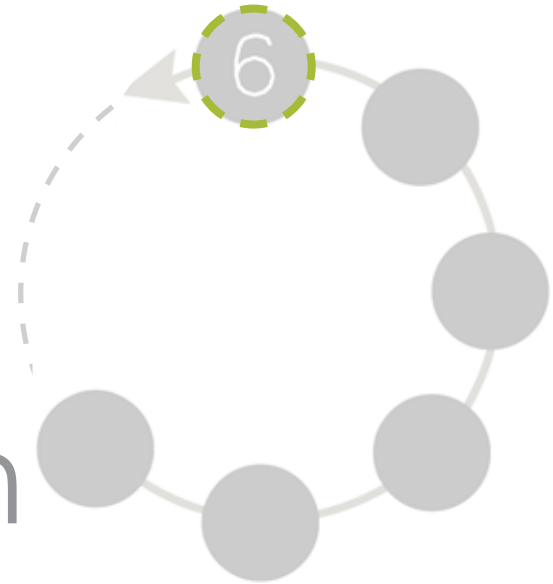
"Good detailing is a function of the spatial arrangement of the elements, their slenderness and lightness, and the connections between them." (Trebilcock, 2004:1)

In this chapter, a visual presentation of the final design and material choices will give expression to design decisions that were taken in the previous chapters.



Design

>>101: Rendered market floor plan.

- TAKE AWAYS
- BAKED GOODS + CONFECTIONARY
- READY MEALS
- SWEETS + NUTS
- FRUIT + VEGETABLES
- SALADS
- SEAFOOD + SUSHI
- DAIRY + CHEESES
- DELICATESSEN
- CUT FLOWERS + PLANTS
- BUTCHERY
- BAKERY

GROUNDFLOOR PLAN

>>102: North-eastern view of market building and aquaponic pond

>>103: South-western view from market courtyard

>>104: View of take away area and visible building systems in service cores

List of Accommodations

Groundfloor:

	Market	**1944m2**
	including circulation areas	
	West wing:	**760m2**
	Take Aways	**304m2**
	T/A1	38m2
	T/A2	40m2
	T/A3	30m2
	T/A4	53m2
	T/A5	34m2
	T/A6	36m2
	Service ducts	25m2
	Wet waste	23m2
	Storage	25m2
	East wing:	**760m2**
	Public toilets	125m2
	Butchery	135m2
	Bakery	203m2
	Service corridor	90m2

First floor:

	East Wing:	**760m2**
	Food Processing and Packaging	**409m2**
	Wet waste + storage	80m2
	Food Processing 1	92m2
	Food processing 2	75m2
	Packaging room	92m2
	Distribution area	70m2
	Central area:	**2130m2**
	Including circulation and atrium areas	
	Restaurant 1	**400m2**
	Kitchen area	65m2
	Outside seating	80m2
	Hydroponics	380m2

	West wing:	**760m2**
	Office 1	45m2
	Office2	23m2
	Kitchenette 1	6m2
	Boardroom	15m2
	Public toilets	94m2
	Educational Facility	
	Classroom 1	102m2
	Classroom 2	100m2
	Kitchenette 2	12m2
	Store room	40m2

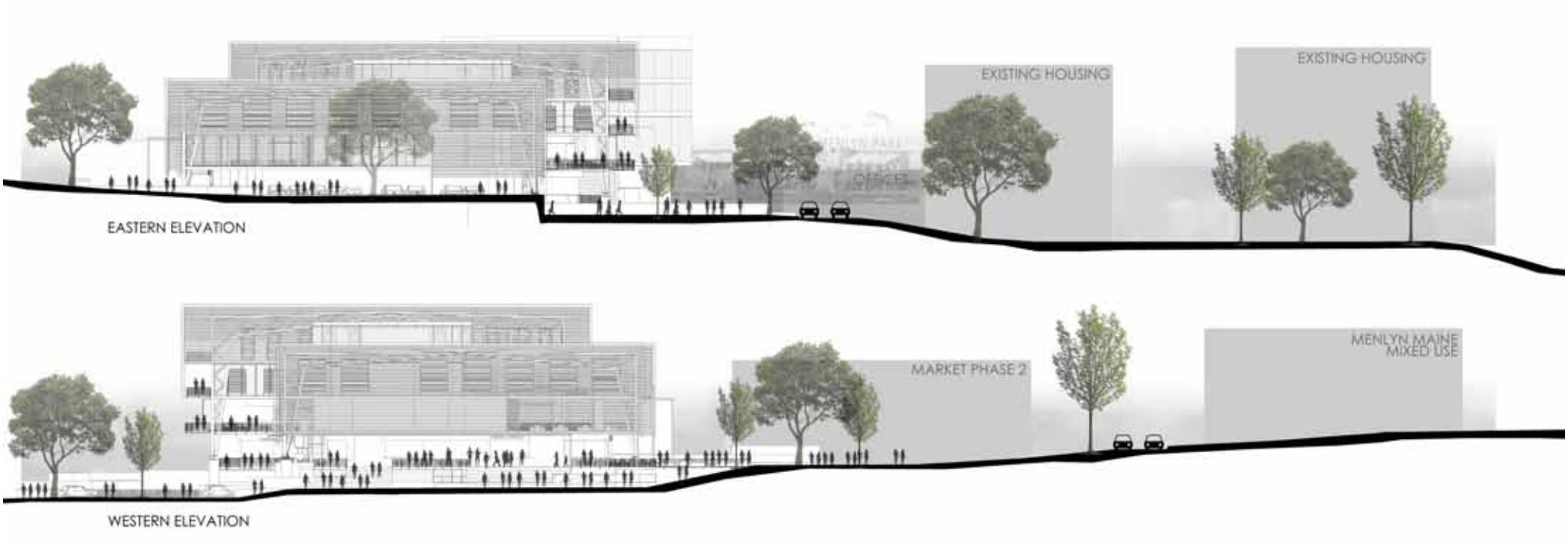
Second floor		3688m2
	Hydroponics + circulation	**3100m2**
	Hydroponics1	1720m2
	Hydroponics2	862m2
	Restaurant 2	310m2
	Kitchen area	63m2
Basement -1	**Basement Parking**	**2600m2**
	36 parking bays	
	Service rooms and storerooms	250m2
Basement -2	**Basement Parking**	**2600m2**
	36 parking bays	
	Service rooms and storerooms	250m2
Basement -3	**Storage floor**	**2080m2**
	Cold rooms	1200m2
	Storage spaces	800m2
	Service areas	80m2
	Productive landscapes	
	Total building area:	**18 392m2**
	SITE AEA:	19 930m2
	PHASE 1 BUILDING AREA:	4 625m2 (23% COVERAGE)
	PHASE 2 BUILDING AREA:	2 350m2
	TOTAL BUILDING AREA:	9 675m2 (49% COVERAGE)

>>105: View from BRT and Transport interchange building.

>>107: Interior view of nutrient film grow trays in hydroponic zone, second floor.

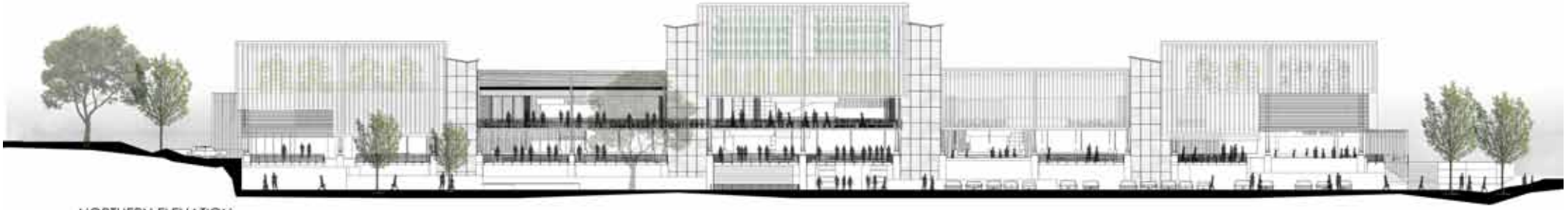
>>106: Interior view of restaurant area on first floor.

>>108: Market floor with courtyard communal space.



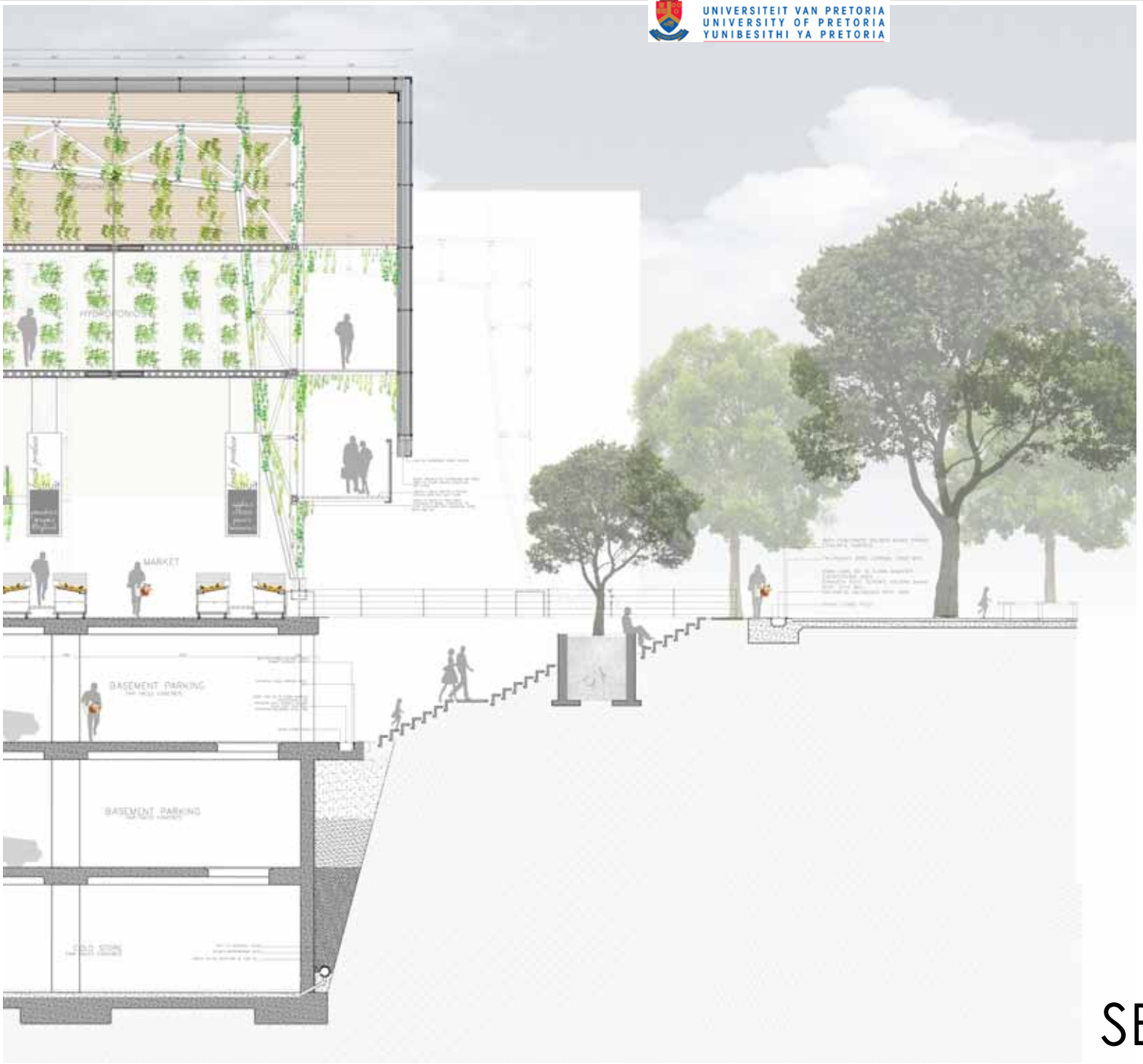
 >>109: Rendered elevations.

SOUTHERN ELEVATION



NORTHERN ELEVATION

>>1010: Rendered section.



SECTION A-A

	MATERIAL	COMPOSITION	STRENGTH	SIZE	FINISH	DESCRIPTION	CARBON FOOTPRINT kgCO2/kg
Substructure / STEREOTOMIC							
Basement floor slab	Reinforced In-situ cast concrete	Cement Aggregates Steel Fly Ash Water	30MPa	300mm depth	Polished concrete	Steel reinforced concrete	0.256
Retaining walls	Reinforced In-situ cast concrete	Same as above	25MPa	500mm width	off shutter	Heavy duty waterproofing membrane	0.256
Concrete floor slabs	Reinforced In-situ cast concrete	Same as above	25MPa	300mm depth	polished concrete floor surface; off shutter soffit		0.256
Concrete columns	Reinforced In-situ cast concrete	Same as above	25MPa	600 x 600mm	off shutter	edges chamfered	0.256
Waterproofing	Reinforced bitumen waterproofing mebrane	Polyester non-woven fabric Bitumen		3mm thick sheets		Sika BlackSeal T-130 PG is a 3mm thick, torch-on sheet waterproofing membrane based, reinforced bitumen, with a sand broadcast surface	unknown
Superstructure / TECTONIC							
PORTAL FRAMES							
I-beams	Hot rolled I sections	Iron	270MPa	300mm x 300mm x3mm	Hand painted	Assembly on site of different parts	2.78
Tension members / struts	Hot rolled circular hollow sections	Iron	205MPa	114mm dia x 1.8mm	Hand painted	Final assembly of part on site	2.5
SUSPENDED FLOORS							
Lightweight concrete floors	Post tension reinforced concrete	Cement Aggregates Fly ash Steel	20MPa	320mm depth	polished concrete floor surface; off shutter soffit	Large span concrete flat-slab systems with internal spherical void formers (SVF)	0.256
Steel cables	Suspension wire ropes	Non-alloy carbon steel	3304kN	25mm diameter	Contained in coloured PVC pipe		5.4
Steel Anchors	Stay cable anchorage system	Steel Stainless steel	4500kN		none	conical steel pipe (bond socket) supporting a wedge plate where the strands are anchored with wedges	unknown

MATERIALS

	MATERIAL	COMPOSITION	STRENGTH	SIZE	FINISH	DESCRIPTION	CARBON FOOTPRINT
ROOF STRUCTURE							
Plexiglass	Roof panels	acrylic thermoplastic	69 MPa	2000mm x 10mm	none	lightweight, rigid and weather-resistant thermoplastic	6
Glass	Laminated float glass panels	Silica Sand polyvinyl butyral interlayer		6.38mm thickness (3 + 0.38 + 3)	none	safety glass for use in roof structures etc	1.27
Power Glass™	Glass laminated with a transparent, thin-film polymer photovoltaic layer	Silica Sand Polymer photovoltaic layer		6.38mm thickness (3 + 0.38 + 3)	none	energy generation through solar radiation	4.9
SUN SHADING DEVICES							
Aluminium louvres	Extruded aluminium louvre blades	Bauxite	250MPa	2mm wall thickn	none	Sun shading devices	11.2
Wood Slat louvres	Wood plastic composite	waste plastics recovered saw dust	38.2MPa	25mm x 75mm	none	Eva-tech is a low-maintenance product which requires no costly stains, sealants or other environmentally-harmful products to maintain	2.5
GLASS CURTAIN WALLS							
Glass sliding doors	Aluminium framed glass sliding doors	Laminated Float glass Extruded aluminium frame		4000mm x 2500n panels	none	Large manually operated sliding doors	3.7
BALUSTRADES							
Posts	Aluminium vertical posts	Bauxite	250MPa	40mm x 40mm x	none		11.2
Steel Cables	Horisontal elements in balustrade	Non-alloy carbon steel	300MPa	10mm diameter			
MARKET STALLS							
Framework	Welded steel frame	Iron	n/a	design specific	hand painted	Purpose designed market stall, see detail	2.2
Cladding	Wood plastic composite	waste plastics recovered saw dust	n/a	25mm x 50mm	none	Market stall cladding, see detail	2.5
STAIRS							
Thread	Wood plastic composite	waste plastics recovered saw dust	n/a	1500mm x 250mm x 75mm	none	Heavy duty and easy maintainable stairs	2.5
Structure	Welded steel frame	Iron	200MPa	5mm wall thickn	hand painted		2.2
Balustrades	Aluminium vertical posts Horisontal elements in balustrade	Bauxite Non-alloy carbon steel	250MPa 300MPa	40mm x 40mm x 2mm 10mm diameter			11.2 5.4

Green Strategies

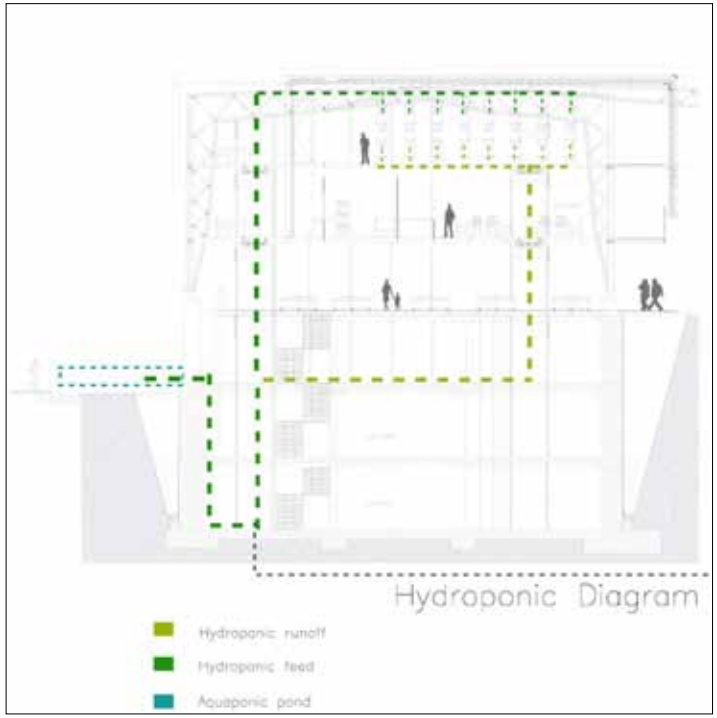
New technologies are constantly being developed to aid and complement standard practice with regard to greener structures. The general purpose of these technologies is that green or more sustainable buildings are designed so that the built environment's impact on the natural environment and human health is reduced. The following ideas are implemented in sustainable building design:

- efficiency in the use of water, energy and other valuable resources
- the cutback in waste, environmental degradation and pollution
- protecting the health of occupants and improving employee efficiency

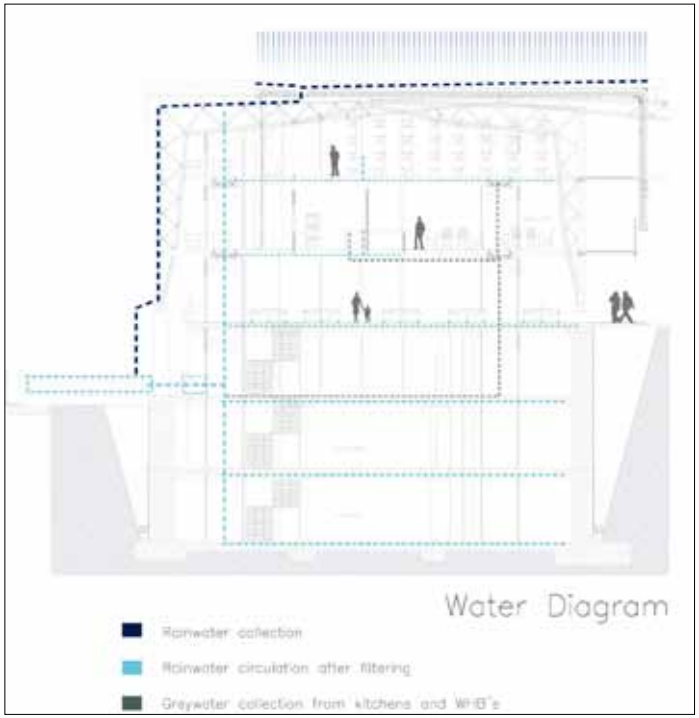
Waste water treatment and reuse:
"Urban hydrology will have an increasing role to play in the sustainability of human societies. Urban population is growing at an accelerating pace and, simultaneously, sources of water supply decrease or, at the best, remain constant in quantity, but decrease in quality." (Niemczynowicz, 1999)

Rainwater collection:
Rainwater harvesting is mainly used for potable water, as this is a clean and nutrient-rich source of water, which can also be used for irrigation of productive landscapes and hydroponics.

Grey and black water cleaning system:
Grey water can be stored in cisterns to be used in non-potable water provision systems within the building and on-site.
Black water (from toilets) is treated with an anaerobic reactor and methane gets excluded from the system and put into the energy cycle. Partly filtered water is then put through a system with an anoxic reactor. Hereafter the water is filtered through a system with aerobic reactors and deposited into an aquaculture tank. This water can then be partly used to feed the hydroponic systems, and the rest filtered even further by being purified in a clarifier. Materials that reside are then deposited into the anaerobic treatment system, or used as compost in the productive landscapes. (Redwood, 2009)



>>111: Hydroponic water circulation diagram.



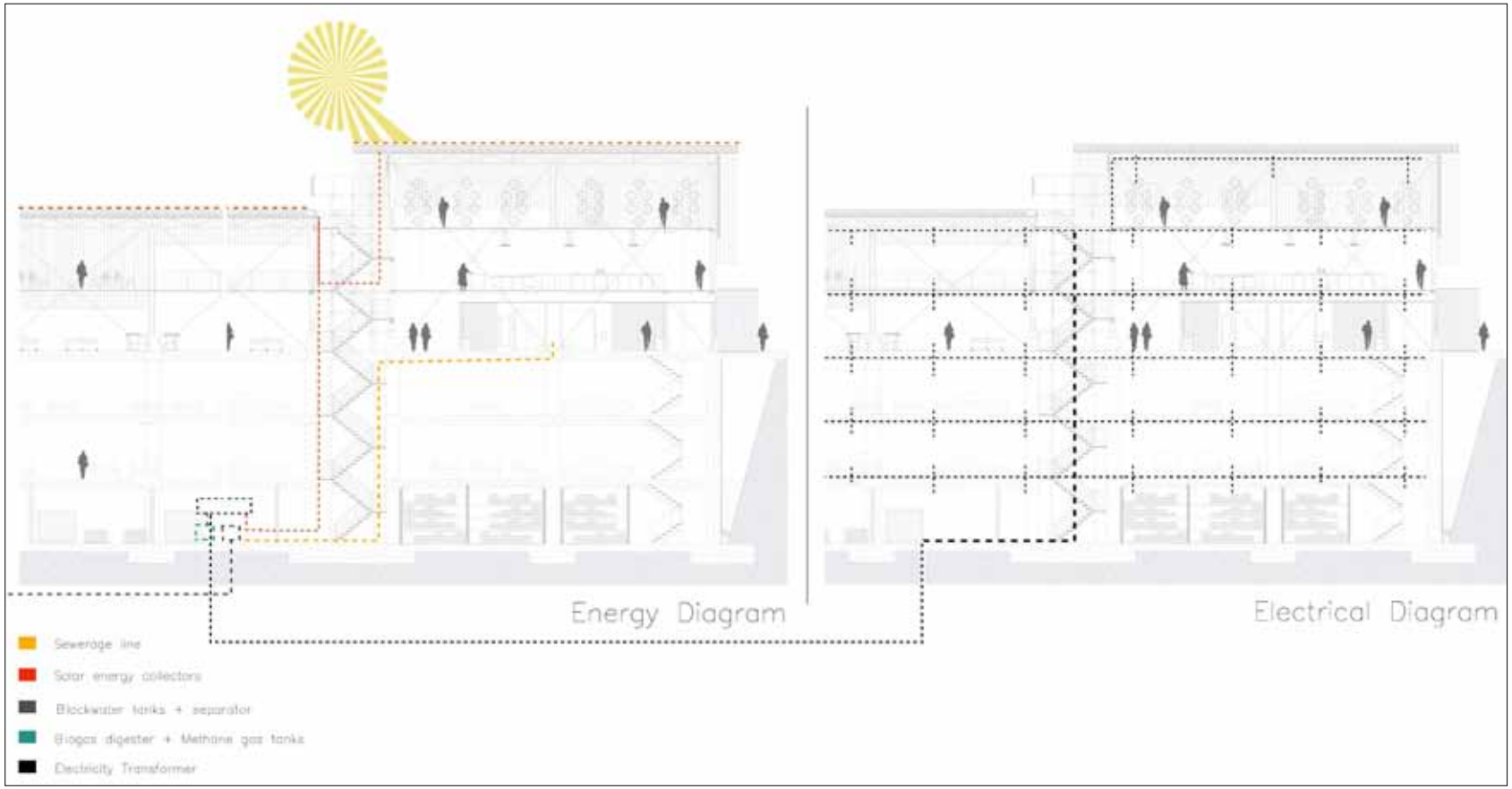
>>112: Greywater and rainwater collection diagram.

Energy use and production - alternative supplemental energy:
There are two main energy demanders in a hydroponic plant. The first includes infrastructural components that are required for the actual growth for the crops – LED grow lights etc. The second energy demand is the storage and harvesting of the crops – cold rooms and packaging. (Taylor, 2006)
Anaerobic digestion technology (methane digester) can assist in reducing the discharge of greenhouse gasses in a few ways:

- replacement of fossil fuels
- reduction of waste treatment plants' energy footprints
- methane emissions
- vehicular movements and displacement of industrially created chemical fertilisers

The essential element of an anaerobic biogas plant is the enclosed container, called the digester, which is an airtight tank filled with organic waste, emptied of processed slurry with a way of catching up the produced methane gas, which is then pumped into the energy cycle to produce biogas. (Omer, 2009).

Added to the production of biogas, solar power will be harvested by means of Power Glass™ (glass laminated with a transparent, thin-film polymer photovoltaic layer), solar cells operating at as much as 50% the efficiency of conventional opaque amorphous solar cells, yet costing as little as 25% of the conventional cell's price to produce. (Cascio, 2005) Solar panels collect solar energy or radiation from the sun and dynamically convert that energy to electricity, also to be used in general for crop production etc.



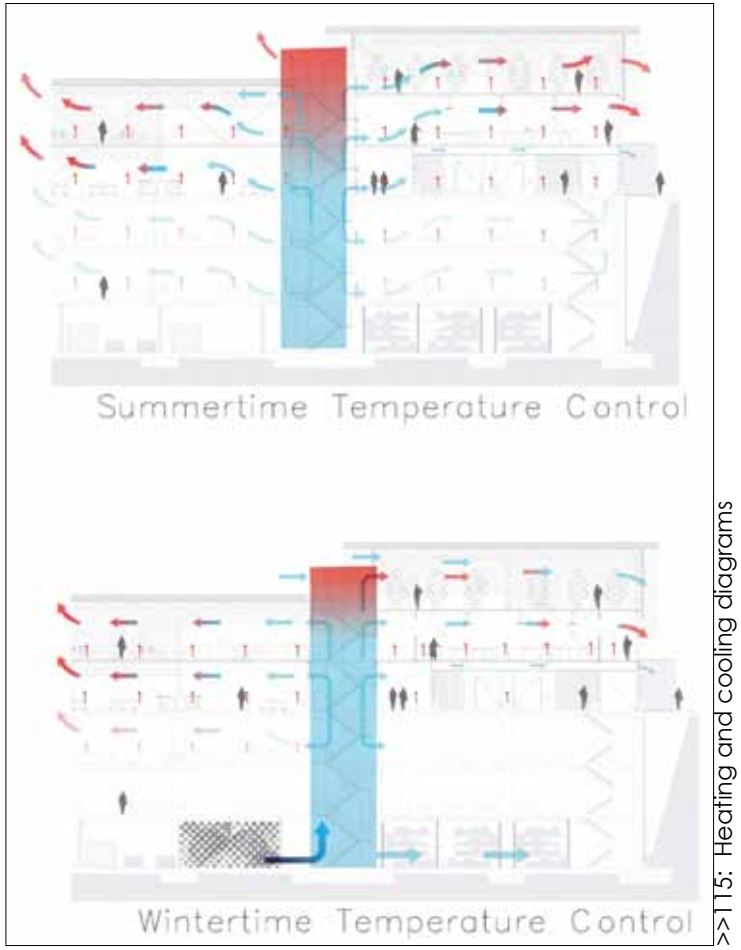
>>113: Energy collection and electricity distribution diagrams.

Passive Design

Site-driven indoor qualities: For this building to be able to act as a biologic entity, the building needs to be wrapped in a few layers of 'skin'. This skin consists of the three main elements namely the floor, wall and ceiling. Each has a unique finish, a structure and a material composition, which influences the energy flow within the structure. Therefore, the skin of the building plays an important role in the success of the building's micro-climate. The determining factors in an effective system include: the orientation, occupant comfort, use of a natural system, the function of the building and a need for natural ventilation. (Gerfen, 2010:62)

Natural ventilation is a very important part of hydroponic farms. A ventilation chimney from basement to top floor level will create a natural ventilation system within this building. By using a louvre system, among many, indoor temperatures will be controlled very efficiently. Ventilation stacks are a beneficial system that aids in the thermal stack effect and this promotes efficiency through thermal inertia. The double skinned glazing facade will contribute to the comfort inside the hydroponic areas. This also ensures good insulation and ample natural light.

>>114: Passive ventilation through ventilation shaft

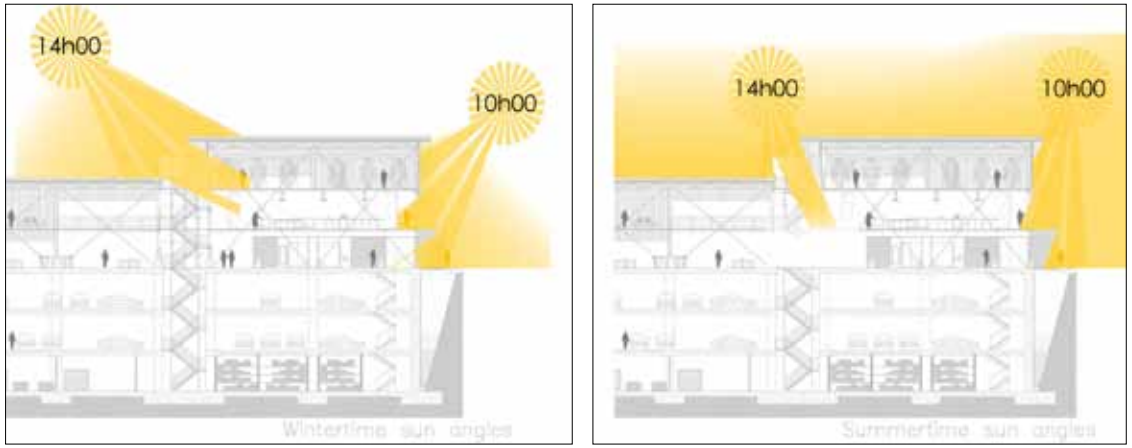


>>115: Heating and cooling diagrams

By implementing a solar energy system into these glazed facades, energy can be generated which drives the passive ventilation system, while providing a warm, humid environment for vegetation. Earth tubes are an efficient way to pull fresh air into the building through underground ducts where the ground's thermal mass provides a constant temperature, cooling the air in summer, and heating it in winter. Depleted air exits into the greenhouse to be exhausted. (Inhabitat, 2008)

In **wintertime**, a good low energy building needs to have:
a) outstanding thermal separation and low transmission losses between the inside and outside through a highly insulated building skin;
b) high quality glazing with low heat flow rate and a reasonably high total energy transmittance; and
c) heat recovery of ventilation air for very high energy efficiency standards, to become a passive building.

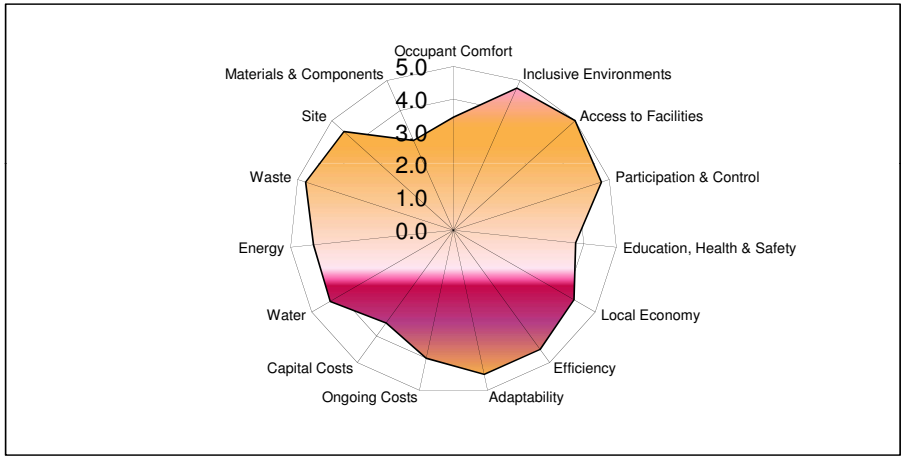
In **summertime**, on the other hand, some additional features will be necessary:
a) good sun protection through shading devices, if possible on the outside of the facade;
b) night ventilation schemes to remove at least a part of the daily loads; and
c) earth heat exchangers to precool ventilation air or to directly cool part of the building mass. (Williams, 2007:[56])



>>116: Winter and summer sun angles

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT
Project title:	Growing urban eco-systems: a food market	
Location:	Menlyn	
Building type:	Market	
Internal area (m2):	3100	
Number of users:	400	



Social	4.3	Economic	4.2	Environmental	4.2
Overall	4.2	Classification			

Table 5: SBAT rating tool results