



Chapter 7: Proposed Intervention

"The existential purpose of a building [architecture] is therefore to make a site become a place, that is, to uncover the meanings potentially present in the given environment."

(Norberg-Schulz, 1979: 18)

This chapter aims to show a movement from theory, and regional- and site- influences, to an architectural concept, dealing with various architectural elements, issue-by-issue, then moving towards a buildable element.

The proposed intervention exists at two scales, an expanded market intervention framework, that will allow for the smooth functioning and integration of the market within its context, and a focus on one core building within an expanded market project framework, being the core market building.

Aim of Proposal

The Maputo Central Market is the only built infrastructure provided for the support of micro-enterprises and traders of the city. Consequently market streets that have developed to the north of the Central Market as a result of a lack of space. These have become fractured and disconnected from these facilities, while the available market building, and the market square behind it, filled to capacity and in desperate need of maintenance.

Illus. 105: Shoe vendor outside the Maputo Central Market. Note car on pavement (author)



Illus. 106: Parti diagram

The proposed architectural intervention seeks to consolidate these street markets, enabling cleaner, more comfortable, and hygienic trade. It aims to address the exclusion of micro-entrepreneurs and vendors who through circumstance are forced to vend their goods on the streets, as well as promoting the continued patronage of the market by customers as a choice destination.

Parti Diagram

The adjacent parti diagram denotes a loose-fit framework, which is mostly horizontal, with repeating spaces into which various elements can fit, allowing for a fluxing usage within a simple set base.

Interface with Transport

An Expanded Market Intervention

A good interface with public transport is essential to the healthy operation of a market, and this is certainly the case with the market streets around the Maputo Central Market, as well as the market itself. The *chappa* mini-bus taxi rank to the immediate north of the intersection of Avenues Zedequias Manganhela & Guerra Popular, in conjunction with the long/medium distance busses on the corner of Avenues Guerra Popular & 25 de Setembro and Tuk-tuk rank at the intersection of Avenues Zedequias Manganhela & Karl Marx form a micro transport triangle within the larger transport triangle of the Ave Guerra Popular road transit, Train Station, and Ferry. These triangles cause a the large flow of pedestrian traffic essential to sales.

It is proposed that the relation to this transport system be considered in the expansion of the market, since the transport sector is an essential driver of customer traffic through the market.

Specific Transport to Market Interface

Long/Medium Distance Bus Rank

It is proposed that the relation between the Box & Rope Market and the Long/Medium Distance Bus Rank be strengthened. This could be done through the removal of the covered parking and spare parts warehouse that separate these interlinked functions. An improved spare parts warehouse can be provided on the open site immediately north of the Bus rank, this would serve both the bus rank and the *chappa* mini-bus taxi rank better due to its location.

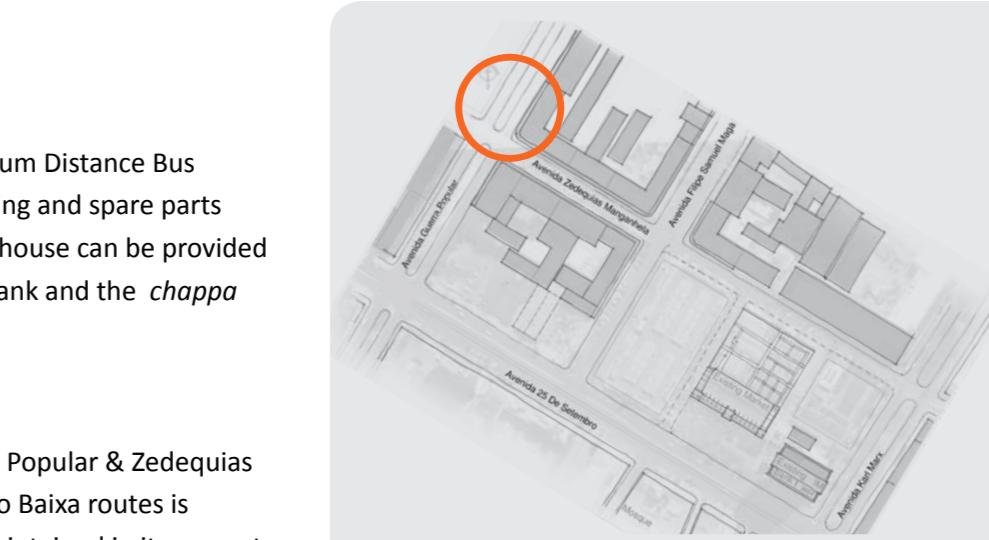
Chappa Mini-Bus Rank

The *chappa* mini-bus taxi rank to the immediate north of the corner of Aves. Guerra Popular & Zedequias Manganhela, serving primarily as a terminus for the P. Combatentes and Ximelene to Baixa routes is essential to effective customer flow across the market. It is proposed that this be maintained in its current location, as a pick-up and drop-off point.

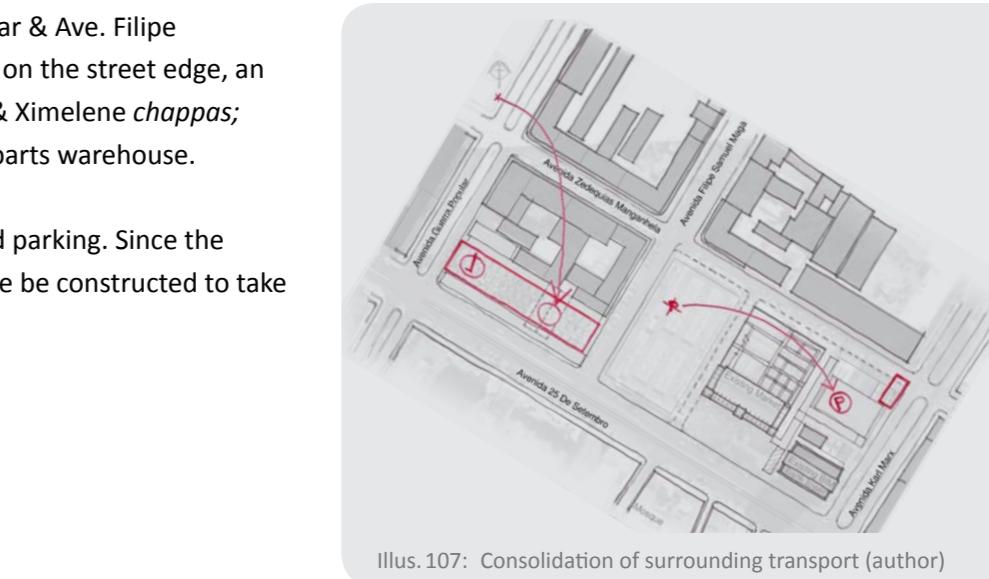
Additional Facilities

It is proposed that the Ave. 25 de Setembro street edge between Ave. Guerra popular & Ave. Filipe Samuel Magaia becomes an expanded transport node, with the Box & Rope Market on the street edge, an expanded holding zone for Long/Medium Distance busses and the P. Combatentes & Ximelene *chappas*; enclosed at the northern edge by an informal mechanics area relating to the spare parts warehouse.

The site (to the east & west) of the existing market is currently being used as shaded parking. Since the shortage of parking is problematic in Maputo, it is proposed that a four level parkade be constructed to take up the parking that will be removed from this site.



Illus. 108: Location of Chappa Mini-bus Rank (author)



Illus. 107: Consolidation of surrounding transport (author)

Proposal

Existing:

BIM Bank building
(Banco International de Maputo)

Existing shaded parking

Existing Market square

Existing *Mercado Central de Maputo*
building

Expanded Market framework:

Tuk-tuk Rank

4 level Parkade

Tshova (push-cart) operators facilities

Goods Delivery

Administration Offices & general meeting spaces

Showers & Ablutions above storage for street vendors

Cold Storage

Curio Market

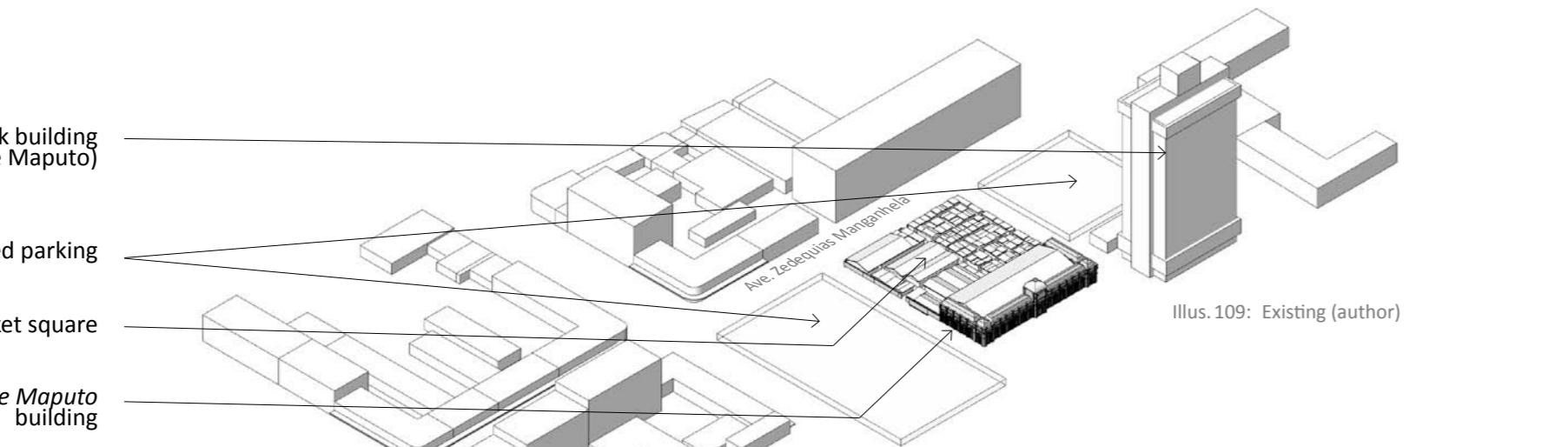
Shading of street vendors in Avenida Zedequias Manganhela

New spare parts warehouse
(Old warehouse demolished)

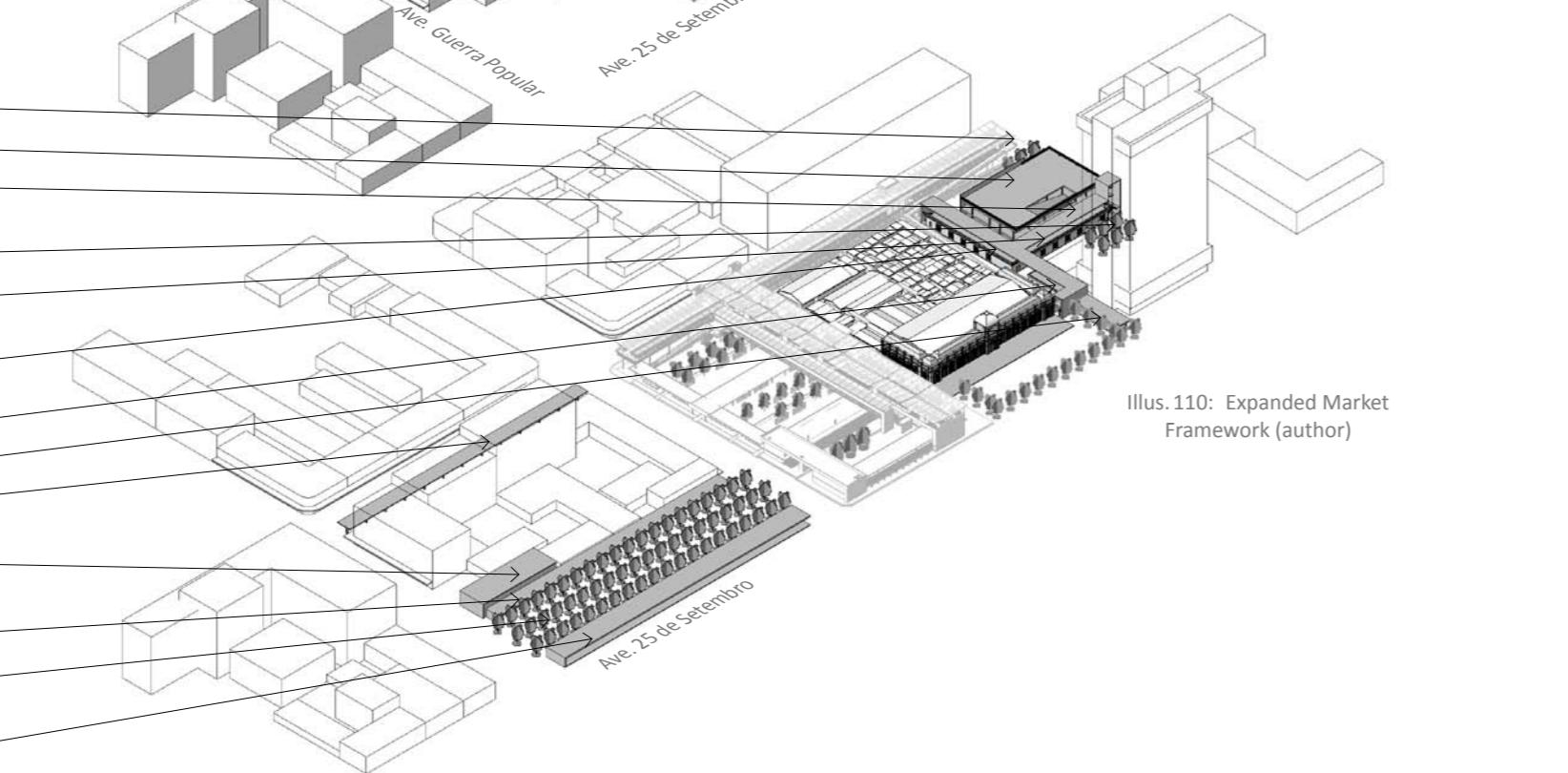
Mechanics & vehicle repair

Shaded *Chappa* Mini-Bus & Bus Holding Zone

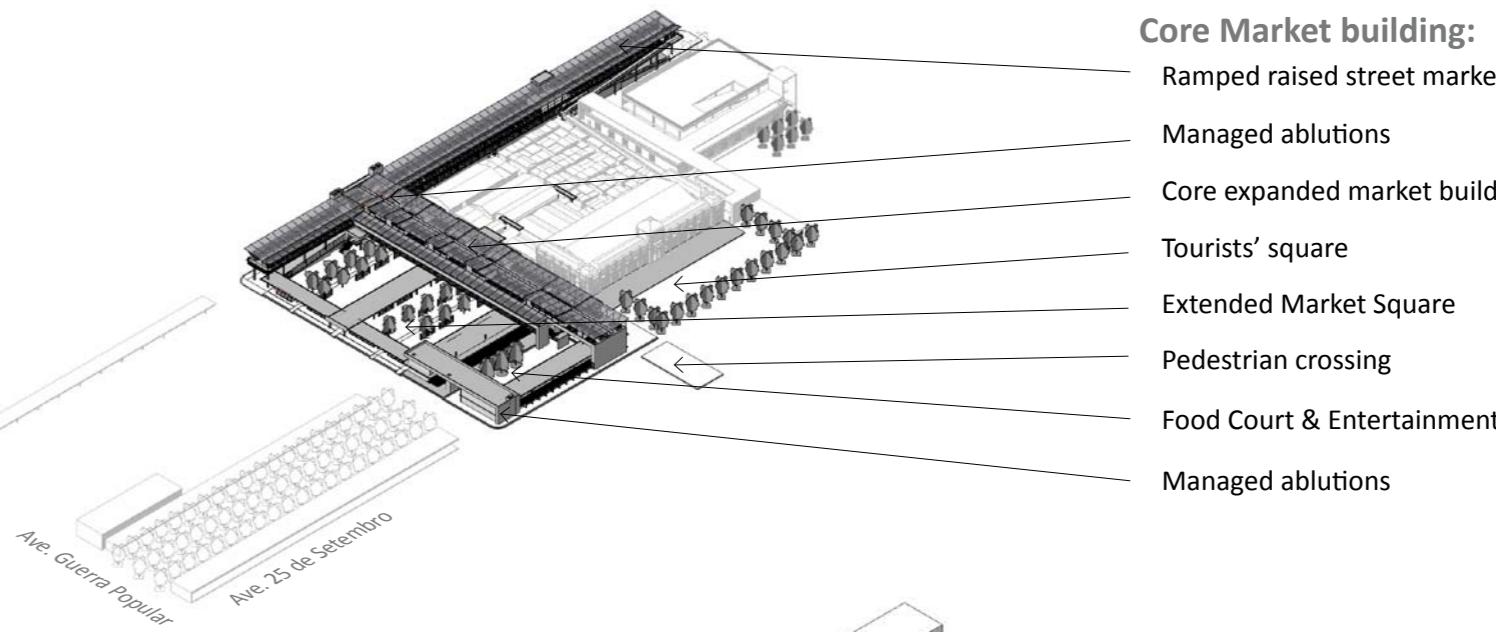
Box & Rope Market



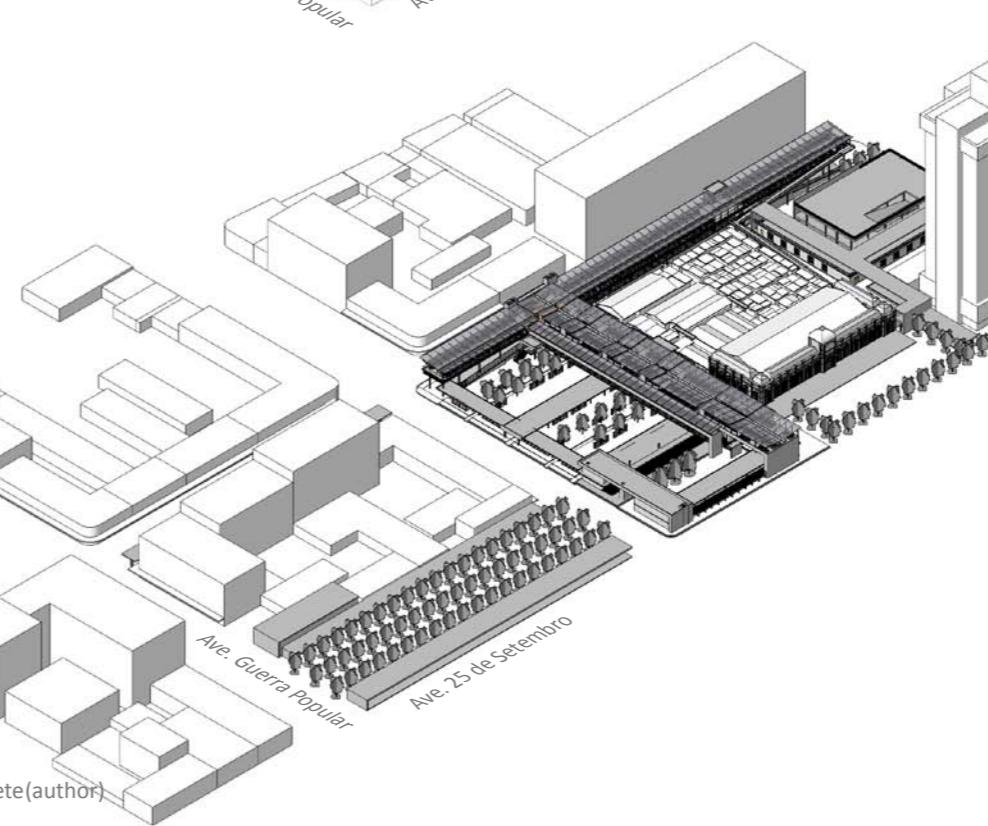
Illus. 109: Existing (author)



Illus. 110: Expanded Market Framework (author)



Illus. 111: Core Market Building (author)



Complete

The adjacent image shows the completed proposal in context, both the Expanded Market Framework, and the Core Market Building.

Proposed Core Market Building Intervention



Illus. 113: Expanded Market Framework Buildings (author)



Illus. 114: Core Market Buildings (author)

It is proposed that for the healthy functioning of an expanded market, in particular the Maputo Central Market, the following facilities will be required (together these form a substantially large complex, with this dissertation focus on the actual built market facilities).

- Expanded Market framework:
 - Goods Delivery
 - Tshova Operators Facilities
 - Administration Offices & general meeting spaces
 - Storage facilities for street vendors
 - Cold storage (refrigeration & freezing of seafood and vegetables)
 - Managed ablution facilities with the specific inclusion of shower facilities
 - An optimised Box & Rope Market, and proposed Mechanics edge with transport holding zone
 - Shading of street vendors in Avenida Zedequias Manganhela
 - Waste Depot (Separation, Recycling, & Buy-Back)
 - Tuk-tuk Rank
 - Modular vending space definition frame
- Core Market building:
 - Expanded facilities for vendors and micro-enterprises
 - Managed public ablutions
 - Tourists' square
 - Eating and entertainment area with related food preparation
 - Production facilities

Interface with significant existing fabric

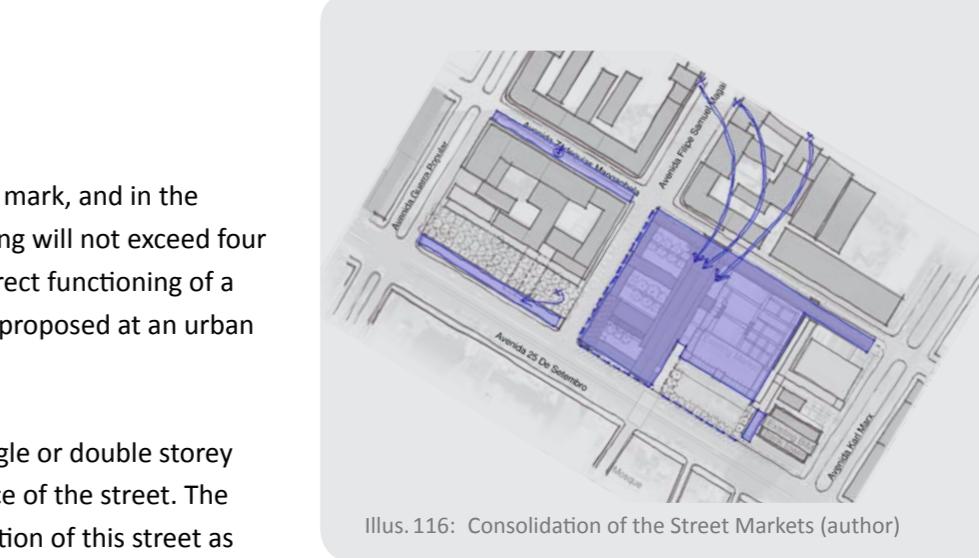
Buildings

The proposed building will allow the 17 storey BIM Building to tower over it as a land mark, and in the urban pattern of scattered skyscrapers prevalent in Maputo. The proposed new building will not exceed four storeys in height so that the link between street and upper levels, essential to the correct functioning of a market, is not broken. This responds to the four storey limit on the historic Old Baixa, proposed at an urban level.

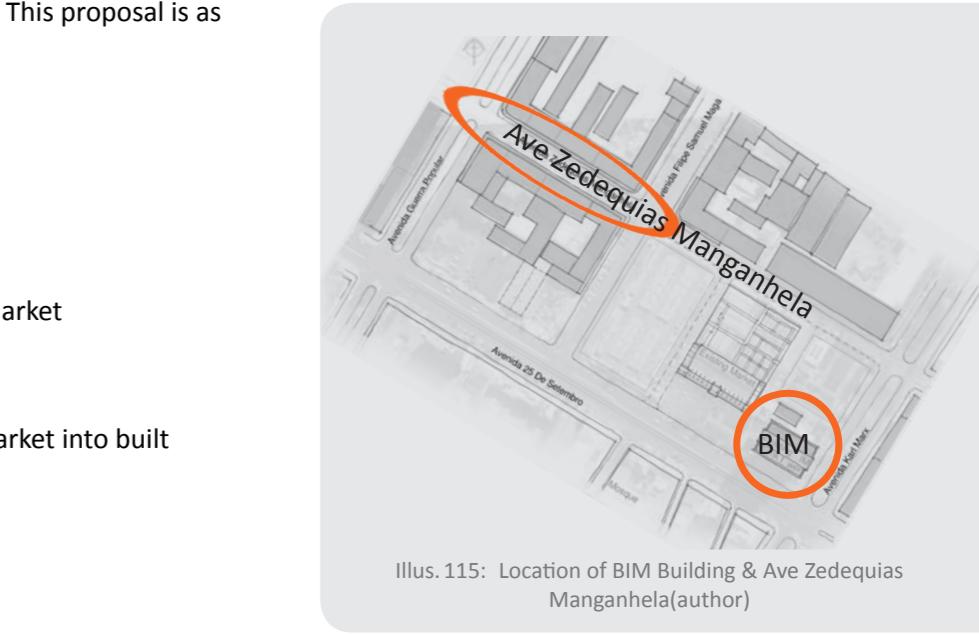
On the Ave. Filipe Samuel Magaia street edge (north west) the building will have a single or double storey mass, allowing the historically significant buildings across the road an equal dominance of the street. The central area of the proposed built edge in this area is also set back to reinforce the notion of this street as an enclosed active space.

The limitation of vehicular access to the existing one way street Avenida Zedequias Manganhela (north east edge) has already been proposed at an urban level. A finer block-by-block approach is proposed in the immediate vicinity of the market in order to foster the market character of this street. This proposal is as follows:

- From Ave. Guerra Popular to Ave. Filipe Samuel Magaia
 - Maintenance of an arcaded (and therefore shaded) built edge
 - Widening of pavements
 - One vehicular thoroughfare with one lane parallel parking
 - A linear shaded structure supporting defined market stands as part of the market
- From Ave. Filipe Samuel Magaia to Ave Karl Marx
 - One vehicular thoroughfare with one lane parallel parking
 - Encroachment of the built market into the street as a continuation of the market into built structure



Illus. 116: Consolidation of the Street Markets (author)



Illus. 115: Location of BIM Building & Ave Zedequias Manganhela (author)



Existing Market

Market Square

It is proposed that expansion of the proposed market be allowed to develop in the manner that has shown itself to be so successful in the open market square behind the existing market building, that is changes done at an incremental ad-hoc basis. It is further proposed that this area be left as the functioning market space that it is, and that the new grain of the proposed market link into the existing grain of the market square. This will allow this square to grow into the existing market, as well as using it as a source of dimensional guidelines for vending runs from existing successful precedent and practice. These vending runs are unbroken usually linear arrangements of vending areas, and their correct orientation and length is essential to the healthy functioning of the market.

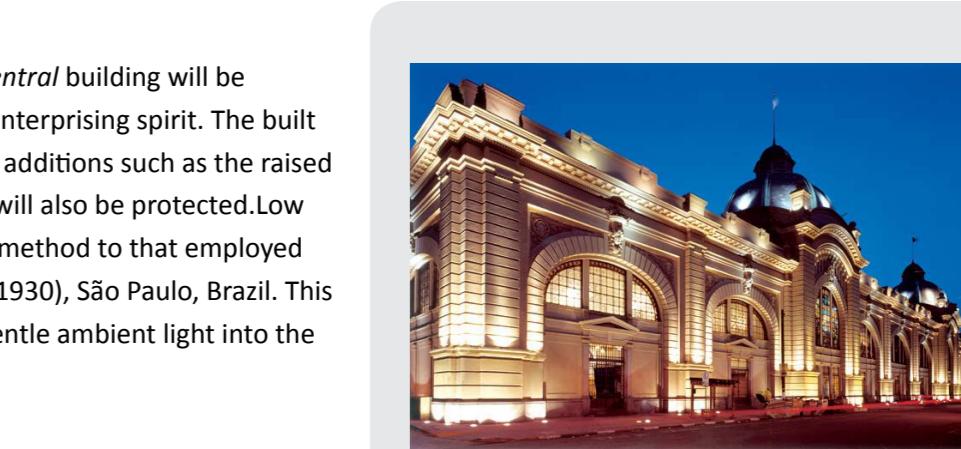


The Rua do Mesquita, an extension of which runs directly past the historic market building is significant to the market. It links the market to the Mosque visually & physically, as well as linking to Rua do Bagomoyo, the predominant night-life street in the area. At a framework level this is also proposed as a link to the water's edge. The built massing deliberately reinforces this, leaving sight lines open to the Mosque and its minaret.

The creation of an open space in front of the historic market building (Ave. 25 Setembro side) allowing it to be viewed as a whole, has been proposed in the previous chapter, as well as that changes to the building do not puncture the front facade. It is also proposed that the existing market square be left as a functioning part of the proposed building.

Market Building

The historic and culturally significant built fabric and function of the *Mercado Central* building will be protected restored, to continue to show the longevity and tenacity of the local enterprising spirit. The built fabric will be restored to its original condition, without removing non-detractive additions such as the raised floor level, which is a response to flooding. The function of the Market building will also be protected. Low level external up-lighting will be installed at the base of the facades, in a similar method to that employed during the adaptive re-use at the Pedro Paulo de Melo Saraiva market building (1930), São Paulo, Brazil. This will light them up at night, increasing the building's hierarchy, and reflecting a gentle ambient light into the surrounding spaces. The lighting angle will highlight the texture of the façades.



Market Functioning & Fabric

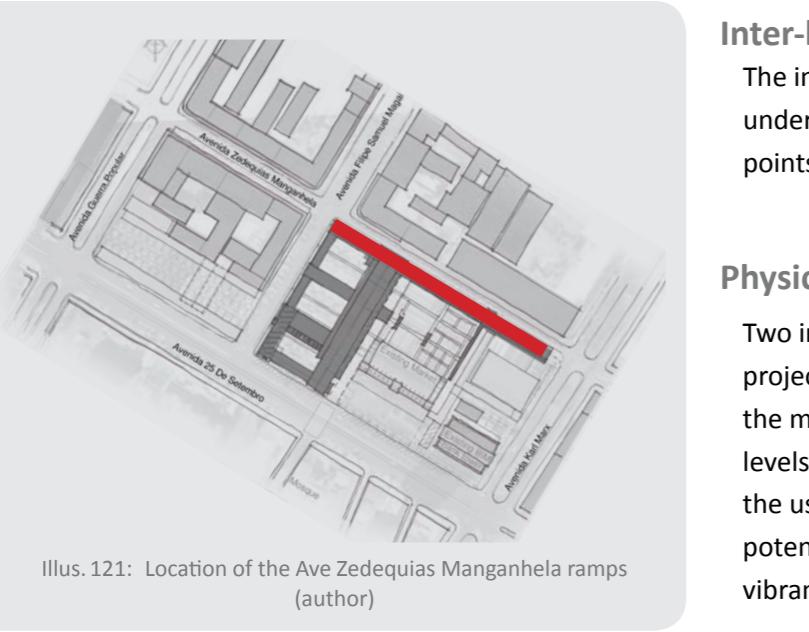
Capacity and Verticality

It is proposed that the primary method of consolidation of these street markets, providing facilities, and recognising the street vendors would be through an increase in capacity of the Maputo Central Market onto the surrounding parking lots. This capacity can then be further increased through the introduction of upper levels, a phenomenon that has not hindered market functionality in the Makola Market district in Accra, or in Warwick Junction, Durban

Goods Delivery

A dedicated area for goods delivery off Ave. Karl Marx has been allowed for. Small trucks can stop here to sell bulk goods to vendors, who then make use of the associated tshova (*push-cart*) operators to move their goods into the market. Consequently the links into the market are deliberately weak, since this serves as a type of back-of-house function.





Illus. 121: Location of the Ave Zedequias Manganhela ramps
(author)

Inter-level Circulation & Push-Cart Accessibility

The importance of the *Tshova* (push-cart) to the healthy functioning of the market cannot be underestimated. Each level of the market is accessible to *Tshovas* through a series of ramps at various points in the market. Broad stairs at several points also allow for pedestrian movement between levels.

Physical levels & Connection

Two interconnected ramps leading off Ave. Zedequias Manganhela, positioned parallel to-, and projecting into- the street, maintaining a visual and physical connection along the market street and into the market. At several other points there are broad stairs that allow for pedestrian movement between levels. A visual connection between the street level, and the 'Upper Market' level is maintained through the use of visually permeable balustrading, and enclosure on the upper market level; this gives the potential customer a view of the type of goods on offer on this level, and contributes to the visual vibrancy of the market.

Physical Levels, Market Levels, & Sectors

General

Precedent has shown that there is an increase in permanence of enterprise on higher physical levels of a market. Reduced foot traffic on these higher levels means that these stalls are generally more established, and of a higher market level than those at street level; consequently and have a larger draw on customers. It is therefore proposed that vendors of market levels five (stall vendors) and six (small shop vendors) be accommodated on the upper physical level.

'Upper Market'

The clothing market, currently operating in dirty overcrowded conditions half a block-to the north, is one such sector that exerts a significant draw on customers. The presence of artisans such as seamstresses, dressmakers, and tailors who are involved in production within the sector means that there is a demand for higher market level facilities, particularly since many of these artisans currently work without basic facilities such as electricity, lighting, and storage. It is predicted that this clothing sector will occupy a large proportion of the 'Upper Market' floor.

'Ramped Market'

The section of raised market directly between the ramps on Ave. Zedequias Manganhela, is likely to be occupied by the electronics sector currently operating in that street selling household appliances, computer accessories and similar electronics. These businesses are restricted because of the limited storage of stock in street stalls, and the possibility of lockable stalls would allow for a greater selection of stock to be kept, and minimise damage through eliminating daily transport of goods.

Ground Level

The ground level is intended as a general market, with lower vending levels two to five (mat, street table, market table, & market stall) accommodated. This area will lock and be guarded at night to allow overnight security of goods.

Entertainment Area (Food & Waiting)

Currently there is a strong relation between the food sector and the transport sector, as commuters and drivers buy packaged or prepared food from vendors around the Ranks, as well as involving themselves in entertainment activities such as board games, pool, and foosball. This has led to the formation of the 'Chicken braaing' sector in Ave. Zedequias Manganhela, west of Ave Guerra Popular. It is assumed that facilities for an improved entertainment and food preparation area be provided directly relating to the expanded public transport holding zone on Ave 25 de Setembro. This will also fulfil the role of market 'food court'.

A stage within this area is proposed as a venue for public performances, small concerts, public meetings, etcetera.

Tourist Facilities

As discussed in the previous chapter, the importance of the market to the tourism industry is mainly in the facade of the historic building as well as a romanticised idea of its functioning. Eating freshly prepared fish at a market is also an activity popular on tourist itineraries, with a distant fish market catering exclusively to the tourists needs. It is proposed that this function, at a tourist orientated level be introduced as part of the tourist interface of the market. This should take the form of small fish restaurants/cafes located in the front face of the historic market building, relating both to the seafood sector of the market and the tourist square.

It is proposed at a built framework level that an area be provided on the eastern edge of this square for the sale of curios, and for premium user-paying toilet facilities operating on the system discussed below.

The required numbers of sanitary fixtures required was calculated according to South African National Standards (SANS 10400 - 1990 Parts A20 & PP13). The Core Market Building was classified as a B2 type occupancy, and for the area of the building, the following sanitary fixtures required fitted are shown in the table below:

	Male			Female	
	WC	Urinal	W. H. Basin	WC	W. H. Basin
Building Type B2	13	17	16	29	15

Table 3: Sanitary Fixtures Required

Market Expansion

It is expected that the proposed intervention should cause the contraction of the existing physical area covered by the existing pavement-based markets immediately surrounding the existing market to as these market functions are consolidated and densified around the existing municipal market. Future growth will then occur through further densification withing or spread of stalls onto the concrete roofs.

Initially this is expected to happen through a building up of the market stands, and an increase in the built permanence and substantiality of the vending stalls in the same manner as in the existing market square. On the upper levels this is expected to occur as an extension of more formal roofed stalls onto un-occupied flat concrete roofs. The surfaces of these roofs will be finished with a waterproofed screed, protected by a trafficable floated concrete layer.

Upper Level Expansion

At the upper levels it is expected that the formality and size of the shops will increase. This should be encouraged until these areas reach maximum capacity. The concrete 'roofs' of ground floor spaces have been deliberately placed at the same level as the upper floors, their finished surface and the interface with the upper floor-slab will allow for the addition of lightweight structure/s to be added as an extension to the more formal market stalls.

Ground Level Expansion

The ground level is intended to be the most flexible and fluxing level, accommodating the lower vending levels which are more fluxing and adaptive by nature. This picks up on the circumstance of the existing market square; this was a trading area defined by built structure into which the market has been allowed to expand in an ad-hoc manner.

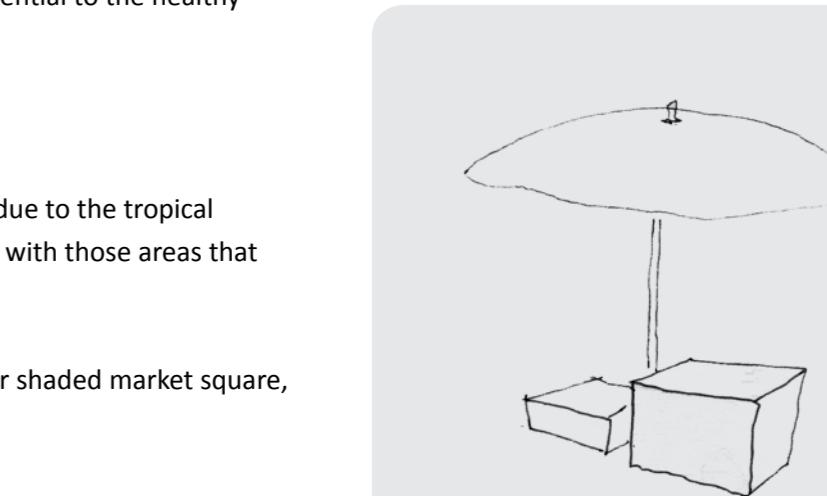
It is therefore intended that the ground floor form an architecturally defined market square into which the functioning physical and metaphysical fabric of the existing market square expands. It is predicted that this will occur in the covered and shaded areas first, gradually formalising structurally and spreading into the open areas. To encourage this the grain of the existing market has been drawn into these spaces through the continuation of axes into the new areas shown by paving and changes of level. There are three of these east-west axes, with the central axis being higher in hierarchy and consequently roofed, with enough shading for vendors and pedestrians.

It is proposed that at the crossings of these three walkways with the mass of the Upper Level market, that atria cut into these levels facilitate the visual connection between levels so essential to the healthy functioning of the market.

Shading

As previously mentioned shading is very important to market functions in Maputo due to the tropical climate. Areas important to trade in the proposed building are therefore all roofed, with those areas that are not roofed being shaded by trees.

The market building forms a more formal solid shading structure, enclosing a lighter shaded market square, defined by a shaded edge. This echoes the existing market building condition.



Illus.122: Sketch of a shading currently used (author)

Inhabitation

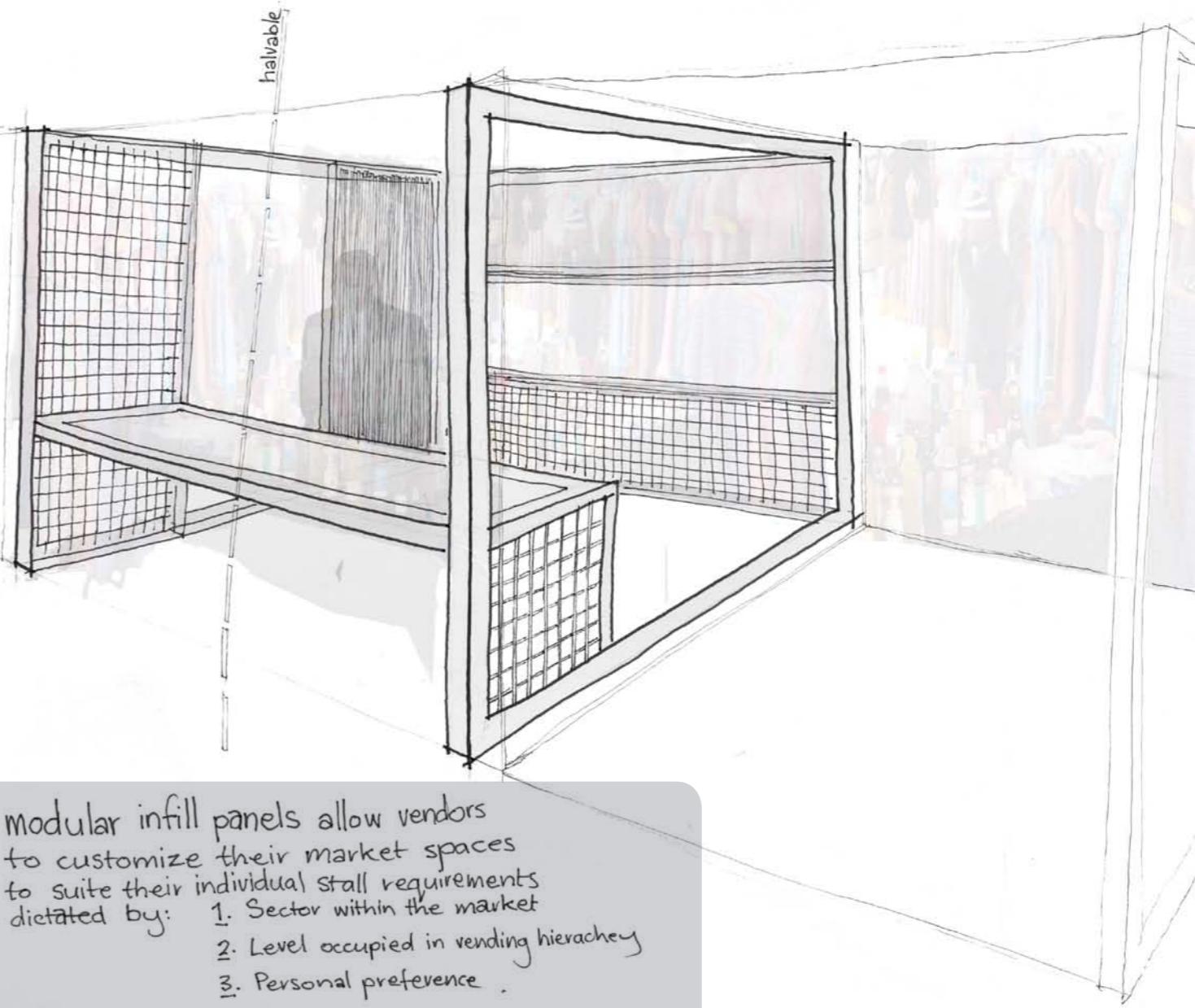
Precedent has shown that no highly designed set of furniture, or spatial application can satisfactorily meet the needs of all the affected vendors. This is even the case at the same vending level in the same sector; as was the case at the Warwick Junction Muthi Market, where vendors with seemingly identical furniture needs rejected the provision of a set furniture piece. A minimal level of prescription in this matter is therefore proposed; allowing rather for a bottom-up spatial appropriation and customisation.

The Vending Stand

A basic three dimensional spatially defining frame is proposed. This frame draws heavily on the principles of 'Open Building', and is intended to allow for the fluxing requirements of the market vendors, allowing them to control and become responsible for their own spaces. A customised frame can be used to facilitate the display of a diverse range of goods, through various added enclosure panels and hanging or shelving systems.

It is proposed that these frames be constructed of timber:

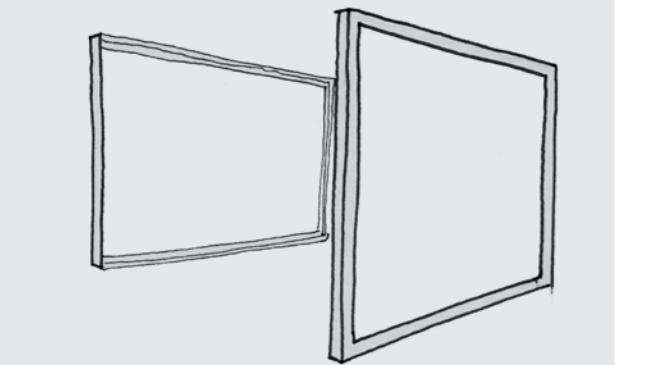
- Rusting due to the caustic costal environment does not occur (any changes using welding would destroy any protective coatings).
- Timber is a low-tech material that is already extensively used in informal adaptations to formal structures in the area.
- Timber can be nailed, bolted, screwed, dowelled, or jointed with ease. Items and hooks can be easily fixed to timber by nailing, stapling, or tieing; and other materials such as corrugated iron are easily fixed to it.
- Timber is readily available and relatively inexpensive.
- The timber will be treated with a fire-retardant.
- Extensive consultation with vendors in the Warwick Junction Muthi Market showed that vendors preferred the more familiar adaptable timber to other materials (Dobson & Quazi, 2011).



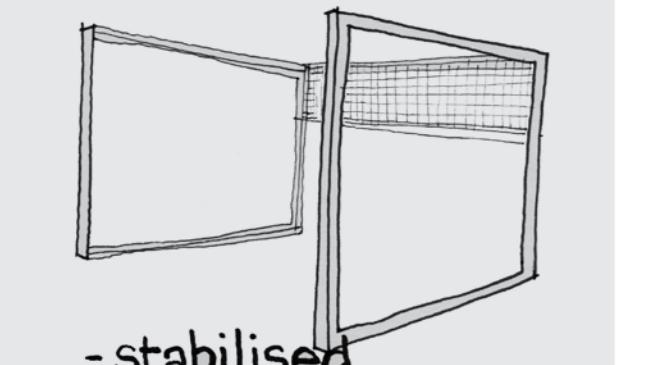
modular infill panels allow vendors to customize their market spaces to suite their individual stall requirements dictated by:
1. Sector within the market
2. Level occupied in vending hierarchy
3. Personal preference

modular market stall

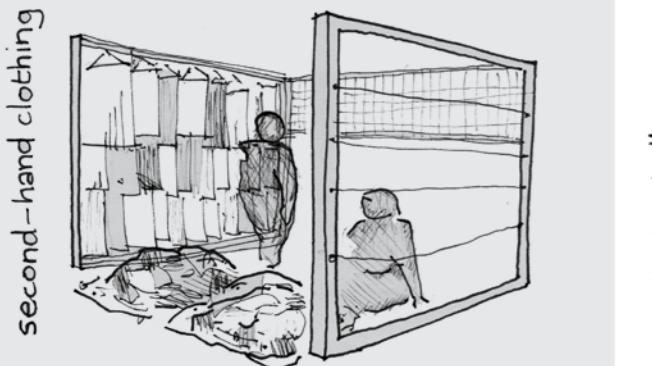
Illus. 123: A variation of the modular market stall (author)



- base



- stabilised



- customised

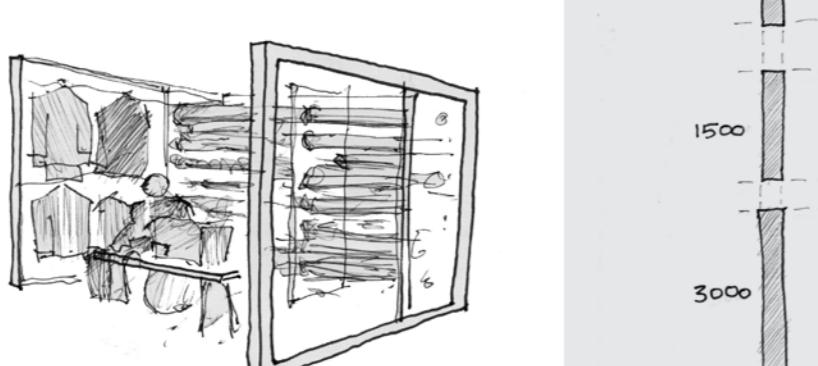
Illus. 124: The formation of the market stall (author)



alcohol stall

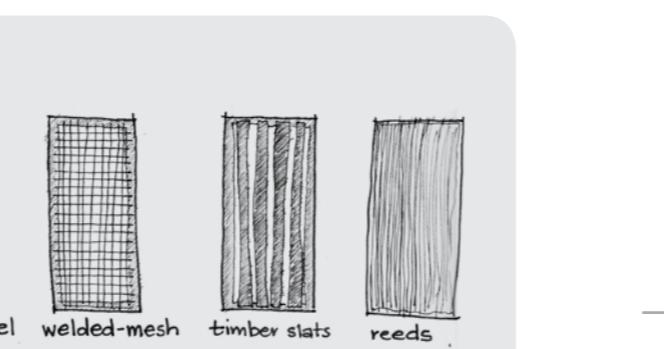


fresh fish stall

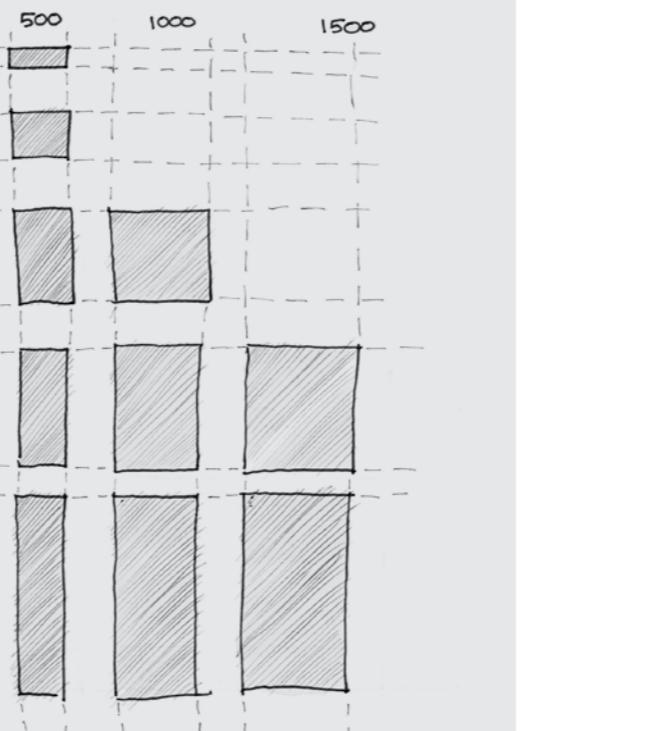


tailor's stall

Illus. 125: Customization of market stall (author)



modular stall panels



Illus. 126: Modular stall panels for adaptation (author)

These frames should be modular in dimension, which will allow a carpenter within the market to produce a range of standard fittings such as shelving, and enclosure panels en-masse. These can be offered for sale to vendors who then fit-out their own spaces.

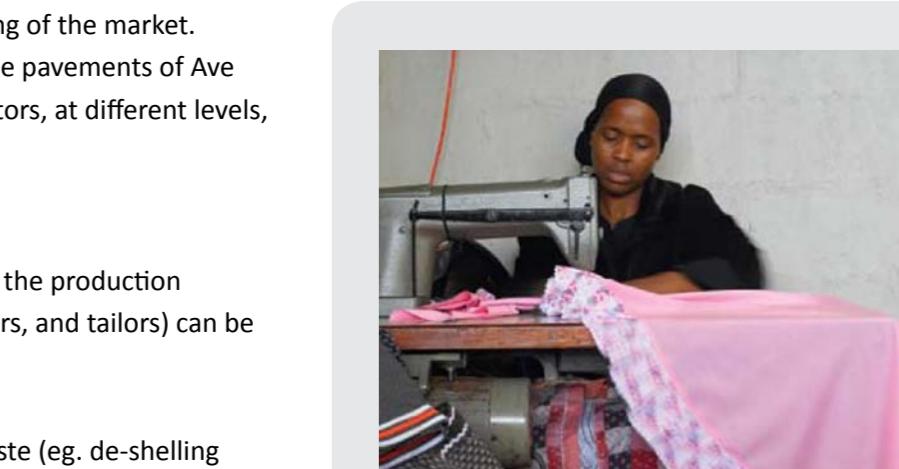
This forms a major part of the strategy for the recognition of the street vendors, with a customizabile vending stand used throughout the market, and used to extend the formal market into the streets. It is proposed that these frames are numbered, fixed in position, that vendors pay a minimum rent to occupy it; and in this way they are recognised by formal bodies.

Production

General

Production, and 'one-step-further' processing is an important part of the functioning of the market. Currently, seamstresses, dressmakers, and tailors work in the clothing market on the pavements of Ave Samuel Filipe Magaia. This processing and production occurs over the different sectors, at different levels, but these can be separated into the following groups with the proposed response.

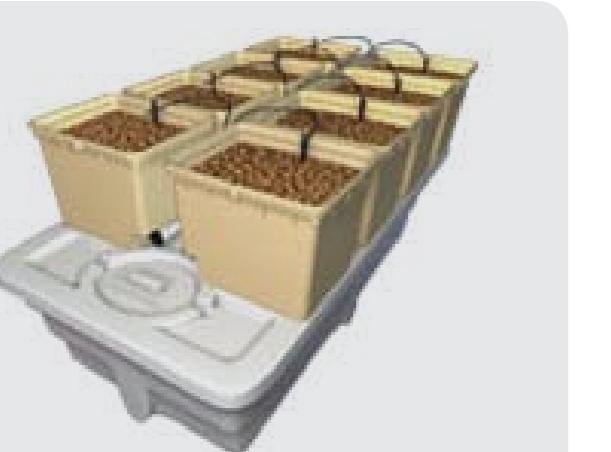
- Production of goods
 - Requiring a little space & some storage, as well as electricity and lighting, the production of goods particularly within the clothing sector (seamstresses, dressmakers, and tailors) can be accommodated in lock-up stalls in the Upper Market
- Refinement of raw produce
 - This typically requires very little space, but generate large amounts of waste (eg. de-shelling cashew-nuts). An effective waste removal system such as the proposed system using *Tshova* push-carts will allow this to happen anywhere within the market.
- Cooking of food
 - Requiring basic hygiene and storage facilities, this will be provided in a dedicated area opening onto the entertainment area.



Illus. 127: Market Production - Dressmaker sewing a pinafore, Warwick Junction. (Dobson & Skinner, 2009)



Illus. 129: Some of the vegetable that could be grown on the production level



Illus. 128: General Hydroponics - DutchPot/EuroGrower Hydroponics system

Dangerous, highly industrialised production, with a high risk of fire will not be allowed in the main market building, as they pose fire and safety dangers, as well as having different electricity requirements.

Vegetable Production

Most sectors in the market has the potential to include a measure of production or processing in their functioning, for example, the cashew nuts can be de-shelled and spiced on site. The fresh produce sector however, is reliant on external production and supply. This is the predominant ‘anchor’ sector of the existing market. It is therefore proposed that a production sector relating to fresh produce could be a significant extension to the market. The concrete roofs of the Upper Market, and Ramped Market be used for this purpose, and an assortment of vegetables could be grown.

In order to reduce the structural loading on the structure of the building a soil-less agricultural system such as hydroponics is proposed. The use of raised growing tables that allow the agricultural systems to be independent of the market structure. These could be ‘suspended-hydroponics’ an intensive agricultural system that grows plants with their bare roots suspended in tanks which are periodically filled with nutrient enriched water. Poor soil conditions in Maputo and surrounds often makes growing crops difficult, and large amounts of fresh-produce is imported by road from South Africa. This would reduce the markets reliance on this source of produce.

The ‘General Hydroponics’ ‘2m² EuroGrower’ (USA model name) / ‘2m² DutchPot’ (European model name) “...user-friendly, reliable, and inexpensive...” (Manufacturer, 2011) removable hydroponic system has been selected for use in the Mozambican context. It will be used with a return drip water system (to reduce use, and increase nutrient efficiency), and use locally sourced coconut fibres as a growing medium. The system is deliberately nonintegrated into the building structure allows for future adaptability or removal of the hydroponics. This system is among those commercially used in South Africa.

Statistics:

- 551 units
- 1102m² growing area
- 17632 plant capacity
- 150ℓ x 551 units = 82650ℓ of nutrient enriched water cycling.

It is proposed that each of the 551 units be individually owned and maintained by fresh-produce vendors, with the initial purchase being subsidised, and training provided in production and maintenance. This will allow vendors direct control of production.

The hydroponic production levels will be accessible to tshova push-cart via a ramps, which link to the goods delivery area. Visibility of this level is unimportant in comparison with the market levels below, and the hydroponics level is only visible at atrium and access points.

An enclosing and protecting green-house roof on the production level acts to protect the plants from the elements and excessive Ultra Violet light exposure common in the southern African context. This will be through the use of ‘Opel 50’ coloured translucent polycarbonate roofing. This will allow sufficient natural light for the growth of sun-loving plants such as Beans, Broccoli, Cantaloupes, Cauliflower, Cucumbers, Eggplant, Lettuce, various Melons, Peanuts, Peppers, Pumpkin, Squash, Strawberries, Tomatoes, as well as various herbs. This will allow for the production of produce already available in the market, increase the variety available, and reduce the travelling distance of the produce.

Lighting

As far as possible natural lighting will be employed, with a floor plate that never exceeds 16 meters in depth. In the Upper Level market diffuse light will be allowed to filter into the circulation spaces from the greenhouse above. Lighting fixtures will be provided to allow nighttime security and trade. Where possible these will be low voltage LED fittings, powered by batteries charged by Photovoltaic cells, located on the roof of the ablution facilities in the eating and entertainment area. This will include a 900mm upstand which will hide the PV cells from view.

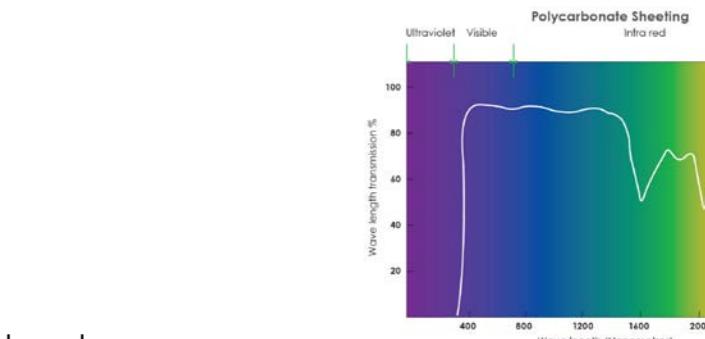
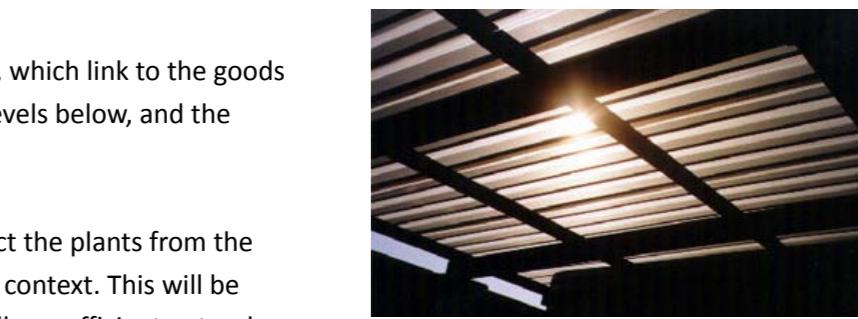


Fig. 10: UV light reduction through polycarbonate sheeting (Manufacturer)



Illus. 130: ‘MODEK Opal 50’ polycarbonate sheeting (Manufacturer)

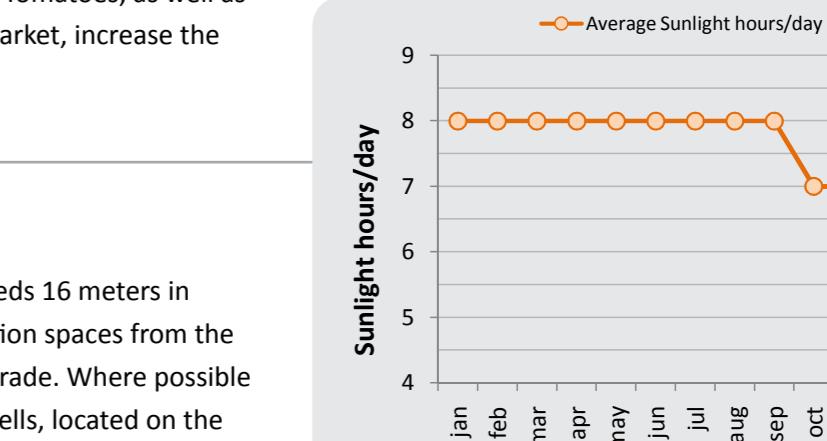
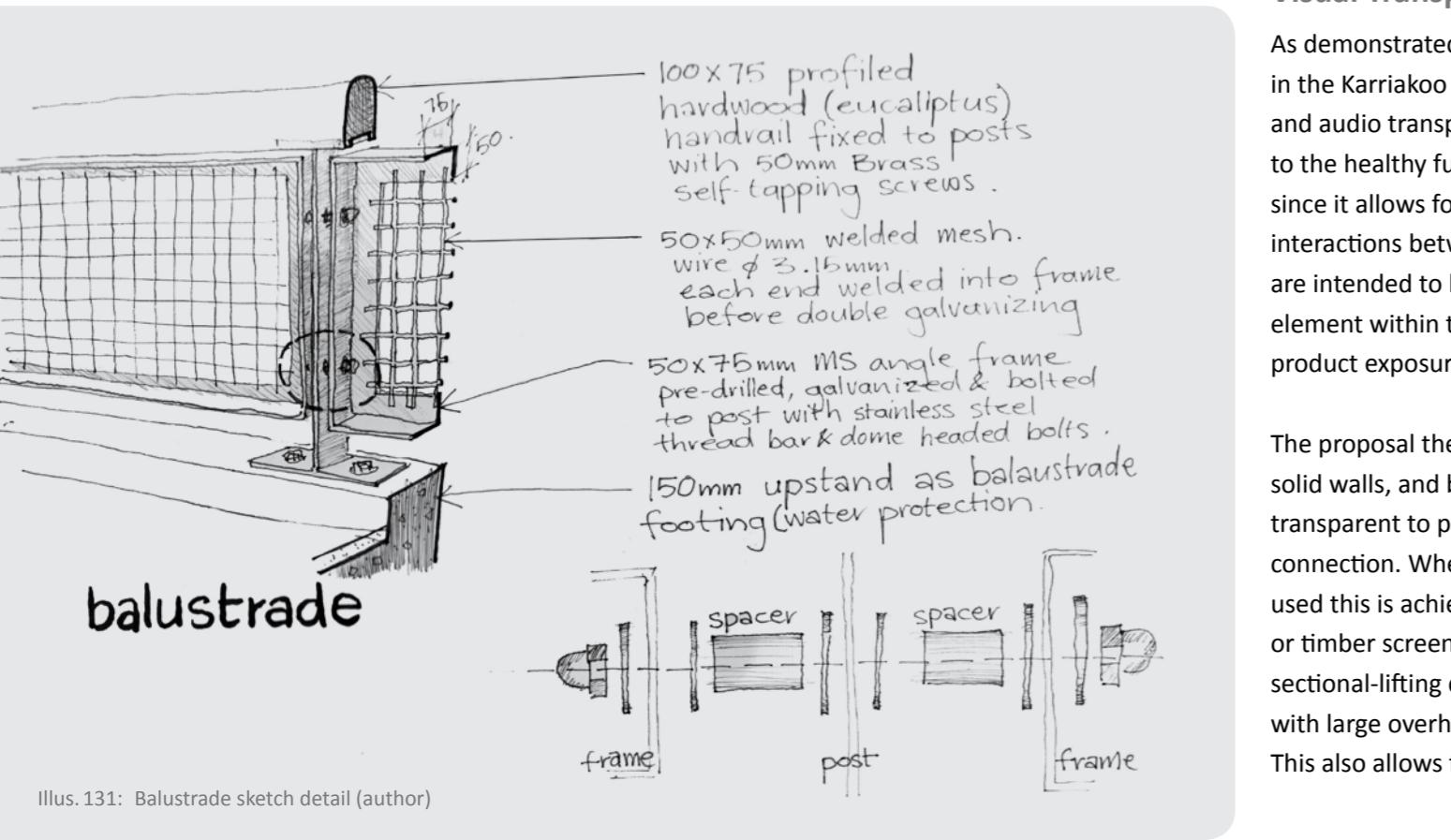


Fig. 9: Graph showing the number of full hours of full sun per day in Maputo (author, BBC Weather)

Thresholds

Vendor Integration

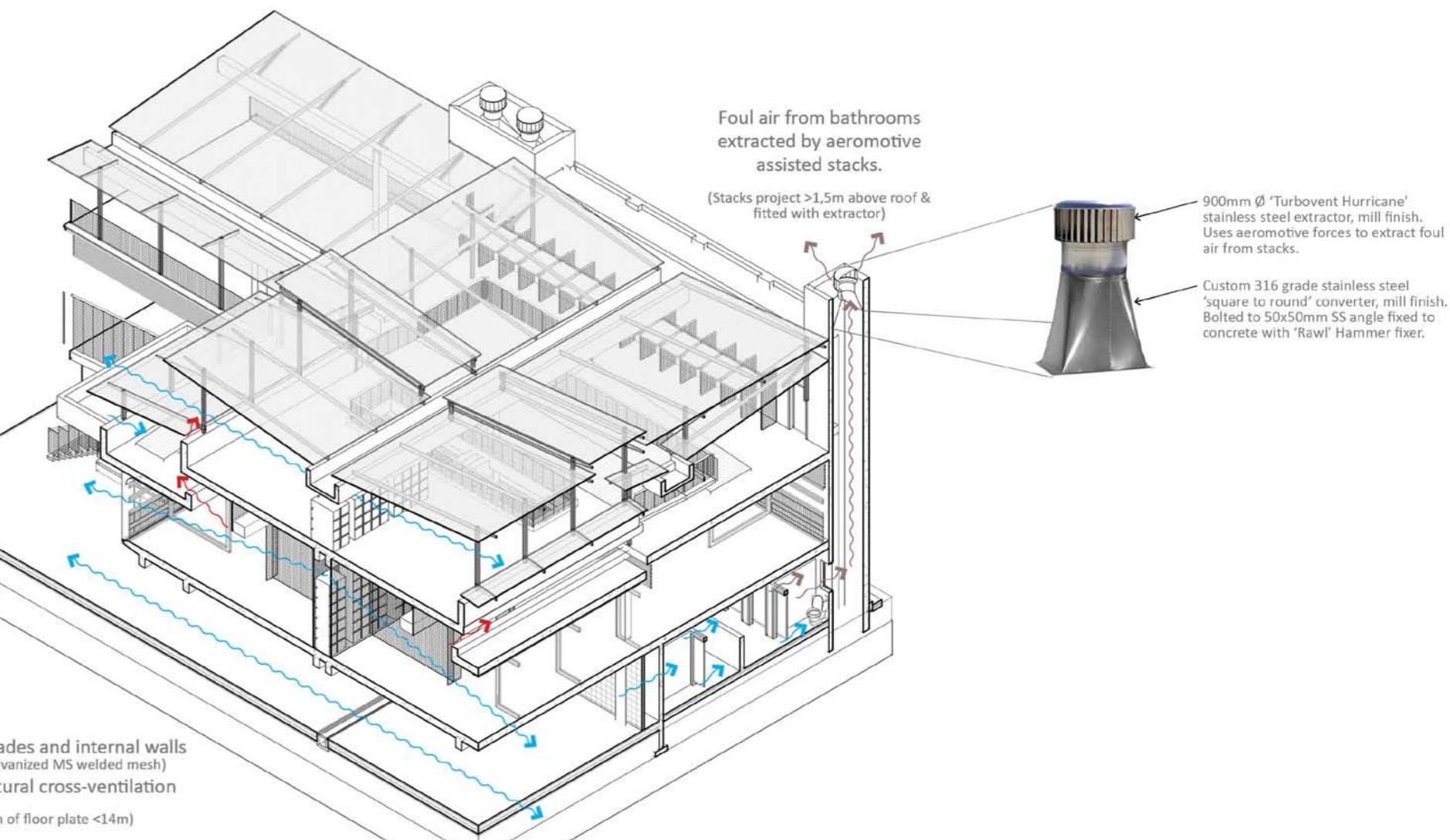
The recognition of vendors on sites outside of the market confines, as well as the permeability of the built edge of the market is intended to create an easy transition between the formal street vendors and the formal market spaces. Thresholds are consequently non-exclusive, but consisting mainly of a slight constriction in space with a small level change, as well as the physical presence of large gates which are used to close off the market at night.



Ventilation

General

Ventilation of this building is essential in the humid coastal tropical climate of Maputo. The relatively narrow floor plates are deliberately unenclosed to allow for natural cross ventilation of these spaces. Ceiling heights are high, and double volume in places to increase the effectivity of this ventilation.



$$Q = C_d \cdot A \cdot \sqrt{2 \cdot g \cdot H_d \cdot \left(\frac{T_i - T_o}{T_i} \right)}$$

Q = Volume Rate of Flow (m^3/hr)
 Cd = Discharge Coefficient (Efficiency) 80% = 0.8
 A = Area of Smallest Opening (2.577m^2 ; 6444m^2)
 G = Gravitational Acceleration = 9.8m/s^2
 Hd = Height of Stack = 15.1m
 Ti = Internal Stack Temperature ($^\circ\text{C}$)
 To = Outdoor Temperature ($^\circ\text{C}$)

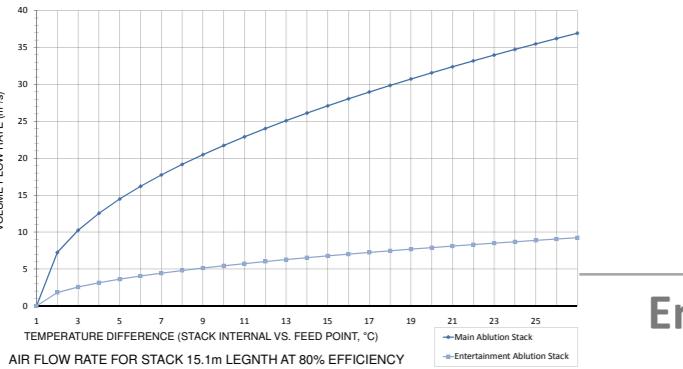


Fig. 12: Air-flow rates for ablution stacks (author)

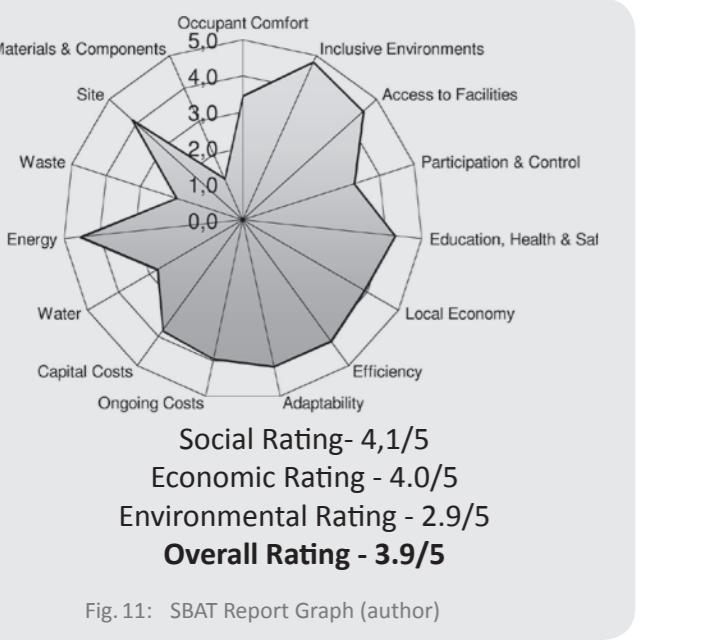


Fig. 11: SBAT Report Graph (author)

Ablutions

Ablution facilities are passively ventilated by the extraction of air through dedicated ventilation stacks. These draw fresh air into the toilet facilities, from the surrounding market spaces; this air is then drawn over the WCs then out through the stacks to a higher level. This draw is created by the extraction of air from these stacks by large 'whirley-birds' driven by the natural aeromotive force of the sea-breeze.

A flow of air is achieved by using the restricting shape of the stack, promoting the occurrence of thermomotive forces. A temperature difference due to the concrete wall of the stack causes air movement through differing densities, since hot air rises and is replaced, therefore in a restricted sectional area this causes a flow of air over the height of the restricted area.

The air-flow can be calculated using the adjacent formula. the results are shown in the graph.

Environmental Sustainability

The environmental sustainability of the building is addressed through the:

- Natural ventilation of market spaces.
- Aeromotive ventilation of ablution facilities.
- Avoidance of high embodied energy materials such as Aluminium.
- Use of locally sourced materials (lowered transportation).
- Avoidance of the use of locally available protected timbers (*Mahogany species Khaya anthotheca* - IUCN Redlisted as well as *Mahogany species Afzelia quanzensis* and *Leadwood Combretum imberbe* - both protected in South Africa).
- Rain-water and Raw-water harvesting on site through storage, or hand and solar pumping.
- Use of low-voltage LED solar lighting (Maputo receives a high proportion of full sunlight per day).
- Elimination of the use of paint, and VOC producing materials.
- The use of photovoltaic powered solar pumping to move ground and stored rain water to raised tanks where it is gravity fed to the point of use.

Although it is hoped that through the above methods the building would become inherently environmentally sustainable, the use of rating tools helped in determining the success of the above sustainability measures. It was decided that many rating tools, such as the Green Star Assessment Tool where not designed or suited to the evaluation of this type of building, being a Market Building. It was then decided to use the SBAT (Sustainable Building Assessment Tool) developed by the South African CSIR (Council for Scientific and Industrial Research), because this tool also considers social aspects as part of sustainability. This rating method rates the building high 3.9 out of a possible 5, which is high.

Topography & Flooding

It has been mentioned that the site is very close to being perfectly flat, and that flooding is a problem at times, with many stalls having been raised 600mm above the surrounding level as a reaction to this. It has been assumed that measures at an urban level, to deal with this flooding will be effective. It is however, proposed that to ensure proper drainage of the site that areas of the site (particularly sales areas) be raised in a series of 150mm high steps to a level of 600mm above the surrounding pavement level.

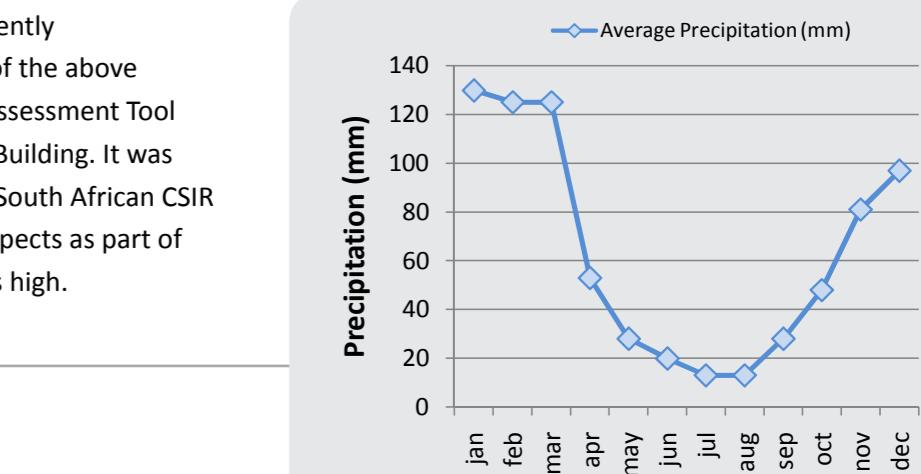


Fig. 13: Graph showing the average monthly rainfall for Maputo (author, BBC Weather)

Services

Many services are intended to be provided by an autonomous service sector within the market, facilitated by the market authorities as a way of reducing administrative load, and ensuring effective service delivery.

Water

The existing water sector of the market is primarily engaged with the sale of cold drinking water to vendors, and it is proposed that this sector be expanded to control the provision, and payment for, all water provided in the market.

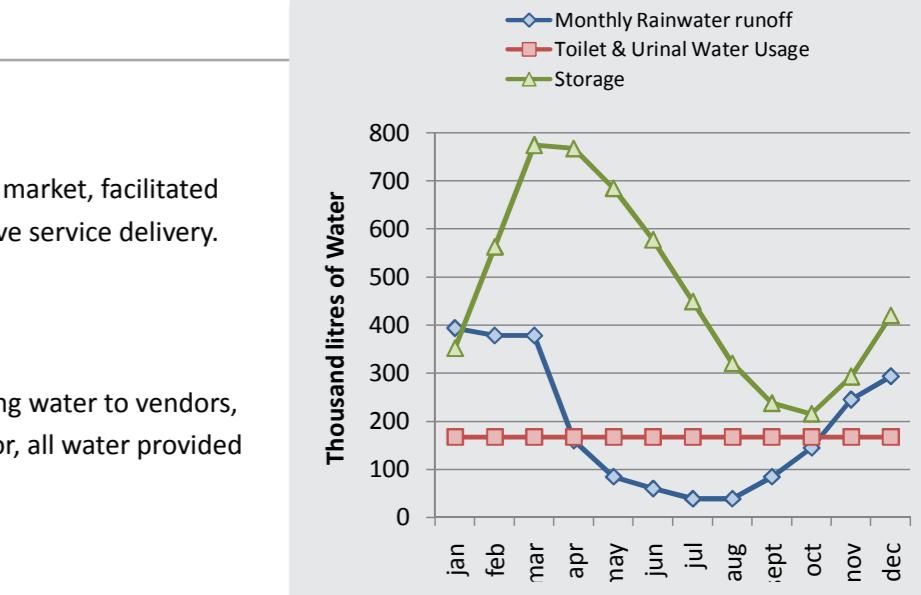
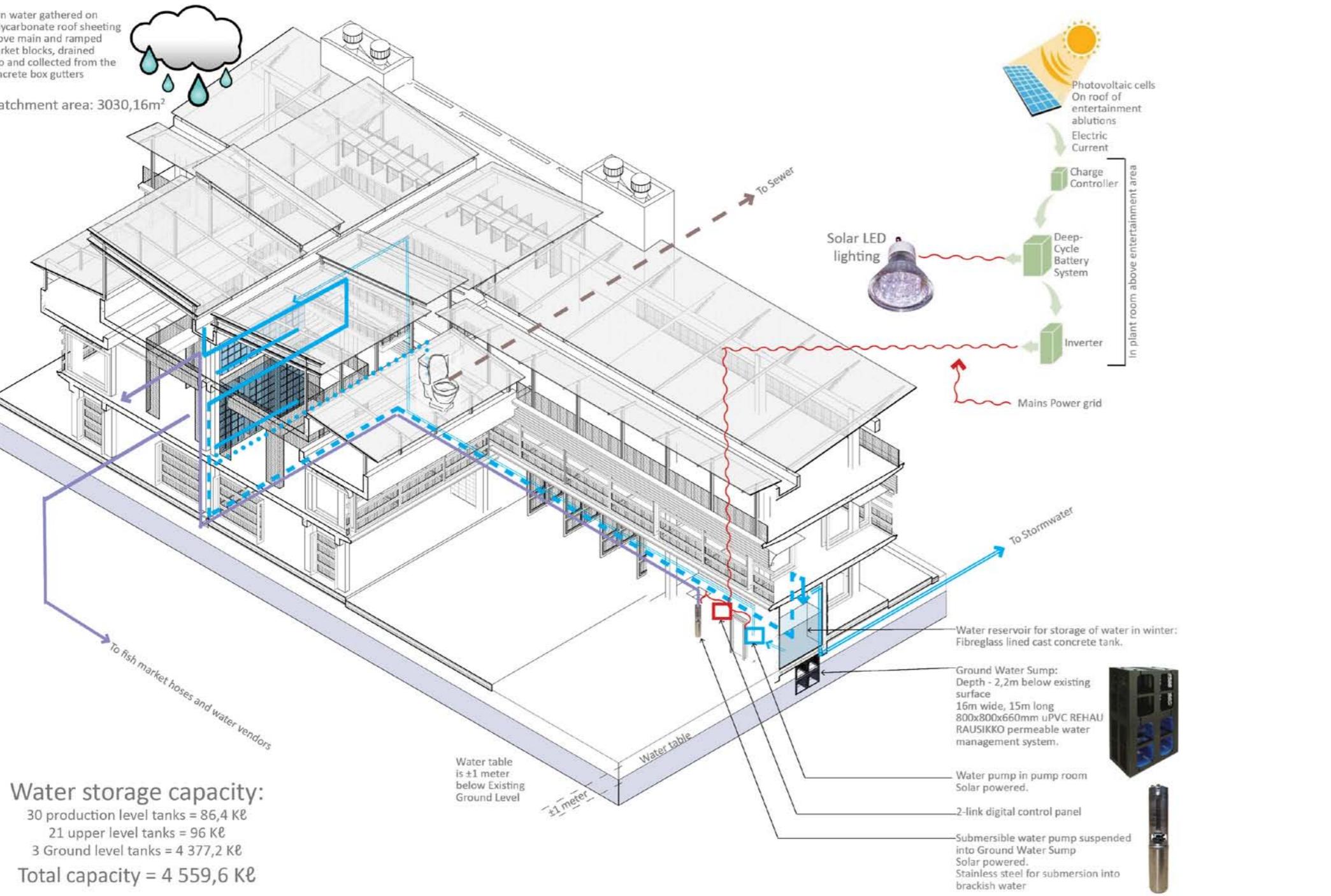


Fig. 14: Graph showing the average monthly water storage vs harvesting levels (author, BBC Weather)



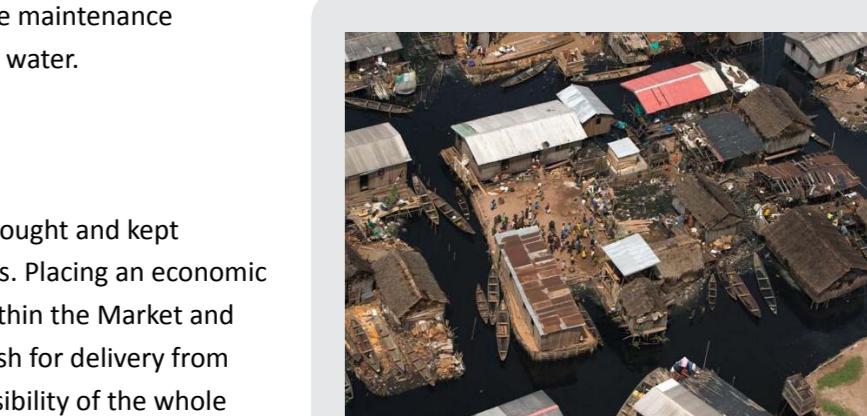
Water will be sourced from the following three sources:

- **Stored rain-water**
 - Gathered from the roofs, not from the potentially very dirty market areas
 - Non-potable fresh water
 - Used for flushing toilets and urinals
- **Water pumped from the water table**
 - Approximately one meter below the surface
 - Non-potable salty water
 - Hand pumped for sale
 - Used to flush toilets and urinals
 - Used for washing down spaces
- **Potable Municipal water**
 - Used in the food sectors
 - Sold as potable water
 - Fire fighting water

Market stalls with stand-pipes for each of these water types, will be provided, allowing the growth of the water sector. Each of these stand pipes will be metered and lockable, with a water vendor paying market authorities for water used. Where possible hand pumping will be used, this will reduce maintenance requirements, dependence on electricity or fuel, and bring down the final price of the water.

Waste Removal & 'Self-cleaning'

A waste depot is proposed at a built-framework level. Waste of various types will be bought and kept temporarily in skips in this area. A municipal removal truck can then collect these skips. Placing an economic value on waste, will encourage the formation of an informal waste removal service within the Market and immediate surrounds, and it is likely that *tshova* push-cart operators will collect rubbish for delivery from the depot on a return trip to the goods delivery or storage areas proposed. The accessibility of the whole market area to *tshova* push-cart then becomes important, and makes the market effectively 'self-cleaning'.



Illus. 132: The Makoko Informal Settlement, Lagos, Nigeria. The precedent for 'self-cleaning' waste removal

Electricity

All stalls will be provided with electricity supplied to each shaded market stand within the formal market, with electric wiring routed through shading structures. A 'Pay-as-you-go' metering system operating on a similar system to cellphone airtime sales, and sold by the same mobile vendors is proposed. The HT/LT Substation is proposed under the eastern Ave Zedequias Manganhela ramp, a position accessible to heavy delivery vehicles.

Security

The current market police force will be increased to regulate the expanded market, with the formal market designed to allow night time locking. Facilities for these market police will be provided at a built framework level.

Sanitation Sector

The provided ablution facilities will be operated as a sector within the market, a pay-toilet system allows the maintenance of attendants in each facility. These attendants would ensure the facilities cleanliness, safety, basic maintenance, and the availability of toilet paper and other sanitary products.

Refrigeration

It is proposed that refrigeration and freezing cold rooms be provided as part of the Expanded Market Framework. This can be operated as a sector of the market, with this sector also providing ice to customers. Vendors will then be able to store produce and keep perishables fresh for longer periods of time, and buy in larger amounts. This should have a direct physical link to the fish and vegetable sectors.

Fire: Escaping, Isolation, Extinguishing, Smoke

The consideration of the effect of fire in the market is demonstrated by the recent fires which gutted the Nakivubo Park Yard Market (2009) and Owino Market (2011), both in Kampala, Uganda. Markets are very vulnerable to fire because of the extensive use of moveable, combustible materials, narrow covered passages and frequent inaccessibility to fire fighting vehicles. Large open fires are often used to cook food.

Escape

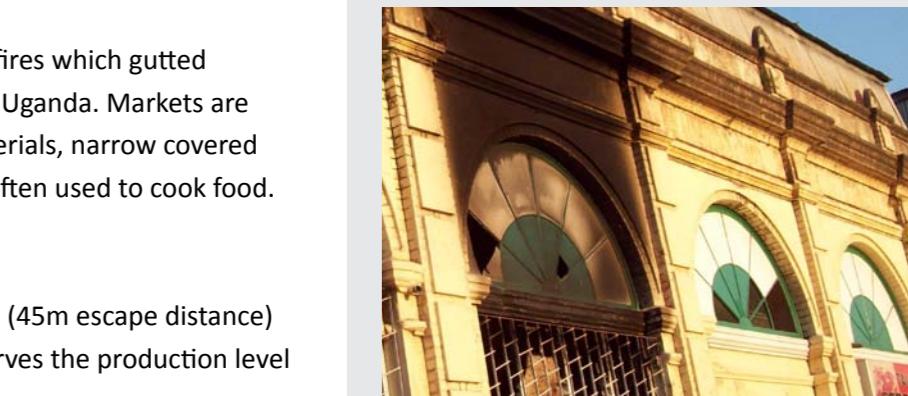
All stairways are designed to operate as fire escape stairs, and are within 90 meters (45m escape distance) of one another. An enclosed fire escape with the appropriate smoke extraction , serves the production level exclusively.

Isolating, Extinguishing, Smoke

The pedestrian walkways running east west, associated atria, and Rua do Mesquita are intended to act as some measure of fire isolation. The atria, being three storeys in height, require to be protected with fire sprinklers, but it is proposed that the whole covered area of the market be protected with these sprinklers. These should be split into sections so that only the sprinklers in a burning area are activated to minimise stock damage. The open nature of the building allows smoke to escape easily.

Accessibility & Water Provision

Rua do Mesquita will allow a fire engine access into the heart of the market. Fire booster points will be provided at points which are less accessible.



Illus. 134: Fire Damage, historic market building, Baixa
(author, photo June 2011)



Illus. 133: Nakivubo Park Yard Market smoulders, Kampala, Uganda, 2009. Fire trucks where unable to get into the market, which was a continuous mass of timber framed stalls (M Mbabazi / Musinguzi, 2011)

Surfaces, Materials, Finishes

General Material Strategy

Durability

All materials need to be durable and have a long, maintenance free life-span. No paint is to be used throughout the building and no aluminium fittings or finishes will be used in the building because of their high scrap value.



Illus. 136: *Calçada Portuguesa* crushed-stone paving common in Maputo. The particular example is notable for the use of multiple coloured stone. (author)

The proximity of the building to the sea means that steel will rust quickly, and will have to be very well protected against oxidation, or preferably avoided in preference of timber, brass, or high grade (316 grade) stainless-steel.

Local Material Use

It is preferable that materials are produced or sourced locally, either from around Maputo, within Mozambique, or neighbouring countries (in that order).



Illus. 135: Goods defining space, Alcohol Market - Maputo (J Casson)

This shows itself in the specific choice to use:

- Mozambican made cement, in-situ concrete work and precast units.
- Exotic Eucalyptus timber from Salamanga, southern Mozambique
- Mopani poles from Mongweni, Mozambique

Extensive use of precast concrete grill-blocks (*grelhais*) popular in Maputo, the thinning of low level concrete edges, and the addition and allowance of a layer of tectonically light and less permanent materials over the a heavier concrete layer, is an effort to respond to the identified regional character. This is also the case with the use of *Calçada Portuguesa* type patterned crushed-stone paving as used locally.

Use of industrial Materials

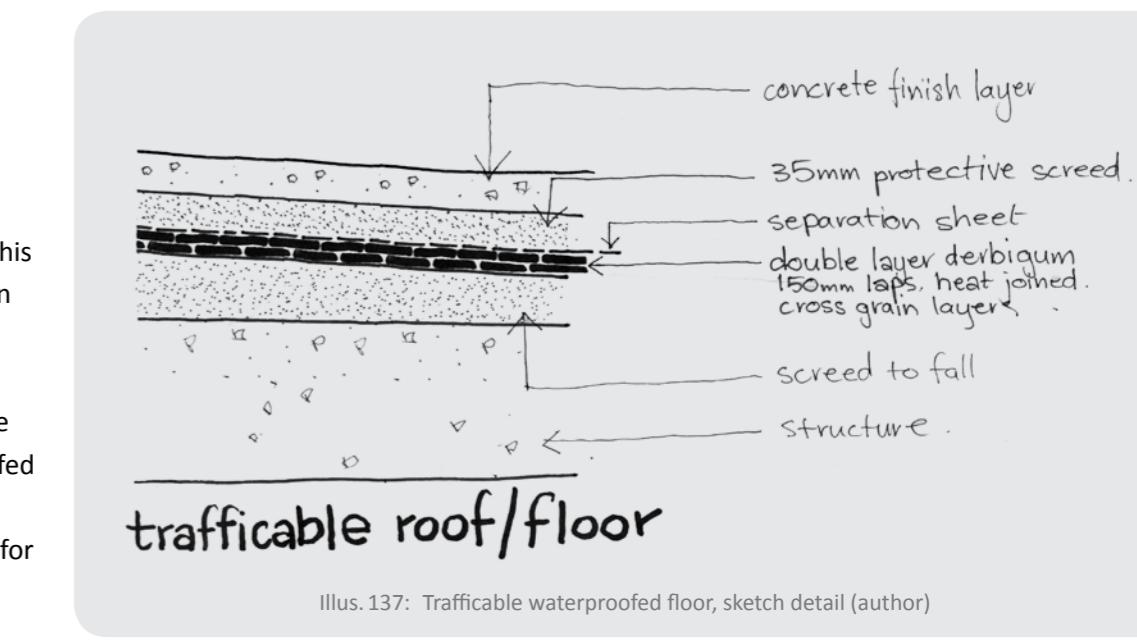
The use of more industrial materials such as concrete, and the industrial fixing of materials forming part of the core structure of the building is proposed. This Modernist use of materials often creates cool, clinical ambients, as well as a remoteness in relation to the user as discussed in Chapter Two. The use of timber and other local materials in a fairly raw state is used to offset this, drawing on elements of Critical Regionalism. The imprecision of the raw materials also reflects the small variations in the market spaces which contributes to the vibrancy of the market.

Material Strategy for Specific Elements

Floors

Surfaces need to be highly durable, but still human in scale. On ground level, the extensive use of *Calçada Portuguesa* crushed-stone paving, commonly used in Maputo and particularly in the Baixa is proposed. This will allow for a durable textured surface, in which the touch of a human hand is clearly evident. A multicoloured patterned surface is proposed.

The finish of all concrete surface-beds as well as the floor / roof surface of all the suspended slabs could be a stained, polished, and waterproofed screed, with the screed on appropriate suspended slabs falling to Full-bore drains. This will allow all concrete roofs to be trafficable, to allow for future ad-hoc expansion.



Illus. 137: Trafficable waterproofed floor, sketch detail (author)

Walls

The finishes of solid vertical elements will where possible, be either smooth finished off-shutter concrete, stained bag-wash finished blockwork, or precast concrete grill blocks commonly used in Maputo to allow ventilation. Where a transparent vertical element is required, this will either be a galvanised, primed, and painted mild-steel welded mesh within a timber frame, or local timber screens. Timber screens will be constructed from vertical Mopani poles, blade-striped of their bark and fixed in such a way that their bases are suspended off the ground to prevent water related rot. This timber will be deliberately allowed to age.

In market areas spatial enclosure through the use of transparent vertical elements is proposed. This will allow for permeability in terms of sight and sound, ensuring that goods are visible to customers, since they become the primary obscuring element within these spaces. It also allows the social and business interactions between stalls essential to the organisation of the market sectors to continue, despite the presence of a physical barrier.

Balustrades

These will be predominantly welded mesh panels with a timber hand rail, with the timber giving a warmth to the more industrial materials, and the welded mesh allowing transparency between levels.

Ceilings

Soffit ceilings of unpainted smooth steel shuttered concrete that has had the joints polished smooth is proposed for its durability and maintenance free character.

Bathrooms

All bathrooms will have a stained and polished screed floor with a coved skirting, as well as durable vandal proof fittings. Walls will be plastered smooth, with the plaster having been stained to prevent the necessity of paint.



Illus. 138: Tiling in 'Prédio Emose', Baixa. Reminiscent of Calçada Portuguesa crushed stone paving common in Maputo (author)

Health & Cleanliness

The presence of sectors that deal with food makes the hygiene of these areas very important. In particular the seafood and cooking areas will be provided with specialised facilities. These will also be the only areas that are formally dedicated to a certain sector or function, allowing other areas a greater degree of flexibility.

Seafood

The fresh seafood sold in the market is not chilled or frozen, it is only kept wet and shaded to prevent it from drying out. A potential for odour and dangerous bacterial levels arises from the following issues:

- Water running off fish stagnating.
 - Proper drainage and hoses allowing the area to be properly cleaned
- Waste from cleaning fish and fish that is 'off' is not disposed properly
 - Provision of 'Food Waste Disposers' that liquidise and dispose this waste into the sewage system
- Ingress of contaminated water into surfaces
 - All surfaces (tables, floor, etc) to be impervious. It is proposed that this be a smooth concrete or screeded finish sealed with a cementitious 'Sika Seal' sealant and with coved skirtings

Water run-off from the seafood cannot be allowed to flow directly into the storm water system, as it may contain or develop dangerous levels of bacteria. The run-off from the seafood area must therefore drain into the sewage system, and the areas surrounding the seafood sales area be raised by 150mm to prevent the flow of contaminated water to the surrounding areas.

The proposed refrigeration and freezing facilities, will allow vendors to better control the freshness of the fish, as well as increasing the availability of ice for chilling fish.

Cooking

Cooking areas are also a potential hygiene risk. It is proposed that the floors of these areas be epoxy sealed screed, falling to a grease trap in each area, and that basic washing facilities be provided in sealed impervious concrete.

Identity of Space

Regional Identity

The Regional identity has been taken from the following guidelines, as outlined in Chapter 3:

- Climate
 - An open, ventilating , climatic response has been chosen.
- Existing architectural tendencies
 - Use of thin Portuguese type modernist concrete edges prevalent in Maputo.
 - Extensive use of concrete.
 - A lightweight, less permanent, layer on a concrete frame.
 - Use of *Calçada Portuguesa* crushed-stone type paving prevalent in the Baixa.
- Heritage:
 - Built heritage considered.
 - Industrial heritage acknowledged through the use of industrially produced vending areas.
 - Intangible economically and entrepreneurially driven heritage is considered and reinforced through support of enterprise and commerce in the market function of the building.
- Scale
 - Pavement dominance, linearity of space, and context massing considered.
- Material use
 - Local characterising materials used.

Spatial Syntax and Identity

Markets are generally spaces that are rich in spatial character. The building will thus be split into several zones, with each of these zones having a characteristic finishing approach. The following measures have been taken:

- Finishes will be constant in materiality, but vary in application pattern, colour, and the size of the smallest material unit.
- Tree species will be varied by grouping, allowing a change in light conditions and shading patterns in the spaces that they define.

Overview

The above considerations form a complex web which sets out the infrastructural base for a unique physical and intangible place. The building becomes a significant item of built civic infrastructure that promotes and legitimises micro-enterprise and trade through the expansion of the market, as well as the recognition of the street as a formal market place. This should occur within a contextually sensitive environment, low in maintenance needs, and facilitating the healthy functioning of the market system in an environmentally responsible manner.