189 171 041,26 | R180 691 589,10 | n/a | n/a | n/a | n/a | n/a | n/a |
| - | Proposal 1_Block | C14 | Annual Revenue Growth Rate | RiskNormal(0,025;0,04;RiskStatic(0,025)) | n/a | n/a | R632 431 479,24 | R604 270 162,69 | n/a | n/a | n/a | n/a | n/a | n/a |
| - | Proposal 1_Block | C13 | Annual Fixed Cost | RiskTriang(88631683,66;96940904;105250124,3;RiskStatic(96940904)) | n/a | n/a | R87 795 825,77 | R84 355 353,00 | n/a | n/a | n/a | n/a | n/a | n/a |
| - | Proposal 1_Block | C12 | Year 1 Revenue | RiskTriang(320000000;400000000;440000000;RiskStatic(400000000)) | n/a | n/a | R262 599 112,66 | R249 649 103,03 | n/a | n/a | n/a | n/a | n/a | n/a |
| - | Proposal 1_Block | C11 | Investment Cost | RiskTriang(160000000;200000000;360000000;RiskStatic(200000000)) | n/a | n/a | R136 308 351,89 | R125 895 048,74 | n/a | n/a | n/a | n/a | n/a | n/a |

# APPENDIX B

## Consistency matrix

**Table 36 - Conventional Brick - Summary BOQ**

| | | |
|---|---|---|
| **Site Name** | Conventional Brick | |
| **Site Size ($m^2$)** | **101** | |
| **Expected Construction Period in weeks** | **8** | |
| **Number of Bricks to be used to build house** | **12474** | |
| **Number of Blocks to be used to build house** | **0** | |
| **Number of Polysmart prefabs to be used to build house** | **0,0** | |
| **Number of Bricks to be used on foundation** | **5973** | |
| | | |
| | | |
| | | |
| e-Mail Address | | |
| Telephone Number | | |
| Cellular Phone Number | | |

**0**

**BILL OF QUANTITIES SUMMARY** — **0**

| | | | Asset Classification | | | | |
|---|---|---|---|---|---|---|---|
| | | | Land & Building | Electrical | Mechanical | Energy / Water Metering | Amount |
| **BILL NO.** | **DESCRIPTION** | | | | | | |
| | **Preliminaries - See below** | | | | | | |
| BILL NO. 1 | MASONRY | | R 125 817,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | | R - | | | | R - |
| BILL NO. 3 | VINYL | | R - | | | | R - |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | | R 97 092,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | | - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | | **R 464 623,40** | **R 3 868,00** | **R -** | **R -** | **R 468 491,40** |
| | **PRELIMINARIES** (Main Contractor/Electrical/HVAC) | | R - | R - | R - | | R - |
| | ***TOTAL:*** | | **R 464 623,40** | **R 3 868,00** | **R -** | **R -** | **R 468 491,40** |
| | | | | | | ***VAT @ 14%*** | **R 65 588,80** |
| | | | | | | ***TOTAL*** | **R 534 080,20** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | R 4 600,23 | R 38,30 | R - | R - | R 4 638,53 |
| ***Rand/m2 (Including Preliminaries)*** | R 4 600,23 | R 38,30 | R - | | R 4 638,53 |

**Table 37 - Conventional Brick - Main contractor BOQ**

| Site Name | Conventional Brick |
|---|---|
| Site Size ($m^2$) | 101 |

| NATIONAL BOQ RATES - LAND AND BUILDING | | | | | | |
|---|---|---|---|---|---|---|
| Bill | Item | Description | Unit | Quantity | Rate | Amount |
| | | | | | | |
| 1 | | MASONRY | | | | |
| | | | | | | |
| | | BRICKWORK | | | | |
| 1 | 1 | Supply and install /$m^2$ brick, incl. brick and mortar. Single Brick, 102.5 x 75 x 225mm. Thickness of wall 112.5mm | m2 | 57 | R 534,00 | R 30 171,00 |
| 1 | 2 | Supply and install /$m^2$ brick, incl. brick and mortar. double Brick, 225 x 75 x 225mm. Thickness of wall 225mm | m2 | 77 | R 1 068,00 | R 82 236,00 |
| 1 | 3 | Supply and install /m2 block, incl. block and mortar. External concrete block size, 210 x 210 x 430mm. Thickness of wall 210mm | m2 | | R 715,00 | R - |
| 1 | 4 | Supply and install /m2 block, incl. block and mortar. Internal concrete block size, 110 x 210 x 430mm. Thickness of wall 110mm | m2 | | R 704,00 | R - |
| | | | | | BRICKWORK TOTAL | R 112 407,00 |
| | | **BRICKWORK SUNDRIES** | | | | |
| 1 | 5 | Cutting toothing and bonding new brickwork to existing | m2 | | R 125,00 | R - |
| 1 | 6 | Splayed mortar fillet one course high in 60mm cavity. | m | | R 40,00 | R - |
| 1 | 7 | Closing 60mm cavity of hollow wall vertically with brickwork half-brick wide. | m | | R 50,00 | R - |
| 1 | 8 | Closing 60mm cavity of hollow wall horizontally with one course of brickwork. | m | | R 55,00 | R - |
| | | **Fair face to brickwork in horizontal stretcher bond pointed with recessed horizontal and vertical joints** | | | | |
| 1 | 9 | Extra for fair face | m2 | 77 | R 75,00 | R 5 775,00 |
| 1 | 10 | **Bagging of 1:3 cement sand mixture** | | | | |
| 1 | 11 | On brick walls, piers, etc | m2 | | R 55,00 | R - |
| | | **Joint forming material in movement joints** | | | | |
| 1 | 12 | 12mm Fibre board built in vertically between brick skins | m2 | 77 | R 75,00 | R 5 775,00 |
| | | **Brickwork reinforcement** | | | | |
| 1 | 13 | 75mm Wide reinforcement built in horizontally. | m | 82 | R 5,00 | R 410,00 |
| 1 | 14 | 150mm Wide reinforcement built in horizontally. | m | | R 10,00 | R - |
| | | **Precast pre-stressed concrete lintels** | | | | |
| 1 | 15 | 110 x 75mm SABS Approved Lintels in lengths not exceeding 3m. | m | 14 | R 75,00 | R 1 050,00 |
| 1 | 16 | **Turning pieces** | | | | |
| 1 | 17 | 230mm Wide turning piece to lintels etc | m | | R 70,00 | R - |
| | | **Galvanised hoop iron cramps, ties, etc.** | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 18 | 30 x 1.6mm 500mm long with one end shot pinned to concrete and other end built into brickwork | no | 10 | R | 40,00 | R 400,00 |
| | | | | | | BW SUNDRIES TOTAL | R 13 410,00 |
| | | | | | | MASONRY TOTAL | R 125 817,00 |
| 2 | | **PARTITONS ETC** | | | | | |
| 2 | | **Gypwall FireStop HiSpec 63F120S50 with fire rating of two hours, covered on both sides with TWO layers of Gyproc Firestop 12,5mm thick wallboards, and one layer of 1,6mm thick galvanised steel plate on the "exterior or attack face", with the steel plate screwed to studs and tracks. Boards to be butt jointed and finished with Gyproc Rhino tape and De Braven Zwaluw Acryl-W Acrylic Silicone jointing compound all in accordance with the manufacturer's instructions. Cover Gyproc Rhinotape with two layers of Gyproc RhinoLite and exposed surfaces of partitons skimmed with one layer of Gyproc RhinoLite. Intersections and abutments are measured separately and descriptions shall be deemed to include any additional corner beads, jointing compound, tape, etc.** | | | | | |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm | No | | R | 1 250,00 | R - |
| 2 | 19 | Extra over partition 2.4m high for vertical abutment, fair end, t-junction, corners etc. | No | | R | 350,00 | R - |
| | | Extra over partition for forming 813 x 2032mm high opening for doors (elsewhere measured) including 64 x 64 x 4mm SHS H-frame, bolts, angles, plates, etc | No | | R | 825,00 | R - |
| | | Extra over partition for forming 950 x 2032mm high opening for doors (elsewhere measured) | No | | R | 750,00 | R - |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm. Including Flush outlet boxes, excluding covers, fixed in drywall partitioning: 100 x 50 x 50mm. | No | | R | 1 270,00 | R - |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm. Including Flush outlet boxes, excluding covers, fixed in drywall partitioning: 100 x 100 x 50mm. | No | | R | 1 280,00 | R - |
| | | | | | | PARTITIONS TOTAL | R - |
| 2 | | **Sundries** | | | | | |
| 2 | | Natural anodised aluminium rebated door frame (typically only applicable when frames are inserted in existing brick wall openings and existing doors rehung) | m | | R | 500,00 | |
| 2 | | 16mm Thick supawood noggins for fixtures and fittings | m2 | | R | 250,00 | R - |
| | | 18mm Plywood for noggins for fixtures and fittings | m2 | | R | 270,00 | R - |
| 2 | | Extra over partition for Load Bearing Track 63.5mm wide | m | | R | 225,00 | R - |
| 2 | | Extra over partition for noggins for Load Bearing stud noggins for heavy duty fixtures | m | | R | 225,00 | R - |
| | | | | | | PARTITIONS SUNDRIES TOTAL | R - |
| | | | | | | PARTITIONS ETC TOTAL | R - |
| 3 | | **FLOOR COVERINGS** | | | | | |
| 3 | | **VINYL** | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | | 2,0mm thick x 300mm x 300mm FloorworX Floorflex semi-flexible vinyl floor tiles in Moor Grey finish (Colour code: MF2502) (S4000) laid in Earthbond solvent free acylic bond adhesive adhesive on and including suitably prepared subfloor, and installed as per manufacturer's recommendations. | m2 | | R | 226,00 | R | - |
| 3 | | Polyflor 2,0mm thick Classic Mystique PUR lifelong polish free Homogeneous vinyl floor colour Nocturne (Colour code: 1380), laid in Earthbond solvent free acylic bond adhesive on and including suitably prepared subfloor, and installed as per manufacturer's recommendations. | m2 | | R | 513,00 | R | - |
| | | | | | | **VINYL TOTAL** | R | - |
| 4 | | **TILING** | | | | | | |
| 4 | | **400 x 400mm Tile Africa Pablo Sand (Light) Glazed ceramic tiles (PL137) flush pointed with tinted jointing compound fixed with adhesive to bedding. Bedding (elsewhere measured)** | | | | | | |
| 4 | | On floors and landings | m2 | 110 | R | 315,00 | R | 34 650,00 |
| 4 | | On narrow widths | m2 | | R | 340,00 | R | - |
| 4 | | On risers 180mm high of stretcher course tiles | m | | R | 100,00 | R | - |
| 4 | | On treads 250mm wide with stretcher course tiles | m | | R | 125,00 | R | - |
| 4 | | Skirting 150mm high | m | 62 | R | 85,00 | R | 5 310,80 |
| | | | | | | **TILING TOTAL** | R | 39 960,80 |
| 5 | | **PRESSED STEEL DOOR FRAMES** | | | | | | |
| 5 | | **1,2mm Rebated frames suitable for half brick walls** | | | | | | |
| 5 | | Frame for door 813 x 2032mm high. | No | | R | 850,00 | R | - |
| 5 | | Frame for door 950 x 2032mm high. | No | | R | 1 150,00 | R | - |
| 5 | | 813 x 2300mm High Access Door - including frame, architraves, ironmongery and varnish. | No | 5,00 | R | 1 952,00 | R | 9 760,00 |
| 5 | | 950 x 2300mm High Access Door - including frame, architraves, ironmongery and varnish. | No | 1,00 | R | 2 241,00 | R | 2 241,00 |
| | | | | | | **PRESSED DOOR FRAMES TOTAL** | R | 12 001,00 |
| 6 | | **WINDOW FRAMES** | | | | | | |
| 6 | | **WOODEN RAMES** | | | | | | |
| 6 | | Swartland Winster 595 x 900mm. Complete with glass panes, vanish and installation | No | | R | 1 400,00 | R | - |
| 6 | | Swartland Winster 995 x 900mm. Complete with glass panes, vanish and installation | No | 1,00 | R | 1 530,00 | R | 1 530,00 |
| 6 | | Swartland Winster 1200 x 900mm. Complete with glass panes, vanish and installation | No | 4,00 | R | 2 900,00 | R | 11 600,00 |
| 6 | | Swartland Winster 1600 x 1400mm. Complete with glass panes, vanish and installation | No | 2,00 | R | 3 400,00 | R | 6 800,00 |
| 6 | | Swartland Winster 2400 x 1400mm. Complete with glass panes, vanish and installation | No | 1,00 | R | 3 900,00 | R | 3 900,00 |
| | | | | | | **WINDOW FRAMES TOTAL** | R | 23 830,00 |
| 7 | | **ROOFING** | | | | | | |
| 7 | | **PROFILED FIBRE-CEMENT SHEETING AND ACCESSORIES** | | | | | | |
| 7 | | **Everite Nutec Bigsix roof sheeting with 875mm cover, fixed at a pitch of 25º to existing timber purlins at 1200mm centres with 90mm drive screws with Everseal washers at second and fourth crest of each sheet and minimum of 50mm from edge of sheet with mitred corners as required with minimum 150mm end laps, all in accordance with the manufacturer's recommendations.** | | | | | | |
| 7 | | Roof covering with pitch not exceeding 25 degrees | m2 | 122,00 | R | 300,00 | R | 36 600,00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | | Side apron flashing | m | 26,00 | R | 100,00 | R | 2 600,00 |
| 7 | | End apron flashing | m | 19,00 | R | 100,00 | R | 1 900,00 |
| 7 | | Plain adjustable ridge / hip capping including junctions and end caps | m | | R | 130,00 | R | - |
| 7 | | Birdproofing | m | 45,00 | R | 85,00 | R | 3 825,00 |
| 7 | | Eaves fillers | m | | R | 100,00 | R | - |
| 7 | | U-flashing | m | | R | 120,00 | R | - |
| | | | | | | ROOFING TOTAL | R | 44 925,00 |
| 8 | | **PAINTWORK** | | | | | | |
| 8 | | **ON FLOATED PLASTER** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |
| 8 | | Extra over for water based primer and water based Double Velvet | m2 | | R | 70,00 | R | - |
| | | | | | | FLOATED PLASTER TOTAL | R | - |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Wall and All** | | | | | | |
| 8 | | On external walls | m2 | | R | 667,00 | R | - |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |
| 8 | | On ceilings and beams | m2 | | R | 68,00 | R | - |
| | | | | | | ONE COAT PP TOTAL | R | - |
| 8 | | **ON PLASTER BOARD** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Polvin Walls and Ceilings** | | | | | | |
| 8 | | On partitions | m2 | 160 | R | 65,00 | R | 10 400,00 |
| 8 | | On ceilings and cornices | m2 | 101 | R | 65,00 | R | 6 541,60 |
| | | | | | | PLASTER BOARD TOTAL | R | 16 941,60 |
| 8 | | **ON FIBRE CEMENT** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On ceilings and cornices | m2 | | R | 65,00 | R | - |
| 8 | | On facias and bargeboards | m2 | | R | 65,00 | R | - |
| | | | | | | FIBRE CEMENT TOTAL | R | - |
| 8 | | **ON WOOD** | | | | | | |
| 8 | | **One coat Plascon Wood Primer UC2 and two coats Plascon Velvaglo** | | | | | | |
| 8 | | On doors | m2 | 12 | R | 77,00 | R | 924,00 |
| 8 | | On windows, sash doors and fanlights | m2 | 6 | R | 79,00 | R | 474,00 |
| 8 | | On louvred windows and doors | m2 | | R | 79,00 | R | - |
| 8 | | On door frames | m2 | | R | 79,00 | R | - |
| 8 | | On roof timbers at eaves and verges | m2 | | R | 79,00 | R | - |
| 8 | | On skirtings, rails, etc not exceeding 300mm girth | m | | R | 35,00 | R | - |
| | | | | | | WOOD TOTAL | R | 1 398,00 |
| 8 | | **ON FLOATED PLASTER** | | | | | | |
| 8 | | **One coat Plascon Universal Undercoat (UC 1) and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On internal walls. | m2 | | R | 67,00 | R | - |
| 8 | | Extra over for water based primer and water based Double Velvet | m2 | | R | 7,00 | R | - |
| 8 | | **One coat Plascon Plaster Primer (UC 56) primer two coats Plascon Wall and All** | | | | | | |
| 8 | | On external walls | m2 | | R | 67,00 | R | - |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | | On ceilings and beams | m2 | | **R** | **68,00** | R | - |
| | | | | | | **FLOATED PLASTER TOTAL** | **R** | **-** |
| 8 | | **ON METAL** | | | | | | |
| 8 | | **One coat Plascon Steel Primer UC501 and two coats Plascon Velvaglo** | | | | | | |
| 8 | | On doors | m2 | | **R** | **77,00** | R | - |
| 8 | | On door frames | m2 | 3 | **R** | **77,00** | R | 231,00 |
| 8 | | On windows | m2 | | **R** | **81,00** | R | - |
| 8 | | On gates, grilles, burglar screens, balustrades, etc (both sides measured over the full flat area) | m2 | | **R** | **81,00** | R | - |
| 8 | | On rails, bars, pipes, etc | m2 | | **R** | **81,00** | R | - |
| 8 | | On eaves gutters | m2 | | **R** | **81,00** | R | - |
| 8 | | On rails, bars, pipes, etc not exceeding 300mm girth | m | | **R** | **35,00** | R | - |
| 8 | | Extra over for water based primer and water based Velvaglo | m2 | | **R** | **8,00** | R | - |
| | | | | | | **METAL TOTAL** | **R** | **231,00** |
| 8 | | **ROOF TILES** | | | | | | |
| 8 | | **One coat Nuroof Acrylic Roof Paint thinned 10:1 with water and one coat Nuroof Acrylic Roof Paint (TRP)** | | | | | | |
| 8 | | On facias | m2 | | **R** | **83,00** | R | - |
| 8 | | On roof tiles | m2 | 122 | **R** | **81,00** | R | 9 882,00 |
| | | | | | | **ROOF TILES TOTAL** | **R** | **9 882,00** |
| | | | | | | **PAINT WORK TOTAL** | **R** | **28 452,60** |
| 9 | | **PLUMBING AND DRAINAGE** | | | | | | |
| 9 | | **RAINWATER DISPOSAL** | | | | | | |
| 9 | | **Galvanised steel gutters** | | | | | | |
| 9 | | 100 x 75mm Eaves gutters, including angles, and end cap | m | 26,00 | **R** | **261,00** | R | 6 786,00 |
| 9 | | 125 x 100mm Eaves gutters, including bends and end cap | m | | **R** | **300,00** | R | - |
| 9 | | 75 X 75mm Rainwater pipes, including outlet, bends and shoe | m | 10,00 | **R** | **196,00** | R | 1 960,00 |
| | | | | | | | R | - |
| 9 | | **Saint Gobain** | | | | | R | - |
| 9 | | 100mm 90º centre bolt side roof outlet with dome grating (03585) | No | | **R** | **822,00** | R | - |
| | | | | | | **RAINWATER DISPOSAL TOTAL** | **R** | **8 746,00** |
| 9 | | **SANITARY FITTINGS** | | | | | | |
| 9 | | **Supply and install sanitary fitting complete, including taps, waste outlets, plugs, valves, traps, connectors, 15mm hot and cold copper water supply and fittings, uPVC waste water pipes and fittings, etc, to form one complete and operational plumbing point. All fitted in strict accordance with manufacturer's recommendations and instructions.** | | | | | | |
| 9 | | **All sanitary fittings to be sealed against wall and floor finishes with De Braven Zwaluw Silicone Sanitary sealant** | | | | | | |
| 9 | | **Stainless steel sinks** | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9 | | "Kwikot" Grade 430 17/10 stainless steel Standard preparation bowl sink and drainer (SPB-STD) overall size 430mm outer diameter x 135mm deep or equivalent, Cobra sink mounted Stella sink mixer (3396ST), chrome waste outlet with chain and plug, No line watersaver insert (P-WS/6-Noline), single bowl flexible P-trap, two 15mm flexible connector valves and cap nuts, two water points and one drainage point | No | 1,00 | R | **4 319,00** | R | 4 319,00 |
| 9 | | Hibiscus vitreous china lavatory basin colour White (Code: 7023), size 510 x 405mm with one taphole including integrated overflow and chainstay hole bolted to wall with two x 10mm bolts (Code: 8448Z0) and including Classic floor mounted pedestal (Code: 7150) and sealed with silicone sealant where basin meets wall, Cobra Watertech Stella Bright 15mm chrome plated basin mixer restricted to 6l/min maximum flow (Code: 3294SB) with pop-up waste (Code: S-380), cast fixed spout and 400mm long flexible inlets, manufactured in accordance with SANS 226:2009 Type 2 (BS 5412)., No-line water saver insert (P-WS/6-Noline), 32mm CP bottle trap, two 15mm flexi connector valves and cap nuts, two water points and one drainage point. | No | 1,00 | R | **4 881,00** | R | 4 881,00 |
| 9 | | **WASTE UNIONS ETC.** | | | | | | |
| 9 | | **Note that waste unions are included in relevant sanitary fittings descriptions** | | | | | | |
| 9 | | **Cobra Watertech** | | | | | R | - |
| 9 | | 32mm Basin waste union. | no | 1,00 | R | **196,00** | R | 196,00 |
| 9 | | 38mm Sink waste union. | no | 1,00 | R | **227,00** | R | 227,00 |
| 9 | | 40mm 317 CP sink waste (slab vanities). | no | | R | **216,00** | R | - |
| | | | | | | | R | - |
| 9 | | **TRAPS, ETC.** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | **Note that traps are included in relevant sanitary fittings descriptions** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | **uPVC** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | 32mm Reseal "P" or "S" trap. | no | 4,00 | R | **138,00** | R | 552,00 |
| 9 | | 40 x 300mm Sink combination for double bowl with deepseal "P" trap. | no | | R | **244,00** | R | - |
| | | | | | | **SANITARY FITTINGS TOTAL** | **R** | **10 175,00** |
| 9 | | **TAPS, VALVES ETC** | | | | | | |
| 9 | | **Note that valves are included in relevant water heater descriptions below** | | | | | | |
| | | | | | | | R | - |
| 9 | | Cobra 126 stopcock, chrome plated. | No | 1,00 | R | **577,00** | R | 577,00 |
| 9 | | Cobra 1003/125-28 fullway gate valve. | No | 1,00 | R | **447,00** | R | 447,00 |
| 9 | | Masterflow II Pressure reducing valve, 400 kPa. | No | 1,00 | R | **1 144,00** | R | 1 144,00 |
| 9 | | 400 kPa Multi valve for 10 litre geyser. | No | 1,00 | R | **761,00** | R | 761,00 |
| 9 | | 400 kPa Safety valve for 10 litre geyser. | No | | R | **751,00** | R | - |
| 9 | | 15mm Vacuum breaker for Kwikot heater. | No | 1,00 | R | **132,00** | R | 132,00 |
| 9 | | 20mm Non return valves. | No | 1,00 | R | **245,00** | R | 245,00 |
| | | | | | | **TAPS. VALVES TOTAL** | **R** | **3 306,00** |
| 9 | | **SANITARY PLUMBING** | | | | | | |
| 9 | | **uPVC pipes and fittings** | | | | | | |
| 9 | | 50mm Diameter pipes and fittings (each fittings count for the equivalent of 0.5m pipe price) | m | 3,00 | R | **128,00** | R | 384,00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | | 110mm Diameter pipes and fittings (each fittings count for an equivalent of 1.5m pipe price) | m | 3,00 | R | **243,00** | R | 729,00 |
| 9 | | **Sundries** | | | | | | |
| 9 | | Cut into existing uPVC plumbing stack and join new 110mm uPVC pipe to existing stack | m | 2,00 | R | **614,00** | R | 1 228,00 |
| 9 | | Testing sanitary plumbing system | Item | 1,00 | R | **1 749,00** | R | 1 749,00 |
| | | | | | | **SANITARY PLUMBING TOTAL** | **R** | **4 090,00** |
| 9 | | **WATER SUPPLIES** | | | | | | |
| 9 | | **Class O copper pipes, capillary couplings and fittings (chased into brickwork including paper lagging)** | | | | | | |
| 9 | | 15mm Diameter pipes and fittings (each fittings count for an equivalent of 0.5m pipe price) | m | 6,00 | R | **161,00** | R | 966,00 |
| 9 | | 22mm Dimater pipes and fittings (each fittings count for an equivalent of 0.5m pipe price) | m | 8,00 | R | **183,00** | R | 1 464,00 |
| | | | | | | **WATER SUPPLIES TOTAL** | **R** | **2 430,00** |
| 9 | | **Sundries** | | | | | | |
| 9 | | 15mm Chromium flexi connector with two cap nuts. | No | 5,00 | R | **158,00** | R | 790,00 |
| 9 | | Search for, locate, expose and cut into existing copper water supply pipe, insert junction and connect new 22mm diameter copper water supply pipe. | No | 4,00 | R | **770,00** | R | 3 080,00 |
| 9 | | 20mm Kent Helix Water meter. | No | 1,00 | R | **1 789,00** | R | 1 789,00 |
| 9 | | Testing water system | item | 1,00 | R | **1 529,00** | R | 1 529,00 |
| 9 | | Disinfecting water pipe and tank system | item | | R | **1 894,00** | R | - |
| | | | | | | **SUNDRIES TOTAL** | **R** | **7 188,00** |
| | | | | | | **PLUMBING AND DRAINAGE TOTAL** | **R** | **35 935,00** |
| 10 | | **ELECTRIC WATER HEATERS** | | | | | | |
| 10 | | **Supply and install fitting including all associated copper piping and fittings, taps, valves, trays, overflow pipes, connectors, earth bonding straps, etc** | | | | | | |
| 10 | | Kwikot 100 Litre Slimline 600i Duel electric water heater (ESG-100-l) complying with SABS 151-2002, overall size 990 x 480mm fitted with isolator switch, operating at 400kPa with temperature and pressure safety relief valve including 20mm draincock with inlet compression, 1160 x 560mm wide polyethelene drip tray with union and back nut connected to 3m long 20mm uPVC overflow pipe taken out at eaves (GSTP-1200) and 15mm pipe work including two 15mm vacumn breakers (KH4.150CX) installed on hot and cold water supply, 15mm 400kPa Kwikot Multi control and expansion valve (KHN3.204), and earth bonding strap, all in accordance with SANS 10254, connected to single phase electrical power supply [to kitchens, ladies and gents toilets] [Branch only, Loan Centre require a Hydroboil] | No | 1,00 | R | **9 114,00** | R | 9 114,00 |
| 10 | | Kwikot 50 Litre Slimline 600i Duel electric water heater (ESG-050-l) complying with SABS 151-2002, overall size 610 x 480mm fitted with isolator switch, operating at 400kPa with temperature and pressure safety relief valve including 20mm draincock with inlet compression, 1160 x 560mm wide polyethelene drip tray with union and back nut connected to 3m long 20mm uPVC overflow pipe taken out at eaves (GSTP-1200) and 15mm pipe work including two 15mm vacumn breakers (KH4.150CX) installed on hot and cold water supply, 15mm 400kPa Kwikot Multi control and expansion valve (KHN3.204), and earth bonding strap, all in accordance with SANS 10254, connected to single phase electrical power supply [to kitchens, ladies and gents toilets] [Branch only, Loan Centre require a Hydroboil] | No | | R | **9 062,00** | R | - |
| 10 | | **Geyser sundries** | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | | ***Note that the below are included in relevant water heater descriptions above*** | | | | | | |
| 10 | | Drip tray suitable for 100 Litre geyser (elsewhere measured) including overflow pipe 2000mm long approximately 3000mm above ground level. | no | 1,00 | R | **851,00** | R | 851,00 |
| 10 | | Kwikhot draincock. | no | 1,00 | R | **253,00** | R | 253,00 |
| 10 | | Earth bonding strap. | no | 1,00 | R | **240,00** | R | 240,00 |
| | | | | | | **GEYSER SUNDRIES TOTAL** | **R** | **1 344,00** |
| | | | | | | **ELECTRIC WATER HEATERS TOTAL** | **R** | **10 458,00** |
| 11 | | **GLAZING** | | | | | | |
| 11 | | **MIRRORS** | | | | | | |
| 11 | | **4mm Silvered float glass copper backed mirrors with polished edges, fixed with double sided adhesive tape and silicone glue** | | | | | | |
| 11 | | Mirror 400 x 600 mm high. | No | 1,00 | R | **600,00** | R | 600,00 |
| 11 | | Mirror 400 x 700 mm high. | No | | R | **700,00** | R | - |
| 11 | | Mirror 450 x 900 mm high. | No | | R | **1 050,00** | R | - |
| | | | | | | **GLAZING TOTAL** | **R** | **600,00** |
| **12** | | **CONCRETE, FORMWORK AND REINFORCEMENT** | | | | | | |
| | | **UNREINFORCED CONCRETE** | | | | | | |
| | | **15 MPa/19mm Concrete** | | | | | | |
| | | Surface blinding under footings and bases | m3 | 12,00 | R | **1 350,00** | R | 16 200,00 |
| | | | | | | **UNREINFORCED CONCRETE TOTAL** | **R** | **16 200,00** |
| | | **REINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES** | | | | | | |
| | | **25MPa/19mm Concrete** | | | | | | |
| | | Strip footings | m3 | | R | **1 450,00** | R | - |
| | | Bases | m3 | | R | **1 450,00** | R | - |
| | | | | | | | R | - |
| | | **30MPa/19mm Concrete** | | | | | R | - |
| | | Strip footings | m3 | | R | **1 625,00** | R | - |
| | | Bases | m3 | | R | **1 625,00** | R | - |
| | | | | | | **RCCAES TOTAL** | **R** | **-** |
| | | **REINFORCED CONCRETE** | | | | | | |
| | | **25MPa/19mm Concrete** | | | | | | |
| | | Surface beds cast in panels on waterproofing | m3 | 12,00 | R | **1 500,00** | R | 18 000,00 |
| | | Slabs, including beams and inverted beams | m3 | | R | **1 550,00** | R | - |
| | | Walls in foundations | m3 | | R | **1 550,00** | R | - |
| | | Walls | m3 | | R | **1 550,00** | R | - |
| | | Columns in foundations | m3 | | R | **1 550,00** | R | - |
| | | Columns | m3 | | R | **1 550,00** | R | - |
| | | Stairs, including landings, beams and inverted beams | m3 | | R | **1 600,00** | R | - |
| | | | | | | | R | - |
| | | **30MPa/19mm Concrete** | | | | | R | - |
| | | Surface beds cast in panels on waterproofing | m3 | | R | **1 650,00** | R | - |
| | | Slabs, including beams and inverted beams | m3 | | R | **1 700,00** | R | - |
| | | Walls in foundations | m3 | | R | **1 700,00** | R | - |
| | | Walls | m3 | | R | **1 700,00** | R | - |
| | | Columns in foundations | m3 | | R | **1 700,00** | R | - |
| | | Columns | m3 | | R | **1 700,00** | R | - |
| | | Stairs, including landings, beams and inverted beams | m3 | | R | **1 750,00** | R | - |
| | | | | | | **REINFORCED CONCRETE TOTAL** | **R** | **18 000,00** |
| | | **CONCRETE SUNDRIES** | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Finishing top surfaces of concrete smooth with a power float** | | | | | | |
| | | Surface beds, slabs etc | m2 | 100,80 | **R** | **30,00** | R | 3 024,00 |
| | | Top of beams, walls, etc | m2 | | **R** | **30,00** | R | - |
| | | | | | | **CONCRETE SUNDRIES TOTAL** | **R** | **3 024,00** |
| | | | | | | **CONCRETE FORMWORKS & REINFOCEMENTS TOTAL** | **R** | **37 224,00** |
| 13 | | **ROUGH FORMWORK (DEGREE OF ACCURACY II)** | | | | | | |
| | | **Rough formwork to sides** | | | | | | |
| | | Strip footings | m2 | | **R** | **220,00** | R | - |
| | | Bases | m2 | | **R** | **220,00** | R | - |
| | | Walls in foundations | m2 | 40,00 | **R** | **280,00** | R | 11 200,00 |
| | | Walls | m2 | | **R** | **280,00** | R | - |
| | | Walls propped up exceeding 3,5m and not exceeding 5m high | m2 | | **R** | **330,00** | R | - |
| | | | | | | **RF TO SIDES TOTAL** | **R** | **11 200,00** |
| | | **SMOOTH FORMWORK (DEGREE OF ACCURACY II)** | | | | | | |
| | | **Smooth formwork to sides** | | | | | | |
| | | Walls | m2 | 134,00 | **R** | **310,00** | R | 41 540,00 |
| | | Walls propped up exceeding 3,5m and not exceeding 5m high | m2 | | **R** | **360,00** | R | - |
| | | | | | | **SF TO SIDES TOTAL** | **R** | **41 540,00** |
| 14 | | **REINFORCEMENT** | | | | | | |
| | | Mild steel reinforcement to structural concrete work of various diameters | ton | | **R** | **14 500,00** | R | - |
| | | High tensile steel reinforcement to structural concrete work of various diameters | ton | | **R** | **14 500,00** | R | - |
| | | **High tensile steel dowel bars** | | | | | | |
| | | 25mm Diameter dowel bar 400mm long with one end embedded 200mm deep in side of concrete at expansion joint and other end greased and wrapped in polythene sheeting including hole through formwork | No | | **R** | **130,00** | R | - |
| | | **Fabric reinforcement** | | | | | | |
| | | Type 193 mesh in concrete surface beds, slabs, etc. | m2 | | **R** | **60,00** | R | - |
| | | | | | | **REINFORCEMENT TOTAL** | **R** | **-** |
| 15 | | **FOUNDATIONS** | | | | | | |
| | | **Brickwork of NFX clay bricks in Class I mortar** | | | | | | |
| | | Half brick (110mm) wall | m2 | | **R** | **285,00** | R | - |
| | | One Brick (220mm) wall | m2 | 100,80 | **R** | **440,00** | R | 44 352,00 |
| | | 280mm Hollow walls of two brick skins including wire ties | m2 | | **R** | **450,00** | R | - |
| | | | | | | **FOUNDATIONS TOTAL** | **R** | **44 352,00** |
| | | | | | | **ROUGH FORMWORKS TOTAL** | **R** | **97 092,00** |
| **16** | | **WATERPROOFING** | | | | | | |
| | | **DAMPROOFING OF WALLS AND FLOORS** | | | | | | |
| | | **One layer of 375 micron "Consol Plastics Brikgrip DPC" embossed damp-proof course** | | | | | | |
| | | In walls. | m2 | 160,00 | **R** | **30,00** | R | 4 800,00 |
| | | **One layer of 250 micron "Consol Plastics Gunplas USB Green" waterproof sheeting sealed at laps with "Gunplas Pressure Sensitive Tape"** | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Under surface beds | m2 | 100,80 | **R** | **35,00** | R | 3 528,00 |
| | | **Two coats "Brixeal" bitumen emulsion waterproof coating:** | | | | | | |
| | | On bagged brick walls | m2 | | **R** | **65,00** | R | - |
| | | | | | | **WATERPROOFING TOTAL** | **R** | **8 328,00** |
| | | | | | | **MAIN CONTRACT TOTAL** | **R** | **464 623,40** |

**Table 38 - Conventional Brick - Electrical BOQ**

| Site Name | Conventional Brick |
|---|---|
| Site Size ($m^2$) | 101 |

| NATIONAL BOQ RATES - LAND AND BUILDING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Bill | Item | Description | Unit | Quantity | Rate | | Amount | |
| | | | | | | | | |
| 17 | | ELECTRICAL | | | | | | |
| | | | | | | | | |
| | | CONDUITS, CHANNELS, WIRING AND ACCESSORIES | | | | | | |
| | | **PVC conduit fixed on surface:** | | | | | | |
| | | 20mm. | m | | R | 18,00 | R | - |
| | | 25mm. | m | | R | 22,00 | R | - |
| | | | | | | | R | - |
| | | **PVC conduit installed in drywall:** | | | | | R | - |
| | | 20mm. | m | | R | 17,00 | R | - |
| | | 25mm. | m | | R | 22,00 | R | - |
| | | | | | | | R | - |
| | | **PVC conduit chased in brickwork, including chasing. (Making good by others):** | | | | | R | - |
| | | 20mm. | m | 22,00 | R | 32,00 | R | 704,00 |
| | | 25mm. | m | | R | 37,00 | R | - |
| | | | | | | | R | - |
| | | **PVC conduit chased in concrete, including chasing. (Making good by others):** | | | | | R | - |
| | | 20mm. | m | | R | 39,00 | R | - |
| | | 25mm. | m | | R | 44,00 | R | - |
| | | | | | | | R | - |
| | | **PVC conduit boxes:** | | | | | R | - |
| | | 60mm round x 25mm deep on surface with cover. | no | | R | 20,00 | R | - |
| | | | | | | | R | - |
| | | **PVC Conduit ends, complete with locknut and bush:** | | | | | R | - |
| | | 20mm. | no | 12,00 | R | 12,00 | R | 144,00 |
| | | 25mm. | no | | R | 18,00 | R | - |
| | | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, chased in brickwork, including chasing. (Making good by others):** | | | | | R | - |
| | | 60mm round x 25mm deep. | no | | R | 23,00 | R | - |
| | | 100 x 50 x 50mm. | no | 5,00 | R | 31,00 | R | 155,00 |
| | | 100 x 100 x 50mm. | no | 7,00 | R | 35,00 | R | 245,00 |
| | | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, fixed in drywall partitioning:** | | | | | R | - |
| | | 100 x 50 x 50mm. | no | | R | 31,00 | R | - |
| | | 100 x 100 x 50mm. | no | | R | 32,00 | R | - |
| | | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, surface mounted:** | | | | | R | - |
| | | 100 x 50 x 50mm. | no | | R | 31,00 | R | - |
| | | 100 x 100 x 50mm. | no | | R | 32,00 | R | - |
| | | Galvanised draw-wires installed in conduits and cable sleeves. | m | 80,00 | R | 5,00 | R | 400,00 |
| | | **PVC insulated MVGP grade conductor laid with cable, drawn into conduit, wiring channel or powerskirting:** | | | | | | |
| | | 2.5mm². | m | | R | 9,00 | R | - |
| | | 4mm². | m | | R | 12,00 | R | - |
| | | 6mm². | m | | R | 16,00 | R | - |
| | | 10mm². | m | | R | 21,00 | R | - |
| | | 16mm². | m | | R | 33,00 | R | - |
| | | 25mm². | m | | R | 51,00 | R | - |
| | | 35mm². | m | | R | 66,00 | R | - |
| | | **Insulated earthwire, drawn into conduit, wiring channel or powerskirting:** | | | | | | |
| | | 2.5mm². | m | | R | 9,00 | R | - |
| | | 4mm². | m | | R | 12,00 | R | - |
| | | 10mm² | m | | R | 21,00 | R | - |
| | | 16mm² | m | | R | 31,00 | R | - |
| | | 25mm² | m | | R | 48,00 | R | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 35mm² | m | | R | **63,00** | R | - |
| | | Copper Earth Bar (10 way - Predrilled 25mmx6mm), mounted on Insulted Supports 300mm AFFL | no | 1,00 | R | **700,00** | R | 700,00 |
| | | **SABS approved twin and earth drawn into wiring trunking or drawn into conduit chased into walls:** | | | | | | |
| | | 2,5mm² x 2-core. | m | 80,00 | R | **19,00** | R | 1 520,00 |
| | | 4mm² x 2-core. | m | | R | **28,00** | R | - |
| | | **Termination by means of gripper glands:** | | | | | | |
| | | No 0 glands | no | | R | **17,00** | R | - |
| | | No 1 glands | no | | R | **17,00** | R | - |
| | | No 2 glands | no | | R | **24,00** | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | **MAIN CONTRACT TOTAL** | | **R** | **3 868,00** |

**Table 39 - Conventional Cinder Block - Summary BOQ**

| | | |
|---|---|---|
| **Site Name** | Conventional Cinder Block | |
| **Site Size ($m^2$)** | **101** | |
| **Expected Construction Period in weeks** | **6** | |
| **Number of Bricks to be used to build house** | **0** | |
| **Number of Blocks to be used to build house** | **1484** | |
| **Number of Polysmart prefabs to be used to build house** | **0,00** | |
| **Number of Bricks to be used on foundation** | **5973** | |
| | | |
| e-Mail Address | | |
| Telephone Number | | |
| Cellular Phone Number | | |

**0**

**BILL OF QUANTITIES SUMMARY** **0**

| BILL NO. | DESCRIPTION | | Asset Classification: Land & Building | Electrical | Mechanical | Energy / Water Metering | Amount |
|---|---|---|---|---|---|---|---|
| | **Preliminaries - See below** | | | | | | |
| BILL NO. 1 | MASONRY | | R 108 593,00 | | | | R - |
| BILL NO. 2 | PARTITIONS ETC | | R - | | | | R - |
| BILL NO. 3 | VINYL | | R - | | | | R - |
| BILL NO. 4 | TILING | | R 39 960,80 | | | | R - |
| BILL NO. 5 | PRESSED STEEL DOOR FRAMES | | R 12 001,00 | | | | R - |
| BILL NO. 6 | WINDOW FRAMES | | R 23 830,00 | | | | R - |
| BILL NO. 7 | ROOFING | | R 44 925,00 | | | | R - |
| BILL NO. 8 | PAINTWORK | | R 28 452,60 | | | | R - |
| BILL NO. 9 | PLUMBING AND DRAINAGE | | R 35 935,00 | | | | R - |
| BILL NO. 10 | ELECTRICAL WATER HEATERS | | R 10 458,00 | | | | R - |
| BILL NO. 11 | GLAZING | | R 600,00 | | | | R - |
| BILL NO. 12 | CONCRETE, FORMWORK AND REINFORCEMENT | | R 37 224,00 | | | | R - |
| BILL NO. 13 | ROUGH FORMWORK | | R 97 092,00 | | | | R - |
| BILL NO. 14 | WATER PROOFING | | R 8 328,00 | | | | R - |
| BILL NO. 17 | ELECTRICAL WORK | | - | R 3 868,00 | | | R - |
| | ***SUB-TOTAL:*** | | **R 447 399,40** | **R 3 868,00** | **R -** | **R -** | **R 451 267,40** |
| | **PRELIMINARIES (Main Contractor/Electrical/HVAC** | | **R -** | **R -** | **R -** | | **R -** |
| | ***TOTAL:*** | | **R 447 399,40** | **R 3 868,00** | **R -** | **R -** | **R 451 267,40** |
| | | | | | | ***VAT @ 14%*** | **R 63 177,44** |
| | | | | | | ***TOTAL*** | **R 514 444,84** |

| | *PC* | *EC* | *HVAC* | *FIRE DETECTION* | *Total TK Boq* |
|---|---|---|---|---|---|
| ***Rand/m2 (Excluding Preliminaries)*** | **R 4 429,70** | **R 38,30** | **R -** | **R -** | **R 4 467,99** |

**Table 40 - Conventional Cinder Block - Main contractor BOQ**

| Site Name | Conventional Cinder Block |
|---|---|
| Site Size ($m^2$) | 101 |

| NATIONAL BOQ RATES - LAND AND BUILDING | | | | | | |
|---|---|---|---|---|---|---|
| **Bill** | **Item** | **Description** | **Unit** | **Quantity** | **Rate** | **Amount** |
| | | | | | | |
| **1** | | **MASONRY** | | | | |
| | | | | | | |
| | | **BRICKWORK** | | | | |
| 1 | 1 | Supply and install /$m^2$ brick, incl. brick and mortar. Single Brick, 102.5 x 75 x 225mm. Thickness of wall 112.5mm | m2 | | **R 534,00** | R - |
| 1 | 2 | Supply and install /$m^2$ brick, incl. brick and mortar. double Brick, 225 x 75 x 225mm. Thickness of wall 225mm | m2 | | **R 1 068,00** | R - |
| 1 | 3 | Supply and install /m2 block, incl. block and mortar. External concrete block size, 210 x 210 x 430mm. Thickness of wall 210mm | m2 | 77 | **R 715,00** | R 55 055,00 |
| 1 | 4 | Supply and install /m2 block, incl. block and mortar. Internal concrete block size, 110 x 210 x 430mm. Thickness of wall 110mm | m2 | 57 | **R 704,00** | R 40 128,00 |
| | | | | | **BRICKWORK TOTAL** | **R 95 183,00** |
| | | **BRICKWORK SUNDRIES** | | | | |
| 1 | 5 | Cutting toothing and bonding new brickwork to existing | m2 | | **R 125,00** | R - |
| 1 | 6 | Splayed mortar fillet one course high in 60mm cavity. | m | | **R 40,00** | R - |
| 1 | 7 | Closing 60mm cavity of hollow wall vertically with brickwork half-brick wide. | m | | **R 50,00** | R - |
| 1 | 8 | Closing 60mm cavity of hollow wall horizontally with one course of brickwork. | m | | **R 55,00** | R - |
| | | **Fair face to brickwork in horizontal stretcher bond pointed with recessed horizontal and vertical joints** | | | | |
| 1 | 9 | Extra for fair face | m2 | 77 | **R 75,00** | R 5 775,00 |
| 1 | 10 | **Bagging of 1:3 cement sand mixture** | | | | |
| 1 | 11 | On brick walls, piers, etc | m2 | | **R 55,00** | R - |
| | | **Joint forming material in movement joints** | | | | |
| 1 | 12 | 12mm Fibre board built in vertically between brick skins | m2 | 77 | **R 75,00** | R 5 775,00 |
| | | **Brickwork reinforcement** | | | | |
| 1 | 13 | 75mm Wide reinforcement built in horizontally. | m | 82 | **R 5,00** | R 410,00 |
| 1 | 14 | 150mm Wide reinforcement built in horizontally. | m | | **R 10,00** | R - |
| | | **Precast pre-stressed concrete lintels** | | | | |
| 1 | 15 | 110 x 75mm SABS Approved Lintels in lengths not exceeding 3m. | m | 14 | **R 75,00** | R 1 050,00 |
| 1 | 16 | **Turning pieces** | | | | |
| 1 | 17 | 230mm Wide turning piece to lintels etc | m | | **R 70,00** | R - |
| | | **Galvanised hoop iron cramps, ties, etc.** | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 18 | 30 x 1.6mm 500mm long with one end shot pinned to concrete and other end built into brickwork | no | 10 | R | 40,00 | R 400,00 |
| | | | | | | BW SUNDRIES TOTAL | R 13 410,00 |
| | | | | | | MASONRY TOTAL | R 108 593,00 |
| 2 | | **PARTITONS ETC** | | | | | |
| 2 | | **Gypwall FireStop HiSpec 63F120S50 with fire rating of two hours, covered on both sides with TWO layers of Gyproc Firestop 12,5mm thick wallboards, and one layer of 1,6mm thick galvanised steel plate on the "exterior or attack face", with the steel plate screwed to studs and tracks. Boards to be butt jointed and finished with Gyproc Rhino tape and De Braven Zwaluw Acryl-W Acrylic Silicone jointing compound all in accordance with the manufacturer's instructions. Cover Gyproc Rhinotape with two layers of Gyproc RhinoLite and exposed surfaces of partitons skimmed with one layer of Gyproc RhinoLite. Intersections and abutments are measured separately and descriptions shall be deemed to include any additional corner beads, jointing compound, tape, etc.** | | | | | |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm | No | | R | 1 250,00 | R - |
| 2 | 19 | Extra over partition 2.4m high for vertical abutment, fair end, t-junction, corners etc. | No | | R | 350,00 | R - |
| | | Extra over partition for forming 813 x 2032mm high opening for doors (elsewhere measured) including 64 x 64 x 4mm SHS H-frame, bolts, angles, plates, etc | No | | R | 825,00 | R - |
| | | Extra over partition for forming 950 x 2032mm high opening for doors (elsewhere measured) | No | | R | 750,00 | R - |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm. Including Flush outlet boxes, excluding covers, fixed in drywall partitioning: 100 x 50 x 50mm. | No | | R | 1 270,00 | R - |
| 2 | 1 | Supply and install /$m^2$ panel, incl. panels and mortar. 110 x 2400 x 1200mm Poly Smart wall. Thickness of wall 110mm. Including Flush outlet boxes, excluding covers, fixed in drywall partitioning: 100 x 100 x 50mm. | No | | R | 1 280,00 | R - |
| | | | | | | PARTITIONS TOTAL | R - |
| 2 | | **Sundries** | | | | | |
| 2 | | Natural anodised aluminium rebated door frame (typically only applicable when frames are inserted in existing brick wall openings and existing doors rehung) | m | | R | 500,00 | |
| 2 | | 16mm Thick supawood noggins for fixtures and fittings | m2 | | R | 250,00 | R - |
| | | 18mm Plywood for noggins for fixtures and fittings | m2 | | R | 270,00 | R - |
| 2 | | Extra over partition for Load Bearing Track 63.5mm wide | m | | R | 225,00 | R - |
| 2 | | Extra over partition for noggins for Load Bearing stud noggins for heavy duty fixtures | m | | R | 225,00 | R - |
| | | | | | | PARTITIONS SUNDRIES TOTAL | R - |
| | | | | | | PARTITIONS ETC TOTAL | R - |
| 3 | | **FLOOR COVERINGS** | | | | | |
| 3 | | **VINYL** | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | | 2,0mm thick x 300mm x 300mm FloorworX Floorflex semi-flexible vinyl floor tiles in Moor Grey finish (Colour code: MF2502) (S4000) laid in Earthbond solvent free acylic bond adhesive adhesive on and including suitably prepared subfloor, and installed as per manufacturer's recommendations. | m2 | | R | 226,00 | R | - |
| 3 | | Polyflor 2,0mm thick Classic Mystique PUR lifelong polish free Homogeneous vinyl floor colour Nocturne (Colour code: 1380), laid in Earthbond solvent free acylic bond adhesive on and including suitably prepared subfloor, and installed as per manufacturer's recommendations. | m2 | | R | 513,00 | R | - |
| | | | | | | **VINYL TOTAL** | **R** | **-** |
| 4 | | **TILING** | | | | | | |
| 4 | | **400 x 400mm Tile Africa Pablo Sand (Light) Glazed ceramic tiles (PL137) flush pointed with tinted jointing compound fixed with adhesive to bedding. Bedding (elsewhere measured)** | | | | | | |
| 4 | | On floors and landings | m2 | 110 | R | 315,00 | R | 34 650,00 |
| 4 | | On narrow widths | m2 | | R | 340,00 | R | - |
| 4 | | On risers 180mm high of stretcher course tiles | m | | R | 100,00 | R | - |
| 4 | | On treads 250mm wide with stretcher course tiles | m | | R | 125,00 | R | - |
| 4 | | Skirting 150mm high | m | 62 | R | 85,00 | R | 5 310,80 |
| | | | | | | **TILING TOTAL** | **R** | **39 960,80** |
| 5 | | **PRESSED STEEL DOOR FRAMES** | | | | | | |
| 5 | | **1,2mm Rebated frames suitable for half brick walls** | | | | | | |
| 5 | | Frame for door 813 x 2032mm high. | No | | R | 850,00 | R | - |
| 5 | | Frame for door 950 x 2032mm high. | No | | R | 1 150,00 | R | - |
| 5 | | 813 x 2300mm High Access Door - including frame, architraves, ironmongery and varnish. | No | 5,00 | R | 1 952,00 | R | 9 760,00 |
| 5 | | 950 x 2300mm High Access Door - including frame, architraves, ironmongery and varnish. | No | 1,00 | R | 2 241,00 | R | 2 241,00 |
| | | | | | | **PRESSED DOOR FRAMES TOTAL** | **R** | **12 001,00** |
| 6 | | **WINDOW FRAMES** | | | | | | |
| 6 | | **WOODEN RAMES** | | | | | | |
| 6 | | Swartland Winster 595 x 900mm. Complete with glass panes, vanish and installation | No | | R | 1 400,00 | R | - |
| 6 | | Swartland Winster 995 x 900mm. Complete with glass panes, vanish and installation | No | 1,00 | R | 1 530,00 | R | 1 530,00 |
| 6 | | Swartland Winster 1200 x 900mm. Complete with glass panes, vanish and installation | No | 4,00 | R | 2 900,00 | R | 11 600,00 |
| 6 | | Swartland Winster 1600 x 1400mm. Complete with glass panes, vanish and installation | No | 2,00 | R | 3 400,00 | R | 6 800,00 |
| 6 | | Swartland Winster 2400 x 1400mm. Complete with glass panes, vanish and installation | No | 1,00 | R | 3 900,00 | R | 3 900,00 |
| | | | | | | **WINDOW FRAMES TOTAL** | **R** | **23 830,00** |
| 7 | | **ROOFING** | | | | | | |
| 7 | | **PROFILED FIBRE-CEMENT SHEETING AND ACCESSORIES** | | | | | | |
| 7 | | **Everite Nutec Bigsix roof sheeting with 875mm cover, fixed at a pitch of 25º to existing timber purlins at 1200mm centres with 90mm drive screws with Everseal washers at second and fourth crest of each sheet and minimum of 50mm from edge of sheet with mitred corners as required with minimum 150mm end laps, all in accordance with the manufacturer's recommendations.** | | | | | | |
| 7 | | Roof covering with pitch not exceeding 25 degrees | m2 | 122,00 | R | 300,00 | R | 36 600,00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | | Side apron flashing | m | 26,00 | R | 100,00 | R | 2 600,00 |
| 7 | | End apron flashing | m | 19,00 | R | 100,00 | R | 1 900,00 |
| 7 | | Plain adjustable ridge / hip capping including junctions and end caps | m | | R | 130,00 | R | - |
| 7 | | Birdproofing | m | 45,00 | R | 85,00 | R | 3 825,00 |
| 7 | | Eaves fillers | m | | R | 100,00 | R | - |
| 7 | | U-flashing | m | | R | 120,00 | R | - |
| | | | | | | ROOFING TOTAL | R | 44 925,00 |
| 8 | | **PAINTWORK** | | | | | | |
| 8 | | **ON FLOATED PLASTER** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |
| 8 | | Extra over for water based primer and water based Double Velvet | m2 | | R | 70,00 | R | - |
| | | | | | | FLOATED PLASTER TOTAL | R | - |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Wall and All** | | | | | | |
| 8 | | On external walls | m2 | | R | 667,00 | R | - |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |
| 8 | | On ceilings and beams | m2 | | R | 68,00 | R | - |
| | | | | | | ONE COAT PP TOTAL | R | - |
| 8 | | **ON PLASTER BOARD** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Polvin Walls and Ceilings** | | | | | | |
| 8 | | On partitions | m2 | 160 | R | 65,00 | R | 10 400,00 |
| 8 | | On ceilings and cornices | m2 | 101 | R | 65,00 | R | 6 541,60 |
| | | | | | | PLASTER BOARD TOTAL | R | 16 941,60 |
| 8 | | **ON FIBRE CEMENT** | | | | | | |
| 8 | | **One coat Plascon Plaster Primer UC56 and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On ceilings and cornices | m2 | | R | 65,00 | R | - |
| 8 | | On facias and bargeboards | m2 | | R | 65,00 | R | - |
| | | | | | | FIBRE CEMENT TOTAL | R | - |
| 8 | | **ON WOOD** | | | | | | |
| 8 | | **One coat Plascon Wood Primer UC2 and two coats Plascon Velvaglo** | | | | | | |
| 8 | | On doors | m2 | 12 | R | 77,00 | R | 924,00 |
| 8 | | On windows, sash doors and fanlights | m2 | 6 | R | 79,00 | R | 474,00 |
| 8 | | On louvred windows and doors | m2 | | R | 79,00 | R | - |
| 8 | | On door frames | m2 | | R | 79,00 | R | - |
| 8 | | On roof timbers at eaves and verges | m2 | | R | 79,00 | R | - |
| 8 | | On skirtings, rails, etc not exceeding 300mm girth | m | | R | 35,00 | R | - |
| | | | | | | WOOD TOTAL | R | 1 398,00 |
| 8 | | **ON FLOATED PLASTER** | | | | | | |
| 8 | | **One coat Plascon Universal Undercoat (UC 1) and two coats Plascon Double Velvet** | | | | | | |
| 8 | | On internal walls. | m2 | | R | 67,00 | R | - |
| 8 | | Extra over for water based primer and water based Double Velvet | m2 | | R | 7,00 | R | - |
| 8 | | **One coat Plascon Plaster Primer (UC 56) primer two coats Plascon Wall and All** | | | | | | |
| 8 | | On external walls | m2 | | R | 67,00 | R | - |
| 8 | | On internal walls | m2 | | R | 67,00 | R | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | | On ceilings and beams | m2 | | R | 68,00 | R | - |
| | | | | | | **FLOATED PLASTER TOTAL** | **R** | **-** |
| 8 | | **ON METAL** | | | | | | |
| 8 | | **One coat Plascon Steel Primer UC501 and two coats Plascon Velvaglo** | | | | | | |
| 8 | | On doors | m2 | | R | 77,00 | R | - |
| 8 | | On door frames | m2 | 3 | R | 77,00 | R | 231,00 |
| 8 | | On windows | m2 | | R | 81,00 | R | - |
| 8 | | On gates, grilles, burglar screens, balustrades, etc (both sides measured over the full flat area) | m2 | | R | 81,00 | R | - |
| 8 | | On rails, bars, pipes, etc | m2 | | R | 81,00 | R | - |
| 8 | | On eaves gutters | m2 | | R | 81,00 | R | - |
| 8 | | On rails, bars, pipes, etc not exceeding 300mm girth | m | | R | 35,00 | R | - |
| 8 | | Extra over for water based primer and water based Velvaglo | m2 | | R | 8,00 | R | - |
| | | | | | | **METAL TOTAL** | **R** | **231,00** |
| 8 | | **ROOF TILES** | | | | | | |
| 8 | | **One coat Nuroof Acrylic Roof Paint thinned 10:1 with water and one coat Nuroof Acrylic Roof Paint (TRP)** | | | | | | |
| 8 | | On facias | m2 | | R | 83,00 | R | - |
| 8 | | On roof tiles | m2 | 122 | R | 81,00 | R | 9 882,00 |
| | | | | | | **ROOF TILES TOTAL** | **R** | **9 882,00** |
| | | | | | | **PAINT WORK TOTAL** | **R** | **28 452,60** |
| 9 | | **PLUMBING AND DRAINAGE** | | | | | | |
| 9 | | **RAINWATER DISPOSAL** | | | | | | |
| 9 | | **Galvanised steel gutters** | | | | | | |
| 9 | | 100 x 75mm Eaves gutters, including angles, and end cap | m | 26,00 | R | 261,00 | R | 6 786,00 |
| 9 | | 125 x 100mm Eaves gutters, including bends and end cap | m | | R | 300,00 | R | - |
| 9 | | 75 X 75mm Rainwater pipes, including outlet, bends and shoe | m | 10,00 | R | 196,00 | R | 1 960,00 |
| | | | | | | | R | - |
| 9 | | **Saint Gobain** | | | | | R | - |
| 9 | | 100mm 90º centre bolt side roof outlet with dome grating (03585) | No | | R | 822,00 | R | - |
| | | | | | | **RAINWATER DISPOSAL TOTAL** | **R** | **8 746,00** |
| 9 | | **SANITARY FITTINGS** | | | | | | |
| 9 | | **Supply and install sanitary fitting complete, including taps, waste outlets, plugs, valves, traps, connectors, 15mm hot and cold copper water supply and fittings, uPVC waste water pipes and fittings, etc, to form one complete and operational plumbing point. All fitted in strict accordance with manufacturer's recommendations and instructions.** | | | | | | |
| 9 | | **All sanitary fittings to be sealed against wall and floor finishes with De Braven Zwaluw Silicone Sanitary sealant** | | | | | | |
| 9 | | **Stainless steel sinks** | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9 | | "Kwikot" Grade 430 17/10 stainless steel Standard preparation bowl sink and drainer (SPB-STD) overall size 430mm outer diameter x 135mm deep or equivalent, Cobra sink mounted Stella sink mixer (3396ST), chrome waste outlet with chain and plug, No line watersaver insert (P-WS/6-Noline), single bowl flexible P-trap, two 15mm flexible connector valves and cap nuts, two water points and one drainage point | No | 1,00 | R | **4 319,00** | R | 4 319,00 |
| 9 | | Hibiscus vitreous china lavatory basin colour White (Code: 7023), size 510 x 405mm with one taphole including integrated overflow and chainstay hole bolted to wall with two x 10mm bolts (Code: 8448Z0) and including Classic floor mounted pedestal (Code: 7150) and sealed with silicone sealant where basin meets wall, Cobra Watertech Stella Bright 15mm chrome plated basin mixer restricted to 6l/min maximum flow (Code: 3294SB) with pop-up waste (Code: S-380), cast fixed spout and 400mm long flexible inlets, manufactured in accordance with SANS 226:2009 Type 2 (BS 5412)., No-line water saver insert (P-WS/6-Noline), 32mm CP bottle trap, two 15mm flexi connector valves and cap nuts, two water points and one drainage point. | No | 1,00 | R | **4 881,00** | R | 4 881,00 |
| 9 | | **WASTE UNIONS ETC.** | | | | | | |
| 9 | | **Note that waste unions are included in relevant sanitary fittings descriptions** | | | | | | |
| 9 | | **Cobra Watertech** | | | | | R | - |
| 9 | | 32mm Basin waste union. | no | 1,00 | R | **196,00** | R | 196,00 |
| 9 | | 38mm Sink waste union. | no | 1,00 | R | **227,00** | R | 227,00 |
| 9 | | 40mm 317 CP sink waste (slab vanities). | no | | R | **216,00** | R | - |
| | | | | | | | R | - |
| 9 | | **TRAPS, ETC.** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | **Note that traps are included in relevant sanitary fittings descriptions** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | **uPVC** | | | | | R | - |
| | | | | | | | R | - |
| 9 | | 32mm Reseal "P" or "S" trap. | no | 4,00 | R | **138,00** | R | 552,00 |
| 9 | | 40 x 300mm Sink combination for double bowl with deepseal "P" trap. | no | | R | **244,00** | R | - |
| | | | | | | **SANITARY FITTINGS TOTAL** | **R** | **10 175,00** |
| 9 | | **TAPS, VALVES ETC** | | | | | | |
| 9 | | **Note that valves are included in relevant water heater descriptions below** | | | | | | |
| | | | | | | | R | - |
| 9 | | Cobra 126 stopcock, chrome plated. | No | 1,00 | R | **577,00** | R | 577,00 |
| 9 | | Cobra 1003/125-28 fullway gate valve. | No | 1,00 | R | **447,00** | R | 447,00 |
| 9 | | Masterflow II Pressure reducing valve, 400 kPa. | No | 1,00 | R | **1 144,00** | R | 1 144,00 |
| 9 | | 400 kPa Multi valve for 10 litre geyser. | No | 1,00 | R | **761,00** | R | 761,00 |
| 9 | | 400 kPa Safety valve for 10 litre geyser. | No | | R | **751,00** | R | - |
| 9 | | 15mm Vacuum breaker for Kwikot heater. | No | 1,00 | R | **132,00** | R | 132,00 |
| 9 | | 20mm Non return valves. | No | 1,00 | R | **245,00** | R | 245,00 |
| | | | | | | **TAPS. VALVES TOTAL** | **R** | **3 306,00** |
| 9 | | **SANITARY PLUMBING** | | | | | | |
| 9 | | **uPVC pipes and fittings** | | | | | | |
| 9 | | 50mm Diameter pipes and fittings (each fittings count for the equivalent of 0.5m pipe price) | m | 3,00 | R | **128,00** | R | 384,00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | | 110mm Diameter pipes and fittings (each fittings count for an equivalent of 1.5m pipe price) | m | 3,00 | **R** | **243,00** | R | 729,00 |
| 9 | | **Sundries** | | | | | | |
| 9 | | Cut into existing uPVC plumbing stack and join new 110mm uPVC pipe to existing stack | m | 2,00 | **R** | **614,00** | R | 1 228,00 |
| 9 | | Testing sanitary plumbing system | Item | 1,00 | **R** | **1 749,00** | R | 1 749,00 |
| | | | | | | **SANITARY PLUMBING TOTAL** | **R** | **4 090,00** |
| 9 | | **WATER SUPPLIES** | | | | | | |
| 9 | | **Class O copper pipes, capillary couplings and fittings (chased into brickwork including paper lagging)** | | | | | | |
| 9 | | 15mm Diameter pipes and fittings (each fittings count for an equivalent of 0.5m pipe price) | m | 6,00 | **R** | **161,00** | R | 966,00 |
| 9 | | 22mm Dimater pipes and fittings (each fittings count for an equivalent of 0.5m pipe price) | m | 8,00 | **R** | **183,00** | R | 1 464,00 |
| | | | | | | **WATER SUPPLIES TOTAL** | **R** | **2 430,00** |
| 9 | | **Sundries** | | | | | | |
| 9 | | 15mm Chromium flexi connector with two cap nuts. | No | 5,00 | **R** | **158,00** | R | 790,00 |
| 9 | | Search for, locate, expose and cut into existing copper water supply pipe, insert junction and connect new 22mm diameter copper water supply pipe. | No | 4,00 | **R** | **770,00** | R | 3 080,00 |
| 9 | | 20mm Kent Helix Water meter. | No | 1,00 | **R** | **1 789,00** | R | 1 789,00 |
| 9 | | Testing water system | item | 1,00 | **R** | **1 529,00** | R | 1 529,00 |
| 9 | | Disinfecting water pipe and tank system | item | | **R** | **1 894,00** | R | - |
| | | | | | | **SUNDRIES TOTAL** | **R** | **7 188,00** |
| | | | | | | **PLUMBING AND DRAINAGE TOTAL** | **R** | **35 935,00** |
| 10 | | **ELECTRIC WATER HEATERS** | | | | | | |
| 10 | | **Supply and install fitting including all associated copper piping and fittings, taps, valves, trays, overflow pipes, connectors, earth bonding straps, etc** | | | | | | |
| 10 | | Kwikot 100 Litre Slimline 600i Duel electric water heater (ESG-100-l) complying with SABS 151-2002, overall size 990 x 480mm fitted with isolator switch, operating at 400kPa with temperature and pressure safety relief valve including 20mm draincock with inlet compression, 1160 x 560mm wide polyethelene drip tray with union and back nut connected to 3m long 20mm uPVC overflow pipe taken out at eaves (GSTP-1200) and 15mm pipe work including two 15mm vacumn breakers (KH4.150CX) installed on hot and cold water supply, 15mm 400kPa Kwikot Multi control and expansion valve (KHN3.204), and earth bonding strap, all in accordance with SANS 10254, connected to single phase electrical power supply [to kitchens, ladies and gents toilets] [Branch only, Loan Centre require a Hydroboil] | No | 1,00 | **R** | **9 114,00** | R | 9 114,00 |
| 10 | | Kwikot 50 Litre Slimline 600i Duel electric water heater (ESG-050-l) complying with SABS 151-2002, overall size 610 x 480mm fitted with isolator switch, operating at 400kPa with temperature and pressure safety relief valve including 20mm draincock with inlet compression, 1160 x 560mm wide polyethelene drip tray with union and back nut connected to 3m long 20mm uPVC overflow pipe taken out at eaves (GSTP-1200) and 15mm pipe work including two 15mm vacumn breakers (KH4.150CX) installed on hot and cold water supply, 15mm 400kPa Kwikot Multi control and expansion valve (KHN3.204), and earth bonding strap, all in accordance with SANS 10254, connected to single phase electrical power supply [to kitchens, ladies and gents toilets] [Branch only, Loan Centre require a Hydroboil] | No | | **R** | **9 062,00** | R | - |
| 10 | | **Geyser sundries** | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | | ***Note that the below are included in relevant water heater descriptions above*** | | | | | | |
| 10 | | Drip tray suitable for 100 Litre geyser (elsewhere measured) including overflow pipe 2000mm long approximately 3000mm above ground level. | no | 1,00 | R | 851,00 | R | 851,00 |
| 10 | | Kwikhot draincock. | no | 1,00 | R | 253,00 | R | 253,00 |
| 10 | | Earth bonding strap. | no | 1,00 | R | 240,00 | R | 240,00 |
| | | | | | | GEYSER SUNDRIES TOTAL | R | 1 344,00 |
| | | | | | | ELECTRIC WATER HEATERS TOTAL | R | 10 458,00 |
| 11 | | GLAZING | | | | | | |
| 11 | | MIRRORS | | | | | | |
| 11 | | 4mm Silvered float glass copper backed mirrors with polished edges, fixed with double sided adhesive tape and silicone glue | | | | | | |
| 11 | | Mirror 400 x 600 mm high. | No | 1,00 | R | 600,00 | R | 600,00 |
| 11 | | Mirror 400 x 700 mm high. | No | | R | 700,00 | R | - |
| 11 | | Mirror 450 x 900 mm high. | No | | R | 1 050,00 | R | - |
| | | | | | | GLAZING TOTAL | R | 600,00 |
| 12 | | CONCRETE, FORMWORK AND REINFORCEMENT | | | | | | |
| 12 | | UNREINFORCED CONCRETE | | | | | | |
| 12 | | 15 MPa/19mm Concrete | | | | | | |
| 12 | | Surface blinding under footings and bases | m3 | 12,00 | R | 1 350,00 | R | 16 200,00 |
| | | | | | | UNREINFORCED CONCRETE TOTAL | R | 16 200,00 |
| 12 | | REINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES | | | | | | |
| 12 | | 25MPa/19mm Concrete | | | | | | |
| 12 | | Strip footings | m3 | | R | 1 450,00 | R | - |
| 12 | | Bases | m3 | | R | 1 450,00 | R | - |
| | | | | | | | R | - |
| 12 | | 30MPa/19mm Concrete | | | | | R | - |
| 12 | | Strip footings | m3 | | R | 1 625,00 | R | - |
| 12 | | Bases | m3 | | R | 1 625,00 | R | - |
| | | | | | | RCCAES TOTAL | R | - |
| 12 | | REINFORCED CONCRETE | | | | | | |
| 12 | | 25MPa/19mm Concrete | | | | | | |
| 12 | | Surface beds cast in panels on waterproofing | m3 | 12,00 | R | 1 500,00 | R | 18 000,00 |
| 12 | | Slabs, including beams and inverted beams | m3 | | R | 1 550,00 | R | - |
| 12 | | Walls in foundations | m3 | | R | 1 550,00 | R | - |
| 12 | | Walls | m3 | | R | 1 550,00 | R | - |
| 12 | | Columns in foundations | m3 | | R | 1 550,00 | R | - |
| 12 | | Columns | m3 | | R | 1 550,00 | R | - |
| 12 | | Stairs, including landings, beams and inverted beams | m3 | | R | 1 600,00 | R | - |
| | | | | | | | R | - |
| 12 | | 30MPa/19mm Concrete | | | | | R | - |
| 12 | | Surface beds cast in panels on waterproofing | m3 | | R | 1 650,00 | R | - |
| 12 | | Slabs, including beams and inverted beams | m3 | | R | 1 700,00 | R | - |
| 12 | | Walls in foundations | m3 | | R | 1 700,00 | R | - |
| 12 | | Walls | m3 | | R | 1 700,00 | R | - |
| 12 | | Columns in foundations | m3 | | R | 1 700,00 | R | - |
| 12 | | Columns | m3 | | R | 1 700,00 | R | - |
| 12 | | Stairs, including landings, beams and inverted beams | m3 | | R | 1 750,00 | R | - |
| | | | | | | REINFORCED CONCRETE TOTAL | R | 18 000,00 |
| 12 | | CONCRETE SUNDRIES | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12 | | **Finishing top surfaces of concrete smooth with a power float** | | | | | | |
| 12 | | Surface beds, slabs etc | m2 | 100,80 | **R** | **30,00** | R | 3 024,00 |
| 12 | | Top of beams, walls, etc | m2 | | **R** | **30,00** | R | - |
| | | | | | | **CONCRETE SUNDRIES TOTAL** | **R** | **3 024,00** |
| | | | | | | **CONCRETE FORMWORKS & REINFOCEMENTS TOTAL** | **R** | **37 224,00** |
| 13 | | **ROUGH FORMWORK (DEGREE OF ACCURACY II)** | | | | | | |
| 13 | | **Rough formwork to sides** | | | | | | |
| 13 | | Strip footings | m2 | | **R** | **220,00** | R | - |
| 13 | | Bases | m2 | | **R** | **220,00** | R | - |
| 13 | | Walls in foundations | m2 | 40,00 | **R** | **280,00** | R | 11 200,00 |
| 13 | | Walls | m2 | | **R** | **280,00** | R | - |
| 13 | | Walls propped up exceeding 3,5m and not exceeding 5m high | m2 | | **R** | **330,00** | R | - |
| | | | | | | **RF TO SIDES TOTAL** | **R** | **11 200,00** |
| 13 | | **SMOOTH FORMWORK (DEGREE OF ACCURACY II)** | | | | | | |
| 13 | | **Smooth formwork to sides** | | | | | | |
| 13 | | Walls | m2 | 134,00 | **R** | **310,00** | R | 41 540,00 |
| 13 | | Walls propped up exceeding 3,5m and not exceeding 5m high | m2 | | **R** | **360,00** | R | - |
| | | | | | | **SF TO SIDES TOTAL** | **R** | **41 540,00** |
| 13 | | **REINFORCEMENT** | | | | | | |
| 13 | | Mild steel reinforcement to structural concrete work of various diameters | ton | | **R** | **14 500,00** | R | - |
| 13 | | High tensile steel reinforcement to structural concrete work of various diameters | ton | | **R** | **14 500,00** | R | - |
| 13 | | **High tensile steel dowel bars** | | | | | | |
| 13 | | 25mm Diameter dowel bar 400mm long with one end embedded 200mm deep in side of concrete at expansion joint and other end greased and wrapped in polythene sheeting including hole through formwork | No | | **R** | **130,00** | R | - |
| 13 | | **Fabric reinforcement** | | | | | | |
| 13 | | Type 193 mesh in concrete surface beds, slabs, etc. | m2 | | **R** | **60,00** | R | - |
| | | | | | | **REINFORCEMENT TOTAL** | **R** | **-** |
| 13 | | **FOUNDATIONS** | | | | | | |
| 13 | | **Brickwork of NFX clay bricks in Class I mortar** | | | | | | |
| 13 | | Half brick (110mm) wall | m2 | | **R** | **285,00** | R | - |
| 13 | | One Brick (220mm) wall | m2 | 100,80 | **R** | **440,00** | R | 44 352,00 |
| 13 | | 280mm Hollow walls of two brick skins including wire ties | m2 | | **R** | **450,00** | R | - |
| | | | | | | **FOUNDATIONS TOTAL** | **R** | **44 352,00** |
| | | | | | | **ROUGH FORMWORKS TOTAL** | **R** | **97 092,00** |
| **14** | | **WATERPROOFING** | | | | | | |
| 14 | | **DAMPROOFING OF WALLS AND FLOORS** | | | | | | |
| 14 | | **One layer of 375 micron "Consol Plastics Brikgrip DPC" embossed damp-proof course** | | | | | | |
| 14 | | In walls. | m2 | 160,00 | **R** | **30,00** | R | 4 800,00 |
| 14 | | **One layer of 250 micron "Consol Plastics Gunplas USB Green" waterproof sheeting sealed at laps with "Gunplas Pressure Sensitive Tape"** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14 | | Under surface beds | m2 | 100,80 | **R** | **35,00** | R 3 528,00 |
| 14 | | **Two coats "Brixeal" bitumen emulsion waterproof coating:** | | | | | |
| 14 | | On bagged brick walls | m2 | | **R** | **65,00** | R - |
| | | | | | | **WATERPROOFING TOTAL** | **R 8 328,00** |
| | | | | | | **MAIN CONTRACT TOTAL** | **R 447 399,40** |

**Table 41 - Conventional Cinder Block - Electrical BOQ**

| Site Name | Conventional Cinder Block |
|---|---|
| Site Size ($m^2$) | 101 |

| NATIONAL BOQ RATES - LAND AND BUILDING | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bill | Item | Description | Unit | Quantity | Rate | | Amount |
| | | | | | | | |
| 17 | | ELECTRICAL | | | | | |
| | | | | | | | |
| | | CONDUITS, CHANNELS, WIRING AND ACCESSORIES | | | | | |
| | | **PVC conduit fixed on surface:** | | | | | |
| | | 20mm. | m | | R 18,00 | R | - |
| | | 25mm. | m | | R 22,00 | R | - |
| | | | | | | R | - |
| | | **PVC conduit installed in drywall:** | | | | R | - |
| | | 20mm. | m | | R 17,00 | R | - |
| | | 25mm. | m | | R 22,00 | R | - |
| | | | | | | R | - |
| | | **PVC conduit chased in brickwork, including chasing. (Making good by others):** | | | | R | - |
| | | 20mm. | m | 22,00 | R 32,00 | R | 704,00 |
| | | 25mm. | m | | R 37,00 | R | - |
| | | | | | | R | - |
| | | **PVC conduit chased in concrete, including chasing. (Making good by others):** | | | | R | - |
| | | 20mm. | m | | R 39,00 | R | - |
| | | 25mm. | m | | R 44,00 | R | - |
| | | | | | | R | - |
| | | **PVC conduit boxes:** | | | | R | - |
| | | 60mm round x 25mm deep on surface with cover. | no | | R 20,00 | R | - |
| | | | | | | R | - |
| | | **PVC Conduit ends, complete with locknut and bush:** | | | | R | - |
| | | 20mm. | no | 12,00 | R 12,00 | R | 144,00 |
| | | 25mm. | no | | R 18,00 | R | - |
| | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, chased in brickwork, including chasing. (Making good by** | | | | R | - |
| | | 60mm round x 25mm deep. | no | | R 23,00 | R | - |
| | | 100 x 50 x 50mm. | no | 5,00 | R 31,00 | R | 155,00 |
| | | 100 x 100 x 50mm. | no | 7,00 | R 35,00 | R | 245,00 |
| | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, fixed in drywall partitioning:** | | | | R | - |
| | | 100 x 50 x 50mm. | no | | R 31,00 | R | - |
| | | 100 x 100 x 50mm. | no | | R 32,00 | R | - |
| | | | | | | R | - |
| | | **Flush outlet boxes, excluding covers, surface** | | | | R | - |
| | | 100 x 50 x 50mm. | no | | R 31,00 | R | - |
| | | 100 x 100 x 50mm. | no | | R 32,00 | R | - |
| | | 100 x 100 x 50mm. | no | | R 32,00 | R | - |
| | | Galvanised draw-wires installed in conduits and cable | m | 80,00 | R 5,00 | R | 400,00 |
| | | **PVC insulated MVGP grade conductor laid with cable, drawn into conduit, wiring channel or powerskirting:** | | | | | |
| | | 2.5mm². | m | | R 9,00 | R | - |
| | | 4mm². | m | | R 12,00 | R | - |
| | | 6mm². | m | | R 16,00 | R | - |
| | | 10mm². | m | | R 21,00 | R | - |
| | | 16mm². | m | | R 33,00 | R | - |
| | | 25mm². | m | | R 51,00 | R | - |
| | | 35mm². | m | | R 66,00 | R | - |
| | | **Insulated earthwire, drawn into conduit, wiring channel or powerskirting:** | | | | | |
| | | 2.5mm². | m | | R 9,00 | R | - |
| | | 4mm². | m | | R 12,00 | R | - |
| | | 10mm² | m | | R 21,00 | R | - |
| | | 16mm² | m | | R 31,00 | R | - |
| | | 25mm² | m | | R 48,00 | R | - |
| | | 35mm² | m | | R 63,00 | R | - |
| | | Copper Earth Bar (10 way - Predrilled 25mmx6mm), mounted on Insulted Supports 300mm AFFL | no | 1,00 | R 700,00 | R | 700,00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **SABS approved twin and earth drawn into wiring trunking or drawn into conduit chased into walls:** | | | | | | | |
| | | 2,5mm² x 2-core. | m | 80,00 | **R** | **19,00** | R | 1 520,00 |
| | | 4mm² x 2-core. | m | | **R** | **28,00** | R | - |
| | | **Termination by means of gripper glands:** | | | | | | | |
| | | No 0 glands | no | | **R** | **17,00** | R | - |
| | | No 1 glands | no | | **R** | **17,00** | R | - |
| | | No 2 glands | no | | **R** | **24,00** | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | | | | R | - |
| | | | | **MAIN CONTRACT TOTAL** | | | **R** | **3 868,00** |

**Table 42 - Conventional – Brick: Investment Inputs and Outputs**

Conventional - Brickwalls

| Known Inputs | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount Rate | 12,00% | | | | | | | | | | |
| Bonus Limit | R120 000 000,00 | | | | | | | | | | |
| | | | | | | | | | | | |
| **Uncertain Inputs** | | | Parameters of Distribution | | | | | | | | |
| | | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 | | | | | |
| Investment Cost | R200 000 000,00 | | Triangular | R160 000 000,00 | R200 000 000,00 | R360 000 000,00 | | | | | |
| Year 1 Revenue | R400 000 000,00 | | Triangular | R320 000 000,00 | R400 000 000,00 | R440 000 000,00 | | | | | |
| Annual Fixed Cost | R106 816 040,00 | | Triangular | R97 660 379,43 | R106 816 040,00 | R115 971 700,60 | | | | | |
| Annual Revenue Growth Rate | 2,50% | | Normal | 2,50% | 4,00% | 0,00% | | | | | |
| Annual Variable Cost Percentage | 50,00% | | Normal | 50,00% | 2,00% | 0,00% | | | | | |
| | | | | | | | | | | | |
| **Discounted Cash Flows Calculation** | | | | | | | | | | | |
| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| Investment Cost | -R200 000 000,00 | | | | | | | | | | |
| Revenue | | R400 000 000,00 | R410 000 000,00 | R420 250 000,00 | R430 756 250,00 | R441 525 156,25 | R452 563 285,16 | R463 877 367,29 | R475 474 301,47 | R487 361 159,00 | R499 545 187,98 |
| Fixed Cost | | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 | R106 816 040,00 |
| Variable Cost | | R200 000 000,00 | R205 000 000,00 | R210 125 000,00 | R215 378 125,00 | R220 762 578,13 | R226 281 642,58 | R231 938 683,64 | R237 737 150,73 | R243 680 579,50 | R249 772 593,99 |
| Cash Flow | -R200 000 000,00 | R93 183 960,00 | R98 183 960,00 | R103 308 960,00 | R108 562 085,00 | R113 946 538,13 | R119 465 602,58 | R125 122 643,64 | R130 921 110,73 | R136 864 539,50 | R142 956 553,99 |
| | | | | | | | | | | | |
| Outputs | | | | | | | | | | | |
| NPV | R434 038 258,77 | | | | | | | | | | |
| Bonus | R314 038 258,77 | | | | | | | | | | |

| | |
|---|---|
| **Number of units per year** | 200 |
| **Fixed Cost per unit** | R534 080,20 |
| **Annual Fixed cost** | R106 816 040,00 |

**Table 43 - Conventional - Cinder Block: Investment Inputs and Outputs**

Conventional - Cinder Block

| Known Inputs | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount Rate | 12,00% | | | | | | | | | | |
| Bonus Limit | R120 000 000,00 | | | | | | | | | | |
| | | | | | | | | | | | |
| **Uncertain Inputs** | | | **Parameters of Distribution** | | | | | | | | |
| | | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 | | | | | |
| Investment Cost | R200 000 000,00 | | Triangular | R160 000 000,00 | R200 000 000,00 | R360 000 000,00 | | | | | |
| Year 1 Revenue | R400 000 000,00 | | Triangular | R320 000 000,00 | R400 000 000,00 | R440 000 000,00 | | | | | |
| Annual Fixed Cost | R102 888 968,00 | | Triangular | R94 069 913,60 | R102 888 968,00 | R112 534 808,80 | | | | | |
| Annual Revenue Growth Rate | 2,50% | | Normal | 2,50% | 4,00% | 0,00% | | | | | |
| Annual Variable Cost Percentage | 50,00% | | Normal | 50,00% | 2,00% | 0,00% | | | | | |

| Number of units per year | 200 |
|---|---|
| Fixed Cost per unit | R514 444,84 |
| Annual Fixed Cost | R102 888 968,00 |

| Discounted Cash Flows Calculation | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| Investment Cost | -R200 000 000,00 | | | | | | | | | | |
| Revenue | | R400 000 000,00 | R410 000 000,00 | R420 250 000,00 | R430 756 250,00 | R441 525 156,25 | R452 563 285,16 | R463 877 367,29 | R475 474 301,47 | R487 361 159,00 | R499 545 187,98 |
| Fixed Cost | | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 | R102 888 968,00 |
| Variable Cost | | R200 000 000,00 | R205 000 000,00 | R210 125 000,00 | R215 378 125,00 | R220 762 578,13 | R226 281 642,58 | R231 938 683,64 | R237 737 150,73 | R243 680 579,50 | R249 772 593,99 |
| Cash Flow | -R200 000 000,00 | R97 111 032,00 | R102 111 032,00 | R107 236 032,00 | R112 489 157,00 | R117 873 610,13 | R123 392 674,58 | R129 049 715,64 | R134 848 182,73 | R140 791 611,50 | R146 883 625,99 |

| Outputs | |
|---|---|
| NPV | R456 227 091,42 |
| Bonus | R336 227 091,42 |