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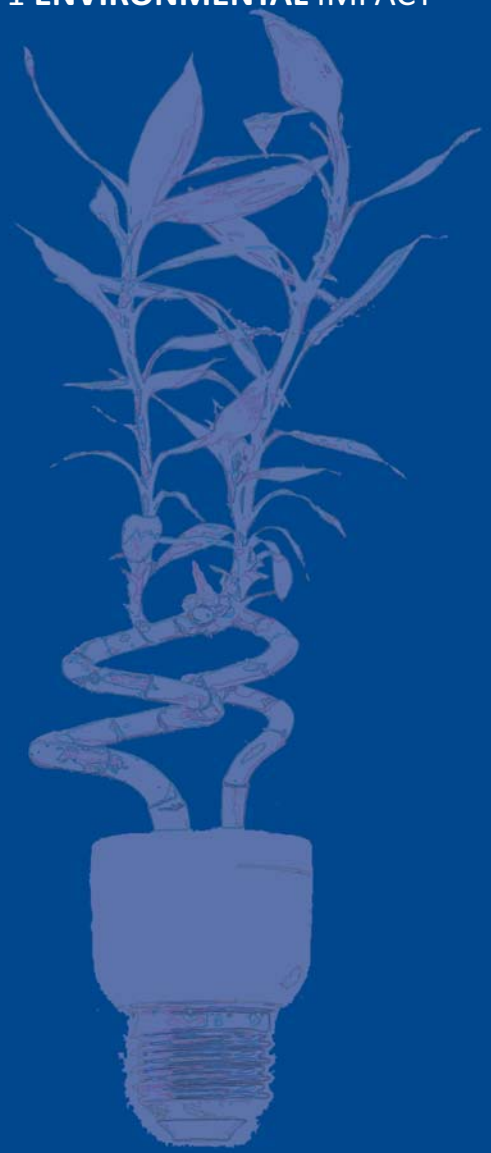
006

TECHNICAL INVESTIGATION

006-1 ENVIRONMENTAL IMPACT



It is becoming more and more important for architects, developers and project managers to be **[re]**sponsible about the choices made and the products specified in building projects new and old.

This chapter will analyse interventions made to the Woltemade building in a simplified manner according to the Green Star Rating System set up by the Green Building Council of South Africa.

The Green Star SA Environmental rating system is a tool used in the comprehensive evaluation of "environmental design and performance of south African buildings" based on a number of criteria (www.gbcsa.or.za).

According to the Green Star SA rating tools nine separate environmental categories are identified:

- Management
- Indoor Environment quality
- Energy
- Transport
- Water
- Materials
- Land Use and Ecology
- Emissions
- Innovation

Fig 006.1: The Green Building Council of South Africa's logo

Fig 006.2: The Green Star Rating System logo

006 - 1.1 MANAGEMENT

The Green Building Council of South Africa (GBCSA) promotes the adoption of sound environmental principles from project inception to the design and construction phases (www.gbcsa.org.za). This process is made easier with a professional on the project team who has a good understanding of the principles of GBCSA and its tools. Furthermore an understanding of appropriate methods of **[re]**cycling and demolition on site.

Attribute: Environmental Management

[Re]lating to the guidelines setup by Davis Langdon, a formal environmental management system needs to be adopted during construction. Guidelines for each project will be different and needs to be drawn up by the professional team involved in the project.

Cost implications
Minor expenses are associated with the process.

Attribute: Waste Management

Waste management is a set of guidelines set up by the professional team and implemented by the site foreman on the construction site. Guidelines included in the waste management protocol are measures which serve to minimise the amount of construction waste going to landfill.

Measures include designated zones for the sorting and storage of construction waste into their various categories

such as steel, timber, plastic, glass and biodegradable waste.

Cost implications
Additional costs for skips and additional space **[re]**quired for storage and sorting of waste

006 - 1.2 INDOOR ENVIRONMENT QUALITY

This category of the GBCSA's main objective is to address the needs of the occupants and ensure their well-being.

Attribute: Mixed Mode Ventilation

The GBCSA refers to mixed mode ventilation as being a hybrid approach to ventilation, combining natural and mechanical means. This approach is common where natural ventilation is aspired to however due to the unpredictable nature of the environment a constant rate of ventilation is not always achieved. Hence the introduction of mechanical means to ventilate the building when **[re]**quired, **[re]**sulting in mixed mode ventilation.

Free standing air-conditioning units will be added to the existing building as it does not have sufficient headroom for new ducting. It is however the intention for the air conditioning to be used only where necessary and when natural ventilation is not sufficient.

Attribute: Ventilation Rates

Natural ventilation is the most sought after method of ventilation promoted by the GBCSA as it is non-mechanical and does not **[re]**ly on the use of fossil fuels thereby lowering the Carbon emissions. Through the incorporation and management of natural ventilation flow of air through the building can take place in the form of air movement through the building or through convection currents which pull the hot air up while drawing fresh cool air into the building.

Cost implications
Minor costs associated with design, but needs to incorporated from inception.

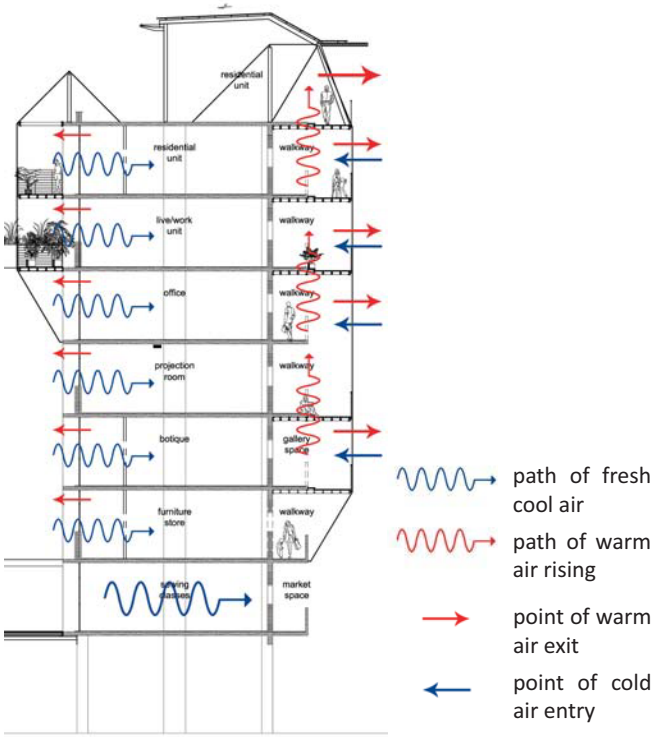


Fig 006.3: Diagram indicating the manner in which fresh air is drawn into and expelled from the building

Attribute: Natural sunlight

Natural sunlight is a natural **[re]**source that is free to use and dramatically improves the qualities of the indoor environment. Too much sunlight is not wanted either therefore it needs to be managed by sunshades and screening elements.

Natural sunlight is taken advantage of on the existing northern façade. The new interventions also utilise the sun's full potential to provide light to the interior and heat to the building during winter months through the installation of overhangs or screening.

Cost implications
None

Attribute: Daylight Glare Control

The definition of glare is "a bright light that blinds and strains the eyes" (Smith, [S.a]:485)

Glare is easily overcome in interior spaces through the incorporation of tinted glazing, external shading or screens. A combination approach is taken in the Woltemade building. Movable screens are used on the host building while tinted glass and screening elements are used on the new interventions.

A **[re]**duced consumption of energy is achieved through the incorporation of daylight glare control measures as heat gain into the building is lowered. At the same time the indoor environment is improved and **[re]**duces the amount of strain on the eyes of occupants.

Cost implications
Costs can be significant depending on the glare control method selected for the project. Costs are also associated with maintenance, especially for systems that are automated.

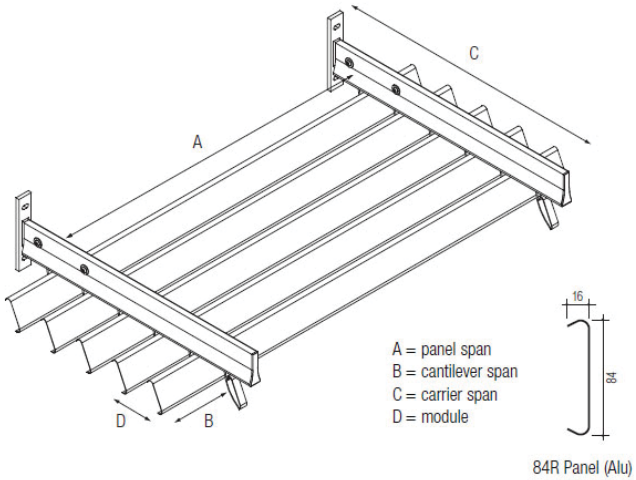


Fig 006.4: A typical sunscreen that can be attached to the façade providing shade to the interior and **[re]**ducing glare

Attribute: Low-E Glazing

Low-E glazing, according to Davis Langdon, is high peformance glazing which allows daylight to be transmitted into the building without the heat. Thereby lowering heat gain and **[re]**ducing energy consupmtion that would otherwise be used to lower the internal temperature.

Smart Glass is a South African manufacturer of glazing products that manufactures a number of products that are deemed appropriate in the application of the Woltemade building.

The products that are ear-marked for the instalation are E-Range, SolarShield, ArmourLam, CoolVue and InsulVue.

Cost implications
Considerable costs are associated with glazing generally especially in terms of safety glass. Safety glass would have to installed to the glazed façades in any case, the additional peformance quality of the glazing therefore comes at a minimal cost. The more complex the composition of the glass the more costly it becomes, however the better the performance.

Fig 006.5: ArmourLam as it would appear if applied to the Woltemade building

Glass Properties:
Shading coefficient = 0.14 to 0.46
Light transmission = 0 to 30

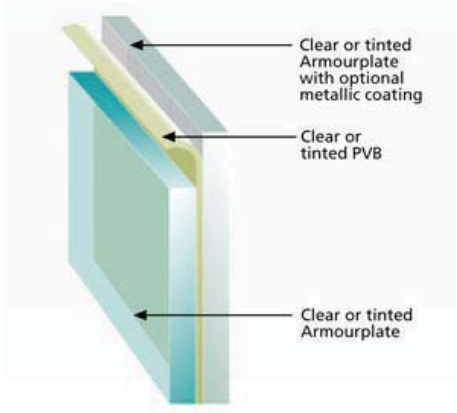


Fig 006.6: A diagramatic drawing of the composition of ArmourLam

Fig 006.7: Characteristics that the ArmourLam posseses are; security, safety, solar control and sound control solutions

Fig 006.8: E-Range low emissivity saftey glass offers superior thermal insulation in a standard frame for single glazing. This glass **[re]**-duces heating and air-conditioning costs

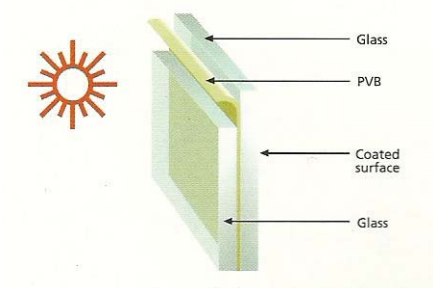


Fig 006.9: The composition of E-Range low emissivity saftey glazing

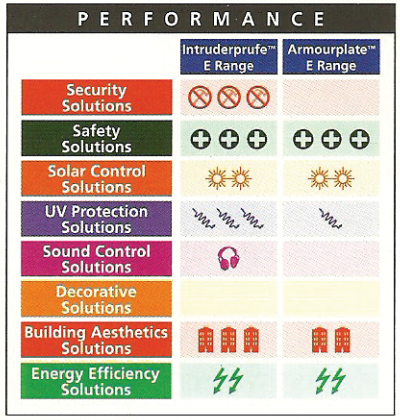


Fig 006.10: The peformance characteristics of E-range glazing

Attribute: Individual Comfort Control

Individual comfort **[re]**fers to the occupant being able to change their own environment instead of lying on a system which would change the internal environment of the whole building. The **[re]**furbishment and **[re]**configuration of the host building allows for individual comfort control. This is because units are already seperate entities defined by columns and ducts of the host building.

Free standing air-conditioning units form part of the individual control occupants have over their environments leading to fewer tenants complaints to management.

Cost implications
Minor, however productivity levels are increased and energy is used efficiently.

Attribute: External Views

This criteria deals with maximising the potential for external views. A visual connection to an external view potentially **[re]**duces eyestrain for occupants especially in areas such as offfices where high levels of concerntration are needed to complete a task (Davis Langdon, 2101:29).

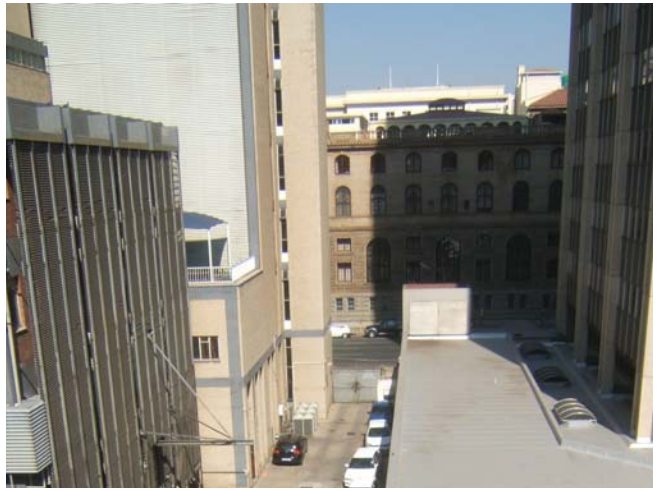


Fig 006.11: An existing view from the the south of the site which can be exploited in Intervention B

Fig 006.12: The view of the Supreme Court and Palace of Justice as seen from the south-west corner of the building

Cost implications
None, acknowledging the views from early in the design is important.

Fig 006.13: The view from the north-west corner of the building showing the New Court Chambers and the Masada building

Fig 006.14: A view to the north **[re]**vealing the Magaliesburg Mountains

Attribute: Internal Noise Levels

Appropriate internal noise levels are important in order to achieve a productive working environment (Davis Langdon, 2010:31). Various materials have different acoustic properties, thereby it is important to select the appropriate material for the internal partitioning to manage the acoustics. Increased insulation and acoustics add to tenant satisfaction.

Cost implications
Costs can be minimal, however acoustic treatment can become costly

Attribute: Volatile Organic Compounds

Typically Volatile Organic Compounds (VOCs) can be found in paint and carpet adhesives. These additives are **[re]**-sponsible for many ailments such as headaches and skin irritations (Davis Langdon, 2010:32). Due to the growing concern of protecting the environment paint manufactures have developed products with **[re]**duced levels of VOC or the complete omission of VOCs from their paint products. Manufacturers such as Dulux and Plascon are the leaders in this field.

Changing a paint specification to a paint with a low or no VOC content is becoming easier and no longer needs large amounts of capital to make it possible. The **[re]**duction of VOCs in the construction process maximises indoor air quality and **[re]**duces the risk of Sick Building Syndrome (Davis Langdon, 2010:32).

Cost implications
Low cost impact, it is important to **[re]**search new products however these are not always readily available.

Attribute: Formaldehyde Minimisation

Formaldehyde is a chemical that is widely used in the construction industry during the manufacturing of many building materials (Davis Langdon, 2010:33). Formaldehyde emissions are toxic and can contribute to irritations of the

skin, eyes and throat should a high percentage of formaldahyde be present in the air.

Many products are available on the market which have **[re]**-duced quantities or formaldahyde namely, carpet adhesives, sealants and a few pressed wood products.

Plywood was eliminated from the partitioning materials as they contain Formaldehyde UF (interior application) and Formaldehyde PF (exterior application).

Cost implications
Minimal costs however alternative materials need to be specified.

006 - 1.3 ENERGY

Attribute: Site Orientation

In the case of the Woltemade building, the majority of the existing building faces north. This increases its efficiency and makes internal environments more comfortable for occupants. The new interventions are forced to wrap themselves around the host building **[re]**sulting in new portions being exposed to the east and west. These area are treated with sunscreens and low-E glazing.

Cost implications
Site specific and dependant on the architectural design.

Attribute: Green Power

Green power is a generic name given to power sources that are considered to be clean and generated from **[re]**newable sources (www.davislangdon.com). Examples of green power include but are not limited to; solar, wind, wave energy, biogas and landfill gas. The green power source used in this thesis is solar energy which is harvested by photovoltaic modules for lighting in portions of the new interventions and hot water geysers on the eighth floor. Each of these elements will be discussed below.

Cost implications
Costs are currently still inflated and consumers are paying a premium to make use of green power. It should however become cheaper in the future.

Attribute: Photovoltaics

Location of intervention
Eighth floor - roof of intervention B

Cost implications
Cost depends on application. Utilising PV cells to only run a portion of a buildings **[re]**quirements for low energy lighting is viable as less PV cells and batteries are needed.

Attribute: Solar Heating - Hot Water

Solar hot water systems are a form of green power. They utilise the sun's energy to generate hot water. The hot water passes through collectors and is stored in a tank ready to be used.

New steel frame structures are added to the existing roof structure to increase the amount of usable space. Currently this space is unaccessable and not used, therefore the introduction of additional programmed space to this area is benificial without exorbitant additional costs. Panels can also be homogenously intergrated with the roofing material.

Fig 006.15: An image of the solar water system that will be installed on the roof of Intervention B

Instead of installing new geysers and plugging them in to the existing power grid, solar heating panels will be added to the roof of the units on the eighth floor. The solar water heating system investigated and deemed relevant for this application

is a Solahart® 302Kf (300 litre) water heating sytem with gas back-up element. This size of system could easily fulfill the needs of two 20m² residential units.

Gas has been chosen as the back-up power source because it is cheaper than electricity (Brümmer, 2010:42). The size of the system is 2475 x 2480mm x 510mm high and weighs 472kgs when full and is fixed onto a hot dipped galvanised mild steel roof angle stand of 20°.

Hot water units are to be orientated to the north and positioned with a clearnce of at least 2m to the left of the unit for servicing purposes and to avoid shadows being cast on adjacent panels. In addition a space of no less than 0.5m around the entire unit should be left clear to ensure that units peform at their best.

Cost implications
Aproximately R30 000 per 300 litre geyser.

Attribute: External Shading

External shading is considered to be anything that creates shading for a building façade. External shading can come in the form of vertical or horizontal shading devices or even an additional skin (Davis Langdon, 2010:53). Devices need not be complicated as shading can be achieved by a simple overhang, window shades, blinds or even trees.

In the case of the Woltemade building additional sliding screens are added to the northern façade. Intervention B has portions of the southen façade screened with a variety of materials, while Intervention C makes use of overhangs to the north, vertical screens to the east an additional skin to the west.

Cost implications
Can become expensive depending on the product and means of installation.

Attribute: Lighting Power Density

Lighting in the Woltemade building

All existing lighting in the Woltemade building is to be **[re]**-place with low Watt power lamps over time. This is so that less power is consumed from the national power grid. Even though a higher capital outlay is initially **[re]**quired, a saving will be made in terms of energy consumption, maintenance and **[re]**palcement of lamps. This simple alteration will not only save the building owner money in the long run but will also **[re]**duce the amount of Carbon Dioxide **[re]**lease into the atmosphere because less fossil fuels are used to generate power for the building. The table below comapres the various lamp types, wattages and Lumen outputs **[re]**-vealing why the LED lamp is the most efficient lamp.

In order to calculate the amount of lighting **[re]**quired for the new portions of the building it is necessary to determine the area of each intervention and insert it into a formula. Khyansia Electrical Suppliers in Midrand use the following formula to determine the number of lamps needed;

m² ÷ lux quired ÷ 54 ÷ lumen= no. lamps **[re]**quired

An average of 600lux has been used across the board because the spaces provided for are generic and gain character onces occupants inhabit the space. Should additional lighting be **[re]**quired it can be achieved through free standing floor lamps, task lighting or any other method as long as the method is energy efficient and does not overload the transformer.

LAMP WATTAGE COMPARISON

Incandescent	CFL	Halogen	LED	High Pressure sodium	Approximate Lumen range
					
12-5W			1.3W		
25W	5-6W	25W	3W		
30W	7-9W				
40W	9-13W	50W	5W		**450lm**
60W	13-15W	60W	7W		**800lm**
75W	18-23W		9W		**1100lm**
100W	25-30W		13W		**1600lm**
150W	30-52W				**2600lm**
		150W	40W		
			35W	150-250W	**2500lm**
			70W	250-300W	**5000lm**
			140W	300-400W	**10 000lm**
			210W	400-450W	**15 000lm**
			224W	450-550W	**20 000lm**

Fig 006.16: Table comparing the characteristics of various lamps

The following table is a summary of these areas:

AREAS TO BE LIT IN BUILDING		
GROUND FLOOR		
Existing to be [re]placed		484m²
New intervention		
	Parking	429m²
	TOTAL	**429m²**
FIRST FLOOR		
Existing to be [re]placed		896m²
New intervention		
	Intervention D	429m²
	Block C	250m²
	TOTAL	**679m²**
SECOND FLOOR		
Existing to be [re]placed		514m²
New intervention		
	West block roof	317m²
	Intervention C	263m²
	TOTAL	**580m²**
THIRD FLOOR		
Existing to be [re]placed		514m²
New intervention		
	Intervention A	172m²
	Intervention B	76m²
	Intervention C	249m²
	Glass Gallery Box	28m²
	TOTAL	**525m²**
FOURTH FLOOR		
Existing to be [re]placed		514m²
New intervention		
	Intervention A	129m²
	Intervention B	76m²
	Intervention C	307m²
	Glass Gallery Box	28m²
	TOTAL	**540m²**
FIFTH FLOOR		
Existing to be [re]placed		514m²
New intervention		
	Intervention A	133m²
	Intervention B	76m²
	Intervention C	322m²
	Glass Gallery Box	28m²
	TOTAL	**559m²**
SIXTH FLOOR		
Existing to be [re]placed		514m²
	Intervention A	128m²
	Intervention B	76m²
	Intervention C	338m²
	TOTAL	**542m²**
SEVENTH FLOOR		
Existing to be [re]placed		514m²
New intervention		
	Intervention A	128m²
	Intervention B	76m²
	Intervention C	135m²
	TOTAL	**339m²**
EIGHTH FLOOR		
Existing to be [re]placed		177m²
New intervention		
	Intervention B	187m²
	TOTAL	**187m²**

To view the lighting selection go to the "Lighting Schedule"in the Appendix.

Intervention A

Average size of floor plate = 138 m²
138m² ÷ 600lux = 82 800 ÷ 54 = 1533.3 ÷ 18 = 85W
85W ÷ 9W(LED) = 9.4 lamps
Therefore 10 x 9W lamps per floor
10 lamps x 5 floors = 50 lamps
50 lamps x 9W = 450Watt

Intervention B

6 floors x 76m² + 111m²(roof units) = 456m²
14 x (12 x 0.1W) = 16.8Watts per floor (Footlights)
Therefore 16.8Watts x 6 floors = 100.8Watts
16 lamps x 9W = 144Watt
144W x 7 floors = 1008Watts (Passage lights)

Intervention C

36 lamps x 9W per floor plate = 324Watts
36 x 5 floors + 39 lamps (floor 6 & 7) = 219 lamps **[re]**quired
219 lamps x 9W = 1971Watts

Glass gallery Box

28m² x 600lux = 16 800 ÷ 54 = 311.11 ÷ 5 = 62.22Watts
62.22W ÷ 35W(lamp) = 1.7 lamps [re]quired
However due to the volume of the space and to create an effect 5 lamps will be used
5lamps x 35W = 175Watts

Summary: The total amount of energy [re]**quired**

Intervention A + Intervention B + Intervention C + Glass gallery Box

450W + 1108W +1971W + 175W = 3704Watts or 3.7KW

If all of the new lights were to be place on a photovoltaiic system the **[re]**sult would be over 300 PV cells and battery costs which near one million rand (calculation be First National Battery Consultant). This approach is not deemed to be sustainable and the building does not have the space to accomodate the number of PV cells **[re]**quired.

Therefore the recommended route is to zone the the new lighting **[re]**quirements into areas that are powered by an Alternative Energy System (PV cells) and areas that plug into the existing power grid. The lighting **[re]**quirements have been zoned as follows;

All emergency and emergency passage lighting will be low energy lighting powered by the Alternative Energy System (PV cells) and the **[re]**mainder will make use of of conventional 220V electricity.

A) Lights to be powered by Alternative Energy System (PV cells)

Intervention A	+	Intervention B	+	Intervention C	+	Glass gallery Box
(p + e)[1]		(all)		(p + e) [1]		(all)

75W + 1108W +100W + 175W = 1458Watts or 1.458KW

B) Alternative energy load calculator

In order to power the passage and emergency lights from a solar PV system for 12 hours (night only) the following will be **[re]**quired:

Watts x hours + inefficiencies = Watt/hour

1458W (from A above) x 12 + 20% = **20 995W/h**

I(current) = P(power) ÷ V(voltage)

I = 20995 ÷ 48 = **437Amps**

C) To calculate the battery [re]**quired:**

From the calculation (A) it is now possible to determine the battery size needed for the photovoltaic system. The size of the battery is derived from a 3 day autonomy and allows for inefficiencies (cable and battery losses etc.). Therefore a 1573Amp/h battery will be needed accoding to the First National Battery Consultant.

D) To calculate the PV panels [re]**quired:**

From the calculation (B) it is possible to deduce the number of PV panels needed in the system. If a 210W panel is used then the calculations are as follows:

Load (B) ÷ (peak sunshine hours) = Amp

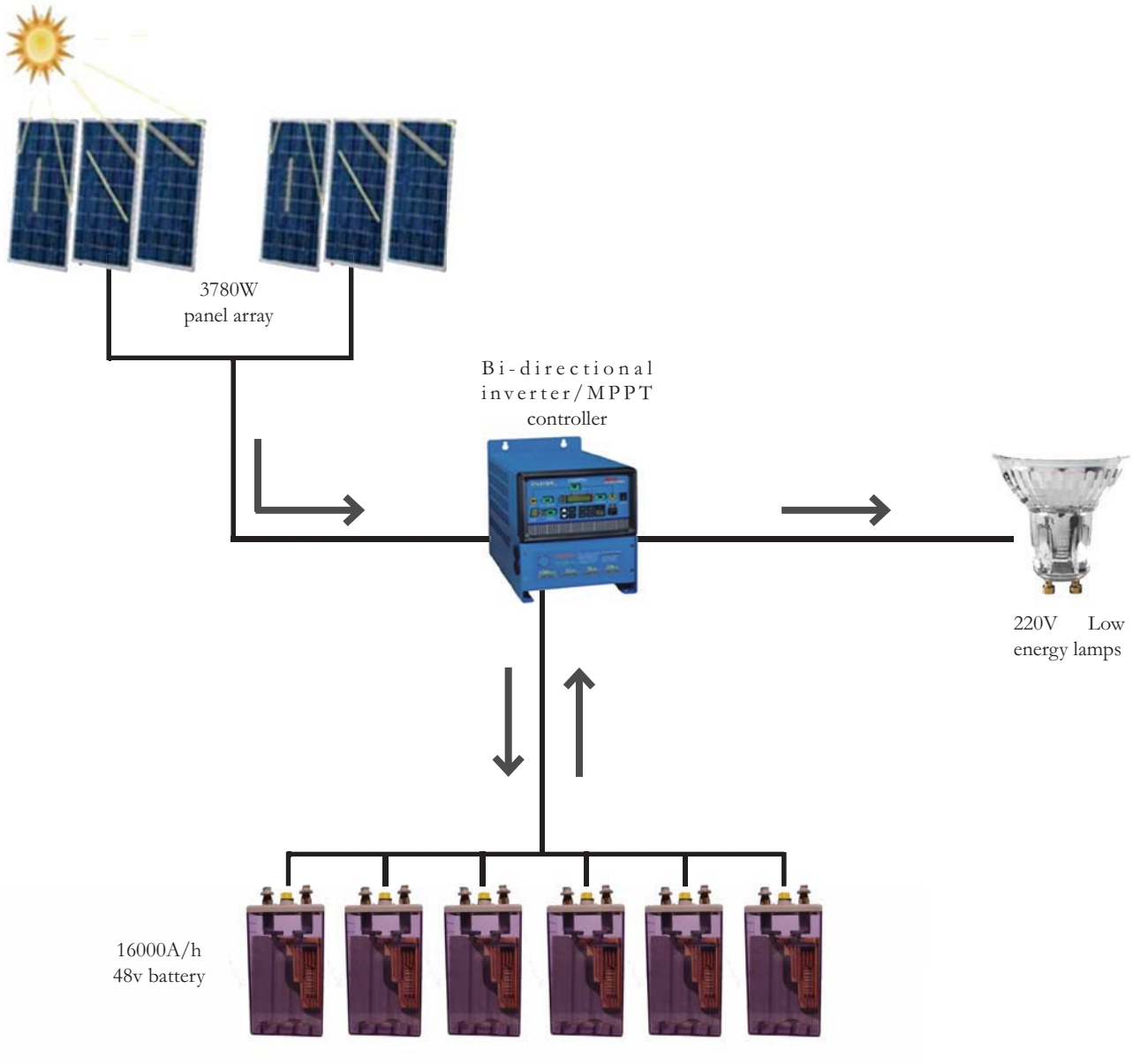


Fig 006.17: Alternative energy system configuration

437 ÷ 5.5 = 79.45A

Amps ÷ I(output of panel) = number of panels

79.45 ÷ 4.4^2 = 18.05
Therefore 18 x 210W PV Panels are [re]**quired**

[1] (p + e) = passage + emergency lights
[2] PV panel Watt ÷ Voltage
= 210W ÷ 48V = 4.4W

E) To calculate the Bi-directional/Maximum Peak Point Tracker (MPPT) [re]**quired:**

From the calculation (A) the load was found to be 1.458KW

Therefore 1 x 3KVA combi-3 inverter will be [re]**quired**

F) System Costing

System costing includes; batteries, PV panels and charge **[re]**gulator would cost approximately R300 000 excl. Vat.

006 - 1.4 TRANSPORT

Attribute: Maximum Car Parking

The Woltemade site is fortunate with its location as it is situated in close proximity to a variety of transportation modes. These modes include the private car, motorcycle, taxi, bus and train. Therefore it is important to promote the various public transportation modes on site as well as motorcycles and bicycles.

The number of motor vehicle parkings has been decreased in order to include motorcycle and cyclist parking with its necessary facilities.

Through the promotion of these different modes of transportation savings can be made with **[re]**gards to fuel for the individual, thereby decreasing carbon emissions (Davis Langdon, 2010:69). As the parking area is already provided for on site, little capital needs to be spent on this category.

Cost implications
No additional cost is associated with this as the parking is already in place and will only **[re]**quire **[re]**configuration.

Attribute: Fuel Efficient Transport

Fuel efficient transportation modes include; smaller cars, motorcycles and public transportation. These modes of transportation need to be encouraged for the weekly commute to work.

Fuel efficient transportation methods also **[re]**duce the amount of fuel consumed as well as a **[re]**duction in carbon emissons for the user.

Cost implications
No costs associated to the buiding owner, however motorcycles are considered dangerous and carpools are not always practical.

Attribute: Cyclist facilities

According to a Davis Langdon's *Quick Guide* (2010:71), bicycle storage needs to be secure and under cover. The dedicated storage area needs to be in close proximity to changing facilities with showers and locker facilities.

Cyclist facilities are provided for at The Woltemade building as they promote healthy living, **[re]**duce carbon emissions and encourage alternative means of transportation. Cycling is deemed appropriate in this instance as the framework (section 009.2 in the Appendix) promotes the inclusion of cycle lanes on major routes within the city.

Cost implications
Bicycle racks are relatively inexpensive however the ancillary spaces could significantly add to the cost of a project.

Attribute: Local Connectivity

The Woltemade site is conveniently located to community amenities such as the German Club, Church Square and Church Street to name but a few. The close proximity to these amenities **[re]**duces the amount of trips that would otherwise be taken in a private motor vehicle or public transport.

Cost implications
None

006 - 1.5 WATER

Attribute: Rainwater Harvesting

Rainwater harvesting is simply the collection of water from roofs or other hard surfaces (Davis Langdon, 2010:77). The installation in the case of the Woltemade building will consist of a series of downpipes that lead to a storage tank. Water will be used for irrigation purposes on the site. Various collection points will serve different planters, potted plants and the large palm trees found on site.

Utilising rainwater **[re]**duces the amount of potable water consumption as well as **[re]**ducing stormwater runoff.

Cost implications
Minimal

Attribute: Water Efficient Fixtures and Flow Restrictors

Flow **[re]**strictors can be retrofitted to old installations as well as fitted to new installations. Many showers and user interface valves (taps) make use of these **[re]**strictors to **[re]**-duce the quantity of water consumption.

All new installations in this thesis will be fitted with water efficient fixtures. Not only will this significantly save on the amount of water used it can potentialy save 60% on domestic water heating costs (Davis Langdon, 2010:79).

Cost implications
Minimal per fixture

Attribute: Waterless Urinals

No urinal is truely waterless, however this category of urinal significantly **[re]**duces the amount of potable water used for flushing. These urinals are similar in appearance to the conventional type however water in not used continiously for flushing. An air seal and air trap are the two components that make the system work.

Liquids flow through the trap and are immersed through a floating layer of sealant liquid, which controls potential odours.

This system does cost more than the conventional system and **[re]**quires more maintenance however the saving in potable water consumption is significant.

Cost implications
R1000 - R3000 per fixture including labour, excluding pipe work

Attribute: Water Meters

Water meters aid in monitoring water usage and locating potential water leaks and identify areas of high usage. A water meter will be added to each floor to monitor the amount of water consumed, water should not be used in areas of **[re]**tail at night therefore making it easier to locate a water leak.

Cost implications
Meters are **[re]**latively cheap and easy to install

Attribute: Landscape Irrigation

Rainwater will be used for the irrigation of landscaped and potted plants on the Woltemade site **[re]**ducing the amount of potable water consumed.

Indigenous plants are also used to further **[re]**duce the quantity of water consumed.

Cost implications
None

006 - 1.6 MATERIALS

Attribute: Building **[Re]**use

An existing building has been chosen in order to **[re]**duce materials consumed during the construction phase. By **[re]** using an existing building, such as the Woltemade, much of the structure is maintained and added onto in order to create a much more diverse programme that has the potential to draw people further up Paul Kruger Street past Church Square.

Natural **[re]**sources are saved and demolition is overted **[re]**-sulting in less waste that needs to go to landfill.

Cost implications
Minimal, however some buildings can be expensive or unpractical.

Attribute: **[Re]**used Materials and Concrete

[Re]cycled concrete may contain a portion of **[re]**cycled aggregate meaning that less raw materials need to be mined. Some manufactures such as Lafarge and AfriSam produce “green concrete” that is available as a pre-mix which is available in various strengths. Intervention A and C will make use of **[re]**cycled concrete and aggregate in the floor slabs.

Advantages associated with **[re]**cycling concrete is that less waste is sent to landfill and given a second life.

With **[re]**gards to **[re]**using materials in the Woltemade building, every effort will be made to **[re]**use the existing materials on site as well as sourcing additional materials from other sites and salvage yards.

The general approach in this thesis is that elements that **[re]**quire structural strength and integrity will have to be manufactured from portions of **[re]**cycled material and not **[re]**used material as the structural integrity cannot be guaranteed. Areas that will adopt this approach is Intervention B with its wrapping steel structure. Structural components of Intervention C and the new balcony extensions on the northern façade.

The screening materials used on the sliding screens on the northern façade could very easily incorporate **[re]**used materials as long as they still fufill the programmatic needs of the interior space. **[Re]**used materials could include, but are not limited to salvaged timber, corrugated sheeting and steel and aluminium off-cuts.

Walls which are demolished in the existing structure will first be cleaned and prepared to be **[re]**used for new walls and ducts while the **[re]**mainder is to be donated to an organisation that aids in persons building their own home. Material will be offered to them free of charge all that is **[re]**-quired is the labour needed to clean the bricks.

Internal partitions could also incorporate **[re]**used materials to a degree however regular sizes with similar materials and finishes will be difficult to achieve. In addition a neat finish may not be possible, therefore an analysis will have to be done when internal partitions are to be manufactured The analysis will include sizes and quantities of appropriate salavaged or **[re]**used materials available in comparison to new materials. If new materials are deemed the most viable option then the material choice needs to be **[re]**sponsible.

The following information relats to table 1:

Supawood is an engineered medium density fibreboard (MDF) with wood fibres bonded with synthetic resins. This allows for traditional woodworking techniques. The surface is ideal for priming, painting, veneering and laminating. Laminating can take the form of Formica, Deccon, paper foils and melamine impregnated paper.

SupaLam Super White is a white melamine faced MDF. This board can be routed with patterns before being painted with a PVC or Acrylic paint. This particular board is mostly used for decorative door panels and kitchen carcasses.

Hardboard, otherwise known as Masonite, is formed from reduced ligno-cellulose fibres which are wet-felted and hot pressed to form a board. Natural resins are used to bond the panels together opposed to synthetic resins. Tempered hardboard is suitable for vertical exterior applications, provided all surfaces and edges of the board are adequately sealed and protected with a good quality paint or varnish.

Orientated Strand Board consists of resin coated wood strands laid in three cross-directional layers. Performance rated structural OSB panels are engineered boards with superior strength and uniformity. Typically OSB is used in the following applications; walls, ceilings, roof construction, mezzanine floors, display material and shop fittings to name but a few.

Plywood products are constructed using an odd number of wood veneers bonded together in a cross-directional fashion. Hardwood Plywood makes use of a variety of hardwood species bonded together using an exterior grade waterproof and pheolic resin. Unfortunately both the interior and exterior plywoods make use of formaldehyde.

Nu-tec Board consists of fibre cement, although it is not as **[re]**cyclable a timber, it is a durable product that can be dismantled and **[re]**used somewhere else. For the dismantling to be successful the installation of the product needs to be carefully considered. It is therefore the reason that internal as well as external partitioning be made up into manageable size panels complete with insulation and protected corners to ensure longevity.

MATERIAL: PARTITIONING								
Material	**Thickness**	**Weight kg/m²**	**Sheet size**	**Finish**	**Substrate**	**Distance to site**	**Recyclability**	**Appropriateness**
Supawood 	6mm 9mm 12mm	4.68kg 6.75kg 9.36kg	2750 x 1830mm 2750 x 1830mm 1830 x 915mm	raw	Supawood	Boksburg Board Plant 50km	✓	A wide variety of applications are possible for interior applications
SuperLam Super White 	12mm 16mm 18mm	10.50kg 13.68kg 15.70kg	2750 x1830mm 3660 x 1830mm	Executive Peen Ashwood	Supawood	Boksburg Board Plant 50km	White face is difficult to remove without the use of harmful chemicals should the board be recycled	X Panels are substantially heavier than other panels of the same thickness
Hardboard 	3.2mm 4.8mm 6.4mm	3.20kg 4.80kg 6.40kg	2440 x 1220mm 2750 x 1220mm 3050 x 1220mm 3660 x 1220mm	raw	Hardboard		✓	Natural resins are used for bonding
Tempered Hardboard 	3.2mm 4.8mm 6.4mm	3.20kg 4.80kg 6.40kg	2440 x 1220mm	tempered	Hardboard		✓	Board has superior strength, hardness and water resistance
Orientated Strand Board (OSB) 	6mm 9mm 12mm	3.81kg 5.95kg 7.80kg	2500 x 1250mm	Raw timber strands	Typically Pine, Poplar or Aspen		Boards can be used in a variety of applications increasing its life span	A structural board which is uniform in nature
Plywood (interior application) 	6mm 9mm 12mm	4.20kg 5.80kg 7.5kg	2500 x 1200mm	Raw veneer: Meranti or Seraya	Meranti or Seraya		X	X Contains Formaldehyde UF
Exterior Hardwood Plywood 	6mm 9mm 12mm	4.20kg 5.80kg 7.5kg	2500 x 1200mm	Raw veneer: Meranti or Seraya	Meranti or Seraya		X	X Contains Formaldehyde PF
Material	**Thickness**	**Weight kg/m²**	**Sheet size**	**Sub-frame spans vertical + horizontal**	**Finish**	**Distance to site**	**Recyclability**	**Appropriateness**
Nu-tec Medium Density Board	9mm 12mm	40.50kg 54.00kg	2700 x 1200mm 2700 x 1200mm	600/800mm 600/900mm	paint or wallpaper		✓	
Nu-tec High Density Board	5mm 10mm 15mm	37.3kg 62.1kg	3600 x 1200mm 3000 x 1200mm 3000 x 1200mm	400/500mm 600/800mm 800/1200mm	paint or wallpaper		✓	

Table 1: Study of various partitioning material

The following information relates to table 2:

Kliplok 406/700 is a rolled-formed profile used as a roofing and/or side-cladding solution. Profiles come in continuous lengths of 12.5m and widths of either 406mm or 700mm. The manufacturer recommends a sub-frame of either steel or timber depending on the design and application. **Mascaret** is a perforated aluminium façade system is manufactured to illuminate or filter light into interior spaces. This perforated screen is typically used as a vertical or horizontal sun¬shade.

Cost implications

[Re]cycled/'green' concrete costs significantly more than standard concrete. Salvaged or **[re]**cycled materials are not always cheaper (in the case of bricks) however they have substantial value in **[re]**ducing the amount of virgin material that is mined, minimising the amount of waste going to landfill, **[re]**ducing the embodied energy.

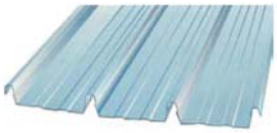
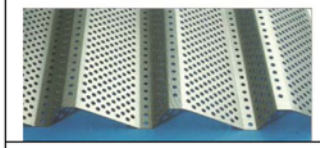
MATERIAL: SCREENING								
Material	**Thickness**	**Weight kg/m²**	**Sheet size**	**Sub-frame spans**	**Finish**	**Distance to site**	**Recyclability**	**Appropriateness**
Kliplok 406/700 (galvanised)  Kliplok 406	0.5mm 0.58mm	5.50kg 6.60kg	12.5m x 406mm or 12.5 x 700mm	1400mm 1800mm	Galvanising with or without paint	Boksburg North 55km	✓	
Kliplok 406/700 (zincalume)  Kliplok 700	0.47mm 0.53mm	5.10kg 5.70kg	12.5m x 406mm or 12.5m x 700mm	1400mm 1700mm	Zincalume with colour choice of Globalcoat™	Boksburg North 55km	✓	
Mascaret 	1.0mm 1.2mm	9.10kg 11.63kg	2950 X 910mm	910mm			✓	

Table 2: Alternatives to screening materials

Attribute: Steel

It is important when specifying steel that **a** certain percentage of **[re]**cycled is steel is incorporated during manufacture. This not only **[re]**duces the amount of accumulated embodied energy, the **[re]**duction of virgin material and the **[re]**duction in **[re]**source depletion (Davis Langdon, 2010:91).

Steel with a percentage of **[re]**cycled material should be used in all steel elements of the Woltemade building. **[Re]**-used steel on the other hand should be limited to elements which do not **[re]**quire inherent structural stength and integrity such as external screens, cable trays and steel framing materials.

Cost implications
Medium to high, but the environmental benifits far out weigh this.

Attribute: Sustainable Timber

Sustainable timber **[re]**fers to timbers that are sourced from sustainable forests, including the management and all other forest **[re]**sources (Davis Langdon, 2010:92). Products that display the FSC symbol carry a Forest Stewardship Council certification, however it is important to note that a full chain of custody (COC) needs to exist for every lot of timber purchased by a supplier who intends to manufacture, process or trade in timber. According to the FSC website a COC serves to demonstrate to customers that a manufacturer is **[re]**-sponsible in the use of raw timber (www.fsc.org).

A major downfall that exists when specifiyng sustainable timber is that a limited choice of timbers are available.

Timber for this project will be sources from Merensky, a hardwood sawmill in Limpopo that is FSC certified. Merensky's kiln drys Eucalyptus hardwood lumber is used for joinery, furniture manufacture and construction.

Even though Eucalyptus is not indigenous to South Africa, Eucalyptus plantations are a sustainable alternative to the logging of endangered tropical hardwood species.

Cost implications
Minimal cost implication, however credentials of supplier needs to be checked in order to be certain that timbers are indeed sourced from sustainable forests.

Attribute: Design for Disassembly

Dissasembly typically goes hand in hand with pre-fabricated components. These components are manufactured off site and delivered to the construction site ready for assembly (Davis Langdon, 2010:93).

In the case of the Woltemade building the componets that are able to be dismounted **[re]**configured and **[re**]installed are the internal partitions. These panels are designed to be dismantled in order to allow for a greater deal of flexibility to the interior configuration. This will allow the building to adapt should the programme of a unit change or need to be **[re]**located.

Generally off-site manufacture of pre-fabricated units saves time and money which is pertinant to any project. On-site congestion is minimised along with material wastage as off-cut materials can be **[re]**used in the factory or sent to the appropriate location.

Unfortunately many pre-fabricated components are difficult to source and waterproofing is not guaranteed. The waterproofing of the elements is not crucial as components are used for an interior application.

Cost implications
Project and item specific

Attribute: Local Sourcing

Transportation emissions are **[re]**duced if building materials are sourced locally and within close proximity to the site. This not only supports local manufacturers but also **[re]**-duces traffic congestion.

Cost implications
Site specific. Additional costs and limited products available in immediate proximity.

006 - 1.7 LAND USE + ECOLOGY

Attribute: **[Re]**use of Land

Although the site used for this thesis project is not being **[re]**developed it does exist with an existing muncipality and does not **[re]**ly on the use of a vacant or greenfield site (Davis Langdon, 2010:99).

Cost implications
Medium to high. The site costs more because an existing building and services are present on site. It does however need to be **[re]**zoned from residential to mixed use.

Attribute: Indigenous Landscaping

The Odhams English Dictionary's definition of indigenous is "native, belonging naturally to" a particular area (n.d:569). Davis Langdon's Quick Guide (2010:100) adds to this notion by including the phrase sustainable indigenous landscaping. This phrase implies that permanent indigenous plants as they will **[re]**quire less water and **[re]**duce the consumption of water for irrigation.

A disadvantage of using indigenous plants is that there is a limited number of species for designers to choose from.

The planting selected for the Woltemade site includes a number of indigenous plants that have been chosen for their drought tolerance, beauty and medicinal qualities.

Cost implications
Cost effective depending on plant choice and quanitity.

Fig 006.18: Aloe plants produce beautiful flowers, are easy to grow and have healing properties

Fig 006.19: The Barleria Repens, commonly known as the small bush violet has a pretty tubular flower and can be used as a climber on a trellis

Fig 006.20: Jasminum multipartitum is commonly known as Starry Wild Jasmine is a sweetly scented plant that is a good climber

006 - 1.8 EMISSIONS

Attribute: Ozone Depletion Potential

The Ozone Depletion Potential of a chemical **[re]**lates to the damage that a particular chemical can cause to the Ozone layer, which supports life on earth. Traditionally refrigerators relied on the compound chloroflourocarbons (CFC's), these compounds are known to contribute to the depletion of the ozone layer. Hydrochlorofluorocarbons (HCFC) have **[re]**-placed CFC's and do not cause damage to the ozone layer therefore they should be used. It is important to ensure that free standing air-conditioning units proposed in this thesis project make use of a HCFC refrigerant.

Cost implications
Project specific

Attribute: Light Pollution

Light pollution **[re]**fers to the unwated discharge of light into the surrounding environment and atmosphere. Sources of light may include illuminated signs for advertising, street and building lights.

Simple measures to ensure light is not discharged into the atmosphere is to direct light where it is needed and shield the **[re]**mainder of the lumanaire.

Cost implications
Minimal cost in the prevention of light pollution

ACCOMODATION SCHEDULE OF DESIGN DEPOT

GROUND FLOOR

EXISTING ROOM/ AREA	AREA
Shop 1	m²
Shop 2	m²
Shop 3	m²
Shop 4	m²
Shop 5	m²
Shop 6	m²

NEW ROOM	AREA
Recycling sorting + storage	m²
Service + deliveries area	m²
Refuse storage	m²

CIRCULATION	AREA
Entrance lobby	m²
New circulation core	m²
"Tunnel"	m²

PARKING	NO.
Old parking bays	
New parking bays	
Total number of bays	
Bicycle parking	
Motorcycle parking	

FIRST FLOOR

EXISTING ROOM/ AREA	AREA
Ablutions	m²
Switch room	m²
Restaurant 1 (converted)	m²
Furniture design office (converted)	m²
Accessory shop (converted)	m²
Sewing class sales (converted)	m²
Sewing class + pattern making (converted)	m²
Trader's stalls:(south (converted)	m²

NEW ROOM	AREA
Restaurant 2	m²
Trader's stalls + platform	m²

CIRCULATION	AREA
Lift lobby	m²
New circulation core	m²
New circulation	m²
Existing passages/circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL FIRST FLOOR	**m²**

SECOND FLOOR

EXISTING ROOM/ AREA	AREA
Restaurant (converted)	m²
Shop (converted)	m²
Live/work unit 1(converted)	m²
Fabric Sales (converted)	m²
Boutique (converted)	m²
Live/work unit 2 (converted)	m²
Furniture store (converted)	m²

NEW ROOM	AREA
Ablutions x2	m²
Restaurant seating	m²
Workshop (scrapbooking, craft + jewellery)	m²
Building manager's office	m²

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL SECOND FLOOR	**m²**

THIRD FLOOR

EXISTING ROOM/ AREA	AREA
Office 1 (converted)	m²
Office 2 (converted)	m²
Platform store (converted)	m²
Main exhibition space (converted)	m²
Main exhibition seating (converted)	m²
Shoe designer (converted)	m²
Boutique (converted)	m²
Dvd rentals (converted)	m²
Ablutions (converted)	m²

NEW ROOM	AREA
Exhibition space	m²
Hanging walkway	m²
Store	m²
Workshop	m²
Express print	m²
Gallery box	m²

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL THIRD FLOOR	**m²**

FOURTH FLOOR

EXISTING ROOM/ AREA	AREA
Confectionary (converted)	m²
Office 1 (converted)	m²
Tailor (converted)	m²
Atrium (converted)	m²
Seamstress sales (converted)	m²
Shoe shop (converted)	m²
Live/work unit (converted)	m²
Projection room (converted)	m²
Trader's stalls (converted)	m²
Ablutions (converted)	m²

NEW ROOM	AREA
Gallery space	m²
Hanging walkway	m²
Design Café	m²
Weaving workshop	m²
Clothing designer	m²
Sewing workshop	

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL FOURTH FLOOR	**m²**

FIFTH FLOOR

EXISTING ROOM/ AREA	AREA
Craft workshop (converted)	m²
Projection room (converted)	m²
Atrium (converted)	m²
Live/work unit (converted)	m²
Office (converted)	m²
Ablutions (converted)	m²

NEW ROOM	AREA
Furniture showroom	m²
Gallery space	m²
Hanging walkway	m²
Design Café	m²
Live/work unit	m²
Office	m²
???	m²

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL FIFTH FLOOR	**m²**

SIXTH FLOOR

EXISTING ROOM/ AREA	AREA
Office (converted)	m²
Arts supply (converted)	m²
Art classes (converted)	m²
Atrium (converted)	m²
Office 2 (converted)	m²
Furniture store (converted)	m²
Live/work unit (converted)	m²
Shop 1 (converted)	m²
Shop 2 (converted)	m²
Ablutions (converted)	

NEW ROOM	AREA
Craft workshop	m²
Gallery space	m²
Hanging walkway	m²
Café + seating	m²

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL SIXTH FLOOR	**m²**

SEVENTH FLOOR

EXISTING ROOM/ AREA	AREA
Residential unit 1 (reconfigured)	m²
Residential unit 2 (reconfigured)	m²
Residential unit 3 (reconfigured)	m²
Residential unit 4 (reconfigured)	m²
Residential unit 5 (reconfigured)	m²
Residential unit 6 (reconfigured)	m²
Residential unit 7 (reconfigured)	m²
Residential unit 8 (reconfigured)	m²
Residential unit 9 (reconfigured)	m²

NEW ROOM	AREA
Roof terrace 1	m²
Roof terrace 2	m²

CIRCULATION	AREA
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²

TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL SEVENTH FLOOR	**m²**

ROOF/EIGHTH FLOOR	
EXISTING ROOM/ AREA	**AREA**
Laundry (reconfigured)	m²
Residential unit 2nd floor + roof terrace (reconfigured)	m²
NEW ROOM	**AREA**
Residential unit 1	m²
Residential unit 2	m²
Residential unit 3	
Residential unit 4	
Residential unit 5	
CIRCULATION	**AREA**
Existing lift lobby	m²
Existing passages/circulation	m²
New circulation core	m²
New circulation	m²
TOTAL AMOUNT OF ADDITIONAL SPACE PROVIDED	m²
TOTAL SEVENTH FLOOR	**m²**