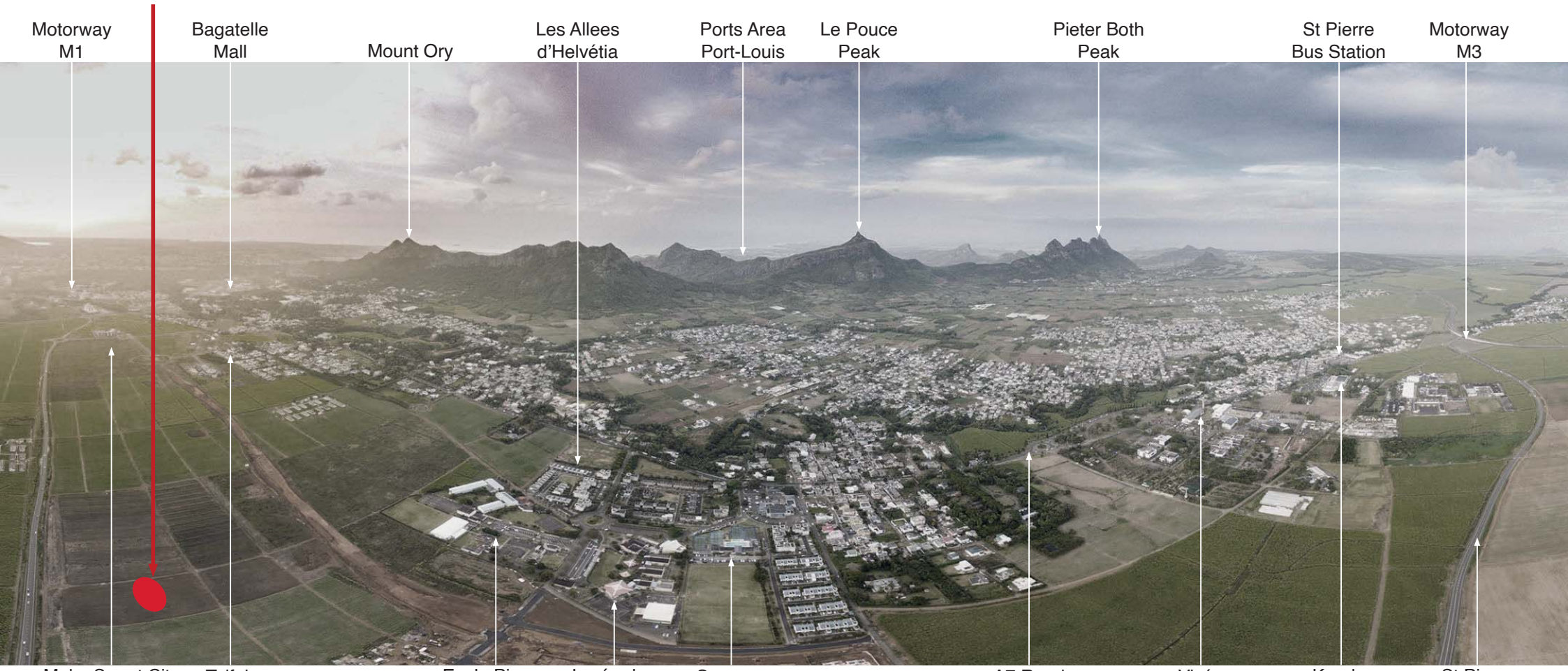
PARCEL 163C - VILLA DURABLE - DESIGN REPORT



Location Plan

Overview

The design is for a residential development under 250m², for a family of 4 members.

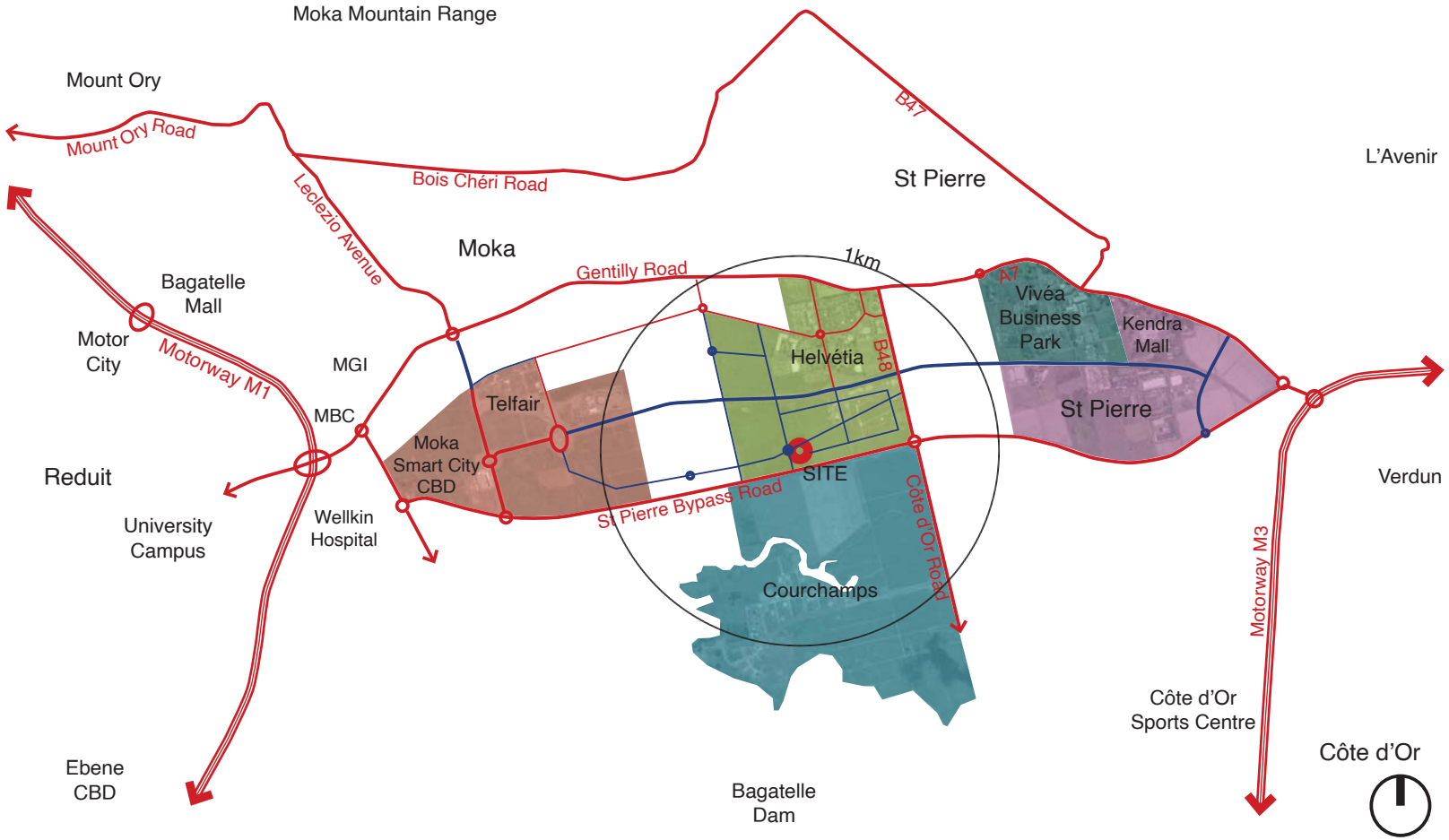
The design proposal is developed under the "Les Promenades D'Helvétia" guidelines for Plot 163C and in accordance with local PPG & Design guidelines.

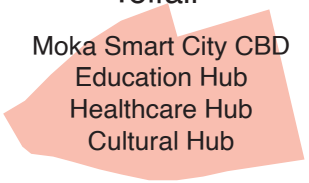
Due care has been taken to develop a contemporary and vernacular project that is harmonious with the surroundings.

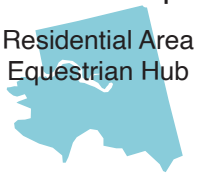
The site sits on prime location within the Moka Smart City with several opportunities that have shaped the proposed building and landscape.

With the completion of the new road networks for the Moka Smart City, the site will benefit from almost direct links to the surrounding motorways and Moka city centre.

The proposed design for the whole plot has been tailored to achieve the highest LEED ratings for a residential development in terms of energy efficiency, water efficiency, waste reduction, green sustainability, indoor air quality, adaptability & flexibility and healthy comfortable living







Site Analysis

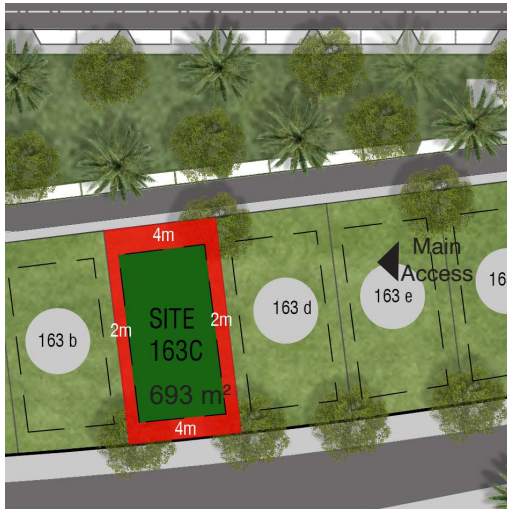
Overview

The site is located on the South-West corner of the "Les Promenades D'Helvétia" residential land plots.

The site is fairly exposed to the prevailing South-East trade wind and to direct sunlight throughout the year unless adjacent plots are developped close to their respective boundary set backs.

Depending on the closeness of the development on the northern plot, the site may enjoy a prestine view over the Moka mountain range. Also, the clearance due to the upcoming roundabout on the West side of the plot may offer a view over the Moka Smart City CBD skyline.

In terms of accesses, the site has an almost direct link to the St Pierre Bypass road down South via a roundabout that also connects to the Moka Smart City CBD and to the northern parts of Helvétia.
A dedicated pedestrian access is also present from Helvétia North through a Green Park Space to the site.



Buildable region | Site Setbacks | Residential Area | Residential Area | Retail | Education Hub | Recreational Hub | Upcoming Roads

LEED Approach

Overview

The site is located within the residential precinct of the Les Promenades D'Helvétia. Plots of land are available for residential development following the 'Les Promenades D'Helvétia' guidelines. Also, the Leadership in Energy and Environmental Design (LEED) certification is targetted and this development is concerned with the LEED v4.1, Residential Single Family Homes, approach.

LT - Location and Transportation

To reduce the environment impact of the development foot print

SS - Sustainable Site

To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.

WE - Water Efficiency

To reduce demand for water through high-efficiency fixtures and efficient landscaping practices.

EA - Energy and Atmosphere

To improve the building's overall energy performance and reduce its greenhouse gas emissions.

MR - Materials and Resources

To encourage environmentally responsible forest management.

EQ - Indoor Environmental Quality

To reduce moisture problems and occupants' exposure to indoor pollutants from kitchens, bathrooms and other sources by exhausting pollutants to outside and ventillating with outdoor air.

IN - Innovation

To maximise opportunities for integrative, cost-effective adoption of green design and construction strategies.

RP - Regional Priority

To address geographically specific environmental, social equity, and public health priorities.

VILLA DURABLE INNOVATION

The proposed Villa Durable incorporates energy saving technologies and passive design features to maximise the score towards the highest LEED certification. These passive principles are dealt with in this report along with energy and water saving measures.

The innovation with the design proposal brings back the reinvented traditional vernacular forms and materials of construction in Mauritius but in a refreshed modular prefab sheme. As such, a combination of metal, stone and timber will be used smartly for the design. A prefab scheme has been chosen as it allows:

- better adaptability to different house typologies
- ease of construction with standardised modules
- better control over clean material sourcing and transportation.

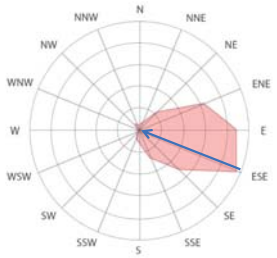
LEED CASE STUDY - KAUPUNI VILLAGE

Kaupuni village is located in Waianae Valley, Oahu, Hawaii. The Kaupuni Village Home project consists of a street of 19 single-family affordable homes and a community resource center. The project has received a LEED Platinum from the US Green Building Council.

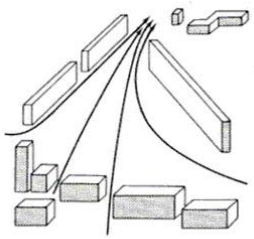
This case was chosen due to its similarities to Mauritius in terms its tropical climate, isolated location and relative means of access to resources. Each home is designed for maximum energy efficiency and utilises renewables to reach net-zero energy performance. Energy efficiency measures in a Kaupuni Village home reduced energy consumption by more than 40% over a standard-built baseline home. The south-facing orientation of the houses and the roof angles are intended to increase the efficiency of the PV systems which provide the renewable electricity to make net-zero energy homes. Each of the high-performance homes incorporates energy efficiency appliances and lighting, renewable energy technologies, effective building envelope insulation, and high performance glazing with optimal overhangs/eaves. Water heating is done by using solar water heating fitted on the roof. The concrete driveway is pervious to capture runoff and reduce the urban heat island effect. Solar daylighting is achieved with solar tubes while efficient compact fluorescent lighting is used at night.

Wind Analysis

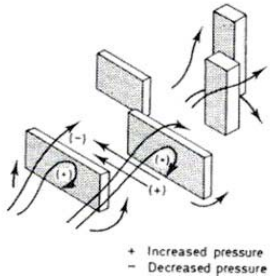
The road South of the plot will funnel and amplify the prevailing South-East Trade Wind towards the site. Trees and future developments down South may tailor down the strength of this prevailing wind.



Prevailing SE Trade Wind



Funnelled trade winds



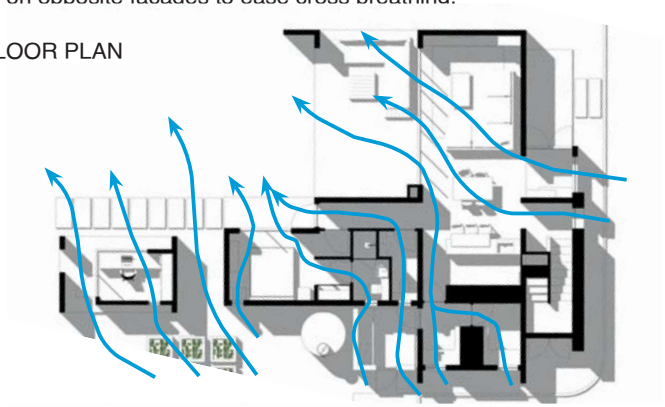
Dampening of trade winds

Passive Design Features

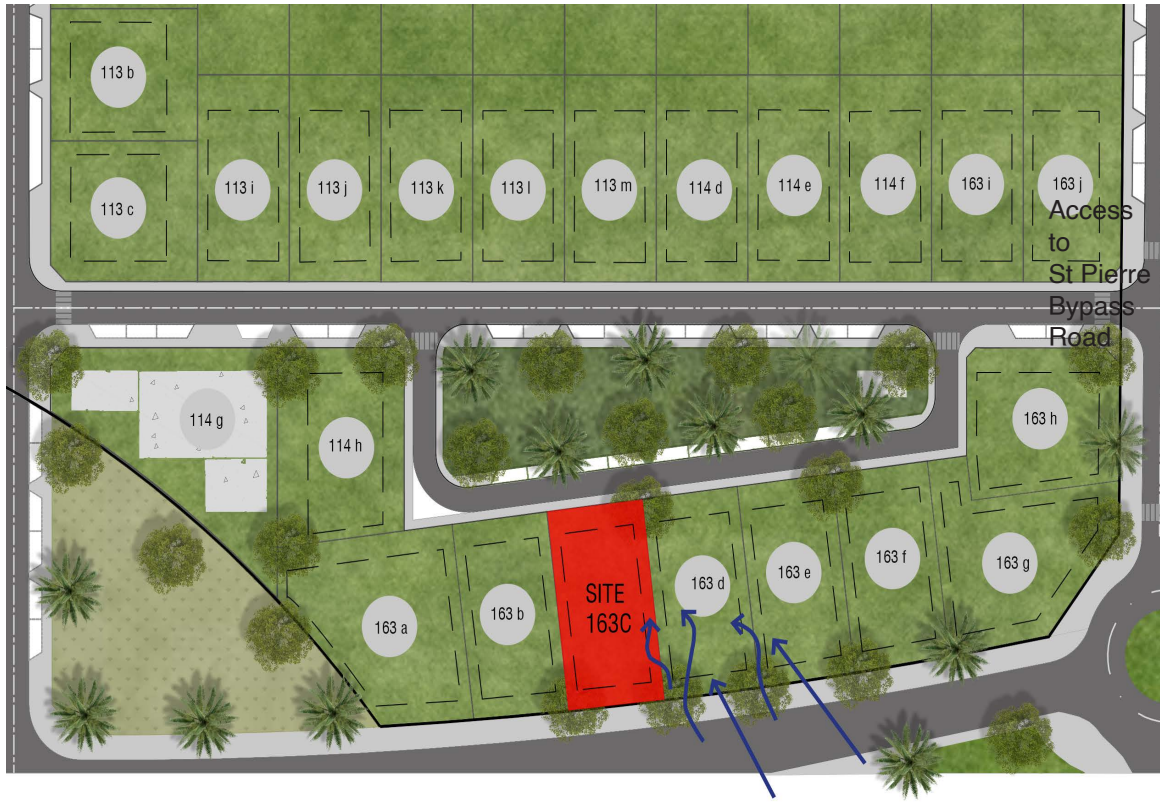
Building Orientation

The building is orientated in such a way so as to maximise natural cross ventilation driven from the Island's prevailing South-East trade wind. Each space in the house has at least one opening on opposite facades to ease cross breathing.

GROUND FLOOR PLAN



FIRST FLOOR PLAN

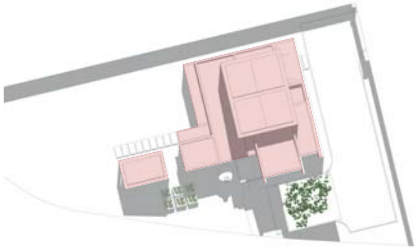


The L shaped house responds to its natural environment and its orientation to the North maximises both north solar exposure and mountain views. All areas of this house are naturally ventilated with air flowing from the south East across the spaces. The L shape protects the outdoor verandah from direct winds coming from the south east for maximum comfort for its users.

Solar Analysis

Solar analysis was carried out at different times to identify orientation to achieve optimum passive solar heating, quality of natural lighting and shadow pattern on neighbouring plots.

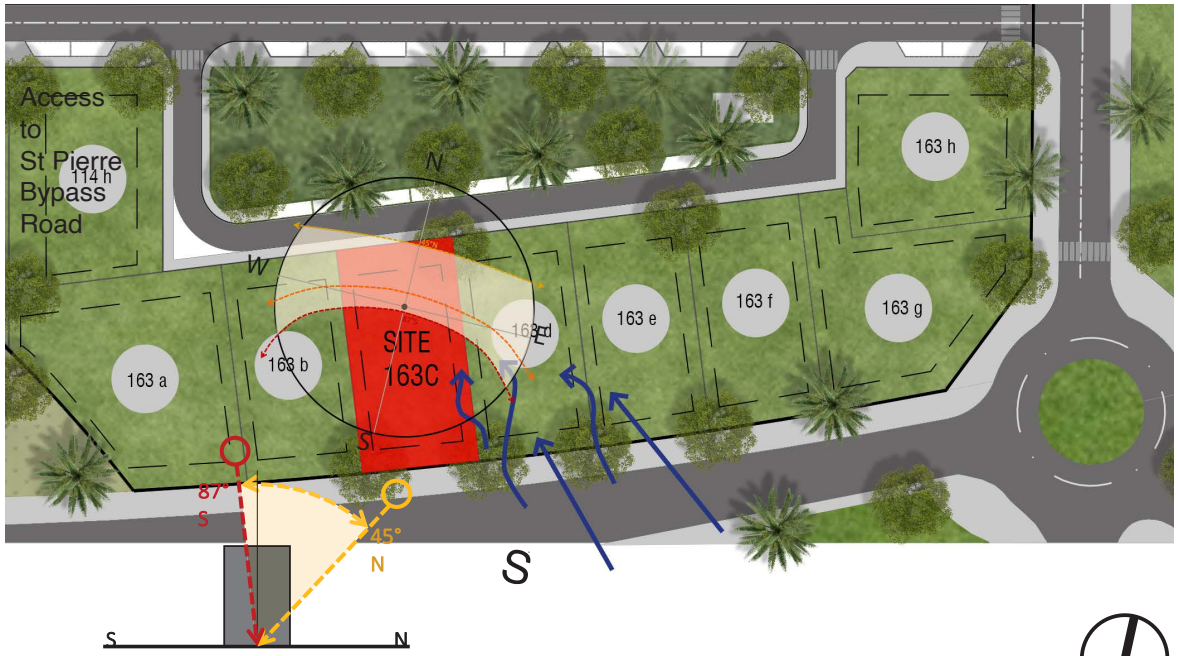
Winter Solstice at 12:00



Summer Solstice at 12:00

Equinox at 12:00

Summer Solstice at 16:00

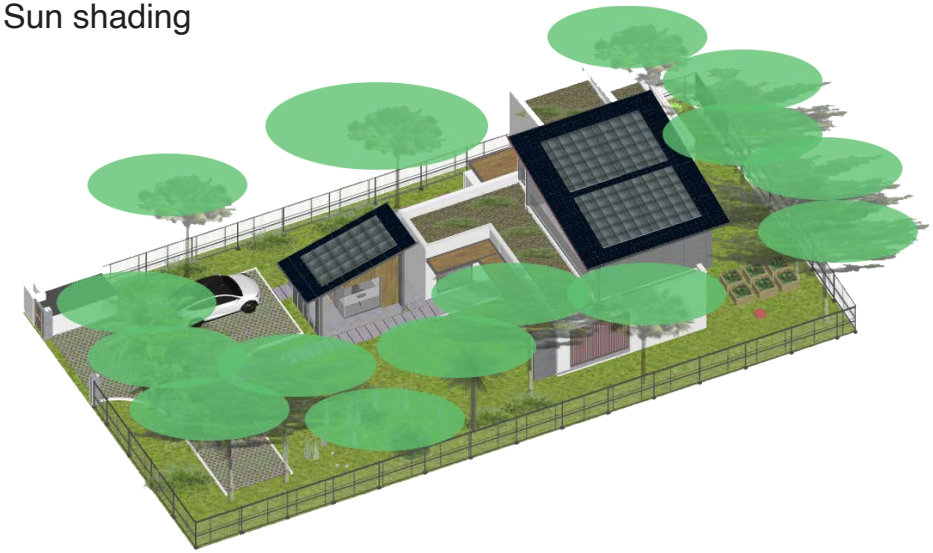


Passive Design Features

Overview

The new development has passive design features that shades the building and other parts of the site from unwanted solar gains. Overall orientation, screens, awnings, green roofs and tree positionings form part of these informed design features.

Sun shading

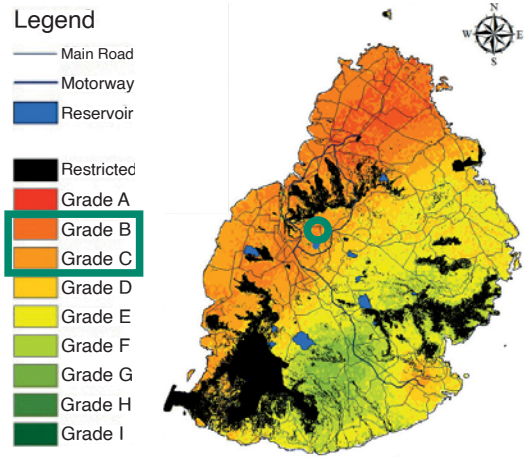


Renewable Energy Production

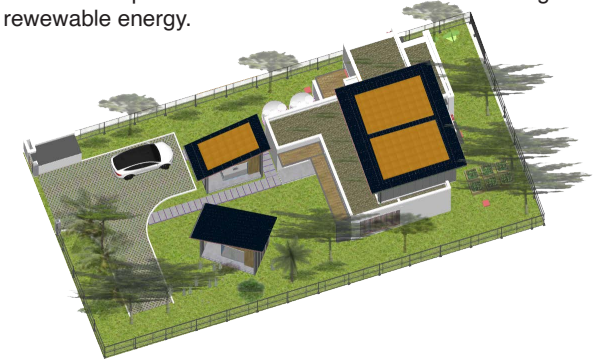
Overview

Spatially clustered cloud covered zones are found to influence significantly the spatial distribution of global solar irradiation on a horizontal surface on the island, which varies from a maximum value of 22.5 MJ/m^{2}day to a minimum of 9.5 MJ/m^{2}day throughout the year giving an average of about 16MJ/m^{2}day.

Solar Photovoltaic potential map of Mauritius



The roof design caters for the incorporation of PV panels as an attempt to lower Green House Gases through rewewable energy.



The new development can achieve a PV installation covering up to 36m^2 thus potentially generating an average of 580MJ per day.

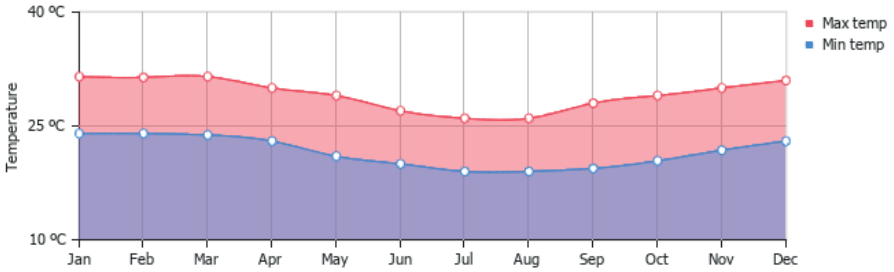
Local Climate Analysis

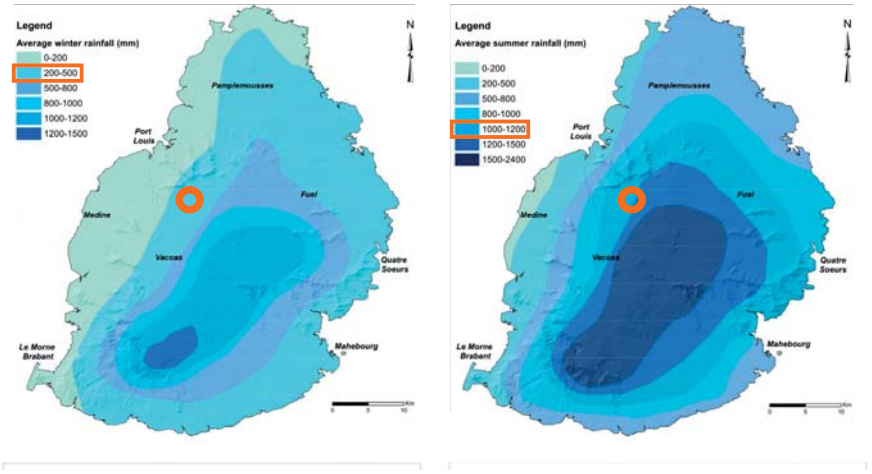
Mauritius enjoys a mild tropical maritime climate throughout the year. The country has two seasons: a warm humid summer extending from November to April and a relatively cool dry winter from June to September.

Long term mean annual rainfall (1971-2000) over the Island is 2010 mm. The wettest months are February and March. The driest month is October.

Mean summer rainfall (1971-2000) is 1344 mm, which is 67% of the annual amount over the Island. Mean winter rainfall (1971-2000) is 666 mm. Most of the rainfall occurs in summer months.

The Island receives 6.5 to above 8 hours of bright sunshine daily. In summer months around 6.0 hours of bright sunshine are received over the high grounds. In winter months, the Central Plateau receives around 5.0 hours of bright sunshine.





The impacts of climate variability and **extreme weather** events are becoming a concern to the Republic of Mauritius. The climate of the South West Indian Ocean (SWIO) small island states is influenced by large ocean-atmosphere interactions such as trade winds. They are often affected by tropical cyclones and other extreme weather.

Moka has a relatively humid and wet climate and is located at an elevation of 303m above sea level.

Mean summer temperature is 25.0 degrees Celsius and mean winter temperature is 18.8 degrees Celsius. The average annual temperature in Moka is 22.0 degrees Celsius.The warmest months are January and February with average day maximum temperature reaching 28.6 degrees Celsius and the coolest months are July and August when average night minimum temperatures drops down to 15.3 degrees Celsius.

Passive Design Features

Overview

Heavy rainfall in a short amount of time is becoming a recurring event due to climate change and so are flash floods.

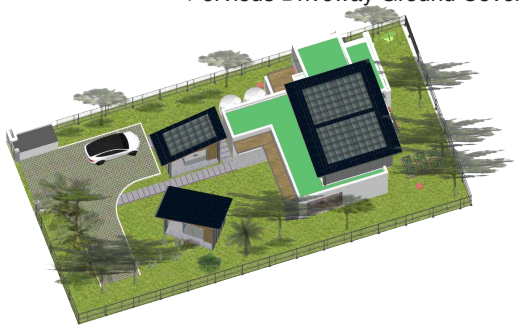
The driveway on site are covered with permeable paving blocks [evergreen pavers] to increase the capacity area of rainwater absorption. The softscape area together with the driveway ensures that 85% of the site is permeable .

Space has been allocated for 2 tanks of 2000L: 4.6m x 2.6m for rainwater tanks

Roof tops are fitted with layers of membranes with specific shrubs which will both filter rain water but also retain volumes of it and reduce the discharge rate into ground soak aways.

Area of green roof: 25m^2

Pervious Driveway Ground Cover



Green Roofs Highlighted

Material Resource & Cost Efficiency

Responsible Materials in Construction & Design for Life-cycle Benefits

A 'Material passport' will document the material ingredients in all built works for future re-use and recycling including information regarding maintenance.

BIM PASSPORT

Construction companies shall write and implement a procedure for waste management from the building site in order to limit waste and promote recycling.

TAKE-BACK AGREEMENT

Preference for modular building components to ensure adaptability, flexibility, replicability and scalability.

BUILDING COMPONENT

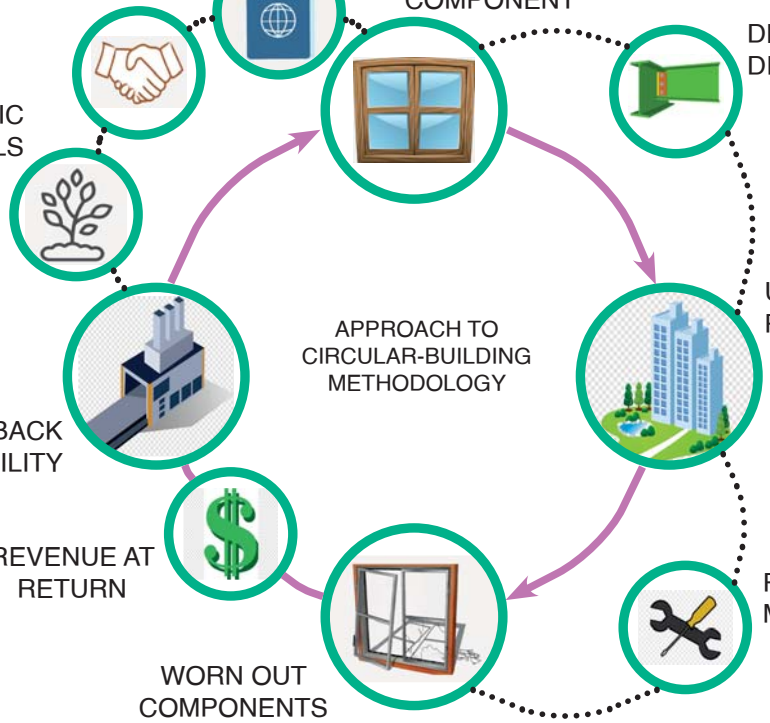
DESIGNED FOR DISASSEMBLY

Preference for separable construction methods to allow raw materials to be recycled and to ease maintenance.

Use of low embodied energy materials where possible. The proposal favours the use of locally available materials wherever possible.
Prioritise the responsible use of materials:

- Any wood sourced from certified responsible sources (Forest Stewardship Council – FSC or USGBC Approved)
- Low VOC & low formaldehyde
- Recycled content of concrete
- Eco-labels will be targetted for finish products and solvent glues used in construction
- Limit use of non-recyclable petrochemical materials

NON-TOXIC MATERIALS



APPROACH TO CIRCULAR-BUILDING METHODOLOGY

Choice of material tailored for residential needs:

- Stainless steel for hygienic surfaces and exposed externally surfaces.
- Non slip and antibacterial materials for wet areas.
- Appropriate use of thermal mass, insulation, and reflectivity for the purposes of passive conditioning and visual comfort.
- Limitation of heat island effect using the roof form and materials, ground cover, water bodies and greenery.

USAGE PERIOD

The approach to the project is to 'Reduce, Re-use and Recycle' in that order where appropriate. Choice criteria includes: Recycled products, recyclable products as well as carbon impact emission.

TAKE-BACK FACILITY

Intensive planning with a full construction team will ensure that the proterty cost will be a purely green investment towards a better way of living and for the environment.

REVENUE AT RETURN

RENOVATION AND MAINTENANCE

A fit-out guide for responsible commissioning of material sources will ensure the avoidance of non-recyclable laminates or materials that cannot be taken apart for recycling.

WORN OUT COMPONENTS

Cost Efficiency

Cost prior to construction

Cost saving measures have guided the design of the house and will be implemented throughout the lifetime stages of the project from conception to construction and to usage.
At the very start of the project, special attention will be paid to the selection of material that will be used for the construction and also how they will weather.
A full team of consultants (MEP, Structural, etc) will ensure that the house has a full fledged consolidated planning prior to construction so that limited spending is made afterward as a result of poor planning or storm damages.

Cost during construction

A set scope of work will have to be followed carefully so as to reduce contingencies.
Materials will be sourced locally as much as possible to save on shipment and also to promote local craftsmanship.
The buidling site will incur less disruption to its surroundings since most of the buidling components will be assembled elsewhere then shipped on site.
The local builder will also have to produce a breakdown of the construction materials used and ensure that these are either recycled or will be recycled.

Cost post construction

Once completed and in use, the house will cost relatively less to opperated than the island's common household due to the water and energy saving measures.
Rain water will be used for ground floor toilet flush, cleaning and landscape watering.
Energy will be saved in terms of heating and cooling thanks to the the adequate cross ventilation through the whole house and the solar water heater system.
The roof inclination of the house has been guided to maximise solar gains for the PV pannels which will in turn alleviate dependance on the grid.

Water, Waste Water & Energy Management

Water & Waste Water Management

Overview
The new development will utilise water to achieve holistic sustainable quality while creating unique experiences.

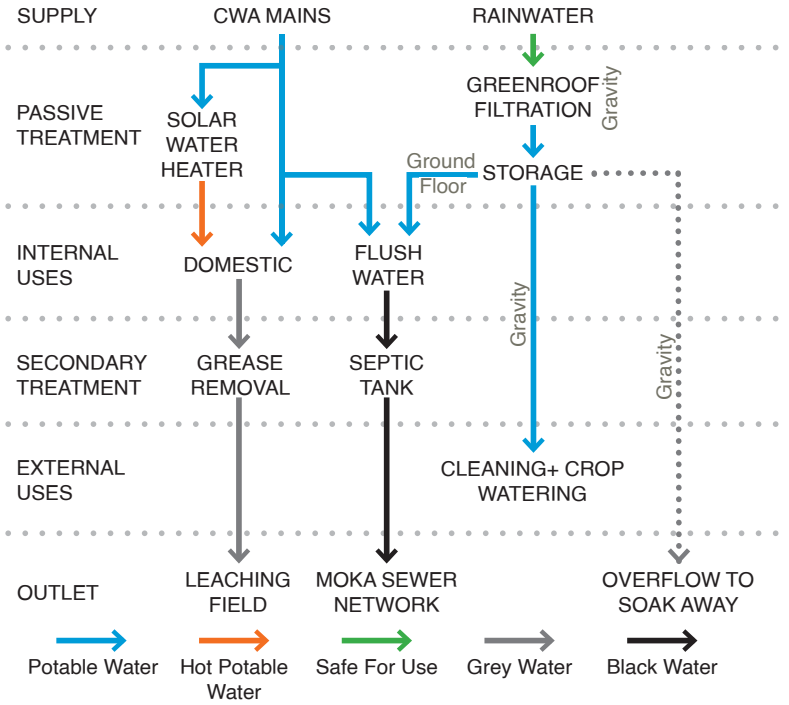
Baseline data versus Targets
The site is targeting a minimum 50% net reduction of potable water against local baseline buildings. The development aims to reduce the need for potable water consumption, capture and recycle rain water.

Site Water
Where possible, potable water use will be reduced or eliminated through the adoption of systems that use recycled rain water or recycled mains water.

Waste Water
Waste will be either effectively treated via individual sewage treatment plant.
A grease trap will be installed on kitchen drain.

Rain Water Recycling
Rainwater or grey-water recycling feasibility will be assessed by a competent specialist.
Water retention tanks will be included to limit instantaneous water discharge to outside environment.

Water System Diagram



Measures include:
- Reduction of water consumption in landscaped areas through native plants and recycled water supply
- Recycling of greywater for non-potable use.
- Use of treated rainwater for high quality water demands

Energy Efficiency Management

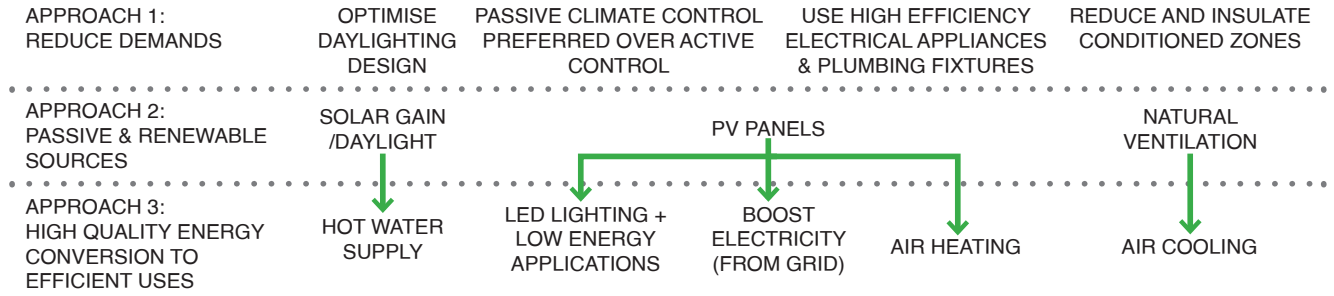
Overview
Only energy-efficient appliances and equipment will be used.

Efficient and bespoke HVAC systems will be appropriately designed and sized for the development. This will include economy cycle mode, CO2 monitoring or temperature band fluctuation control to increase energy efficiency in the design.

Where practical, natural ventilation will be implemented to enable the delivery of high levels of fresh air to spaces and reduce the energy consumption associated with HVAC systems. Switches would automatically deactivate air conditioning when façades are open.

Smart meters will also be used to monitor water and electricity usage as well as electricity production from PV panels.

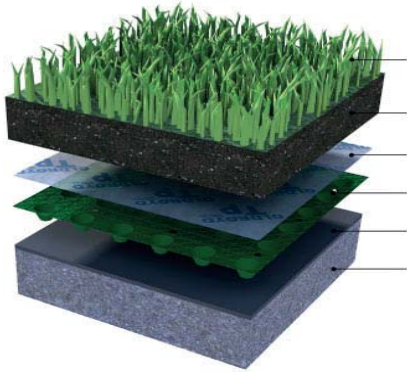
Diagram explaining order of choices in energy system design



Green Sustainability Focus

Overview

A consequent portion of the total land area is constituted by green roofs, evergreen pavements and lush landscaping. The extensive landscaping and greenery are not focused in one area but spread throughout the development and well integrated in terms of design and use.



Green roofs to reduce the heat island effect.

Raised beds for vegetable garden using composted kitchen waste

Reed will be grown ontop of the leaching field

Trees & palms that grow a decent canopy will be planted around the plot to provide shading and privacy and act as a wind and noise barrier

Creepers and perennial plants will be planted around the carport and driveway areas to reduce the propagation of dust particulate.

Shrubs will be planted around the boundary fences to tame the prevailing wind and external noise and also to provide privacy from the road and neighbouring plots.

Green Design Features

- Tropical reed species will be used around the leaching field to ensure that grey water has a further treatment before seeping through the ground.
- Raised flower beds will be used for home grown vegetables and will make use of organic kitchen wastes from the compost bin.
- A selection of endemic flora will be used on site to achieve a low maintenance and low water demand landscaping.
- Species will be also chosen on their ability to complement the proposed architecural style of the new development.
- Trees that constitute the habitats of local fauna such as the Mauritius Gecko and other seasonal birds will be included.
- To reduce the heat island effect, trees with consequent canopies and creeping plants will be positioned around the driveways and carport.
- Some roof top will be covered with greenery and layers of membrane to capture and filter rainwater for further non-potable uses.
- Leafy species will be located on the South East corner of the site to tame down the strength of the prevailing trade wind.
- Evergreen species will be planted around boundary walls to create privacy and also buffer the traffic noise from the adjacent road.

Ensuring Healthy and Comfortable Living

Overview

The proposal provides an environment which facilitates deeply restorative experiences, including the following potential health and well-being responses:

Views

Prestigious views over the green Moka Mountain Range and the upcoming Moka Smart City CBD Skyline. The upcoming leafy streets will also appease the urban context.

Connection with Nature

The selection of endemic Flora to be brought on site will attrack specific birds and insects thus promoting the endemic fauna. The incorporation of green roofs and terraces brings greenery closer to the residents.

Access to Thermal & Airflow Variability

The presence of openings on at least two adjacent or opposite walls in each main spaces favours a controlled cross-ventilation throughout the house.

Dynamic and Diffused Daylight

The tree canopies will filter down the harsh daylight penetrating the house. Each main spaces have openings that will receive natural daylight throughout the day.

Non- Rhythmic Stimuli to the senses

The selection of trees and palms along with the birds and insects will all contribute to mask the regular noises of the city.

Material Connection with Nature

Natural and localised materials, stone walls, wood surfaces, evergreen paving blocks. Prefab construction method will incur a minimum disturbance to nature during construction and usage.

Air quality and safety

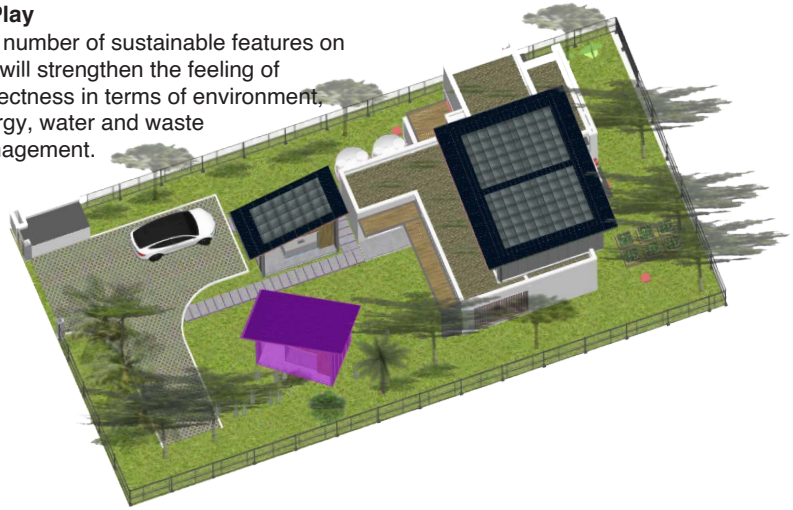
Cross breathing ensures that the house is supplied with constant fresh air and the plants on site reduces the propagation of dust particulates. The prevailling wind also disperses the vehicle fumes at the open carport.

Adaptability and flexibility

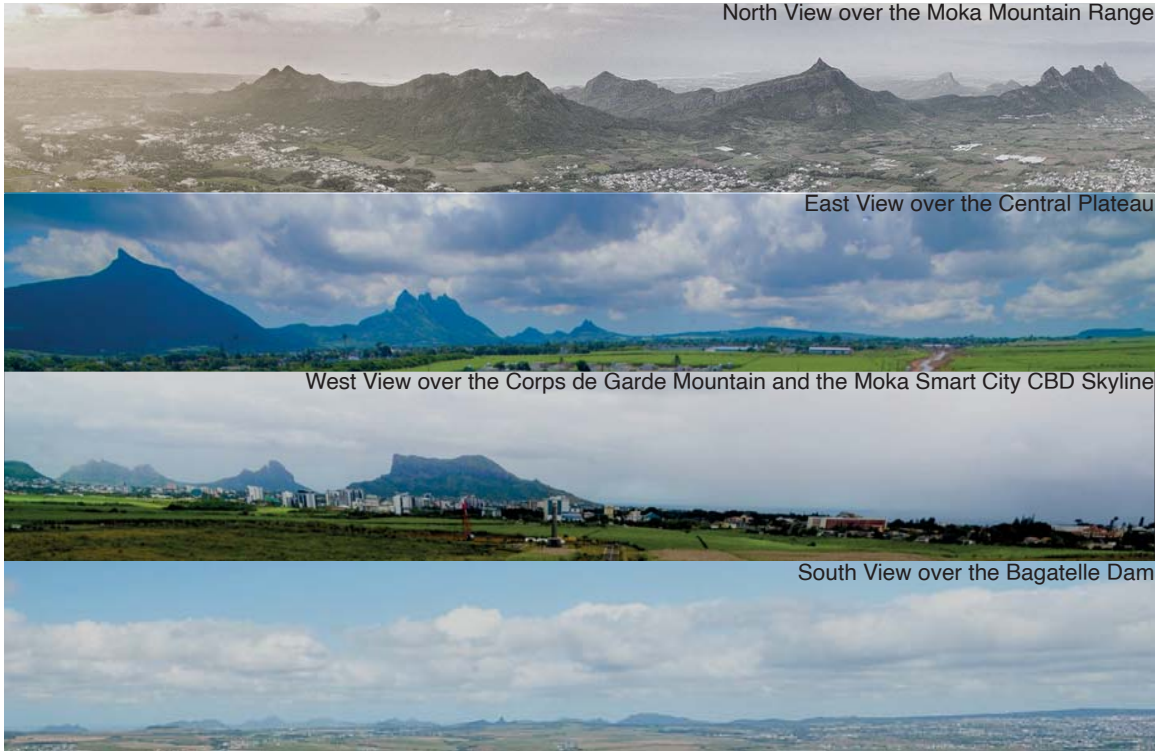
With the absence of internal steps at the ground floor level, it can easily be adapted with step-free accesses to welcomed a wheel chair user.

Live and Play

The number of sustainable features on site will strengthen the feeling of correctness in terms of environment, energy, water and waste management.



The mobile office can be moved around



North View over the Moka Mountain Range

East View over the Central Plateau

West View over the Corps de Garde Mountain and the Moka Smart City CBD Skyline

South View over the Bagatelle Dam

Feeling of connectedness

Planned cycling routes, cycle parking and recreational walking paths enhance the methods of safe travel to and from the city centre and surrounding areas. This will encourage the use of green transport means.

Walking distances from the Site:

The estimated travel time to nearby facilities is as follows:

9 minutes	To Synergie sports centre
11 minutes	To Helvétia shopping centre
5 minutes	To St Pierre Bypass Road
5 minutes	To the main upcomming Boulevard

LEED Aspirations

Sustainability Statement Summary

The Leadership in Energy and Environment Design (LEED) methodologies have been used as a benchmark for the targets and aspirations of the development. This considers the broad environmental concerns of climate change, pollution, impact on occupants and the wider community. It balances these with the need for a high quality, safe and healthy internal environment. These standards go beyond the requirements of the local Building Regulations.

New Development Sustainability Initiatives

The new development proposal incorporates sustainable LEED initiatives to reduce the greenhouse gas emissions, potable water consumption and material resources of the site. The sustainable initiatives outlined in this report are intended to be used as a design guide for the new development. Specific initiatives that will be installed will be determined throughout the development application stage for the building. The design implementation will be subjected to feasibility analysis, including that of the final use and layout. The initiatives will also comply with the guidelines set out by the relevant authorities.

The development's commitment to reducing the overall environmental impact is evident of the holistic approach taken to long-term sustainability.

Documented initiatives cover a range of categories including:

- Energy & greenhouse gas emissions
- Potable water reduction
- Minimising waste to landfill
- The indoor environment
- Occupant amenity and comfort
- Land use & ecology
- Building management

LEED v4.1 Approach

LT - Location and Transportation

Planned cycling routes, cycle parking, and recreational walking paths enhance methods of safe travel to and from the city centre and surrounding areas.

SS - Sustainable Site

Recycling facilities will be provided on site for construction and operational waste. The construction site will be managed in an environmentally sound manner in terms of resource use, storage, waste management, and prevention of pollution.

WE - Water Efficiency

Water consumption will be reduced through the use of low volume flow fittings. Water metering and leak detection alarms will be installed to monitor and minimise wastage. The extensive landscaped area around the house is designed to be self-sustaining and rely minimally on precious resources. Rainwater collected from green roofs will be used for ground floor toilet flush and to irrigate planters all by gravity.

MR - Materials and Resources

Building materials where possible will be sourced locally to reduce transportation pollution & support the local economy. All timber will be purchased from responsible forest sources with the FSC or USGBC approved-equivalent certification. Material choices, building orientation and site placement, along with the wider sustainable issues of community engagement and employment have been taken into consideration during the scheme development.

EA - Energy and Atmosphere

Installing 36m^2 photovoltaic panels on the roof will reduce the carbon emission. The development will use low energy lighting together with daylight linked dimming, where appropriate. Productive Landscapes & Aquascapes will not only serve water quality and sustainability aims but enhance the micro-climate and quality of experience across the site.

EQ - Indoor Environmental Quality

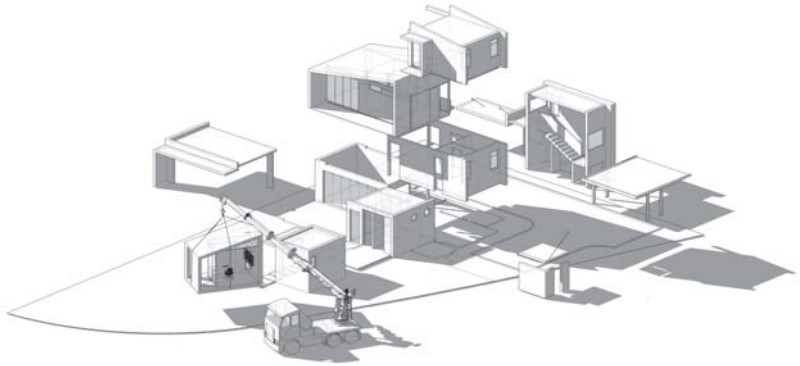
Good solar control will be provided by the selection of glazing/ shading so as to avoid overheating in summer and increase passive gains in winter. Views have been considered for each of the buildings to optimise the access of the building occupants to green or environment enhancing vistas.

IN - Innovation

Green terraces are proposed as a roof covering which will enhance the local habitat and provide a visual connection. The new development will use "Smart" technologies to reduce operation and energy costs. The house is designed following a prefab scheme whereby main spaces have standard dimensions to ease adaptability, construction and transportation.

RP - Regional Priority

With a forecasted annual demand of 4500-5000 housing units up to 2025 in Mauritius, there is the urgent need to shift from the conventional methods of design and construction towards a more sustainable and innovative approach to cater the demands for more housings. This new proposal will be the right way forward.



The proposed 3-bedroom house for a family of 4
members has a total gross floor area of 211m^2.