UNIVERSITEIT VAN PRETORIA
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Ento-mediate

Food for the future - insect farm in the Pretoria CBD

Submitted in partial fulfilment of the requirements
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INGE FüRSTENBURG

RESEARCH FIELD:

Environmental Potential

PROGRAMME:

Entomophagy - Food processing facility

BUILDING ADDRESS:

Pretoria CBD, c/o Boom and Paul Kruger Streets

COURSE COORDINATORS:

Jacques Laubscher (Feb. - Aug.)

Arthur Barker (Aug. - Dec)

STUDY LEADER:

Carin Combrinck

Samevatting

Hierdie studie is 'n ondersoek na die moontlikheid dat die eet van insekte die kookkuns-ondervinding in 'n stedelike omgewing kan verryk en sodoende 'n gevoel van unieke 'plek' teweeg kan bring. Die praktyk van insek-eet is so oud soos die mens, maar lei onder wêreldwye neigings in voedsel produksie en -verbruik. Die mens is verwyderd van die oorsprong en groeiprosesse van voedsel omdat dit as slegs 'n verbruikersartikel beskou word.

Dit behels 'n ondersoek na die vermoë avn argitektuur om deur die werking van die menslike bewussyn 'n bemiddelaar the wees tussen voedselprosesse en die publieke verbruiker. Deur aandag op die waarde van insekte as kos te fokus, is die fokus van die studie om vooropgestelde idees te verander en 'n hernude houding oor die voedselindustrie te bevestig.

Abstract

This study is an investigation into entomophagy (insect eating by humans) as a practice that could enrich a culinary experience and thereby create a sense of 'place' in the urban context of Pretoria. Entomophagy is as old as man itself, but has suffered under globalised trends in food production and consumption. Humans are furthest removed from the origins and growth medium of the food they consume as food has become merely a commodity.

The investigation entails exploring how architecture can be a cognitive tool and mediating device between food production processes and the public consumer. By bringing awareness and value to insects as food, the study hopes to redirect prejudices and open up new thoughts and behaviours in the food industry.

Terminology

Entomophagy:	the scientific term for the consumption of insects by humans.
Micro-livestock:	the farming of insects.
Macro-livestock:	the farming of traditional livestock i.e. cattle, sheep, pigs, etc.
Fodder:	bulk feed for livestock, esp. hay, straw, etc.
Larva:	period in developmental history of insects between hatching and metamorphosis.
Grub:	the short legless larva of certain insects, esp. beetles.
Terrarium:	1. an enclosure for small land animals; 2. a glass container in which plants are grown. (ref)
Insectarium:	a place where living insects are kept, bred, and studied.

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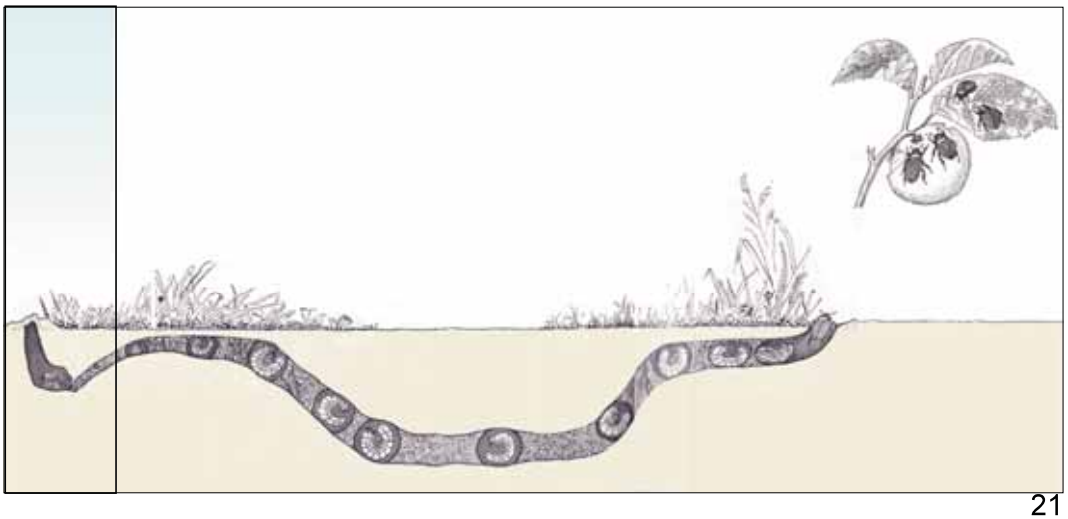
CHAPTER ONE

Introduction



1.1 Problem statement

1.1.1 Population growth and global food scarcity

In 2009 the world population reached seven billion with an estimated 900 million people suffering from malnourishment and starvation (United Nations 2009). On one hand the rising human population is continuously increasing the demand for food, on the other hand there is an associated reduction in the availability of land resources to produce this food. This growing pressure on land is making meat production from macro-livestock less sustainable than ever before. Research by the United Nations indicates that African countries are increasingly adopting Western diets which include higher meat consumption. Since 1997 there has been a 40% rise in the number of cattle slaughtered for public consumption in South Africa (Weber 2008:38).

1.1.2 Globalised food commodities: universal trends and isolated industries

With the advent of the Industrial Revolution much manual processing work was mechanised. This also meant that food processing could move into industries outside the city (Weber 2008:42). Today, the effect is that the finished and packaged product is available on the shelves of supermarkets where no reference to the origin or processing of the food is made. As the importing of goods has become financially viable, food products from all over the world are available in the local supermarkets. Supermarkets and franchised restaurants are becoming ever-more popular, but have become marked by a universal identity. Due to our consumer society and universal trends we find that food has become a commodity and the rituals of cooking and eating are lost in our cities.

The impact of globalisation on present cities has caused a fascination among a large cross-section of population towards fast-food 'culture'. Globalisation in the food industry leads to the refusal to consume locally available, traditional foods. A Westernised diet means there is an increase in the consumption of beef, pork, chicken, and other "Western" foods (DeFoliart 1995:32). Unfortunately, obtaining or raising macro-livestock is difficult in some regions of the world and also has dire environmental consequences in other regions.

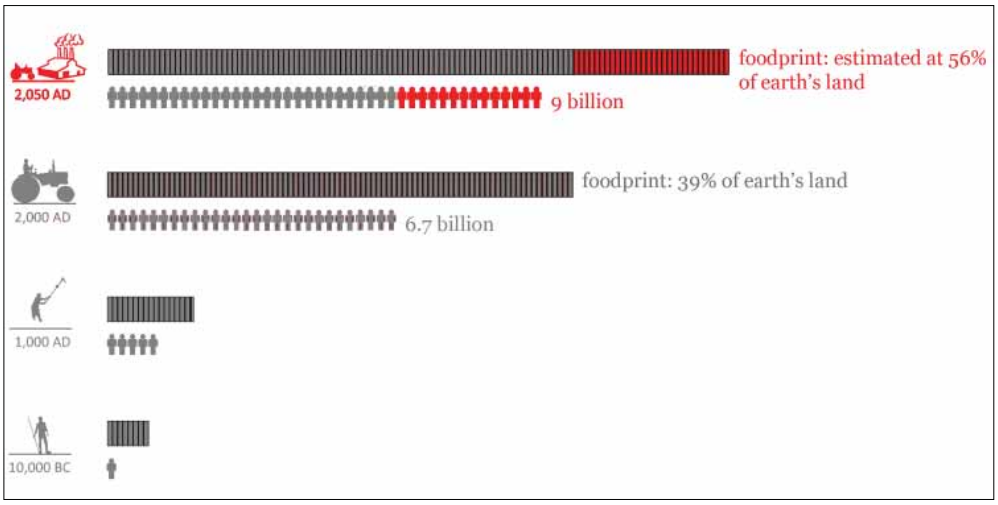


Fig. 1.1 Timeline to illustrate the global population and food consumption relationship (Author, 2012)

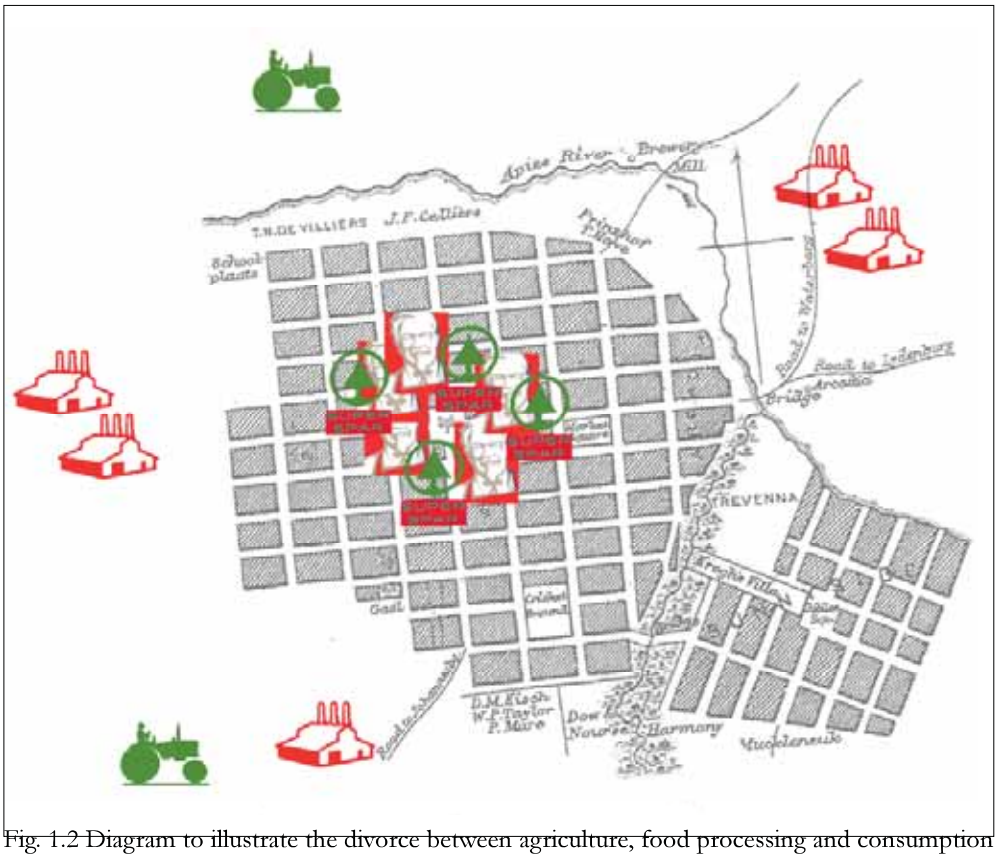


Fig. 1.2 Diagram to illustrate the divorce between agriculture, food processing and consumption (Author, 2012)

1.2 Sub-problems

1.2.1 African informal food culture

Due to the Western urban design principles that determined our city layouts and capitalist ideals that drive our economy, there is little tolerance for the present cultural dynamics in Pretoria: informal street vendors are kept from the public realm by palisades and wire fences. These entrepreneurial businesses are operated from the sidewalks and are utilised as public space without having the basic public amenities such as seating, shading and ablutions. Rituals associated with eating are relegated to fleeting experiences.

Fig. 1.3 Informal trade - a lack of trader facilities and public amenities (Photo by author, 2012)

1.3 Hypothesis

Architecture as a cognitive tool in being a mediating device between food processing and the public consumer is investigated. The farming, processing and eating of micro-livestock (insects) in an urban context is researched and a building proposed to introduce the public to these programmes. As the demand for protein in South African cities rise and the resources available for this farming is limited, an alternative to red meat is hereby addressed.

1.4 Research Methodology

Different research methodologies were used and integrated to gather the necessary information required to strengthen the thesis argument.

Literature study

Literature studies were conducted on subjects regarding entomophagy: the history, value of insects as food and the anatomy of insect disgust.

The 2007 ICOMOC Charter for the Interpretation and Presentation of Cultural heritage sites was consulted to form a suitable heritage approach to the existing buildings on the site.

Context analysis

An analysis of the precinct's physical, cultural and political history was done in order to understand the significance of the study area in preparation for an architectural response.

Precedent studies

International examples of greenhouse structures were studied to understand the relevance of climate regulation when dealing with living organisms.

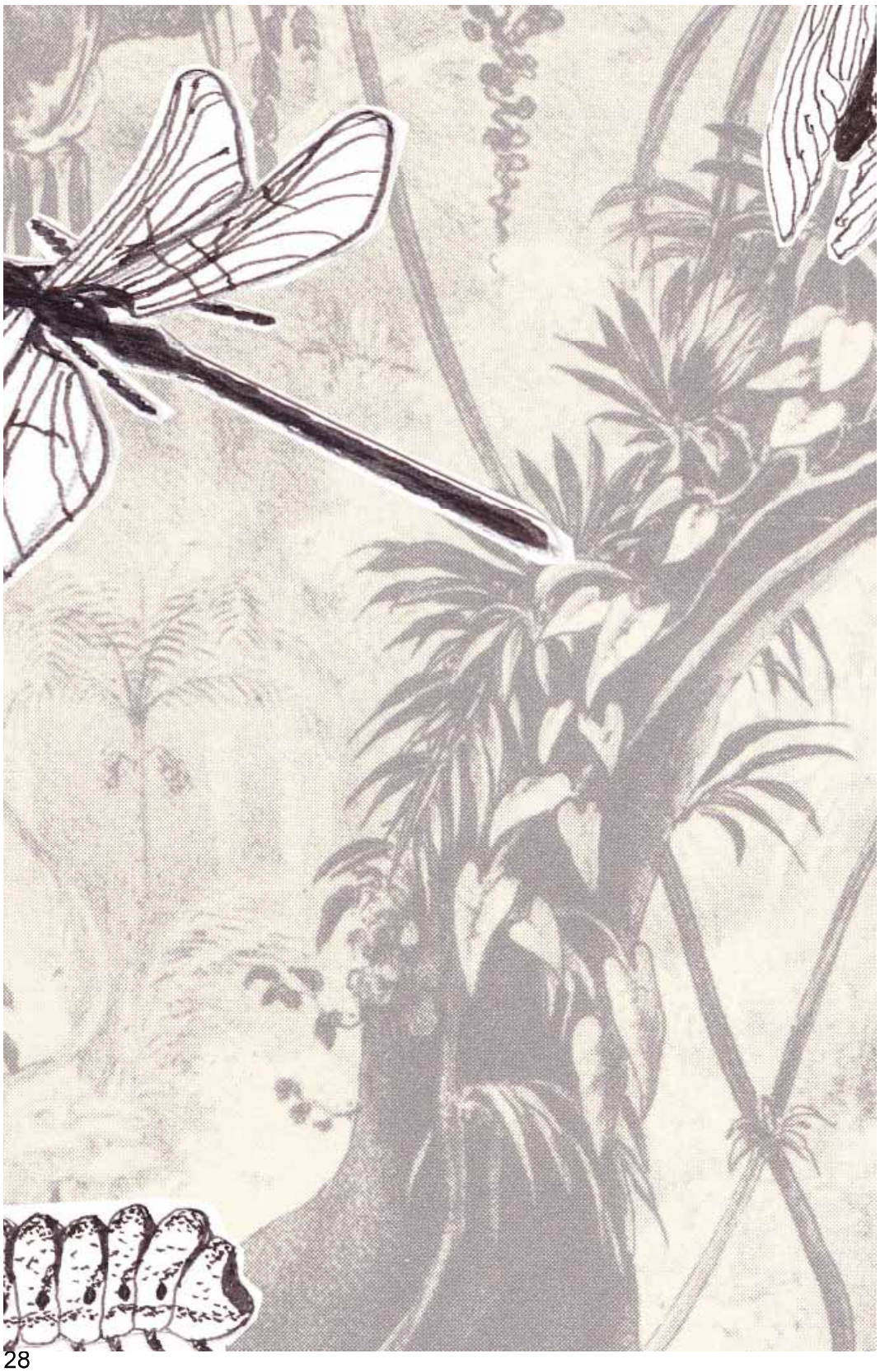
South African precedents were researched to gain an understanding of relevant design approaches: typologies in vernacular design; programmatic requirements; public interface and sustainable systems.

1.5 Client profile

The document entitled 'Food safety for informal traders' that has been issued by the Environmental Departments of Johannesburg and Pretoria have been distributed to informal traders since January 2009. The Departments are now threatening to inspect all informal vending spaces found in the city centres of Johannesburg and Pretoria. If traders are found not to adhere to the laws set out by the documents they will be forced to close their businesses. Since most informal street traders do not have the infrastructure available to meet these requirements while playing a vital role in the provision of food to city dwellers, they have written complaints to the Departments stipulating their position (August 2009).

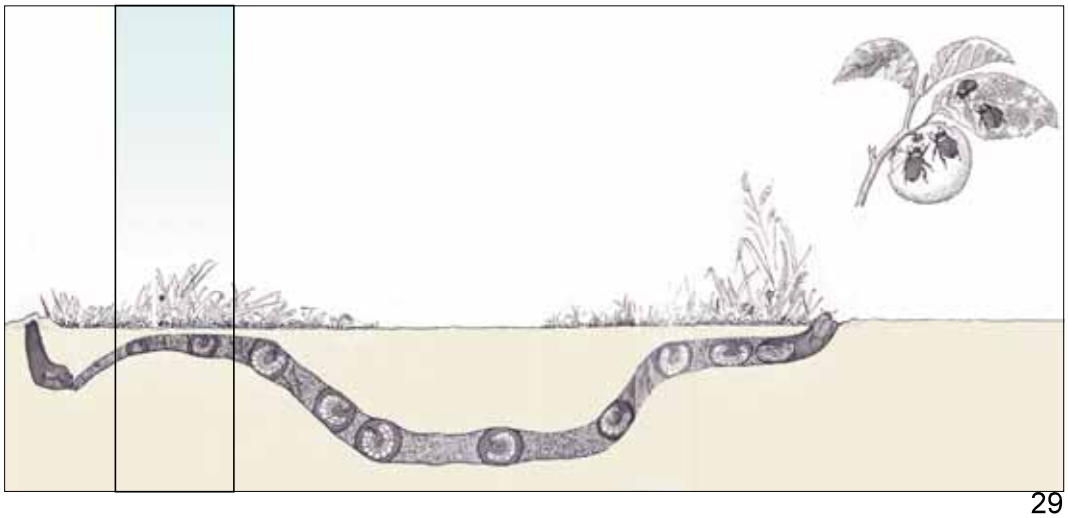
The Agriculture Department of South Africa has, in association with the Entomology Association, endeavoured to furher investigate the advantages of entomophagy in an urban context. They have managed to consolidate and rezone the five stands, R/842, 1/842, R/843 and 844, between Boom, Paul Kruger and Bloed Streets that belong to the City Council. Funding for the facility has been approved by the Department of Finances on condition that the proposed facility co-operate with the informal traders to provide the infrastructure to meet the hygienic and nutrition requirements.

The challenge will be in the co-working of a private institution with individual public clients. The solution will be to set up a brief clearly stating the needs of both parties, what is required of each and how public participation will occur. A professional team of varied disciplines will orchestrate the processes set out by the brief.



CHAPTER TWO

Programme



2.1 Background

2.1.1 Entomophagy through the ages

Analysis of fossilised faeces indicates that mankind has evolved as an antomophagous (the use of insects as food by humans) species. Beginning with the earliest times, one can produce examples of insect-eating at every period down to our own age (Yen 2009:3).

"Entomophagy is what sushi was to North America 25 years ago."
(Blackwell 2009: 22)

Although entomophagy is currently foreign to a large cross-section of the global population, especially in urban contexts, it is practiced all over the world. Whereas it is the food supplement of the economically 'backward' people in some situations, it is by no means 'a poor-man's subsistence'. In North-Eastern India, Central- and Southern-Africa, South-East Asian countries, Central- and South-America and in parts of Australia and Europe, insect species are used in many an elite cuisine (ibid).

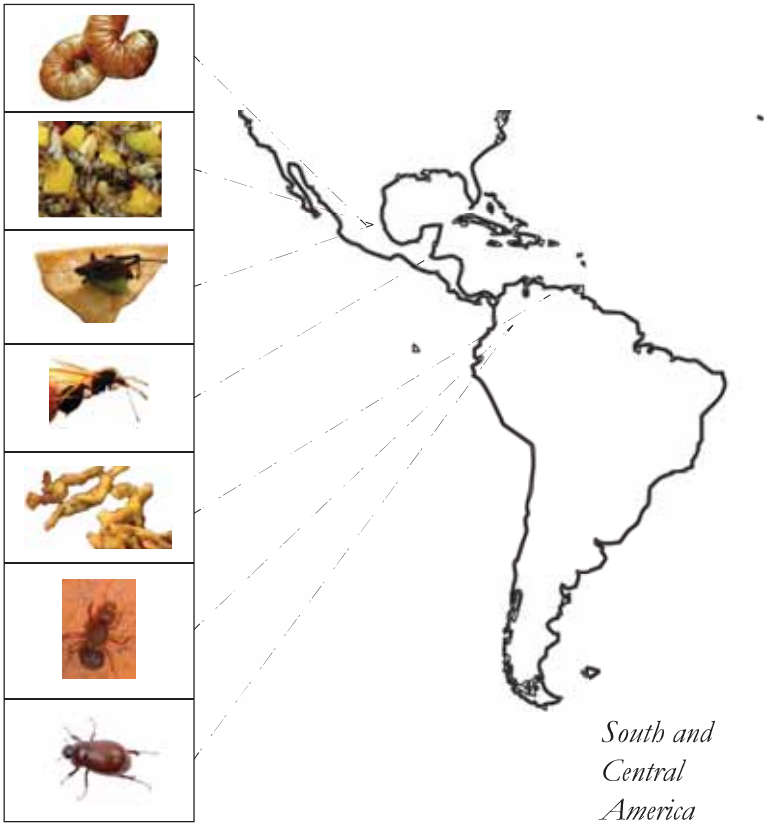


Fig. 2.1 (a) Insects consumed in South and Central America (Author, 2012)

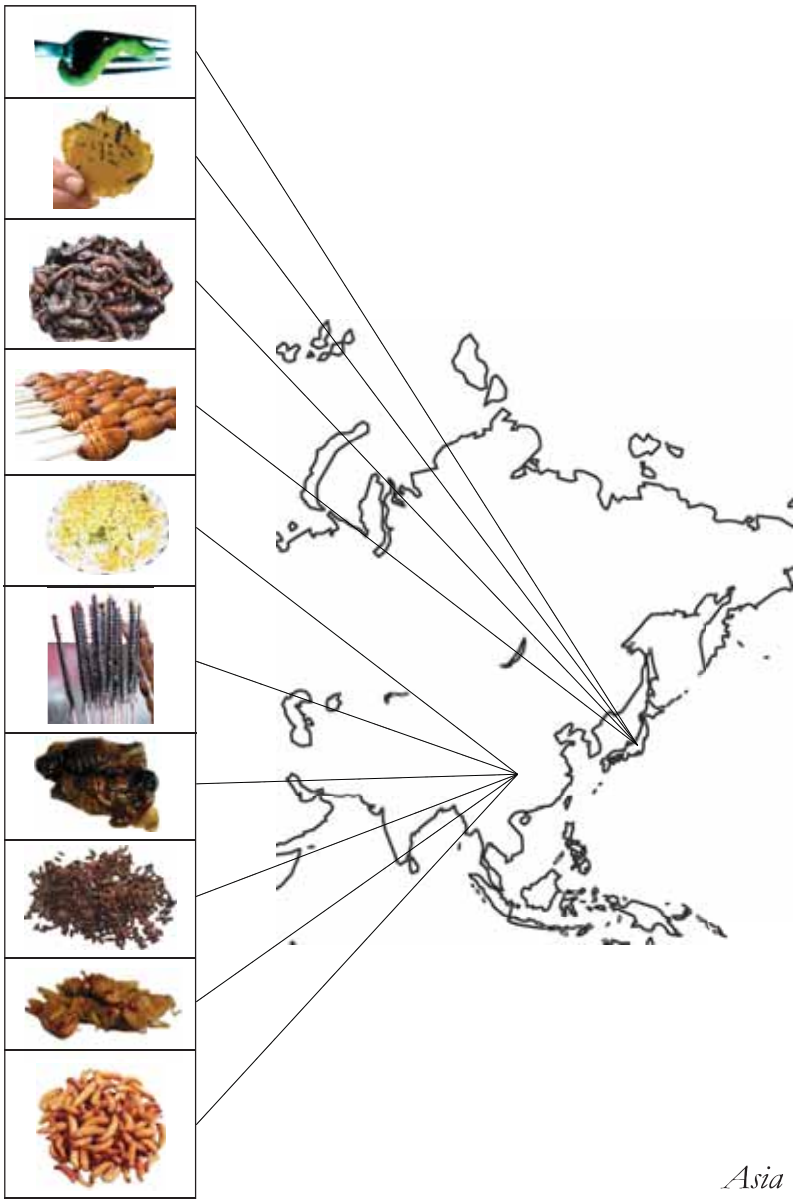


Fig. 2.1 (b) Insects consumed in Asia (Author, 2012)

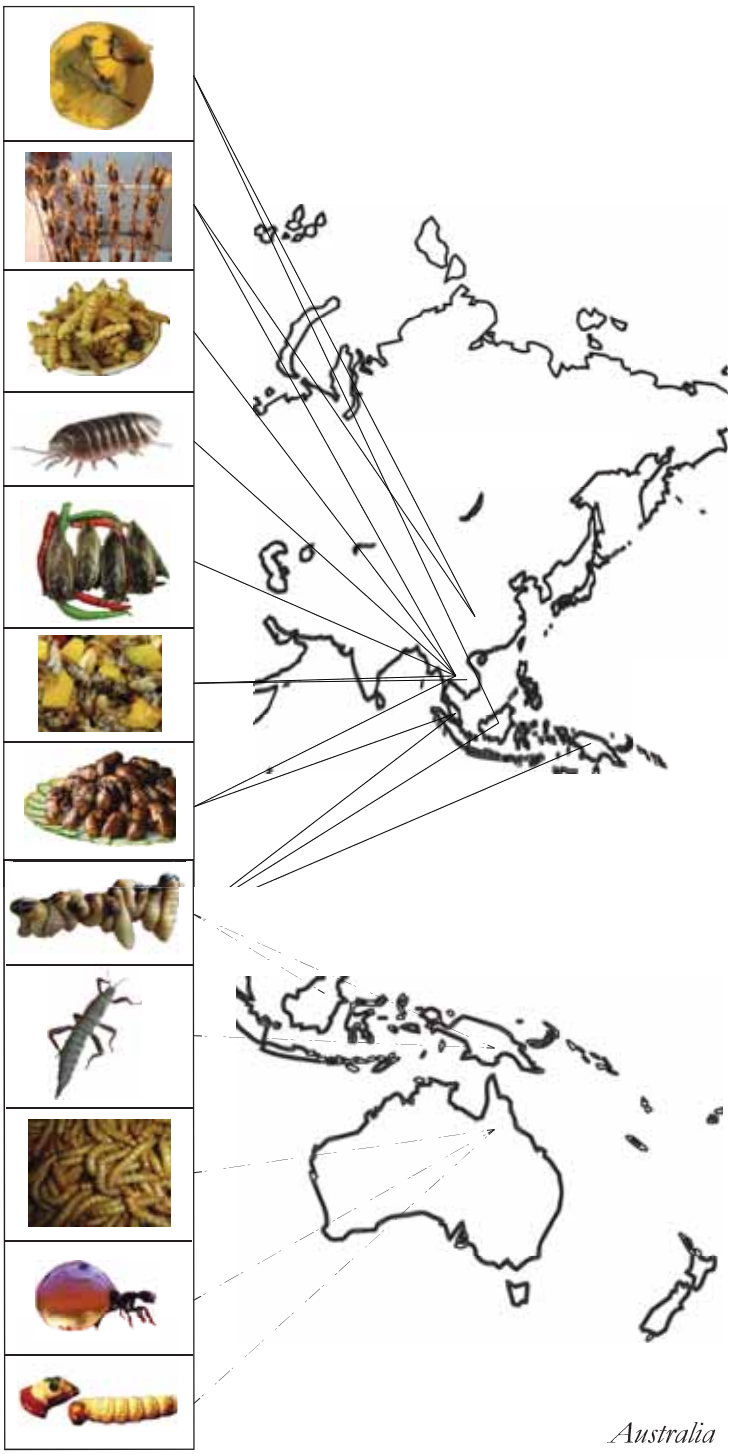


Fig. 2.1 (c) Insects consumed in Asia and Australia (Author, 2012)

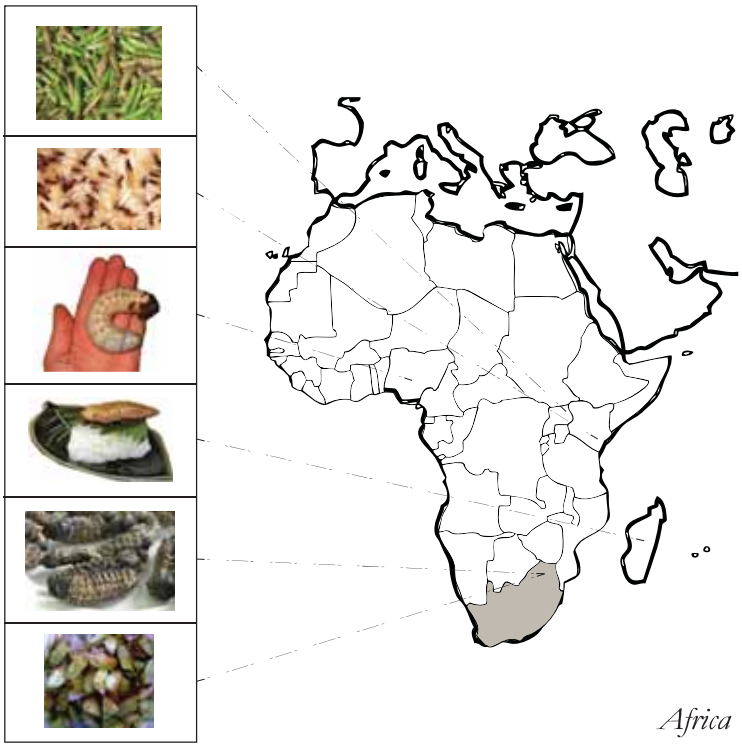


Fig. 2.1 (d) Insects consumed in Africa (Author, 2012)

2.1.2 Entomophagy in South Africa

The impact of globalisation and the fascination among a large cross-section of the population towards fast-food 'culture' has weaned a large number of protein-hungry people of the third world from what until now was a rich and affordable source of animal protein for them, i.e.insects (Abbasi 2011:2).

Mopane worms, locusts, termites and Bagrada bugs are the most popular edible insects in South Africa (Toms 2005:6). However, it is not possible to breed all these insects in the temparate climate zone that Pretoria is situated in. The author's research on the breeding conditions of edible insects in South Africa indicated that it is only viable to breed two species in Pretoria—mealworms and brown locusts. The building will incorporate breeding facilities that provide the required living conditions for these two species.

Fig. 2.2 Conditions for breeding mealworms (Photos by author, 2012)

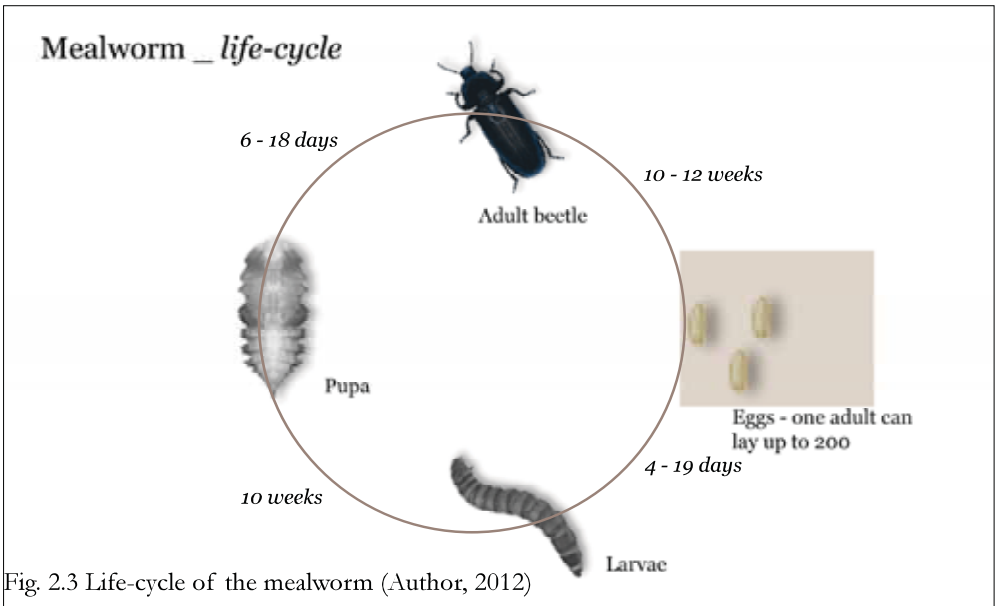


Fig. 2.3 Life-cycle of the mealworm (Author, 2012)

Breeding conditions

1. Temperature: 25-30 °C
2. Thermoregulation:
- 50 Watt rheostat controlled ceramic heater

3. Relative humidity: 70%
Use - moistened sponge/ salt dish
4. Watering:
- carrot slices
- potato slices

5. Lighting:
- prefer darkness
6. Ventilation:
- natural
7. Feed:
- oatmeal/ corn meal

1. Mealworm breeding facility in the Netherlands.
2. Mealworm beetles growing and laying eggs.
3. Rows and stacks of crates used to grow the mealworm beetles (mealworms are the larvae of mealworm beetles), but the same crates are used for the mealworms.
4. Stack of crates—easily movable.
5. A wheel barrow of mealworm food and drink - carrots and whole wheat flour. These mealworms do not eat any meat products and are not given any antibiotics.
6. A hand stirring up the worms. You can see the carrots that they haven't eaten yet. You can also see the brown "dust"; the mealworm's manure.
7. One person dumping a crate of mealworms into the sifter. The other sifting the manure and uneaten food from the mealworms. Each week they sift 1000 kg of mealworms at 5000 mealworms per kilo.

8-9. The different stages and forms are visible.

10-11. A huge bag of mealworm manure that a local fruit farmer uses as compost.

12. A container of whole wheat flour.

13-14. Freeze-dried mealworms all packaged and ready to be sent out for consump tion.

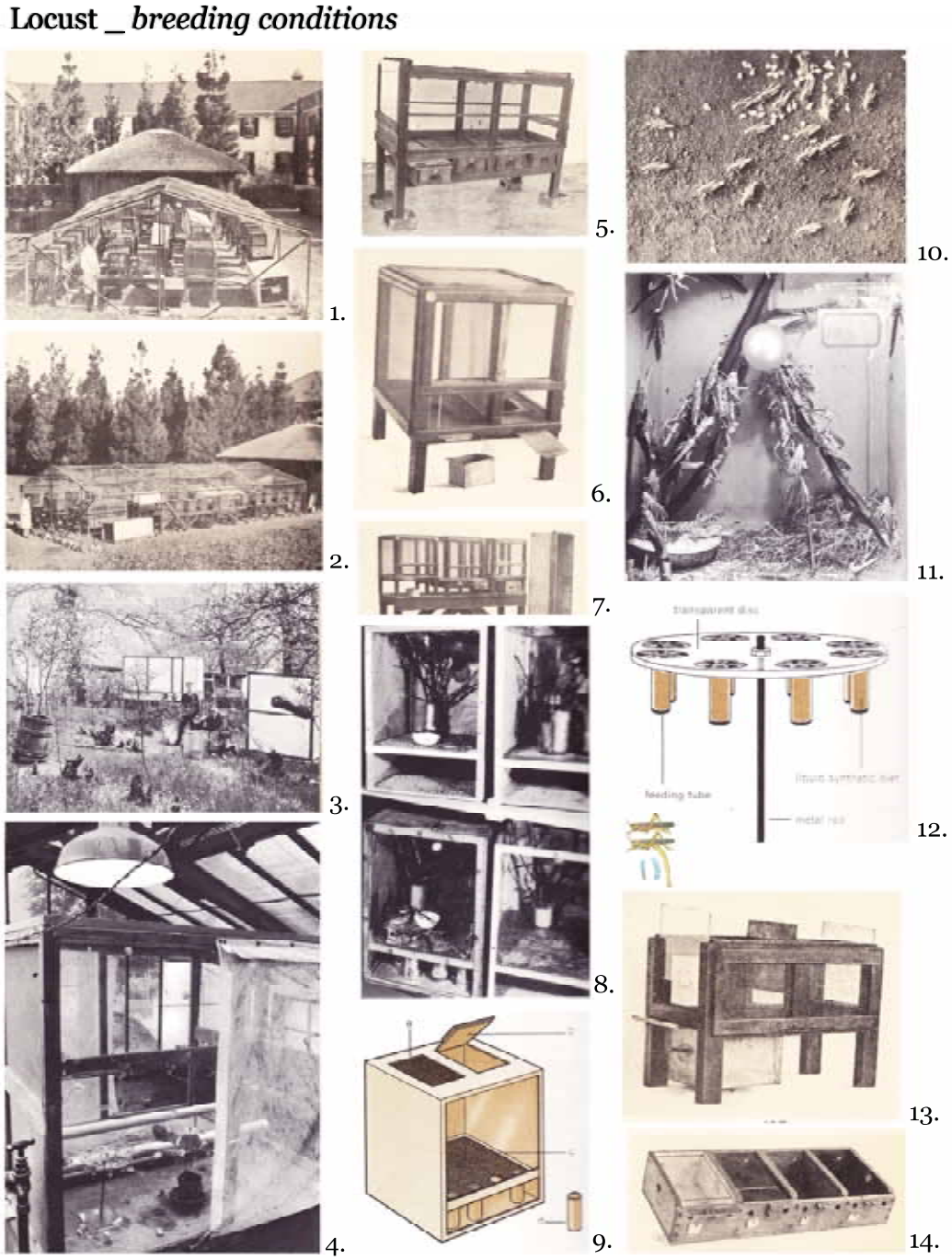


Fig. 2.4 Breeding conditions for the brown locust (Photos by author, 2012)

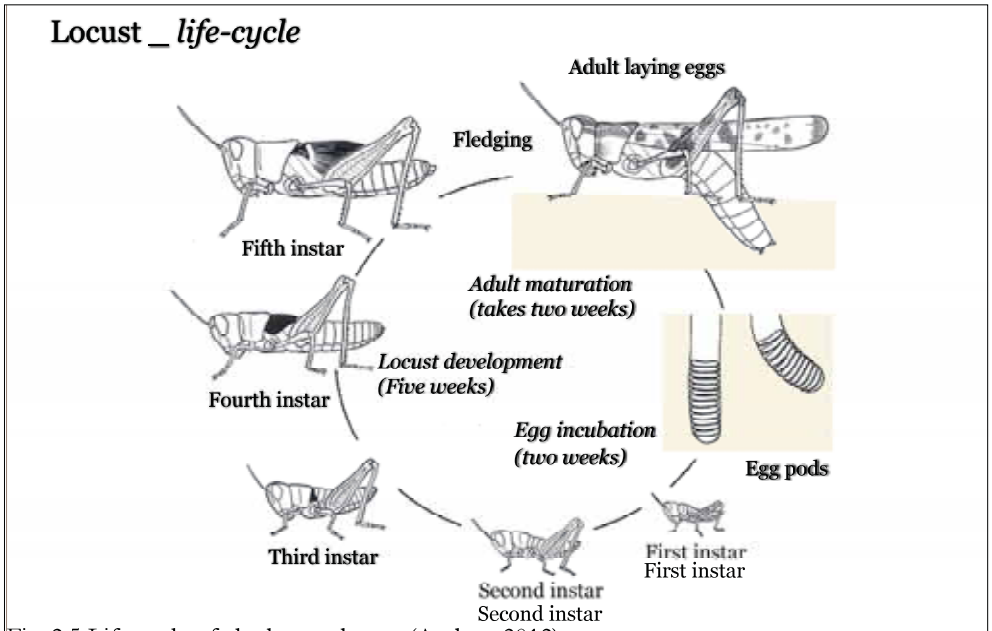


Fig. 2.5 Life-cycle of the brown locust (Author, 2012)

Breeding conditions

1. Temperature: 28 - 35 °C
2. Thermoregulation:
- UTH heating pads
- 75 Watt heating lamps
3. Relative humidity: 40%
4. Moisture: moisten soil
5. Lighting:
- natural
- avoid direct sunlight
6. Ventilation:
- natural
7. Feed: freshly washed
- lettuce
- cabbage

1-2. Outdoor breeding facility with wire netting roof to protect cages against hail.
3. Outdoor cages with timber frame and wire mesh sides for ventilation.
4. Glasshouse breeding facility with indoor cages.
5-7. Double breeding cage of wood and galvanised wire gauze, glass front. Soil in drawer.
8. Hoppers rest on dry twigs near heat-giving bulb. Containers of moist soil are provided for egg-laying adults.
9. Diagram of construction of cage. (a) provides ventilation; (b) false floor; (c) has holes for oviposition tubes.
10- 11. Adults are kept in large breeding cages. The light bulbs keep the temp. at 34°C and is kept on 12 hrs a day. Feed is changed daily. A cage of two cubic feet can house 300 adult locusts. The tops of the sand-filled oviposi tion tubes are visible as they lie flush with the false floor. The oviposition tubes are at least 10cm deep and the soil in the tubes are moistened. The number of egg-pods per female is eight and the amount of eggs per pod is twenty, thus on average 160 eggs per female.
12-14. The eggs are removed for the small hoppers to hatch in a smaller cage. Once they reach the 5th instar, they are moved back to the adult cages.

Photo by Onny Carr

alternatives as pork, dairy or eggs. Beef in particular is environmentally offensive no matter what label you may put on it.

What's right with mass production?
Its efficient use of finite resources.

Does in vitro meat have a soul?
No more than Michele Bachmann does.

MARCEL DICKE is head of the entomology laboratory at Wageningen University in The Netherlands. In 2007 he received the NWO-Spinoza award, also known as the Dutch Nobel prize. He promotes the idea that instead of mammals, we should be eating insects.

Why we eat shrimps but not insects is an interesting question only for those living in Europe and North America. Shrimps and lobster are considered a delicacy in these continents. Locusts are a delicacy to many in Africa and Asia. Locusts have six legs and live on land; shrimps have 10 legs and live in water. Both are arthropods.

A locust is nutritionally highly comparable to beef, containing high levels of proteins, the right fatty acids, minerals and vitamins. In contrast to the large amount of feed needed to produce a pound of beef (10 to 1), it takes only a fraction of feed to produce a pound of locusts (10 to 8).

In fact, there is no reason whatsoever why we should not eat locusts. In Australia some people recognise this and call locusts "sky shrimps". In fact, locusts are one of 1 800 insect species that are eaten as a delicacy somewhere on the globe.

FRANK TJEPKEMA is a Dutch product designer who does a lot of work on restaurant interiors. In 2009 however, he conceptualised Oogst – three self-sufficient farming systems for different sized communities. He presented it as part of the Design Indaba Protofarm 2050 project.

Can you design food culture?
Yes you can. Ferran Adrià and McDonald's have both influenced food culture by design. I'm taking two extremes because you have to include every manifestation of food culture in the discussion. Companies such as McDonald's should be part of your scope, even if we consider that McDonald's represents the enemy of "good" culture.

Will the city kids' idea of milk coming from factories come true one day?
It's very possible, but it's not bad news per say. Synthesising food may offer a lot of benefits for both humans and animals. It's too easy to dismiss it as inhuman. Either we limit world population by birth control (also controversial) or we rethink our food resources. Yes there should always be natural milk available, and kids should know where natural milk comes from... But does 100% of our milk need to be natural? Why?

Can eating design go beyond the restaurant?
Everything is connected in the food chain. I believe that as a consumer, you are responsible for the way the food you eat is produced. The simple act of consuming is never innocent. I also acknowledge that it's very hard to feel connected to this responsibility. It's so easy to just consume blindly and in a sense we are blind. Blinded by commercials, brands, globalisation etc. More transparency and connection will help us feel more responsible. Here food design can definitely help!

Fig. 2.6 Article on entomophagy in the Time magazine (Time, 2012/03:15)

2.1.3 A culinary revolution

Danish chef, Rene Redzepi, is leading the latest revolution in European cuisine from the best restaurant in the world called Noma (Abend 2012:35). His aim is to get to know his immediate surroundings.

"This helps explain why he is standing in his kitchen offering a skeptical patron not some truffle covered delicacy from France or a pricey sea urchin from Japan, but a plate of scuttling Danish ants." (ibib:36)

Redzepi's sense of possibilitties expanded when he started taking his cooks on foraging trips. From then on, previously strange ingredients made their way onto the restaurant menu.

"I wanted to learn how to integrate these ingredients so that we were cooking a part of our culture," Redzepi explains. "I wanted to taste the soil." (ibid:37)

By attempting to convey a sense of place in his cooking, Redzepi's aspirations caused chefs all over the world to realise that the limitations of geography can enliven creativity.
Redzepi is pleased with those ants because he believes in deepening the connection between nature, culture and the plate. He states, "They have a completely exotic flavour, very floral," and then pops one into his mouth. "You'll see. One day every fine-dining restaurant will be serving them." (ibid:36)

Fig. 2.7 Article on a revolutionary Danish chef (Time, 2012/03:15)

Fig. 2.8 Article in the Sunday Times (Sunday Times, 2012/ 15 Jun:10)

2.1.4 Mediation

In the urban contexts of the Pretoria CBD, with the exception of Marabastad and a few informal vendors, the commerce of insects as food is a foreign concept. The dried Mopane worms sold in Marabastad come primarily from the Limpopo Province. There is no reference to the origin and natural processes of most food products urbanites consume.

In the 'Raw and the Cooked' (1989), French structural anthropologist, Claude Lévi-Strauss, states that there is an opposition between the natural world (the raw) and the cultural world created by humans (the cooked). He further explains that because they lie on opposite sides of an axis, a mediator or 'cook' is required to manipulate the raw product so that it may be acceptable in the culture world. Humans can identify with culture and therefore it has meaning.

In Stellenbosch in the Western Cape, the blend of local resources and methods, such as wine production and architecture (Dutch Colonial), has created a viable regional identity with an international appeal. The architecture includes all the spaces where the wine is made and tasted. Humans can relate to these buildings created by man and therefore the wine is transformed into a product of culture. If the building is a mediator on different levels, the architecture can transform urbanites' ideas of nature as 'foreign' into a product that can define culture.

"In order to make the step from concept to reality insect farming requires much more factual depth and cross disciplinary innovation in fields ranging from psychology to biology to culinary arts to farming to architecture." (Blackwell 2009:14)

2.1.5 Understanding the anatomy of insect disgust

South Africa is home to a multitude of races and cultures, each with their own, and often very different, food culture and eating rituals. Many African people living in the rural areas from the Limpopo Province to Natal daily consume insects. The Mopane worm is a great source of protein especially in the Limpopo Province where they are found in their thousands; and the Bagrada stinkbug is caught by the Venda and fried as a delicacy (Wood 2001:5). Insects are often preferred due to their abundance as well as beef and mutton being too expensive to meet daily protein requirements (ibid). On the other hand many South African urbanites have never even considered tasting an insect. Entomophagy remains a foreign concept in our cities despite the facts that the price of traditional livestock meat is ever-increasing, and looking through 'sustainability glasses', the farming of livestock is becoming frowned upon.

Reasons for urbanites' unfamiliarity with entomophagy are investigated in order to understand the role architecture would have to fulfil. Disgust is a common human emotion that plays a powerful role in regulating our behaviour. It is an emotional mediator that, through an instinctive dislike, ensures that we do not cross the

boundaries that define our culture (Rozin & Fallon 1987: 99). It is much easier to give intellectual approval to academic arguments on the value of insects as human food than to overcome the negative instinctive reactions to the sight of insect legs in our food. Research has discovered that insects provide an attraction and a challenge to humans. These aspects create the ideal conditions in which learning takes place (ibid:4).
"Core disgust" is an inborn response to bitter tastes, but disgust also plays a role in human behaviour through socialisation. Young children do not have the same 'food boundaries' as adults. They find bad tastes disgusting, but not 'culturally unacceptable' substances. Pre-schoolers put many unsuitable things in their mouths. However, by age seven to eight they have adopted the food preferences of their culture and will not eat 'culturally unsuitable' food. In an urban culture, insects will be viewed as unsuitable for consumption (ibid:4).

The question is: By what means is insect disgust learned and therefore, how can acceptance be cultivated?

1. The most likely mechanism is modelling. In Pretoria's urban culture (consisting of people with Western aspirations as well as people originally from rural areas who have adopted an urban mentality), insects are not widely available in grocery stores and do not appear on restaurant menus or family dinner tables. Children have little exposure to insects. Eating new foods with respected others in social settings is key to creating a preference (ibid:3).

2. Another mechanism is learning through association. Food likes can be influenced by associating food with familiar and pleasant tastes such as associating tea or coffee with cream and sugar. Food dislikes develop when foods are associated with unpleasant tastes or experiences, such as bitterness or nausea. Once we find insects disgusting, eating them is likely to cause nausea, further establishing our rejection. The associations of some insects with the disgusting objects on which they feed (sewerage, manure, or rotting bodies) may cause an association of all insects being disgusting. The fact that most edible insects eat fresh vegetables, leaves, and fruit should overcome associations between insects and decay (Yen 2009:5).

Many cultures, considered "primitive" or "uncivilised" by urbanites, use insects as a major source of food. Upon examination it will be found that most edible insects are more fit for eating than the unclean pig or the raw oyster.
People express disgust, but simultaneously show a cautious interest. As omnivores, humans consume a varied diet. While caution about trying new foods protects us from potential toxins, curiosity about new foods ensures that we will try unknown foods because it might provide nutrition (ibid:3). By engaging with this cautious interest, it may be possible to alter people's attitudes.

This dissertation will consider architecture as the cognitive tool in creating mediating spaces where human perceptions can be altered because architecture has the ability to transform or strengthen perceptions. Perception is established when sensory information is integrated into a person's understanding of the world (Brebner

2001:31). Social interaction and aesthetics are two elements that provide sensory information. Architecture inherits both of these elements. Perception determines a person's behaviour which in turn influences one's attitude - such as acceptance or rejection. Behaviour may be determined through the aesthetic properties of objects and environments. The environment shapes behaviour by reinforcing specific habits based on stimulus and response (ibid:33). Stimulus are elements that activate the human senses: smell, sight, feel, hear and taste. Through the creation of sensuous spaces, the human mind is stimulated to perceive and respond through social interaction to a activity present in the environment.

Conclusion

An emotional mediation is required to make the leap from instinctive aversion to accepting and eating an unfamiliar cuisine. As stated, the cautious interest to taste new foods such as insects is inherent in man. Thus, if insect dishes taste good and appear appetising and people are made aware of its nutritious qualities, it should be accepted in the urban culinary realm. This acceptance should be cultivated in young children as they react only to bad tastes and are not influenced by cultural biases. The site for the proposed building should therefore be located where an influx of children is present.

Insect foods are currently not regularly available in grocery stores and on restaurant menus in Pretoria. The mechanism of modelling can therefore only be applied by creating social settings where people can dine on insects with respected others. Architecture is the primary discipline that has the ability to create social settings for the activity of dining in the city.

To foster acceptance, people should be allowed to learn by associating insects with the pleasant tastes induced by the fresh plant matter they feed on. This can be achieved by allowing the internal programmes of the building to be visible to the users. Consumers should be able to see the living conditions of the insects as well as the freshly grown plant matter they feed on and to smell the appetising aromas of the insect dishes being cooked.

From studies conducted on human psychology and perception by various researchers it can be argued that there are more ways than one in which to make urbanites used to insects as food as a rich supplement/ alternative source of protein. One may suggest that the most effective way to do this lies in subtlety. If 'insect-containing' products just appear on the supermarket shelves (in traditionally packaging) and restaurant menus, it may be more easily accepted than trying to educate people about it. Ultimately, the means by which our attitude toward insects as food will effectively be altered will go beyond logic and information to our dining on insects with others in social urban settings.

In order to alter perceptions, the architecture will need to become a mediating device on different levels.

Mediation is required between:

a. The consumer and the product.
b. The programme of the building and the existing street activities.
c. Monotonous spaces required for linear man-made production processes and the specific spaces required for cyclical and natural processes.
d. The building structure and the existing site conditions.

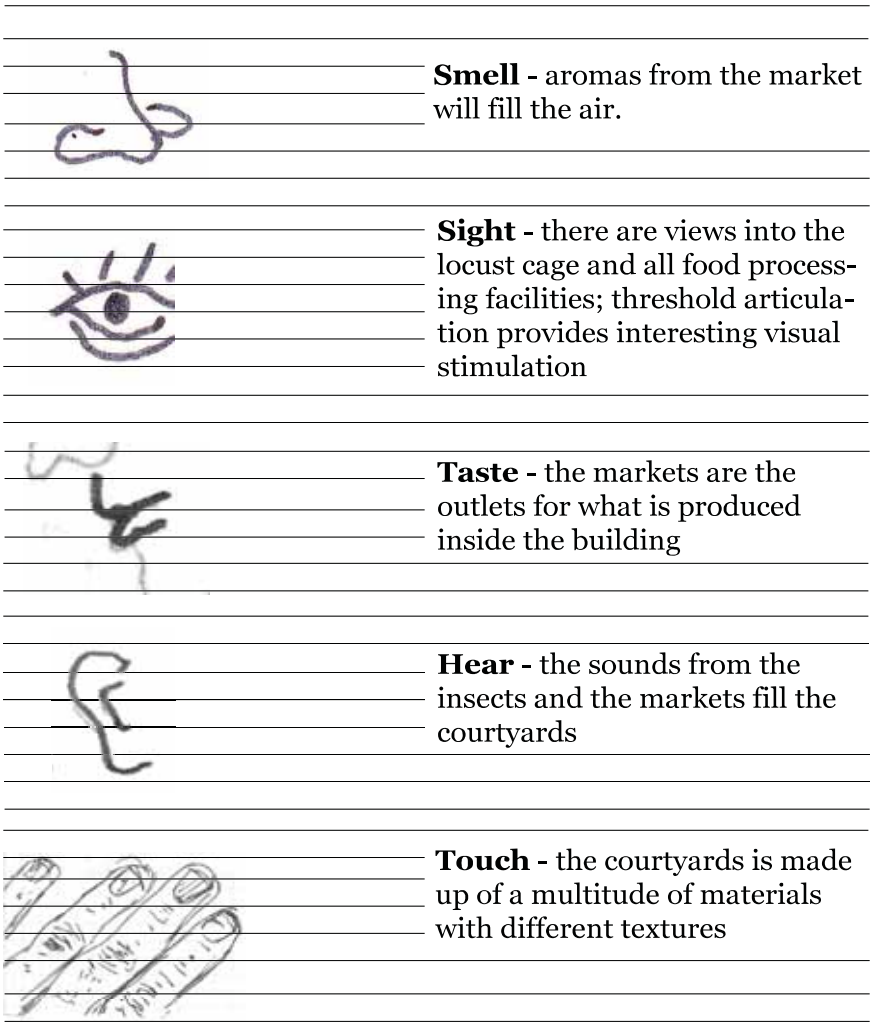


Fig. 2.9 Summary of sensory experience (Author, 2012)

Fig. 2.10 Children tasting insects at the Pretoria Zoological Gardens (Photos by author, 2012)

2.2 Value of insects as food

2.2.1 Mini-livestock versus macro-livestock

Greenhouse gas emissions

Every year, 38 billion tonnes of warming gases such as carbon dioxide, methane and nitrous oxide enter the atmosphere as a result of human activities. According to the FAO, the livestock industry produces 18% of those gases, approximately six billion tonnes. 25% Of those are methane emissions, considered to be among the most dangerous of greenhouse gases. As Mark Post makes clear, cows are relatively inefficient at converting plant matter into protein. There is the very real possibility that the mass production of beef, pork, chicken and fish (the standard protein sources for many millions) might not be possible indefinitely (Toms 2001: 5).
An analysis from Netherland's Wageningen University shows that rearing house crickets produces almost zero greenhouse gas emissions, just 1.5 grams per kg of body weight gained. Consider this compared to the nearly 3 kg of greenhouse gases that beef cattle emit for every 1 kg gain (Blackwell 2009:22).

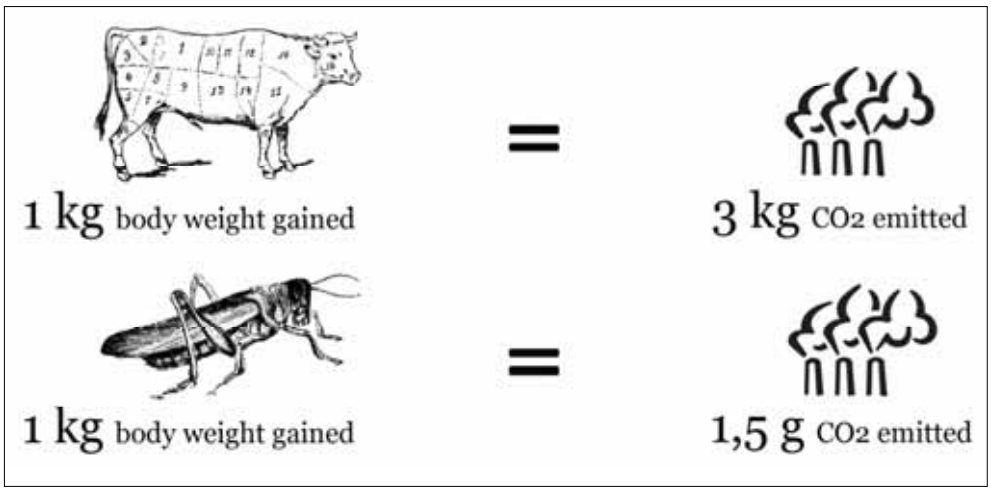


Fig. 2.11 The amount of CO2 omitted kilogram bodyweight gained (Author, 2012)

Another problem is the great volume of waste produced by macro-livestock, estimated at fourteen billion tonnes annually. This, combined with the large scale use of fertiliser to grow livestock feed, causes high levels of ammonia and nitrate pollution of land, water and air (ibid: 21).

Human health comparison

The large scale use of pesticides in used to grow livestock feed and growth hormones fed to livestock leads to an accumulation of chemicals in our food and eco-systems. African countries have shifted towards western diets and research shows that this is visible in the increasing number of cattle slaughtered for human consumption in South Africa (Abbasi 2011: 2).

Land use comparison

Developed nations have higher per capita protein consumption than developing nations (about 96 g/person/day) and a much greater proportion (65%) of this is derived from meat. In contrast the protein consumption in developing countries is much lesser (about 56 g/person/day) and a still lesser portion (only 15%) of it is animal protein (Blackwell 2009:88).
Livestock production, including feed crop production, occupies 70% of the world's agricultural land (or 30% of the earth's land), and consumes 77 million tonnes of plant or animal protein to produce annually just 58 million tonnes of protein for human consumption (ibid:89).
Many edible insect species can thrive under very different environmental and physiological conditions, but most importantly on a much more diverse range of food than traditional livestock. Micro livestock can be fed traditional fodder crops, such as cereals (the same we use to feed traditional livestock); they can also be fed plant species (some of which have rapid growth rates like algae); or they can be fed industrial/ agricultural waste products that are not ordinarily considered edible such as paper, wood, pulp and non-usable lumber. Five hectares of grain is required in South Africa to raise one head of cattle to the slaughter age of 18 months. The same amount of agricultural land could sustain 30 people.
In many locations insects are abundant and can be cultivated requiring minimal space. These organisms are not only vastly more efficient for farming food, but the actual processes that will be involved in this type of farming can play key roles in making the functions of our cities more sustainable. The tectonics of traditional farming will be changed as the operations are moved into cities (ibid:40).

Life-cycle comparison

Insects have much higher fertility and a much faster growth rate: for example each individual produces thousands of offspring compared to just a few that are produced by macro livestock. These offspring reach adulthood within a matter of days or weeks compared to months taken by chicks and years by calves (Blackwell 2009:112).

Energy use comparison

Insects are far more efficient in transforming plant biomass into animal biomass than conventional livestock: hence far more protein is generated per kilogram of plant biomass consumed by insects than by conventional livestock. Livestock meat is the most resource-costly food as most of the energy and protein value of their feed is used for digestion and normal bodily functions (Yen 2009:3).

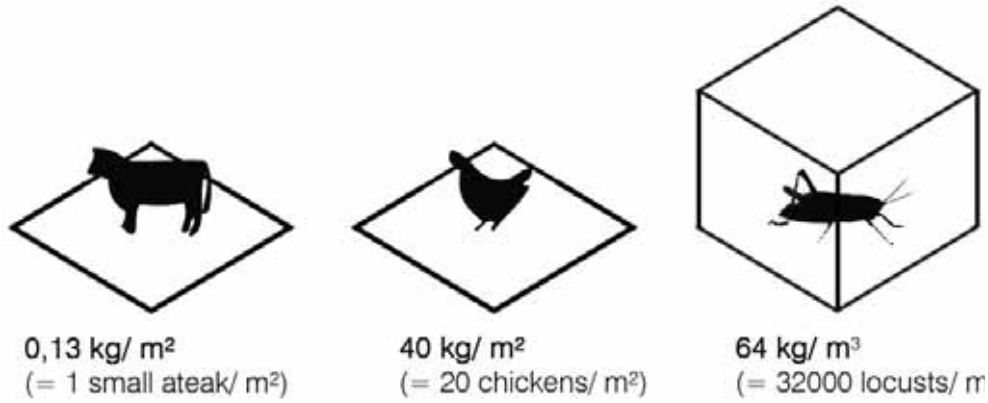


Fig. 2.12 Weight of meat produced per square meter land (Author, 2012)

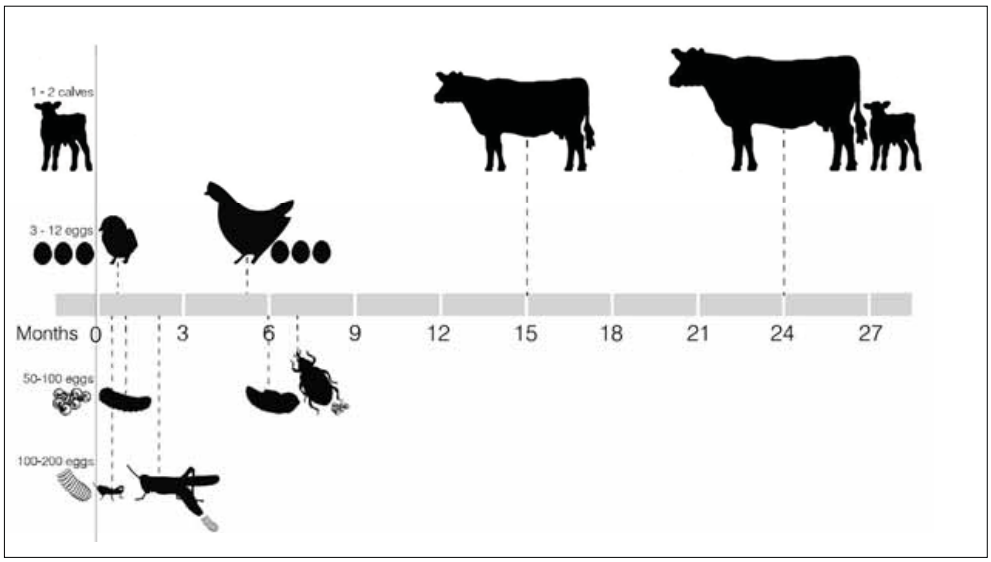


Fig. 2.13 Timeline of life-cycles comparison (Author, 2012)

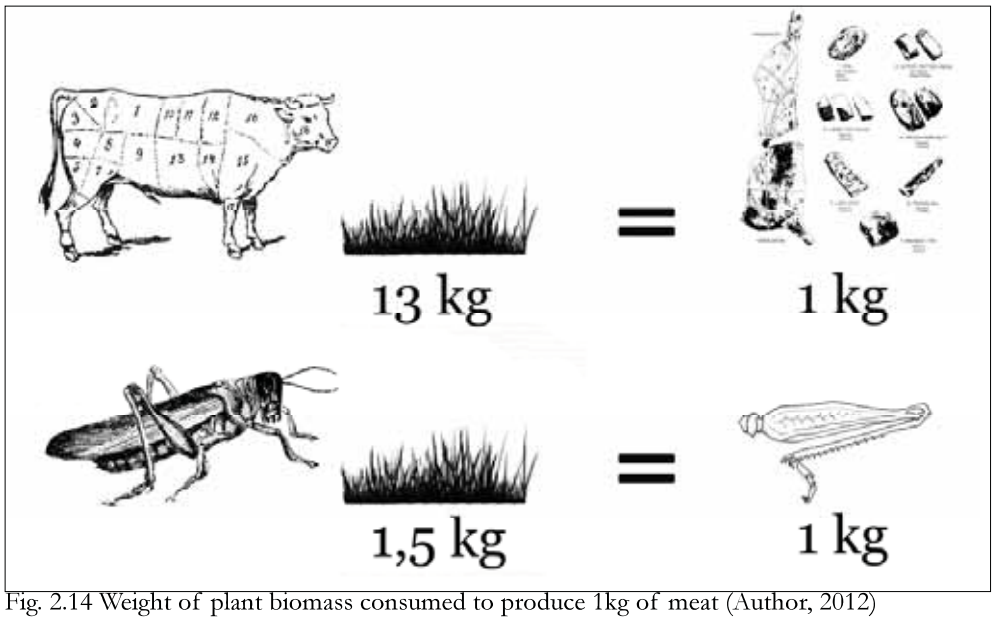


Fig. 2.14 Weight of plant biomass consumed to produce 1kg of meat (Author, 2012)

Human acceptance

The majority of people eat meat, but many are also disgusted by the way it is produced. Increasingly cheaper and more efficient means of raising and slaughtering livestock resemble industrial and mass production operations (Roland 1996: 40). In an industry that is driven by lowest cost, there is increasingly less room concern for the quality of life, and death, of the animals we use for food. Many people struggle with this ethical dilemma; some deal with it by giving up meat, and many turn a blind eye. Farm animals have recently been recognised as 'sentient beings', capable of suffering and feeling pain. Insects, on the other hand, cannot feel pain and the harvesting and killing process is much less emotional than that of farm animals.
A lot of insect species are strict herbivores with much cleaner eating habits than the supposedly healthier and valued choice of the elite: lobster, prawns, pork and rumen. (Blackwell 2009:75).

Alternatives to pest-control

Agriculture has been the single most powerful, persistent, and expanding of human activity that has always caused eco-degradation. The damage to biodiversity wrought by agriculture has given rise to the phenomena of 'insect pests' by repeatedly creating situations which favour a few insect species to the elimination of several others. The favoured ones then multiply and are termed as pests. Billions then need to be spent to control these 'pests'; in turn seriously harming the environment further with pesticides. Even this anthropogenic excess can have a beneficial outcome because many of the insect 'pests' are edible, and are indeed utilized as food in some countries. This enables hundreds of families to make a living from the activity of insect harvesting. (Yen 2009:3).

Nutritional values comparison

Insects are a source of high-quality protein, lipids, carbohydrates and certain minerals. As many as 1500–2000 species of insects and other invertebrates have been consumed by 3000 ethnic groups across 124 countries in Asia, Australia, Europe, Africa and America, and there is evidence that shift from entomphagy to 'modern' foods in some regions was accompanied by a general deterioration of the concerned people's health.

Accounts of DeFoliart (1995: 30) and subsequent studies reveal that the level of proteins and fats in the insect species is generally high, above those of traditional sources of protein such as meat, dairy products and some seeds. And one can eat much less insect meat than red meat to survive because it is a more concentrated source of protein and vitamins. Besides the high amount of proteins that insects can provide, several investigations have made evident their high quality in a great variety of species. In a nutritional sense, the phrase 'a protein of high quality' implies that it contains different types of amino acids in adequate proportions and that it is highly digestible by the organisms that consume it. Minerals and vitamins are also present in insect-based foods at a significant level (DeFoliart 1995: 34).

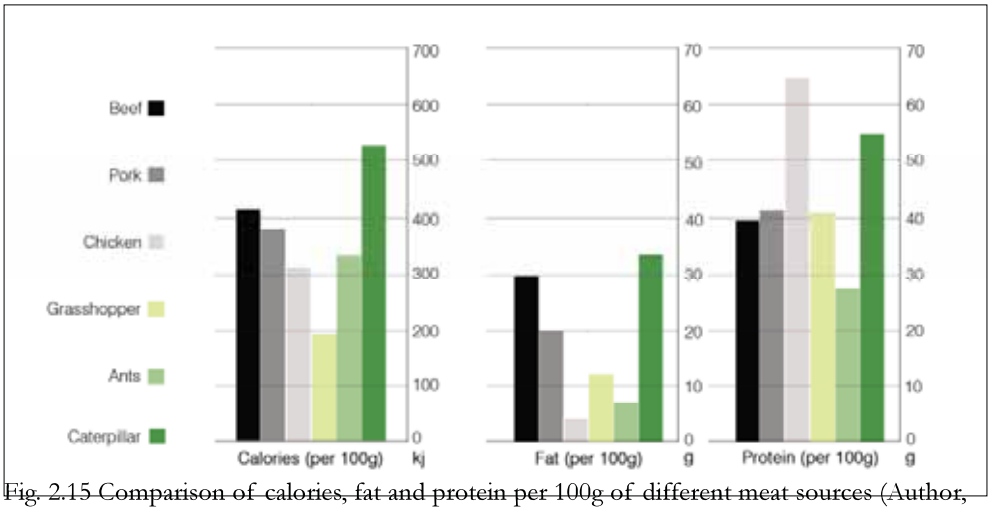


Fig. 2.15 Comparison of calories, fat and protein per 100g of different meat sources (Author, 2012)

Conclusion

It is apparent that insects are a valuable supplement for traditional proteins such as beef, chicken and pork. Firstly, the building would have to add clarity and factual depth to the concept of micro-farming. The ability of insects to rapidly reproduce should be harnessed by the building for the production of food. Secondly, the building should create spaces with a sense of 'place' where people can dine on insects to allow them to accept entomophagy in an urban context.

2.3 Movements in architecture

2.3.1 Industrial architecture

In food processing in the early nineteenth century there came a shift from an agrarian to an industrial system. Urbanisation spread, there came sudden technological advances and an overall concern about civic hygiene developed. Buildings for food processing became part of the larger industrial sector and were located on the periphery of the city with the rest of the industries. Mechanisation of the processing resulted in a decline for the need of skilled labour (Jones, 1996: 49). The separation of the public from the mechanised industries caused a separation from the origin, harvesting, processing, and in some cases, cooking, of the food the public consumed in the cities.

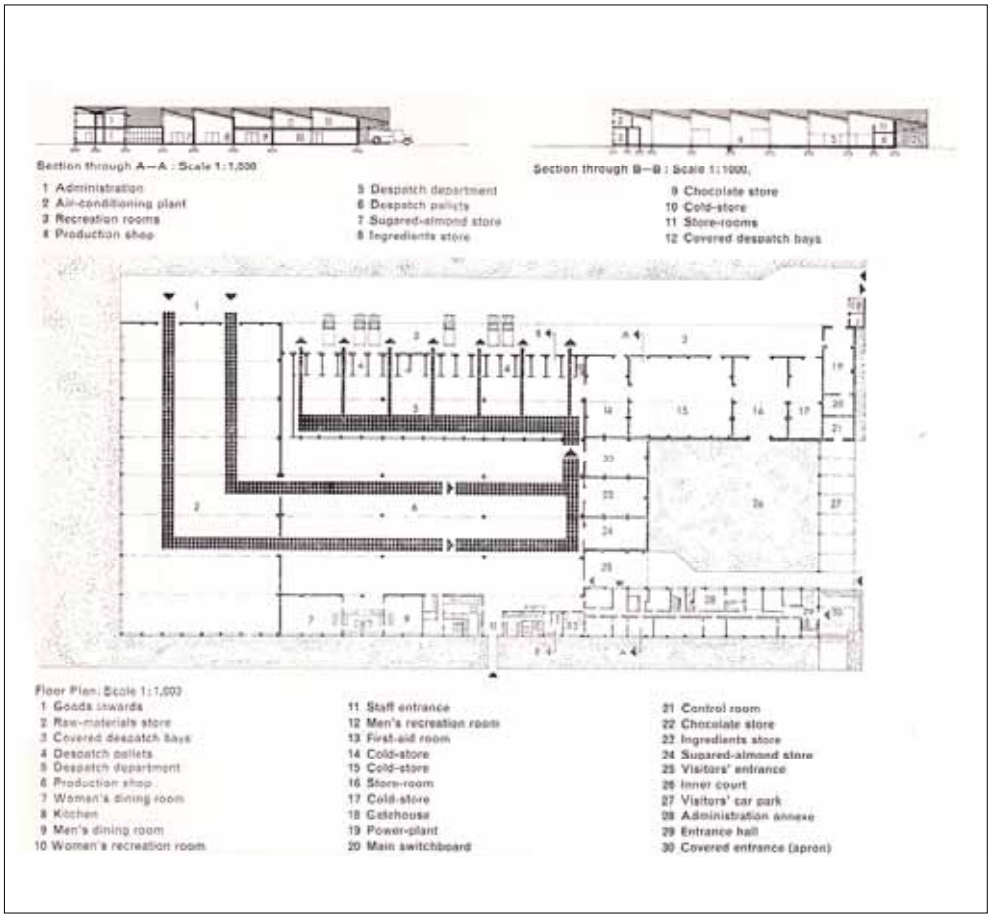


Fig. 2.16 Industry characterised as a 'sausage machine'

The advances in the mechanisation of food processing, caused the belief that for the full development of industrial building, one must start with the requirements of the process. The exterior became dictated by the requirements of the interior. The industrial building became characterised as a 'sausage machine': the raw material goes in at one end, passes through a series of processes and emerges at the other end as the finished product. Then there is a point from where this product is dispatched for human consumption elsewhere (ibid: 45).

The factories of the late eighteenth and early nineteenth centuries were the work of practical men who required well-functioning buildings and they established an aesthetic to agree with this need. In some factories and warehouses of the nineteenth century, we see a building which is far removed from the mean proportions of either dwelling houses or public buildings of the time. This further estranged the public from industries.

Today a more humane building is expected for industry as it is not only a place for production and its associated processes, but also a shelter for many humans during the most precious and active hours of the day. Light, space, cleanliness and planning in relation to the site context become more essential for the social conscience. The industrial building type has to have utilitarian advantages which increase the capacity for production and have a beneficial influence on the mind of the worker as well as on the outlook of the community (ibid: 43).

Conclusion

Due to food processing industries being situated outside the city, it becomes "out of sight and out of mind". This fosters an urban lifestyle where there is no conscience with regards to the sustainability of the products consumers take from the supermarket shelf or order from the franchise restaurant menu.

The building typology for light industrial processing should be adapted to the urban context where the public can interact with the programme. By establishing a set of interface conditions between the public users and the building programme, a relationship of mutual caretaking can start growing. Currently, light industrial buildings in South Africa can be seen as warehouses made of standardised elements. A relation with the urban context that considers the human interface, climatic conditions, and site conditions, poetic narrative of programme as well as functional requirements of programme should be established. Critical regionalism provides a valuable attitude towards a solution.

2.3.2 Regionalism versus globalisation

The Modern Movement, especially the International Style, saw space as abstract, neutral, and continuous. It placed objects in a universal Cartesian grid, ignoring circumstance and place. Modernists saw space as flowing freely within open interiors and between the interior and exterior in buildings that were increasingly transpar-

ent. Limits, in the form of walls, floors and roofs, are what differentiate place from raw space, whether they separate sacred from profane space or one secular space from another (Lynch 1980: 34).

To an architect, regionalism means thinking smaller: resisting the influences that homogenise buildings across the country and around the globe in favour of local aspects. Critical Regionalism is an attitude that embraces that which is unique in an area. It is a reaction against the standardisation and universality that Modernism promoted (Fischer & Le Roux, 1996: 49).

Critical Regionalism: The Pretoria 'Vernacular'

Pretoria Regionalism, the 'Third Vernacular', reflects a particular response to the natural context in opposition to the evolving doctrines of the Modern. Regionalists in Pretoria developed an architecture which 'drew inspiration from and epitomised the Highveld. Unusual sources of natural light were to become one of the distinguishing features of the Pretoria Regionalist idiom: additional central natural lighting was derived from roof skylights' (Le Roux, 1996: 56). Emphasis on the traditions associated with connection to place was to be continued.

Eaton described his regionalist attitude as "an endeavour to achieve visual quality and character which bears reference to the general 'feel' if not the actual form of man-made things, peculiar to the African continent".
It is unclear how to define an 'African' Pretoria Vernacular: it is not necessarily a long connection with African soil; and it is not connected to political and cultural biases (Le Roux, 1996: 49). Fischer & Le Roux (1996) explains that it is most likely that the common bond is a sense of African landscape and of an understanding of the strategies of climatic response.

Conclusion

Architecture is in a rare position to embody and express regional differences – more so than manufactured products like cars and clothing. Possibly only food could be as local. The problem is that today regional food products are shipped far and wide. Supermarkets provide a image of year-round availability, although most products are seasonal or region-specific. Because architecture is a site-specific and one-of-a-kind production, it can resist the commodification of culture and place. And because it is one of the few hand-built items left in the industrialised world, it can resist standardisation (Le Roux, 1996: 58). Architecture can and should be rooted in local climate, topography, flora, building materials, building practices, architectural typologies, cultures, history, and mythology.

2.3.3 Landscape versus urbanism: landscapes of infrastructure

Elizabeth Mossop (2005) argues that "the relationship between natural systems and public infrastructure of the city begins to suggest a means of developing urban strategies through development of landscape infrastructure related to ecological systems. Infrastructure and its associated landscapes must become an important informant in the generation of public space. Ecological processes must be made operational in design" (Mossop 2005:164).

A re-interpretation of the mono-functional realm of infrastructure is required. There must be an engagement between infrastructure, social needs of the community and ecological processes in the surrounding area. Ecological processes refer to the cycles of natural systems such as succession of water cycles, sunlight used to heat and cool spaces, organic waste composting, etc (ibid: 163).

Ecological processes should be made operational in design through the incorporation of natural phenomena in the generation of infrastructure systems. Landscapes of infrastructure is the most effective means to explore the relationship between natural processes and the city. In the 1880s, Frederick Law Olmsted's proposals for Boston's Emerald Necklace illustrate the marriage of transport infrastructure, water engineering, scenic landscapes, and urban planning. This project integrated ideas about nature and infrastructure as well as social recreation and human well-being (ibid:165)
Lewis Mumford described the city as "composed from human processes intricately interwoven with natural processes". He critically understood how to apply ecological processes and natural systems to human settlements (ibid:168). He believed that if there was a design process, the solutions would be successful. Historically there existed a divorce between design and ecological sustainability.

"These two schools of thought have tended to separate themselves in terms of scale, with ecological/environmental planning operating at the regional scale and design-focused projects at the scale of individual sites."
(ibid:169).

The field of urban ecology has developed more recently. It entails research on the characteristics of plant and animal communities in the urban context which are subject to natural processes but greatly influenced by the impact of development by humans. A strategy developed where design can be instrumental in co-operating with natural processes to make new hybrid ecological systems that will deal with human activity and natural processes in the urban environment. The fact remains that the most permanent and enduring elements of cities are most often related to the underlying landscapes - the geology, the topography, the rivers and the climate.

"This does not mean a denial of the realities of globalization or the influence of technology, but recognition of the importance of place and of connection to natural systems"
(Mossop 2005:168).

Conclusion

The physical geographical separation and the psychological dislocation associated with the food industry need to be addressed in order to establish public discourse. Mira Engler (1996) states that architecture should "re-examine the nature of the apparent oppsitions between clean and dirty, between central and marginal landscapes, to nurture dialectical relationships... to normalise and integrate places of waste into communal and public space in the everyday landscape." The unpleasant waste production associated with insect breeding in an urban context can be addressed by using ecological systems within urban infrastructure to transform these wastes into re-usable resources. This thought process can be referred to as landscapes of infrastructure (Engler 1996: 49).

Networks can be established as part of the design development and ecological systems embraced to enrich the building function. Networks refer to plant and animal communities whose lifecycles can contribute to and inform design intentions if adequately embraced. Systems of natural resources can be accommodated in urban design to fulfil the same function than in natural landscapes. These systems include rainwater harvesting and re-use, evaporative cooling, organic waste composting, etc. Man-made infrastructure imitates natural ecological systems to benefit human activity and comfort as well as allow nature to redeem its course in urban environments. This will allow a merging between the linear processes of man and the cyclical processes of nature which will root the architecture to create meaningful place.

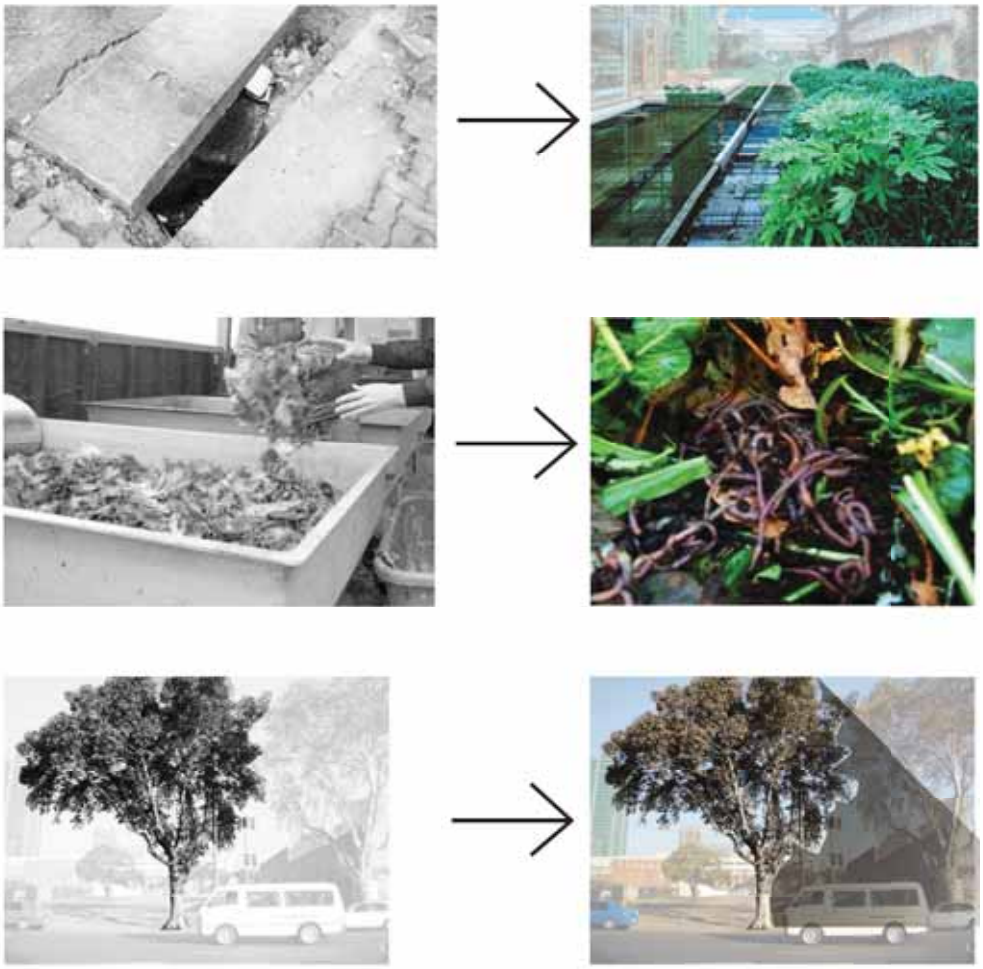
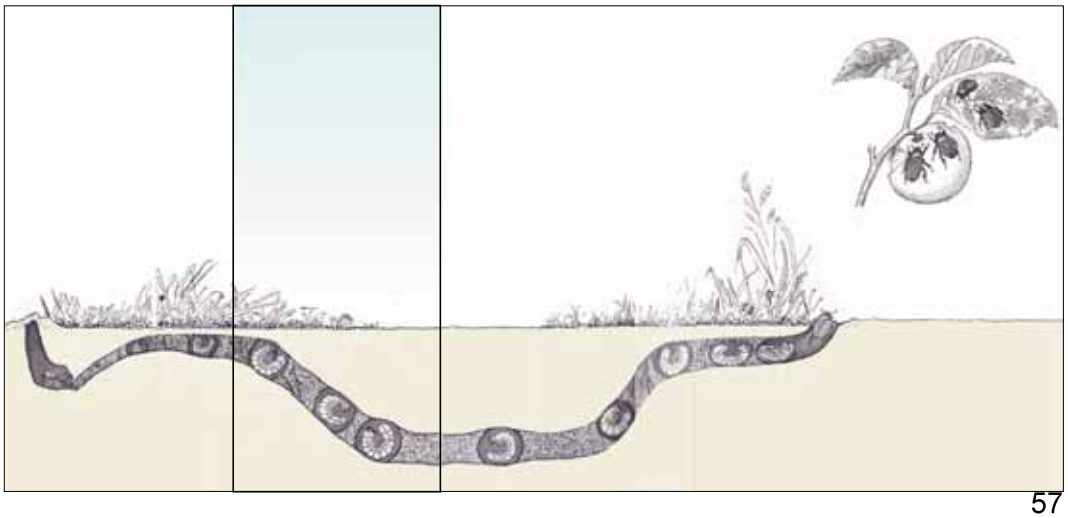


Fig. 2.17 Ecological systems integrated into city landscapes (Author, 2012)

CHAPTER THREE

Theoretical discourse



3.1 Significance of Place: The relationship between city, landscape and man

In order to understand this relationship it is necessary to realise that man is the determinant. Norberg-Schulz states that place is comprised of the landscape (natural) and the settlement (man-made). The settlement concretises man's understanding of the natural landscape, forming a cultural landscape (Norberg-Schulz 1980:52). Following the Roman orator Cicero, John Dixon Hunt (1992:131) defines cultural landscapes [Second Nature] as transport infrastructure, agriculture and building infrastructure. It consists of all the elements introduced into the physical world by man to make the environment more comfortable for him. "The place is the concrete manifestation of man's dwelling, and his identity depends on his belonging to places." (Norberg-Schulz 1980:6). To establish a sense of place will therefore bring the relationship between city, landscape and man into harmony with one another.

Fig. 3.1 Collage to illustrate the author's perception of Pretoria's character (Author, 2012)

3.2 The 'non-place'

Marc Augé (1995) describes 'non-places' as being "rail and motorway routes; the cabins of aircraft, trains and cars; airports and train stations; hotel chains; malls; and franchised shops and restaurants; the spaces we are in when we drive down the motorway, wander through the supermarket, and sit in the airport lounge waiting for the next flight" (Augé, 1995:46).

'Non-places', which can be viewed as a manifastation of modernity, homogenise all places. The aspect of the 'non-place' is very apparent in the food culture in Pretoria. As Pretoria is becoming more influenced by universal trends, places for food are becoming more generic. The regional identity is lost if one observes all the franchised restaurants and supermarkets in the city centre. The four characteristics of 'non-places', as explained by Augé, are briefly discussed below.

1) Some non-places are defined by texts that give the users instructions that either prescribes what they should do or prohibits or informs them. Users do not interact with individuals in the non-place, but with institutions whose intentions are communicated through messages on signboards. (ibid: 43).

2) The user of a non-place "is in 'contractual relations' with it: the ticket that is bought, the card that is shown at the tollbooth, the trolley that is trundled in the supermarket. He becomes no more than what he experiences in the role of driver, passenger, customer or buyer." The user loses his identity once he enters the non-place and gains it again only at the exit counter or -booth (ibid).

3) Non-places are merely for passing through and are therefore measured in units of time. History is rejected as only the past day or two is of concern for the user. Only a foreigner to place can feel at home in the "anonymity of the non-place: among the supermarket shelves, at the franchise restaurant counter or staring at the television screen in the mall" (ibid).

4) When individuals get together, they interact socially and organise places. The space of 'non-place', however, transacts only with individuals (customers, passengers, users, listeners) who are identified (name, occupation, place of birth, address) only at the entrance and exit (ibid).

a. Interact with texts

b. Contractual relations

c. Measured in units of time

d. Spaces of solitude and similitude

Fig. 3.2 'Non-places' (Photos from flickr.com)

3.3 The aspects of place

Augé (1995) states that the three characteristics of a place (as the opposite of a non-place) are identity, history and relations. If these aspects are present there is a strong sense of place. He explains these three aspects in context of the human life: "to be born is to be born in a place, to be 'assigned to residence'. In this sense the actual place of birth is a constituent of individual identity. The rules of residence which assigns a child to his position (usually with his mother, and therefore also with his father, grandfather and grandmother) situate him in an overall configuration whose inscription on the soil he shares with others – these are his relations. The place which the ancestors have built, that is at regular intervals dictated by rituals are places of history" (Augé, 1995: 41). The space of non-place is similar everywhere, isolated from its surroundings and there is no reference to history.

Sketches of Provence (a district of France) are used below to illustate how these characteristics of place are translated into architecture.

History influences the development of a town or city. Historically churches were the first structures built in towns in Provence. These churches were usually located at the top of a hill and the rest of the buildings lowere down.

Most towns in Provence originated near a hill and most buildings were therefore located on sloped ground/ rock. This caused a specific relationship between the buildings - one of closeness caused by narrow alleys and stairways.

Due to the history and relations, builings in Provence have a unique identity.

Fig. 3.3 Sketches of Provence to illustrate the aspects of place (Author, 2012)

3.3.1 Identity

Identity and food [and user]

"Geography, climate, soil, politics and religion are supposed to come together on the stove. The problem is that this is no longer the case. The world is becoming one in ways that at times arouse apprehension. Modern city architecture looks much the same in Brazil as in Johannesburg. We have got rid of geography by flying over it, and of climate by temperature control. The abstractions of science that make this possible have led to a triumph of the abstract over the concrete and of formulae over individuality and experience. All airports are much the same, all airplane food is much the same. The former are spaces instead of places, and the food is on the way to being non-food. It is food in the abstract, not food made concrete by climate, geography, and the pietas of local and traditional skills."
(Versveld 1993:38)

Where food entities have succumbed to globalisation, the rituals associated with food – farming, production, cooking and eating - are lost. Food and its consumption sustain greater enjoyment when it is associated with its place of origin (birth). There is a crossover between food and architecture concerning the identity of place, in particular, how food traditions, local food products and architecture can be combined. Attentive diners can uncover much about their territorial surroundings in the richly layered sensations provided by a well-situated meal. Calvino (2001) argues that to experience such an event out of its proper context, therefore, is to experience a shadow of its significance. Transplanted into another environment – into an 'exotic' restaurant or take-away box – the characteristic embellishments of a particular cuisine fall out of place. The pleasure of a good meal contains thematic resonance between the food and its contexts, contexts that include not just the diners' immediate surroundings but also the broader regional and cultural environments. Architectural settings and their broader physical contexts play a vital role in framing shared experience with food (Anderson 1999:248).

The creation of a territorial identity pivots around the idea of the environment not only as a space for production, but also as a space for consumption. It starts with the promotion of local food traditions, products and methods for production and ends with the evaluation of life in general. Central to such a process is the transformation of the working farm – from a utilitarian to a polyvalent site of production as well as of intensive cultural life (ibid:247).

The proposed building can embrace all these elements of culinary experience brought in relation to site conditions by allowing all the processes, from feed growth to insect breeding to food processing and finally to consuming the products, to take place on the site.

Identity and architecture [and user]

Identity cannot be supported by a universally abstract environment, but rather one that is culturally and situationally articulated (Cullen 1961:38).

In his investigation of townscape, Gordon Cullen (1961) examines the places of our immediate experience. He attempts this by investigating our reactions to the relationships between buildings, spaces, objects, and activities.

There are three elements in our experiences of the environment:
1. first is 'place' - defined as "our immediate position defined visually as an enclave or enclosure";
2. second is 'content' - appearance in all its facets, colour, texture, scale, style, and character;
3. third is 'serial vision' - defined as "the sequence of views as we move into, out of, and between 'places', a constant interplay of the anticipated and the revealed view that binds together the various static 'places' and their content".

Cullen concludes by stating that the elements of the environment cannot be dissociated from one another and more importantly it is the manner of the association of these elements and the physical qualities of appearance that give particular places unique identities in our experiences of them (Cullen 1961:134).

Since the study hypothesis states that architecture can be a mediating device between product and consumer, the user experience of place is of great importance. The three elements of place, content and serial vision as described by Cullen (1961) should be implemented to lead the user through a series of unfolding experiences and views to aid them in understanding the full building programme.

Fig. 3.4 Elements in our experience of the environment (Cullen, 1961:34)

3.3.2 History

History and food [and user]

Memories are human references to past experiences. The extent to which an experience can be distinctly recalled, indicates identity and a sense of place within that particular environment because it brings everything in relation to history (Lynch, 1981: 131).

Anderson (1999) places emphasis on Brillat-Savarin's writings that show with intensity that "cuisine and place conspire to intensify sensual experience, to consolidate and to elicit memories, and to satisfy curiosity". When a meal and its setting resonate and thereby stir the senses, the result will be memorable. Through an alchemy unleashed by their combination, a sense of well-being expands in the imagination, even as the flavours and atmosphere that precipitated it fade. This phenomenon creates a memory, and humans tend to go back to places of memory. Marcel Proust demonstrates how manifold and expansive the relationship between food and its setting can become in a well-known passage of Remembrance of Things Past, when on a cheerless afternoon his mother offers him tea and a piece of cake (Anderson 1999:145).

"And soon, mechanically, dispirited after a dreary day with the prospect of a depressing morrow, I raised to my lips a spoonful of the tea in which I had soaked a morsel of the cake. No sooner had the warm liquid mixed with the crumbs touched my palate than a shudder ran through me and I stopped, intent upon the extraordinary thing that was happening to me. An exquisite pleasure had invaded my senses, something isolated, detached, with no suggestion of its origin." (Anderson 1999:145)

Anderson (1999) explains that Proust recognised that the taste was attached to a place that takes shape and grows in his memory. As soon as he had recognised the taste of the madeleine soaked in lime-blossom tea that his aunt used to give him, his memory raises up the room, the house, and the village his aunt used to live in. He could remember all the colours, textures and odours. The aroma and flavour evoked a pleasing memory (ibid:148).

A good meal-setting combination stimulates the imagination, evokes memories, and conveys ideas. It does so through surprising combinations of flavours and with their setting to provoke the complacent and astonish the alert diner. A deeply satisfying comprehension of their surroundings – and its past – can occur. Thus, memories carry the meaning of history. By evoking memory, history is also enlivened and places us in relation to history (ibid:158).

This is where a consumer awareness of the origin and processing of modern food can be nurtured. The pleasure of dining reaches beyond the dining room and into its regional context. The consumer or user of the building should be made aware of the natural and production processes that act as intertwined networks. The experience

of dining in a visually stimulating environment is likely to evoke memory. Through memory there is an integration of place with our lives.

History and architecture

"Against the century's rootlessness, memory valorises the aura of place…"
Curulli, 2003: 5

Cities went from the idea of vertical density to horizontal urbanisation (suburban sprawl). This decentralisation of a city leaves in its wake sites without purpose. Roger Trancik describes these sites as 'lost space' within the city and defines it as: undesirable urban areas in need of redefining because it makes no positive contribution to its surroundings; have no defined boundaries and do not connect to elements adjacent to it (Trancik 1986: 4).

The selected site is a 'lost space' (this statement is substantiated in the folloeing chapter). It was set out as a suburban erf, after sprawl it emerged as a semi-industrial site for automotive repair works. Currently the site is in dire need of redefining as it is located in an area commissioned for redevelopment. The unique characteristics of the area can be realised in meaningful creation of place. The question is: how can meaning be given to this 'lost space' to transform it into place?

Curulli (2006) argues that the meaning of these wasted sites is "derived from the social context and history, where memory and associations are emotionally loaded". These sites have the ability to motivate perception and encourage memory. Thus the site can be regarded as the raw material for the proposed design. The key elements of the site's history should still be recognisable in order to evoke memories of the atmosphere. Design should guide us by virtue of memory towards history. As these sites were damaged by human activity to witness human progress, they now have to make us aware of the damage and the need to replenish them. The question is how to interpret memory in design. Curulli states that we should "see the ground as a

Fig. 3.5 Lingotto: transformed into housing, but the key elements of the factory are still recognisable and can evoke memories (Curulli, 2006:8)

written page where the text carries inscriptions of the past" to contribute in establishing the region's identity. History and memory become essential words in the text. Memory is a personal recollection of events and is subjectively evoked. History is an official explanation of events in the past. Wasted sites stimulate our imagination because they want us to remember, to rethink the past and the role we played in it (Curulli 2006:8).

Conclusion

A new intervention on the site should focus on the process of transformation rather than the final product (Curulli, 2006: 6). If elements of the past are visible in the new proposed building, it will gain meaning through the evocation of memory. The previous layers on the site will not be wiped away, but built on to create a rich and meaningful building process.

3.3.3 Relations

Relations and food [and user]

Two of the three main entities for food in the Pretoria CBD are 'non-places'. According to Versveld (1993) eating is one of the principal forms of commerce between ourselves and the world, and one of the principal factors in constituting our relations with other people. The 'non-place' creates spaces of solitude and therefore cannot embrace eating as a rich sensual activity that bring people in relation to one another. "Physical form plays no significant role in the satisfaction of important human values, which have to do with our relations to other people." (Lynch, 1981:99). Users and activities in an environment contribute to its character.

Thus, the architecture of place should establish three forms of relations: Firstly it should foster activities where the users are brought in relation to each other. Secondly, it should bring the user in relation to the programme associated with food; Thirdly, it should bring the building's form and systems in relation to its context and programme.

Relations and architecture

The building should respond to the context in which it is to be situated with regards to the natural elements (trees, stormwater channels, etc.), other buildings (scale, material finishes, public/private, etc.) and human activities (social spaces, religious gatherings, etc.). The buildings to which humans give form determine the manner in which they live in and around them, thus creating a perception of that environment (Lynch 1995:26). Architecture that does not respond to its context is a 'non-place' and 'non-places' do not inherit enough meaning to be cared for by its users.

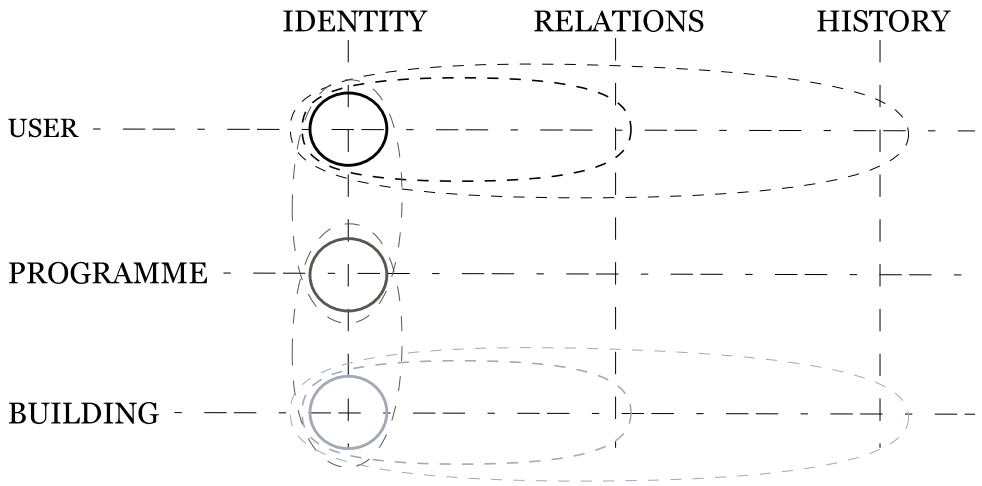
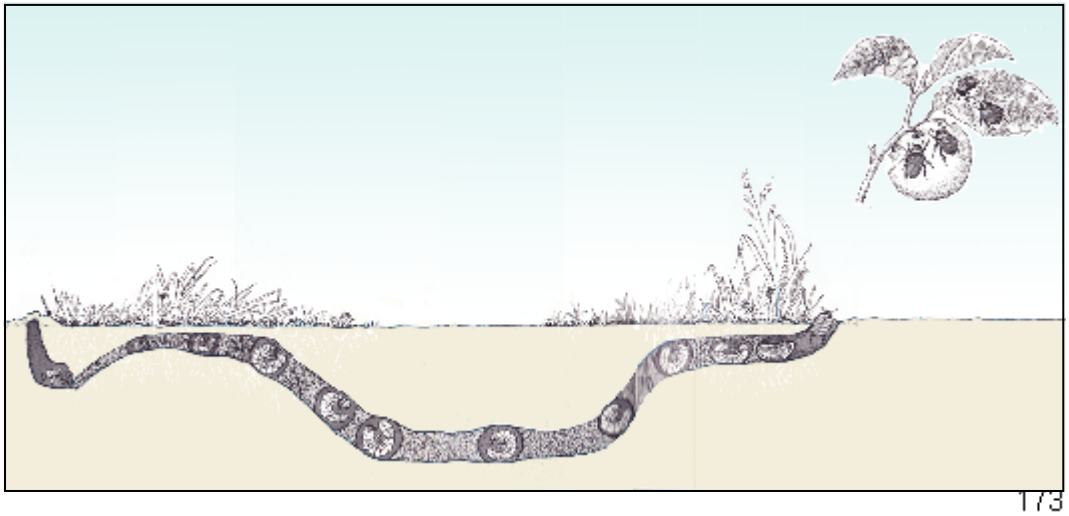


Fig. 3.6 Summary of design intentions (Author, 2012)

Conclusion

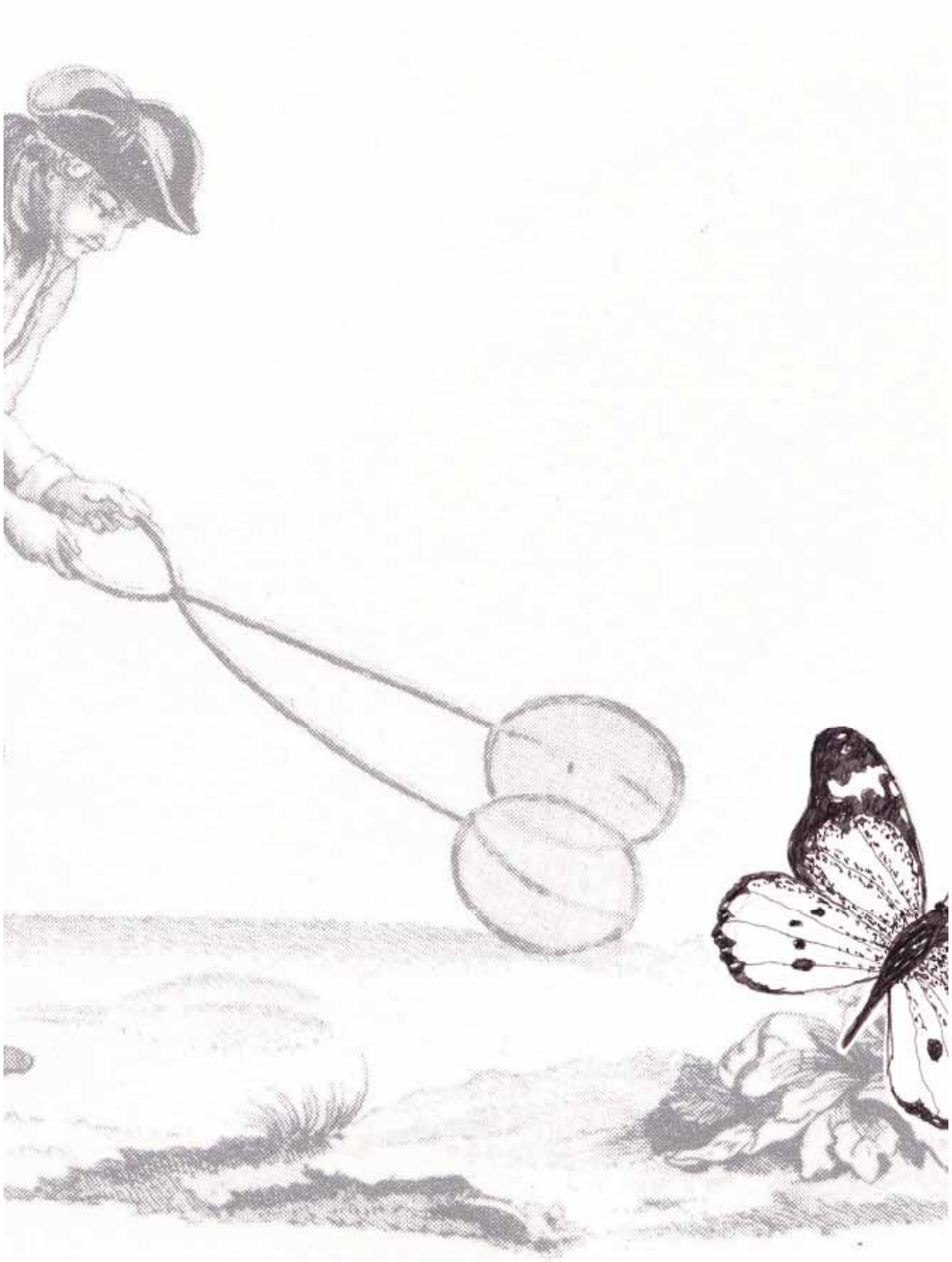
According to Kevin Lynch cities are the physical manifestation of man's existential ordering of his environment. They display the identity of an individual, culture or region. Elements employed transcend culture and history. Therefore identity and uniqueness by embracing the character of place should be our ultimate goals. Through the use of place a new experiential history is created.

CONCLUSION



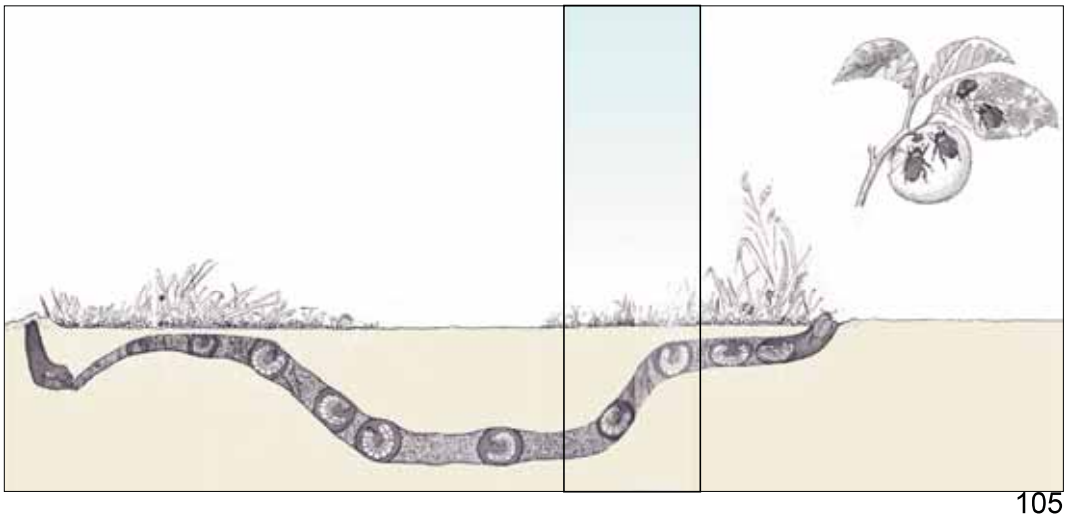
It has been shown that buildings profoundly affect peoples' well-being. The decline in the quality of 'buildings for food and eating' has resulted in environments that do not have an identity or do not contribute to the regional identity with regards to growth and production of food products.

This dissertation has investigated how built environments and architectural space can influence peoples' perceptions through sensory stimulation. The programme of an insect farm and processing facility was used to study the relationship between food, thought and the senses. The unique programme established an architectural solution which does not belong to a specific typology, but creates opportunities for the exploration of space by the user. At different threshold levels the user has either a visual or direct connection with the programmatic processes of the building. The design followed the detailed investigation of the programme. However, whether people will start eating insects at a large scale is unsure as such a study, within the author's knowledge, has never been conducted to support the argument. Therefore, along the design process the aspect of future adaptability was kept in mind to ensure the building's usefullness.



CHAPTER FIVE

Precedent studies



5.1 Botanical Society Conservatory, Kirstenbosch, Cape Town, Western Cape

Architects: MLH Architects
Project: conservatory glasshouse for South African plants for public aware-making

Description

The conservatory was designed for research and educational programmes aimed at the public's awareness of conservation and appreciation of indigenous plants. Kirstenbosch was unable to display flora from outside the Cape winter rainfall area before 1988. The conservatory houses predominantly succulent varieties which could not survive at Kirstenbosch without roofed enclosure and climate control. There are four subsections for ferns, bulbs, alpines and 'stone plants'. The plant displays are grouped regionally into Bushveld, Namib Desert, Eastern Cape, Namaqualand and Richtersveld, Little Karoo, Knersvlakte and Nama-Karoo. 'There are two viewing routes: visitors can follow the square layout of the periphery ambulatory system passing the corner dioramas or meander up the spiral path in the central area.' (De Jager, 1997: 17).

The serrated roofs contribute to the passive approach to climate control. The glasshouse was designed as a 'background' in which the plants would be the main focus. The three-part pyramidal roof was adapted from earlier multi-serrated prototypes for maximum exposure to northern light. The excessive technical complexities and high cost was made less severe by the functional qualities of the serrated roof. Mesh-covered openings along the lower sides of the roof provide ventilation and act as bird screens. The conservatory is primarily naturally conditioned except for the fernery and afro-montaine unit where the micro-climate can be modified. 'Humidity control for the ferns is provided through a wall plenum from a localised heating/humidity system.' The afro-montaine area is locally cooled. When the natural ventilation and shading systems are unable to handle the demand, roof mounted fans and ventilation flaps operate to regulate temperatures. Shade-seeking plants are protected by white fabric blinds mounted to the roof (ibid: 17).

Relevance

Historically the glasshouse, a northern hemisphere typology reaching its peak in the 19th century, has traditionally been an out-house – usually free-standing in a garden. The concern at looking at a new example is the relationship and balance of plants and building. The same relationship is needed between insects and the building because they vary enormously in scale: the building can easily overpower the living occupants. The interior is customised to form a visual transport to the specific climes and latitudes of the plants on displayso that the plants are not subdued by the architecture. The arid-region plants, due to their physical desolation, ask for differ-

Fig. 5.1 (a-d) The glasshouse structure blends into its context (De Jager, 1997: 17)

ent terms of engagement from the visitor if a sense of their indigenous spatial and scalar context was to be assembled: planted backdrops and borders were vital in contextualising the study material.

Conclusion

The building succeeded in creating realistic and functioning habitats for plant species that are not naturally from the region. This is achieved mainly by the use of passive systems – natural ventilation, daylighting, etc. – with a few exceptions. The same passive principles will be applied to the insect breeding facilities as the conditions required for the mealworms are similar to that of the ferns and the optimal conditions for the locusts are the same as the arid-region plants.

The visitor can interact with the different regional contexts and in so-doing be made aware of the power of conservation and foster an appreciation of indigenous plants. By creating visual links with the locust breeding cage and physical links to the food production processes, the public's attention is focussed and an awareness for natural cycles is created.

The need for two viewing routes lessens the strength of the impression a route is supposed to make on the visitor. Only the one route – spiralling up to a climax – would have been more powerful, as the ambulatory route around the building does not convey the strong concept of creating public awareness. The public access points need to be well thought through in order to create a public interface that has the ability to clearly convey an awareness for its programme.

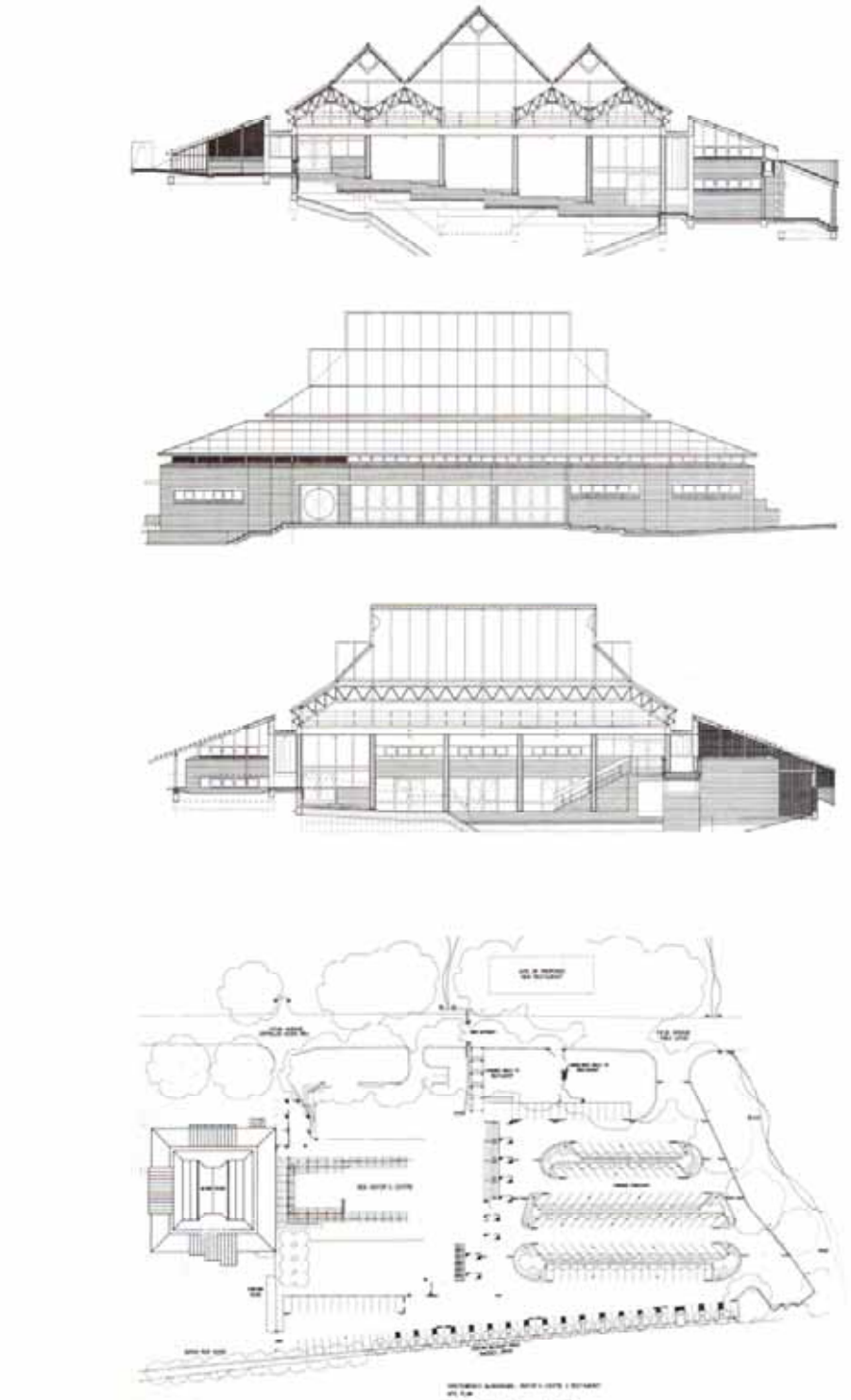


Fig. 5.2 (a-d) New possibilities of a glasshouse were explored to create the complex form (De Jager, 1997: 17)

5.2 Institute for Forestry and Nature Research, Wageningen, Netherlands

Architects: Stuttgart-based Behnisch & Behnisch
Project: an agricultural research institute that combine well-tempered open spaces and offices.

Description

"In the Netherlands, those who study and regulate the environment are housed in exemplars of green design."

The architecture is characterised by a basic 'E-shaped' layout and standard greenhouse component structure that can provide a framework to be appropriated by future functions - the layout does not dominate the programme. The institute brings previously dispersed functions into close proximity, the work spaces with direct connections to covered or open gardens (Behnisch, 2000: 17).

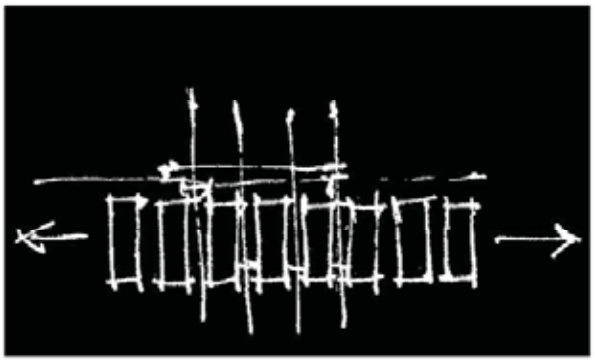


Fig. 5.3 Diagram to illustrate how building can grow

The conceptual parti is based on a continuous spine on the northern side containing the laboratories, from which three wings of double-loaded offices extend southward to form the legs of the 'E'. These 'legs' culminate in communal spaces: library, cafeteria and conference room. The truly innovative architectural response lies in the articulation of the two spaces between the office wings. These spaces are both ecological gardens and climatic buffers. The covered gardens between the offices help to reduce heating and cooling costs by trapping large volumes of air. The air attenuates temperature differences between inside and outside. The architects stand point was based on minimising embodied and consumed energy, re-using water and avoiding toxic products. These ecological and economic considerations limited materials used and consequently the building form. The humane type of office environments were also not to be compromised. Pragmatic orders rule as the building is entirely orthogonal with very few colliding details (Behnisch, 2000: 18).

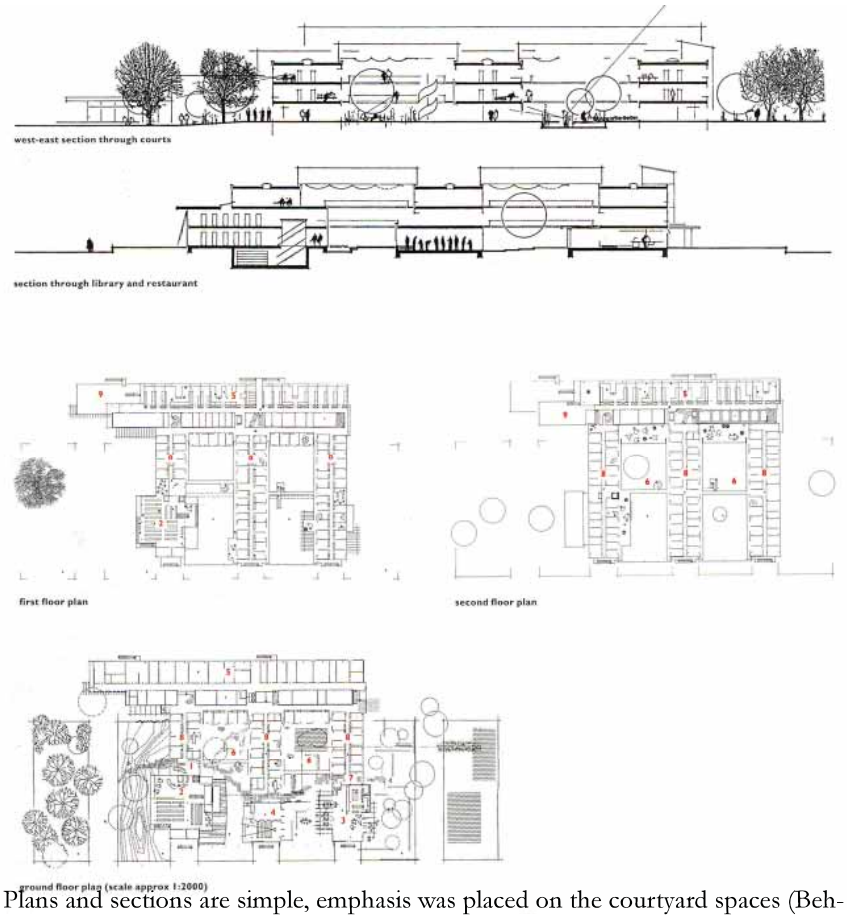


Fig. 5.4 Plans and sections are simple, emphasis was placed on the courtyard spaces (Behnisch, 2000: 18)

Covered with standard Dutch horticultural glazing units, these courts are not fully indoor spaces. They house ecological experiments while providing views and recreational spaces for the staff. In summer, the plants humidify and cool the air. As climatic buffers they act as solar collectors in the winter. Light re-radiation is prevented by reflective blinds pulled across under the glazed roof. If the temperature rises high enough, the heat is transferred to the offices by opening windows. If the heat gain is low, heat loss from the offices is also reduced. In summer the blinds are closed to stop solar input while the large roof vents are opened to provide thermal chimneys. Cool air is sucked in through the crawl space of the north wing. The adjoining office spaces can thus be cross-ventilated by opening the doors and windows. Exposed concrete slab ceilings in the offices act as heat stores to stabilise the temperature of the working environment. In winter the slabs are gently heated. During high temperature summer days, heat build-up is dissipated at night through night draughts, exhausted by the open roofs of the courts (Behnisch, 2000: 19).

The site was a field where the soil was depleted of nutrients due to intensive agriculture. The institute's plan was to restore the site by creating experimental ecological

gardens and a green corridor between the Rhine valley and the Hoge Velwe Park. The corridors created links between protected areas allowing plants and animals to spread and form networks (Behnisch, 2000: 17).

The concept was for each atrium space to have its own atmosphere. The western atrium is more lush, the eastern more arid. The use of water on site was studied and includes a sophisticated greywater recycling system utilising rainwater and a sequence of ponds. In summer there is evaporative cooling from the ponds which are filled by rainwater runoff from the roofs.
The shallow suspended pool in the more public atrium has an audible flow of water that drops to a storage tank underneath. The pools contribute in regulating the climate as well as site drainage. Constructed wetlands outside the building treat and store stormwater from the site. Water from the pond enters the west atrium pool and drops into a filter. From there the water flows underground to the east atrium, where it flows over a shallow planted pool. The plant roots are held in screens. The water runs over the edges of the shallow pool into a deep tank where it is kept warm and re-used for irrigation of the gardens (ibid:20).

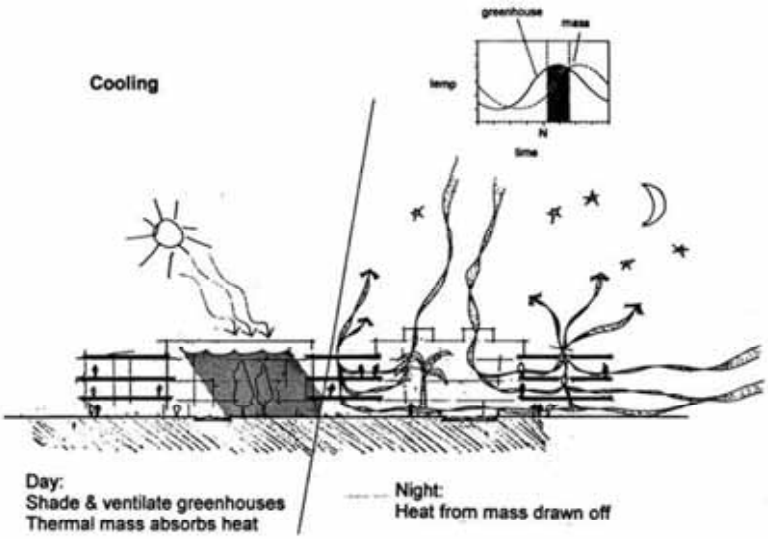


Fig. 5.5 Systems used: natural and night ventilation, natural daylighting (Behnisch, 2000: 18)

Fig. 5.6 Good integration between nature and building (Behnisch, 2000: 18)

Conclusion

The facility shows how a building can be sustainable without extra financial incentives for 'green architecture'. The building was to signify the ecological concerns of the institute, while avoiding 'Eco-rhetoric'.
The building is not image-driven as the principles were most important. The image is the result of the processes of the relationships between ecology and infrastructure. The gardens epitomise the integration of systems. They function to accomplish this integration. The systems include water treatment – from stormwater treatment and rainwater harvesting to climate control inside the building; creating green corridors between the facility and protected areas in its proximity; between current programmatic needs and future adaptations; the work spaces in connection to natural research material.

5.3 African Relish, Prince Albert, Western Cape, South Africa

Architects: Team Architects
Project: culinary school and public restaurant

Description

Prince Albert has a sublime setting: surrounded by a dramatic mountain landscape that separate the Great and Little Karoo and with the towering Swartberg to the south. The town has numerous historic and original Cape Dutch, Karoo and Victorian buildings. Local farming activities, weekly market and annual Olive Festival made the town a growing 'gourmet destination' (Abate, 2009: 63).

A 153-year-old langhuis dominates the site's frontage on to the main road. The recreational culinary school is situated between the existing building and a planted olive orchard. The roof planes are inclined with vertical chimney flues and parapet profiles to bring attention to the vertical proportion of the main hall. Natural light and views to the north and south are embraced (ibid).

Relevance

The new school's response to the significant 'langhuis' is of note. In architectural terms the new and existing buildings are sensitively connected by means of light structures: covered verandas and walkways. The two buildings are independent to conserve the hierarchical importance of the 'langhuis' and yet function as a whole through the implementation of lighter connecting structures.

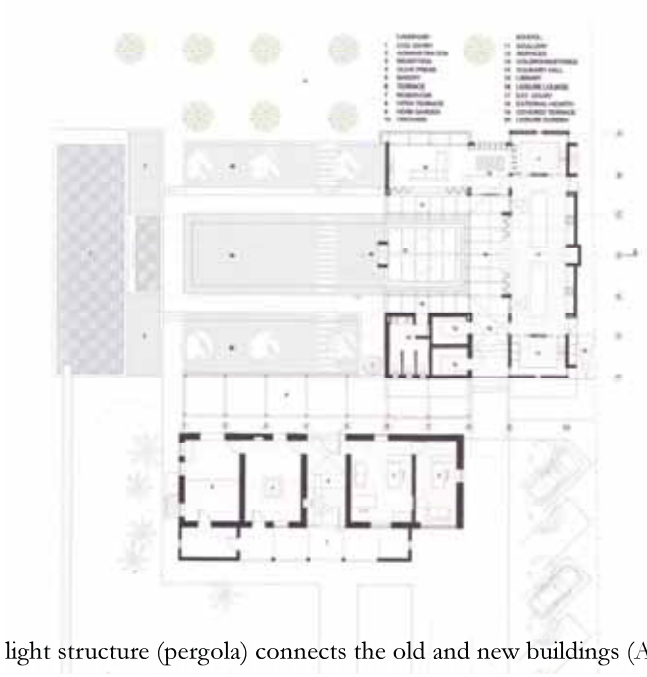


Fig. 5.7 A light structure (pergola) connects the old and new buildings (Abate, 2009: 63)

Conclusion

The building is a true representation of its context: natural setting and cultural history. A strong heritage approach has been followed regarding the langhuis – the house is used for the processing of olives (from the orchard) and the baking of bread (used in the restaurant). The building focusses on the Karoo vernacular: a single-storey nestled in the natural topography of the site to mimic the scale of the local residential typology. A sensitive approach is followed in both aesthetic and programmatic responses and the diner is made aware of this through interaction with the open kitchen.

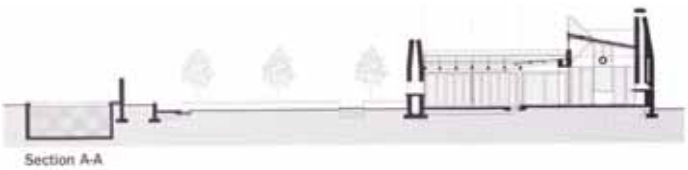
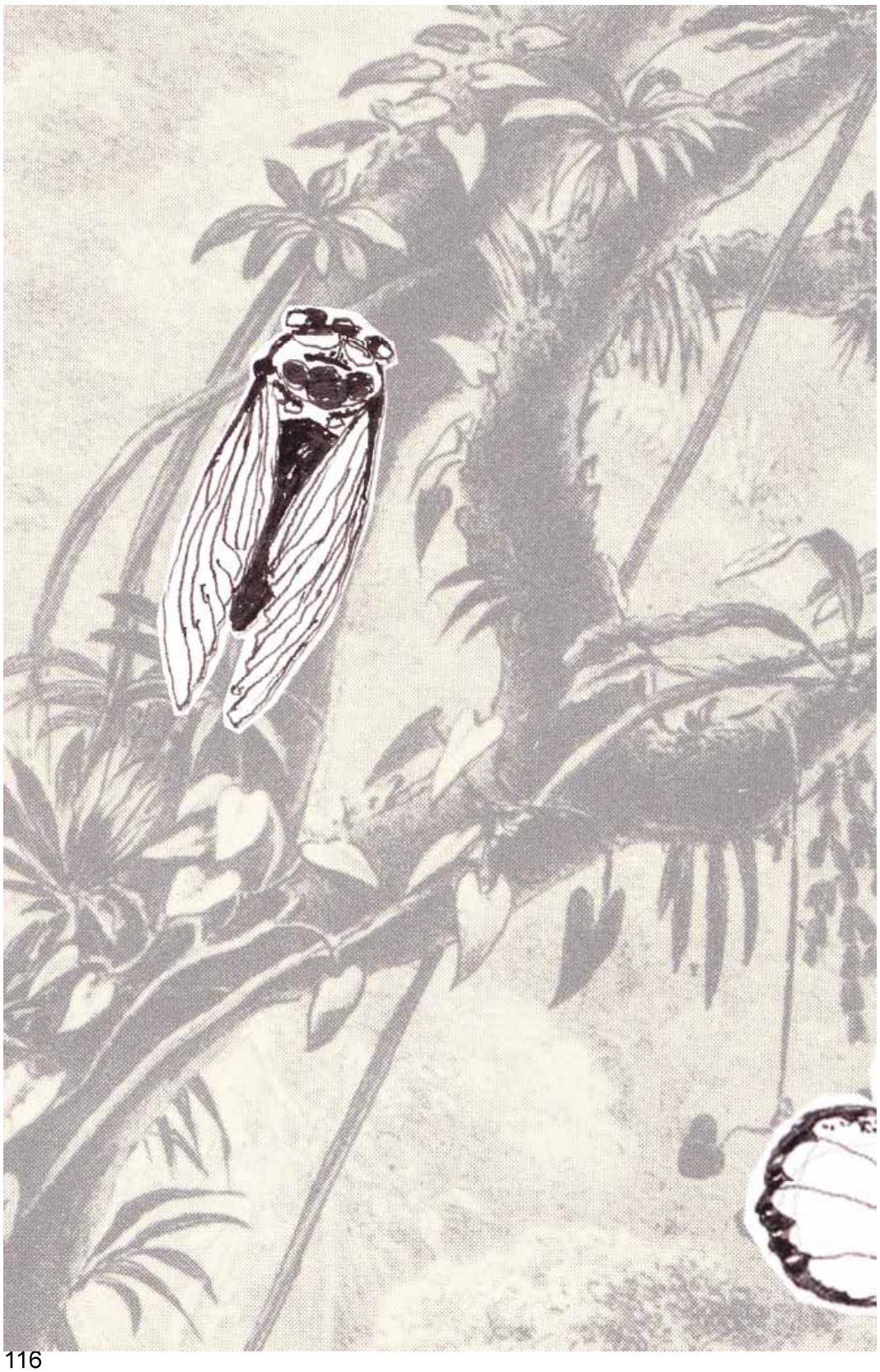


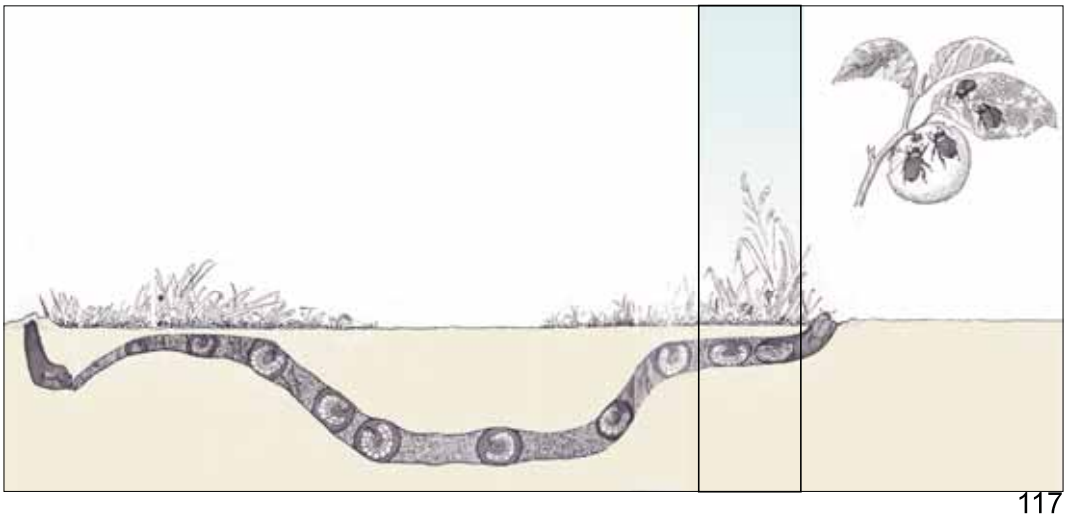
Fig. 5.8 An open-plan layout provides user/cook interaction (Abate, 2009: 63)

Fig. 5.9 Vernacular typology (Abate, 2009: 63)

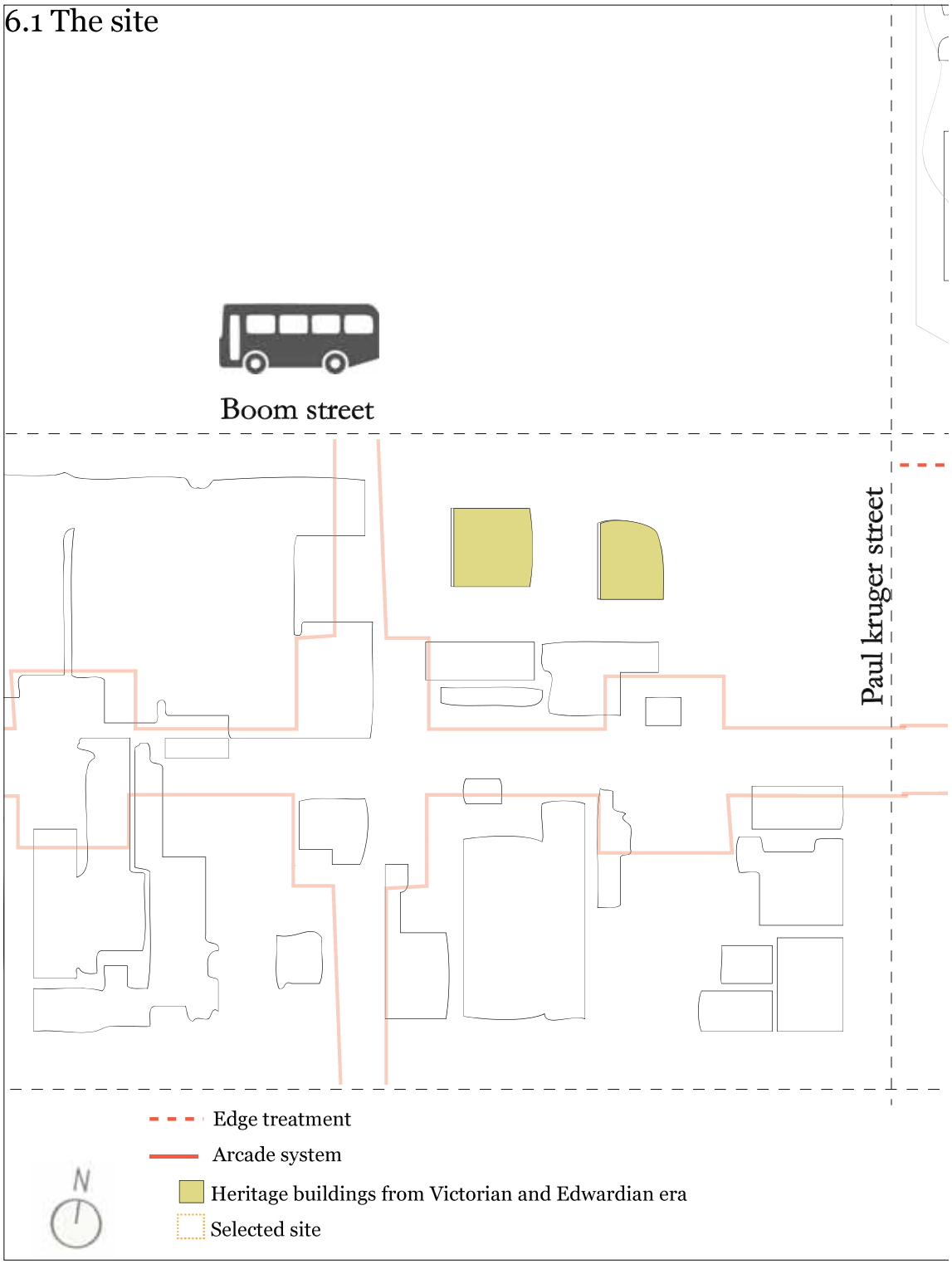


CHAPTER SIX

Concept and
Design development



6.1 The site


Boom street
Paul kruger street
Edge treatment
Arcade system
Heritage buildings from Victorian and Edwardian era
Selected site
N

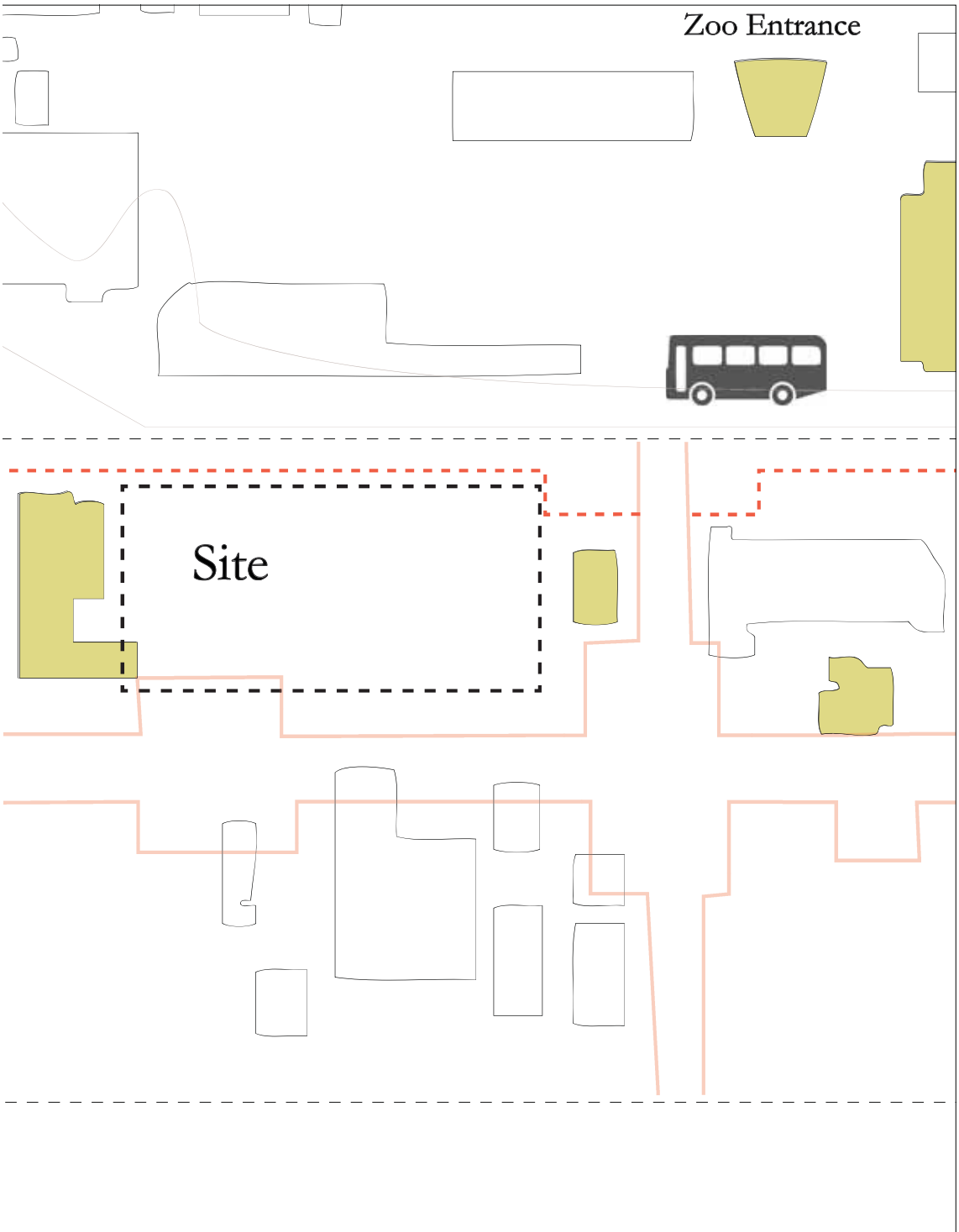


Fig. 6.1 Site plan (Author, 2012)

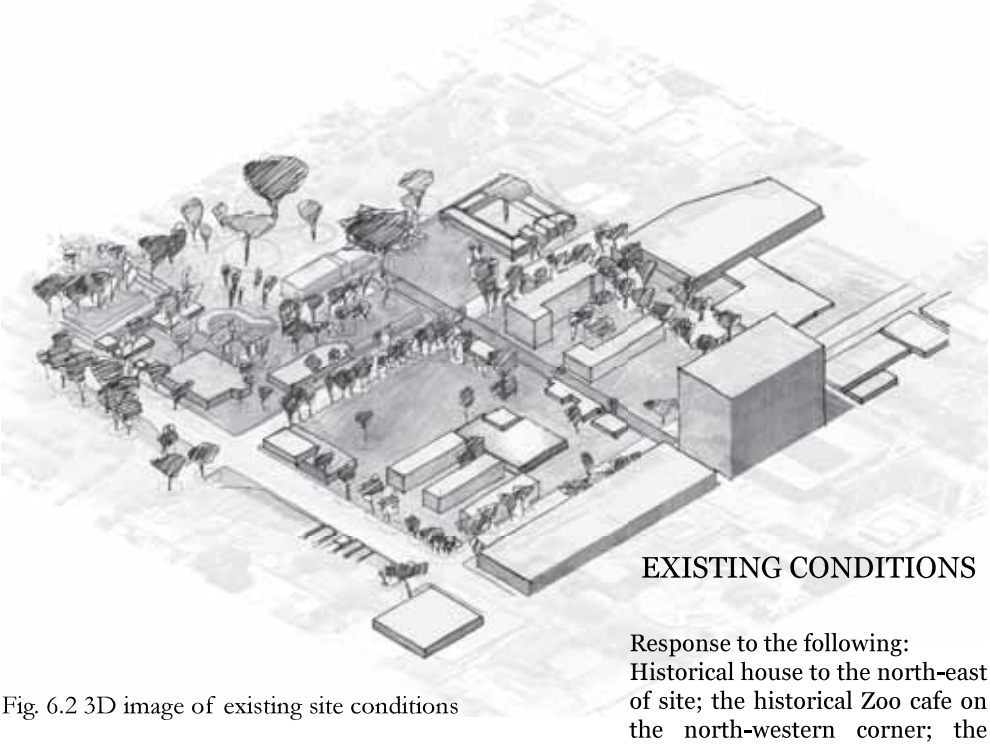


Fig. 6.2 3D image of existing site conditions

EXISTING CONDITIONS

Response to the following:
Historical house to the north-east of site; the historical Zoo cafe on the north-western corner; the current activity on the site (informal traders and restaurant, taxi stop, ablutions); the residential flats to the east and the physical conditions of the site.

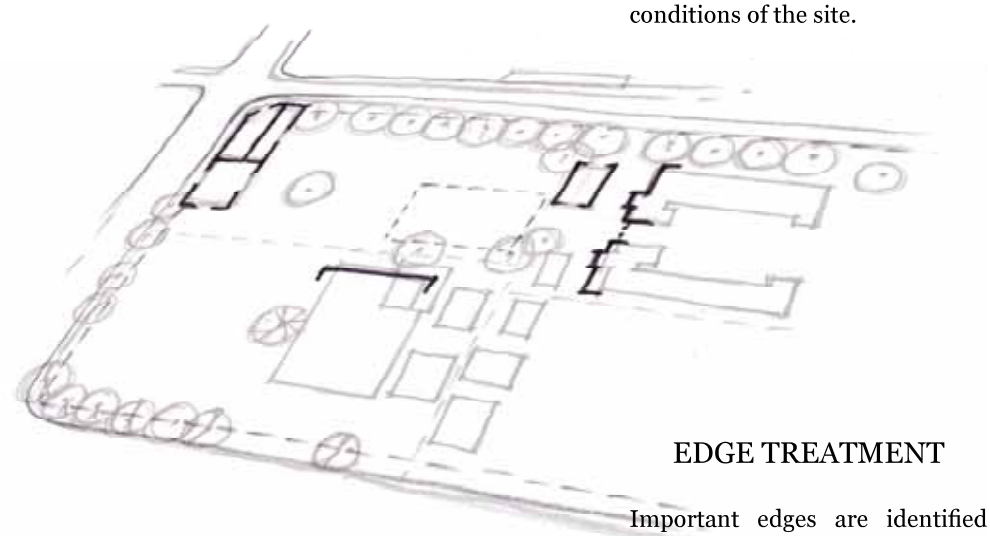


Fig. 6.3 Edge conditions and their treatment (Author, 2012)

EDGE TREATMENT

Important edges are identified and their role in the new development are considered. Access, permeability, privacy and public spaciality are issues considered.

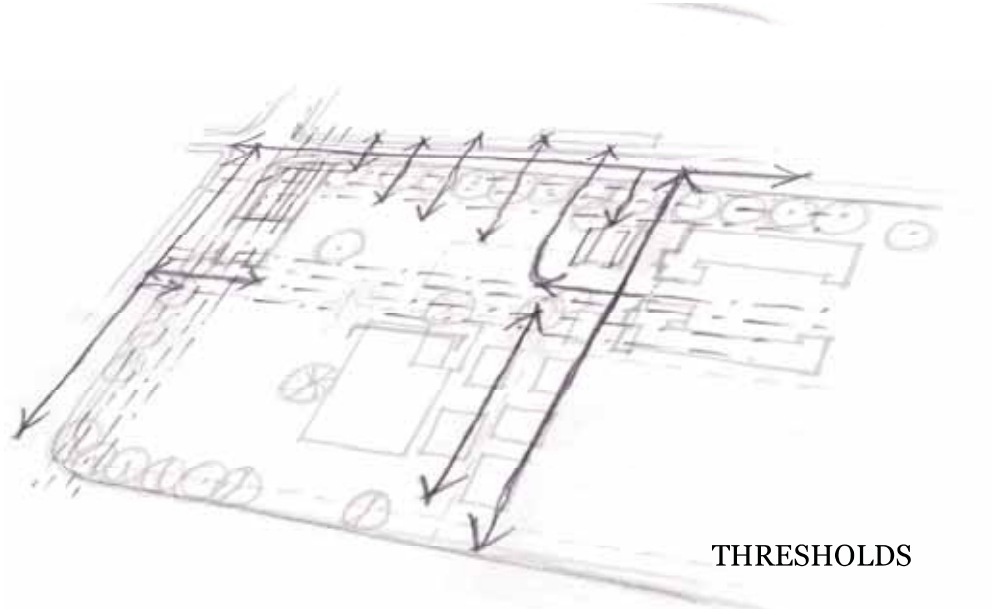


Fig. 6.4 Threshold articulation (Author, 2012)

THRESHOLDS

In response to existing site conditions , theoretical generators and precedent studies, a number of thresholds are layered inwards from the street to the internal courtyards.

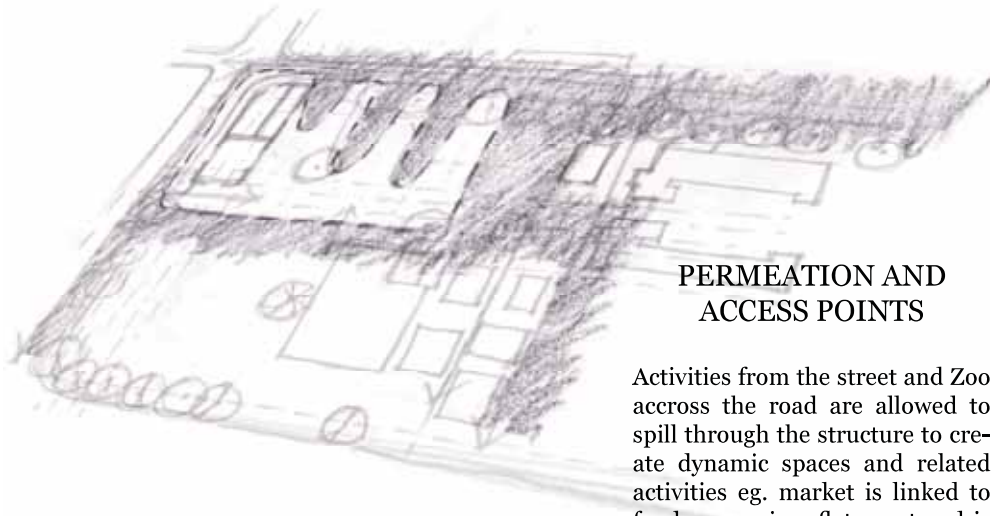


Fig. 6.5 Permeability of edges (Author, 2012)

PERMEATION AND ACCESS POINTS

Activities from the street and Zoo accross the road are allowed to spill through the structure to create dynamic spaces and related activities eg. market is linked to food processing, flat courtyard is linked to glasshouse; glasshouse influences dining experiences in restaurants, etc.

6.2 Design informants

The positioning of the proposed design in the public realm requires a fine balance between legislation and design along with addressing the heritage of the site. A series of informants were identified to guide the design process:

Legislation
Although it is foreign, it is assumed that insect food products are the same as any other. The processing facility has to adhere to food processing legislation set out by SANS 100049 by the South African Bureau of Standards.

Production
Food processing facilities require a production line where the layout is process orientated.

Orientation
The building needs to make use of the site's northern orientation for optimal day lighting and thermal performance. However, parts of the building will face west and east and the required adjustments will be made to keep excessive sunlight out.

Boom Street
To test the hypothesis, the building will have to establish a relationship with the activities in and around Boom Street.

Heritage
Both buildings adjacent to the site, east (house) and west (café), have heritage values that need to be responded to. In an ill-defined precinct the site has gone from suburban erven to semi-industrial automotive repair businesses. The site with its beautiful setting became a wasted scape that needed an appropriate intervention to give it meaning.

Environmental performance
Food processing facilities are resource intensive and produce large amounts of waste. Because the cyclical elements of the processes form part of the production line, as much as possible used resources are recycled for re-use.

6.3 Concept development

Layered concept

1. Problem statement + Hypothesis + Methodology

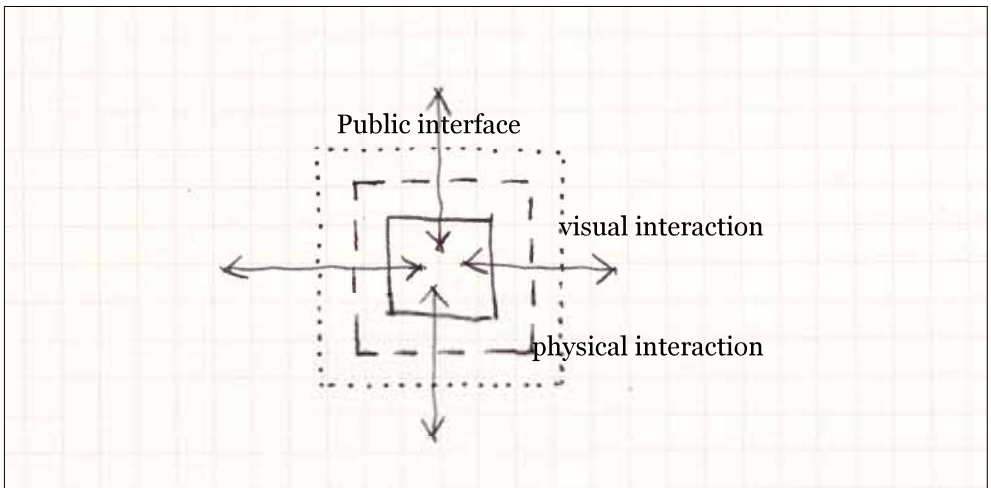


Fig. 6.6 Concept diagram 1 (Author, 2012)

The proposed project set out to investigate how architecture can be a cognitive tool in being a mediator between the processing of food and the consumer. The methods that were researched established that certain types of spaces are mediating. Courtyards and arcades, as spaces that mediate between building and landscape, enclosed and open, were investigated. Thresholds were an important tool as they define the nature of the mediating space. The conceptual diagram illustrates how thresholds can be used to define both visual and physical interaction between building and user.

2. Programme (food production line + legislation + orientation)

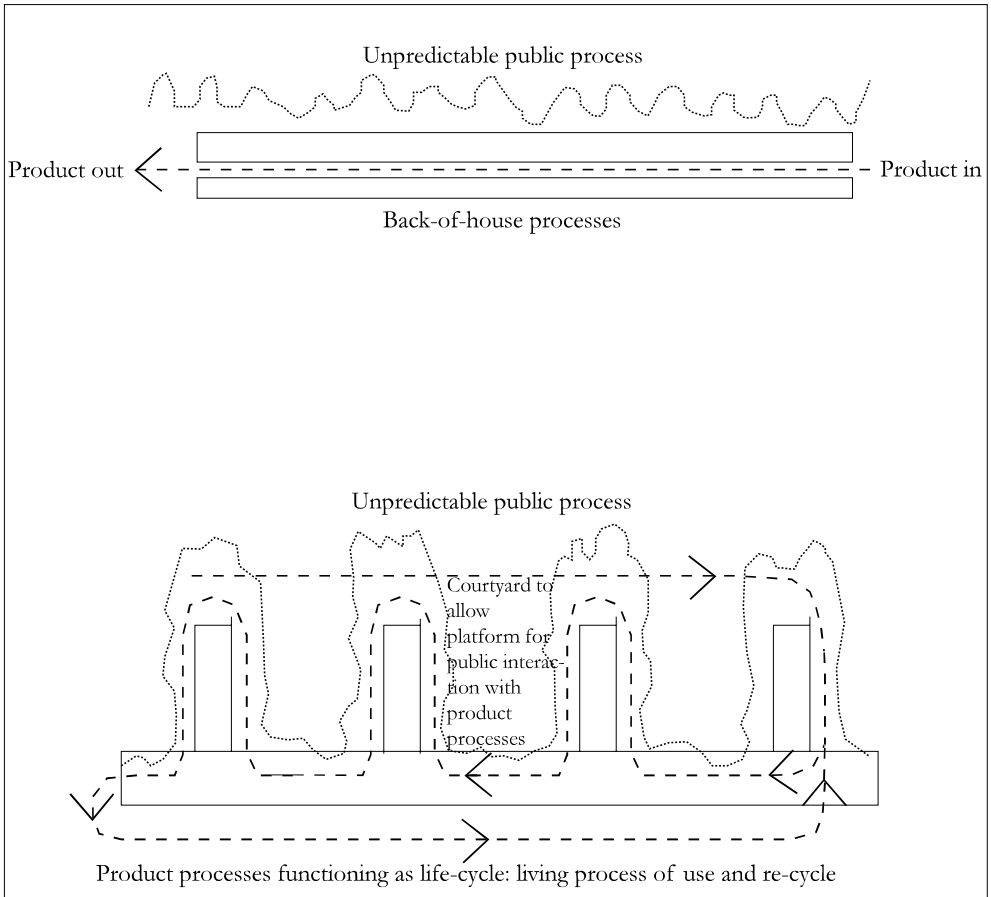


Fig. 6.7 Concept diagram 2 (Author, 2012)

The linear nature of the design responds to the production processes and a north orientation. The public/ user interface is achieved by means of public courtyards that contain market spaces and public seating. All four edges of the courtyards are defined by elements that create a specific threshold condition. These elements are terraced planting, market facilities, public seating and a columned walkway.

3. Theoretical discourse

Theory of 'place'
- Identity
- Relations
- History

Identity

The building form responds to the unique nature of the programme. The location, programme, aesthetic qualities of the building and the layered public interface give the building its identity.

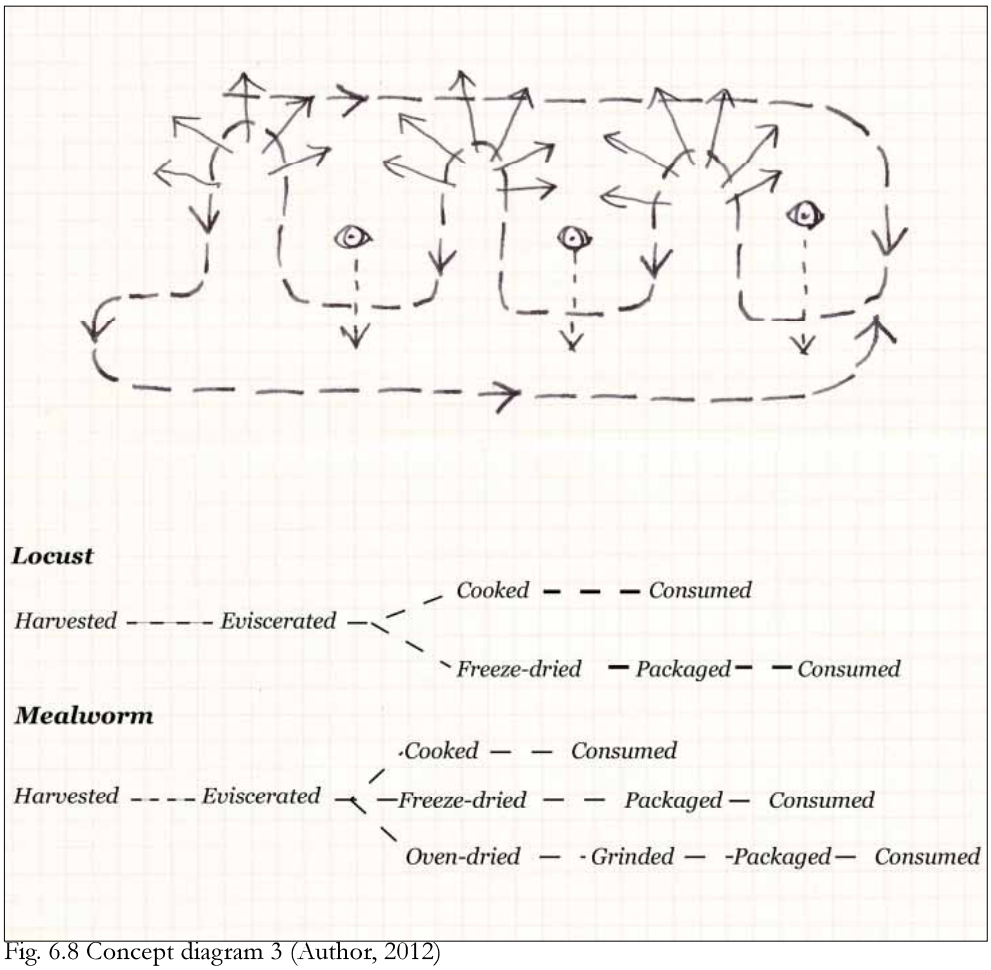


Fig. 6.8 Concept diagram 3 (Author, 2012)

Relations

The proposed building's positioning, scale and layout has relations with the buildings and natural elements adjacent to it. The building's internal programme and external circulation relates to surrounding street activities.

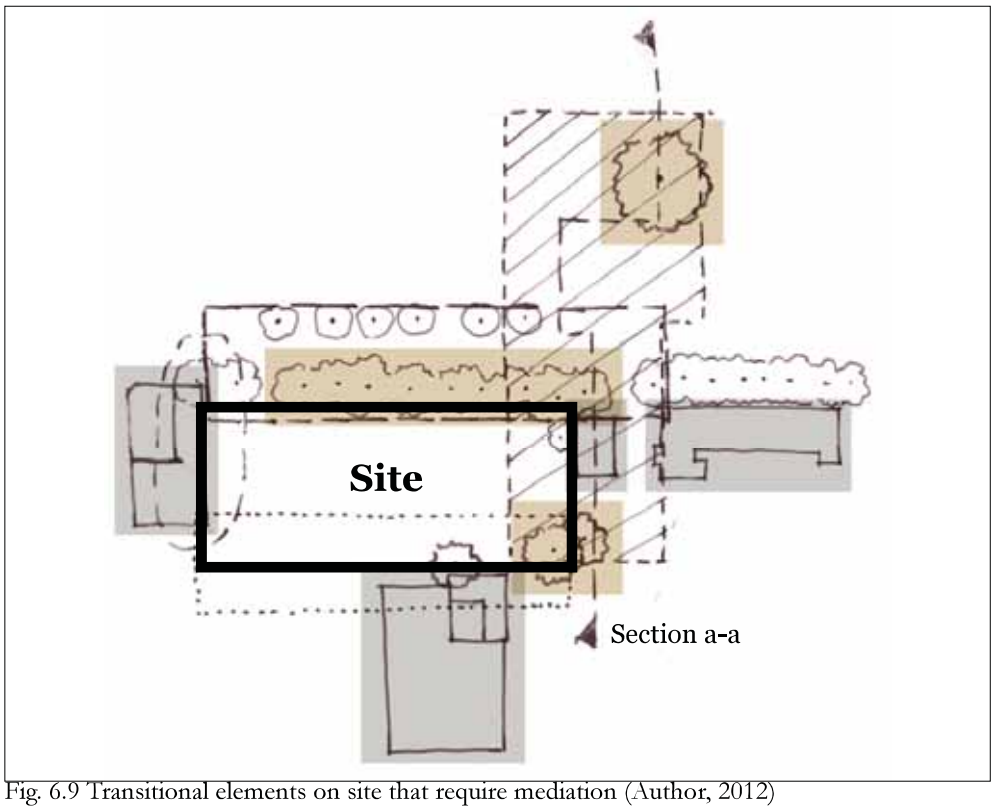
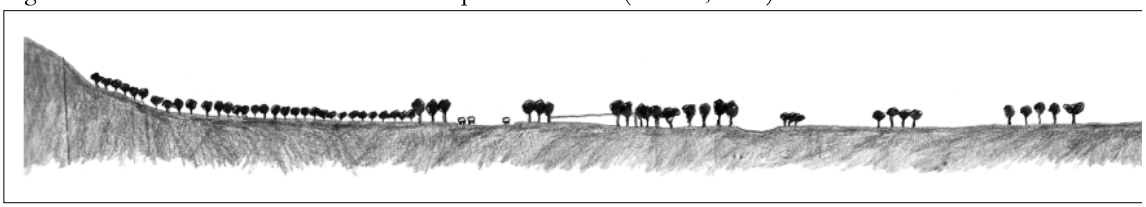


Fig. 6.9 Transitional elements on site that require mediation (Author, 2012)



Section a-a

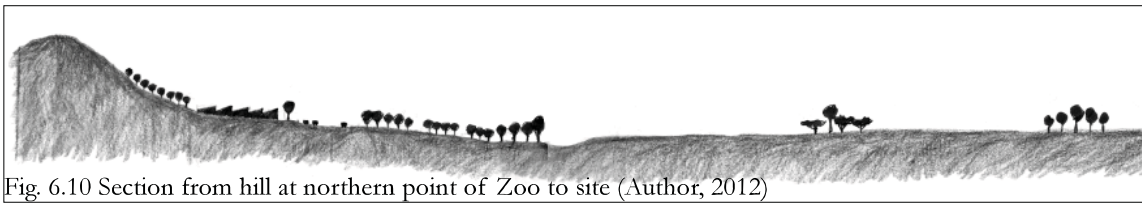
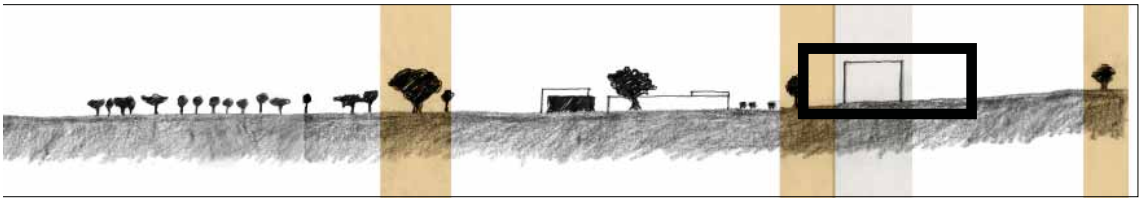
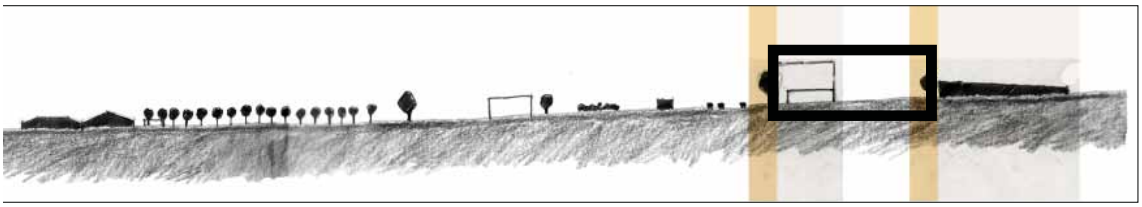


Fig. 6.10 Section from hill at northern point of Zoo to site (Author, 2012)

The mediator

As stated previously, the building is required to be a mediator between several site and social conditions. On the northern side, the lifted locust cages relate to the row of full-grown Platana trees. These cages are the highest part of the building as the scale is reduced towards the south. This responds to the scale of the hill to the north of the Zoo in relation to the small buildings around the site. The part of the building on the western side where packaging takes place, latches onto the existing Zoo Café and breaks through in order for despatching and delivery of goods to happen through the existing building. The southern edge of the site is seen as the digestive system of the building where the main services are located.





History

A response to the history of the site is required. The historical use of the site as suburban erven is acknowledged as this contributed to the current fragmented nature of the precinct. The fragmentation caused by the low scale and low density (small, maximum double storey buildings on large sites) is developed. This attitude is contrary to the belief that areas on the periphery of the CBD should be vertically and horizontally densified. By creating longer and narrower buildings, the potential for interaction between building and street activities are enhanced. The solid parts of the building represent the approximated positions of the houses that once stood there. The massing of these buildings also provides the necessary insulation for its processing and storage functions.

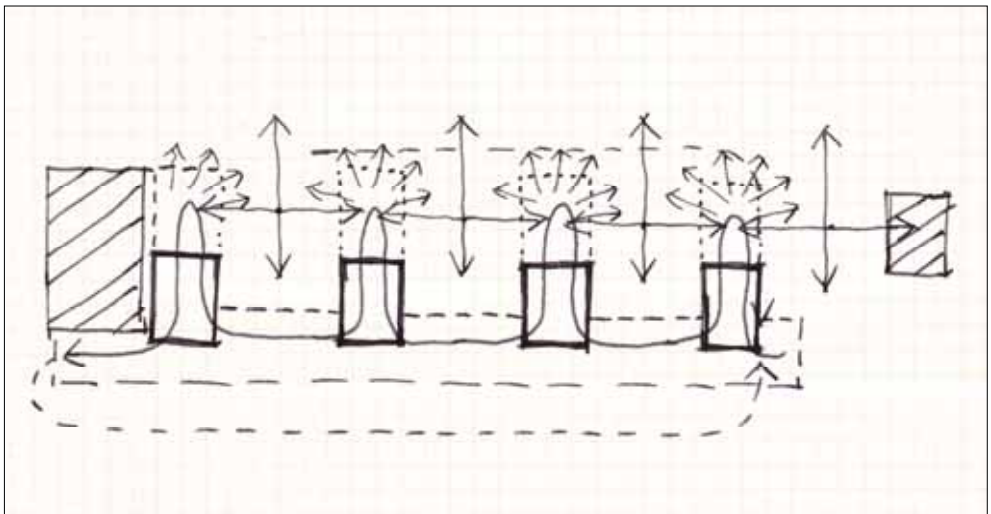


Fig. 6.11 Concept drawing 4 (Author, 2012)

Fig. 6.12 3D image of suburban houses that were located on the site (Author, 2012)

6.4 Concept synthesis

The programmatic conceptual development establishes a series of connections along a linear process to Boom Street on the northern side and the heritage buildings to the west and east of the site. The initial response was to lift the locust cages into the air and recess the mealworm breeding areas into the ground to control heat gain.

The conceptual model shown in fig. 6.13 shows the linear staff circulation route overlaid with a series of connections formed by human process over production process. The string shows the public engagement with the product process. The white blocks represent the platforms for public engagement, whether physical or visual

On the northern edge Boom Street was conceptualised as a constant condition against which the changing nature of the production processes would be juxtaposed. The southern edge was to be programmed with regenerative processes.

The concept is based on the layering of processes. The four layers are based on:
- Product life- and death-cycles
- Worker circulation
- Public interaction
- Product circulation

The process was conceptualised linearly to make it possible for the public to interact at any point.

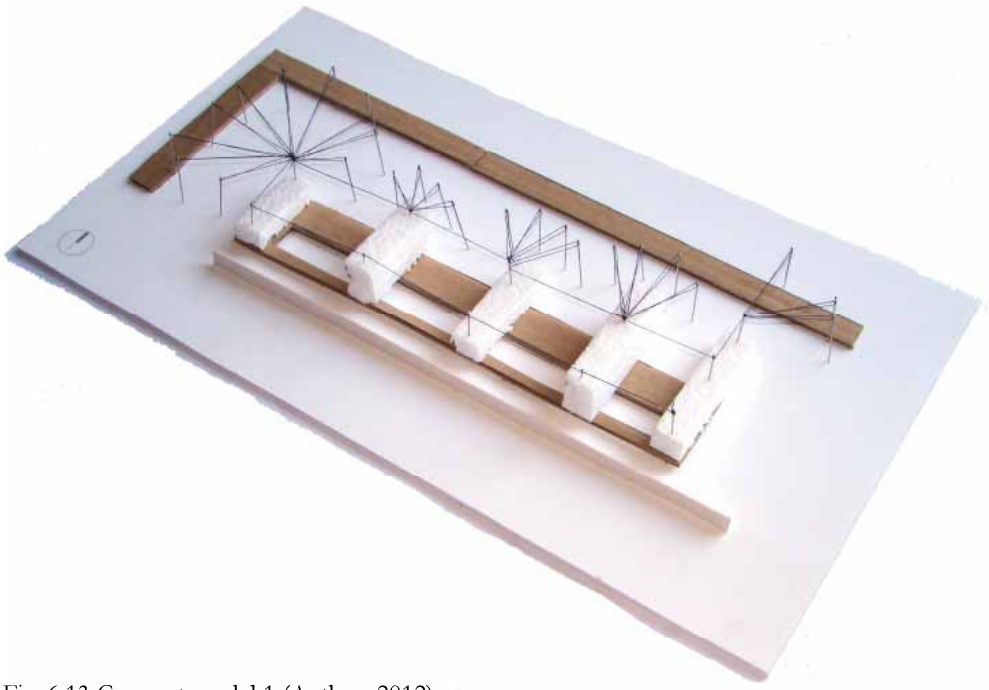


Fig. 6.13 Concept model 1 (Author, 2012)

6.5 Design_ inspiration from insects

Detail and fine layers

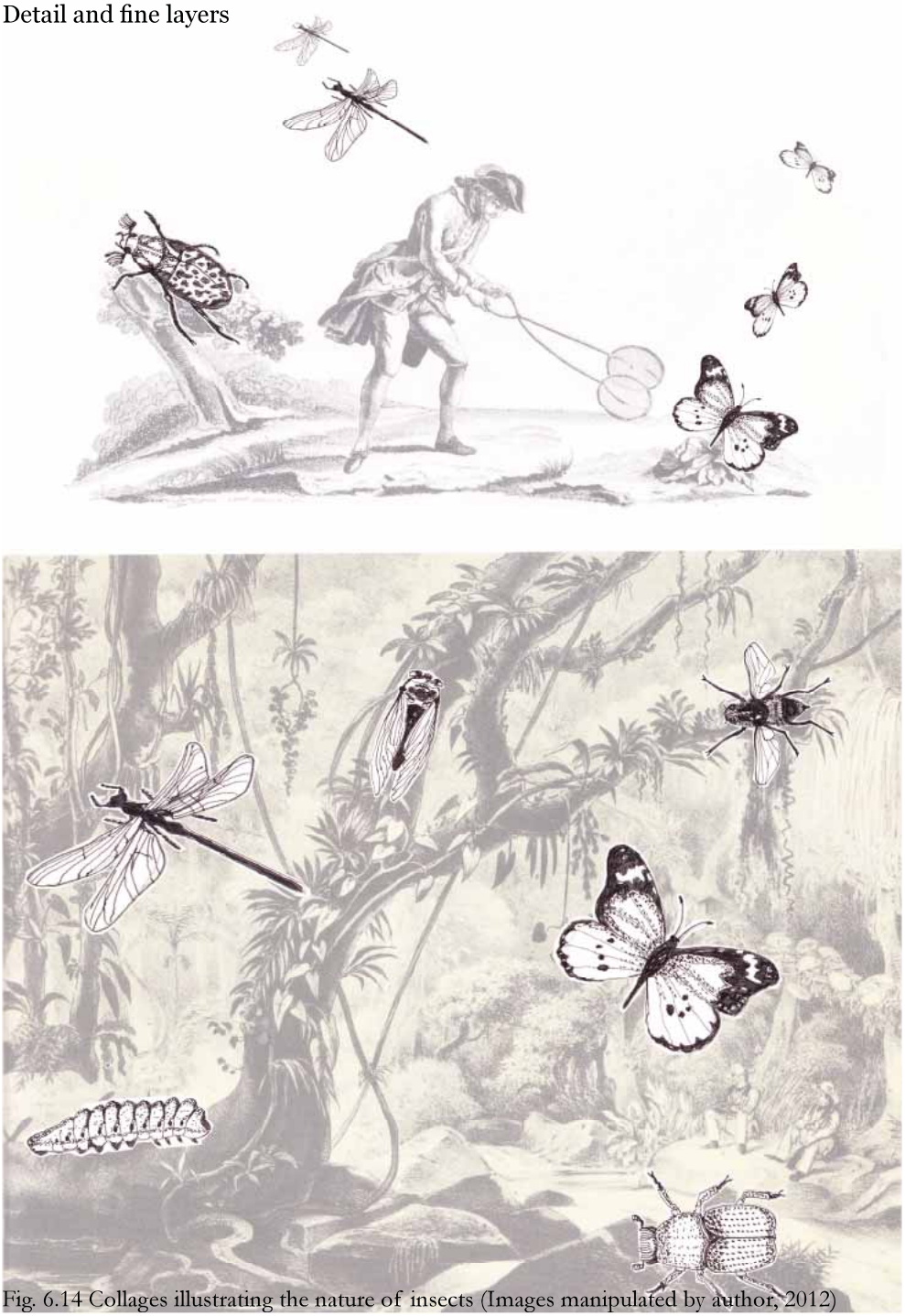


Fig. 6.14 Collages illustrating the nature of insects (Images manipulated by author, 2012)

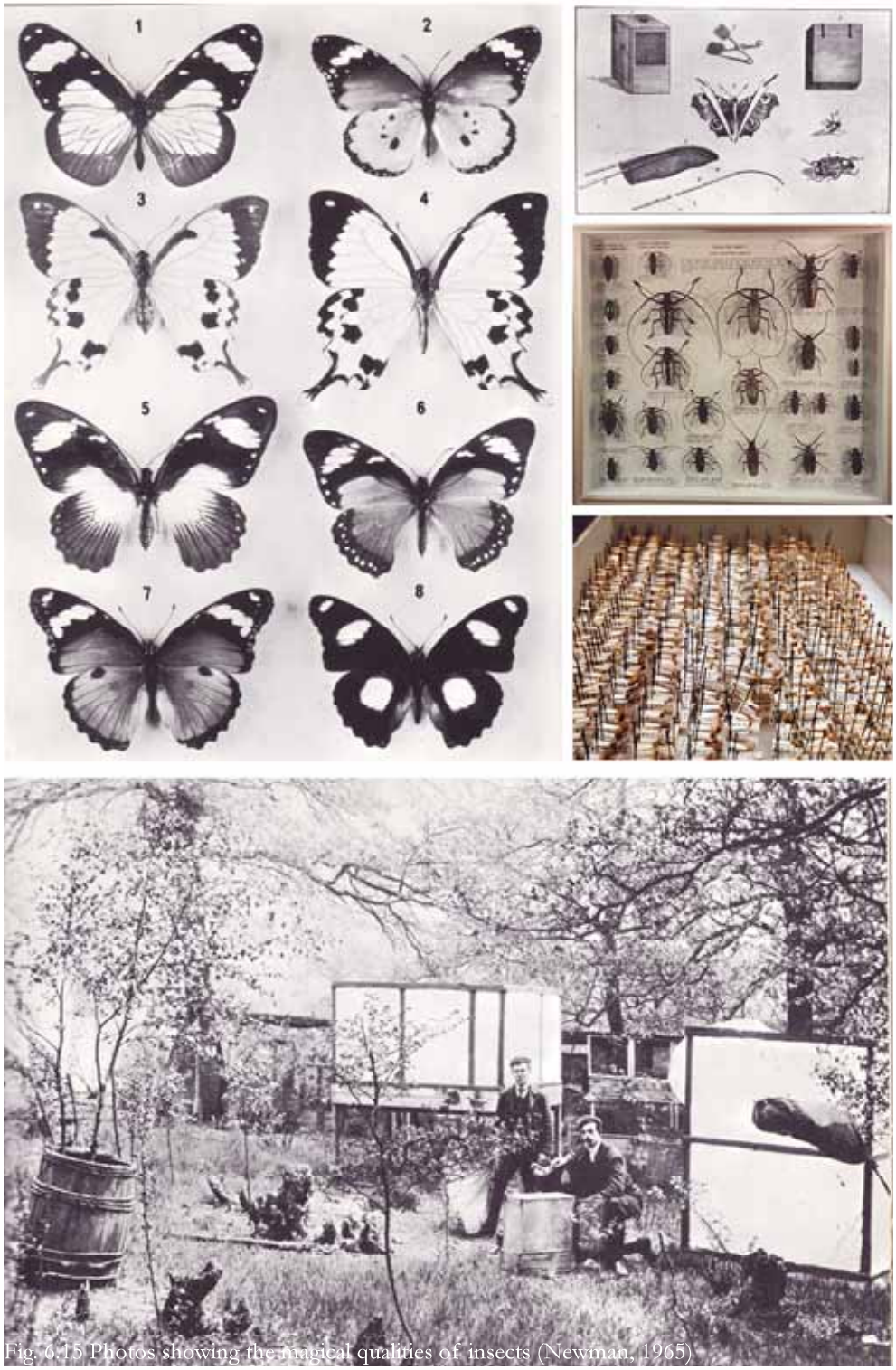
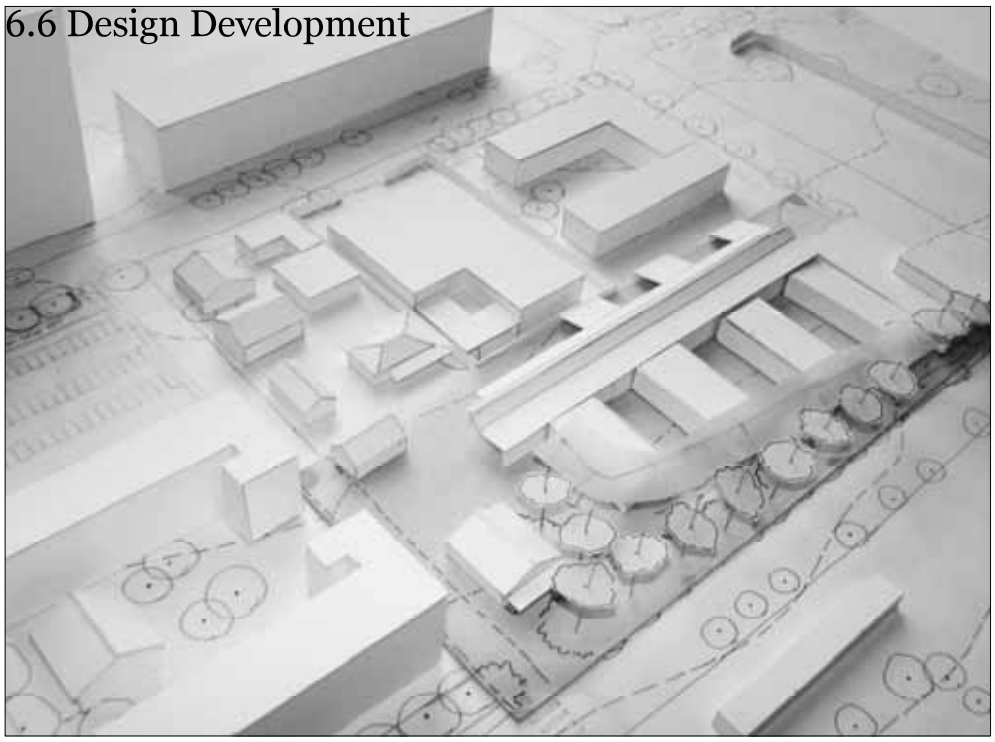


Fig. 6.15 Photos showing the magical qualities of insects (Newman, 1965)

6.6 Design Development



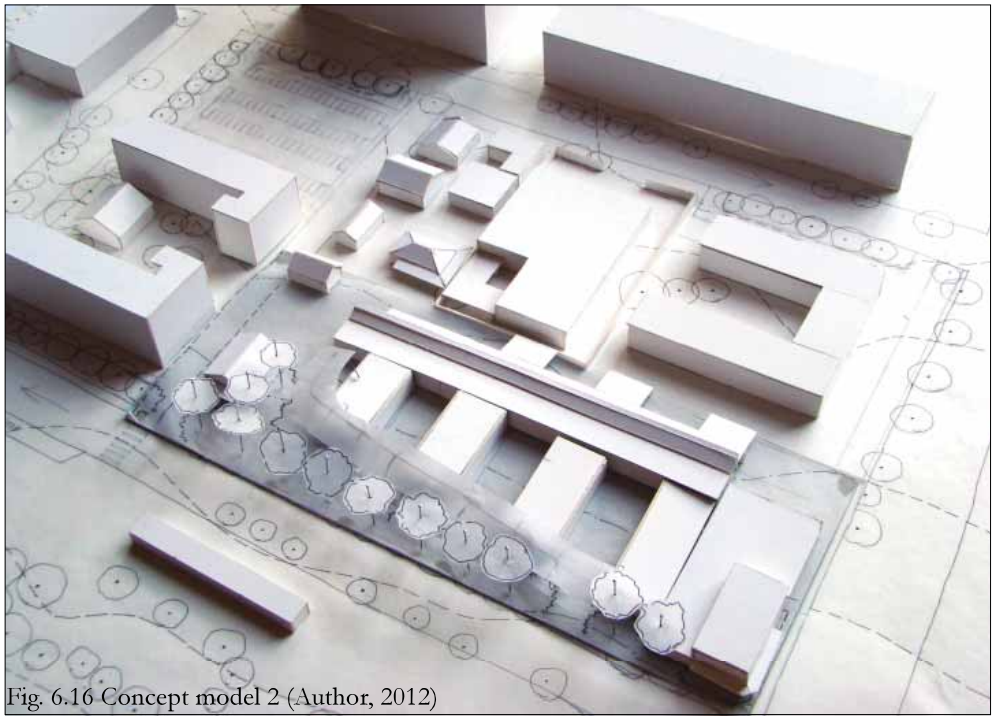


Fig. 6.16 Concept model 2 (Author, 2012)

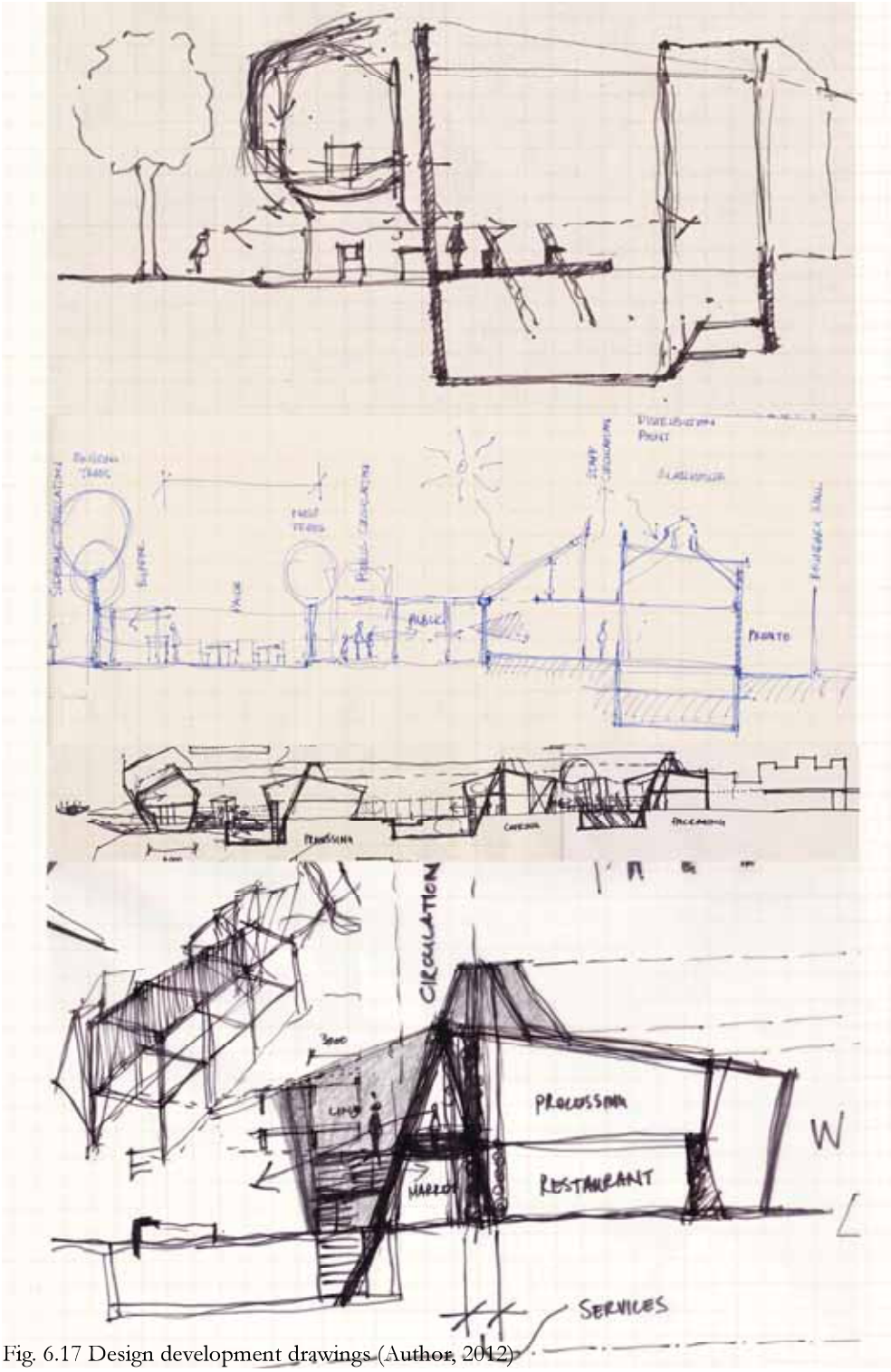


Fig. 6.17 Design development drawings (Author, 2012)

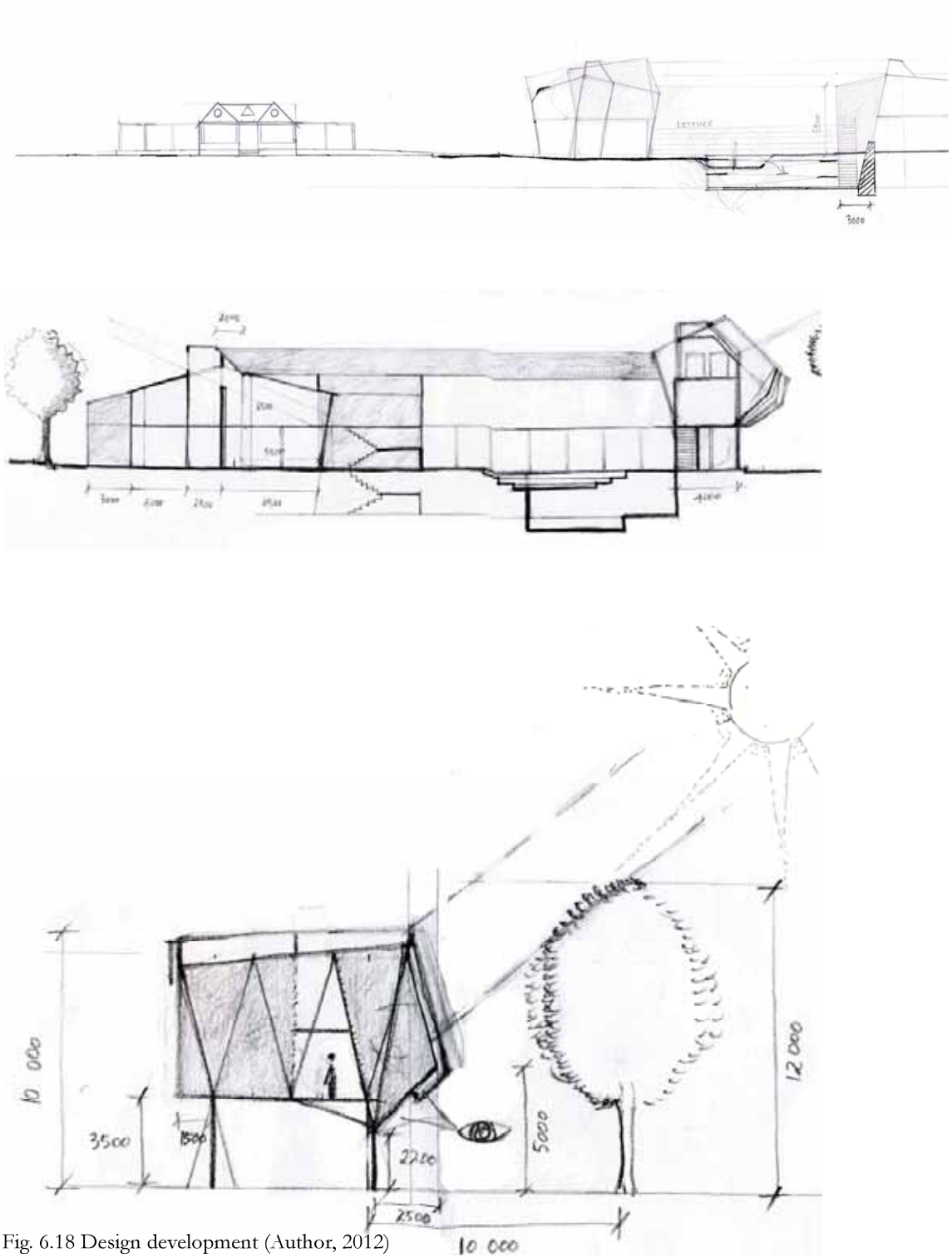


Fig. 6.18 Design development (Author, 2012)

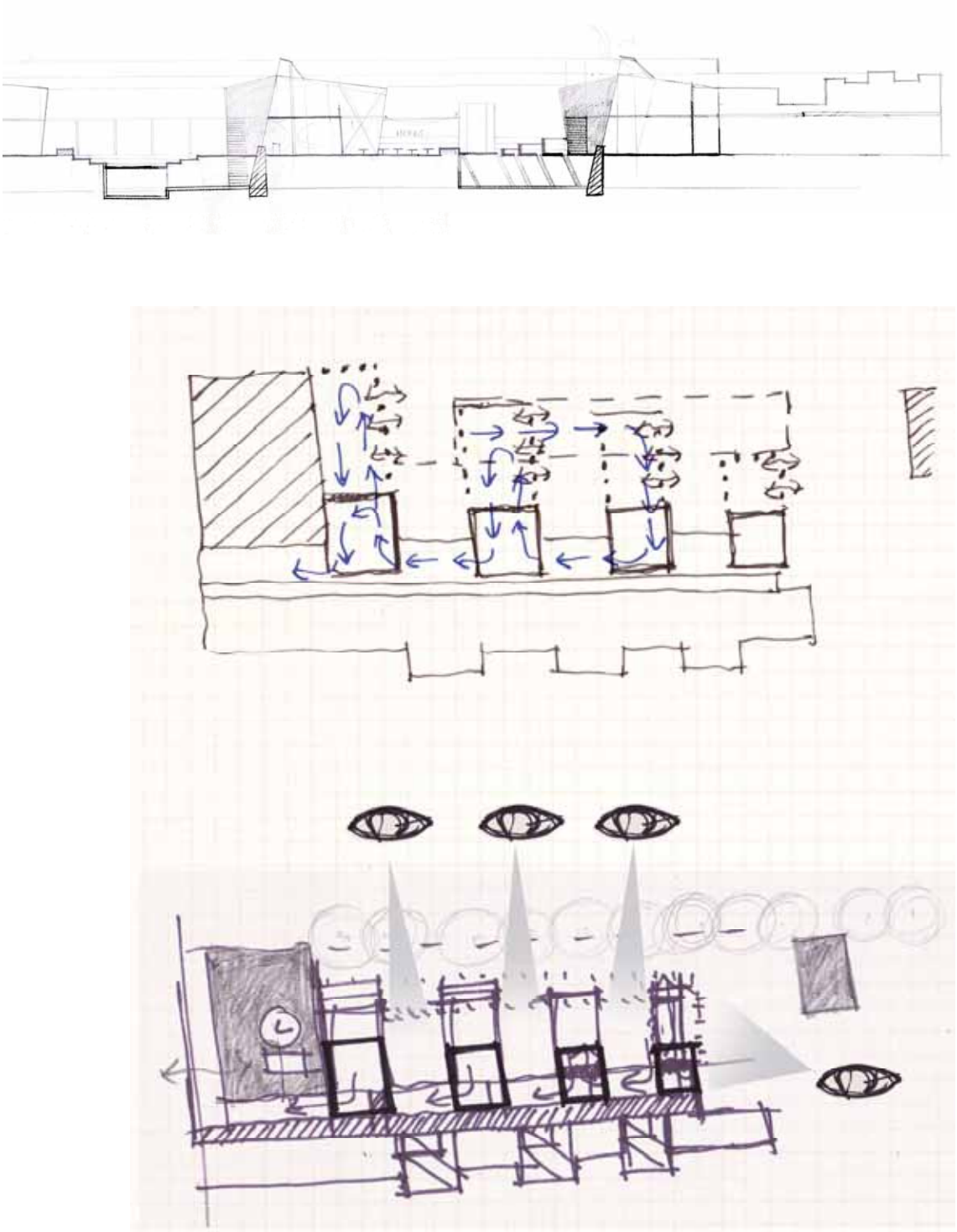
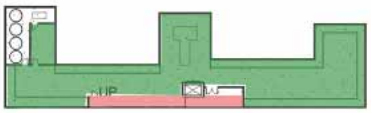


Fig. 6.19 Circulation explored (Author, 2012)

Plan layouts



Lower Ground

Despatch	Market	Reception/ administrative offices
Public toilets	Terraced vegetable garden	Locust breeding cages
Product processing	Clean circulation	Mealworm breeding area
Dirty circulation	Staff amenities & storage	Earthworm tunnels

Ground

First

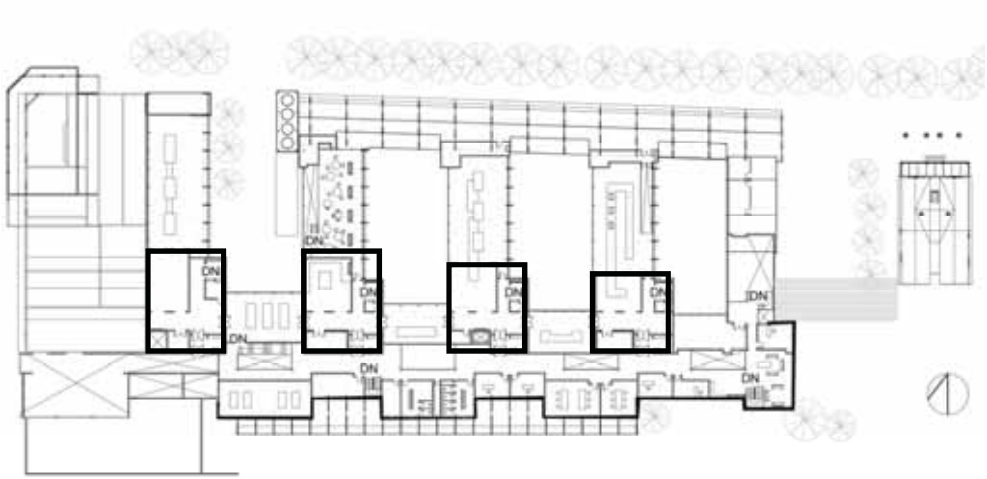


Fig. 6.20 Solid and lighter structures (Author, 2012)

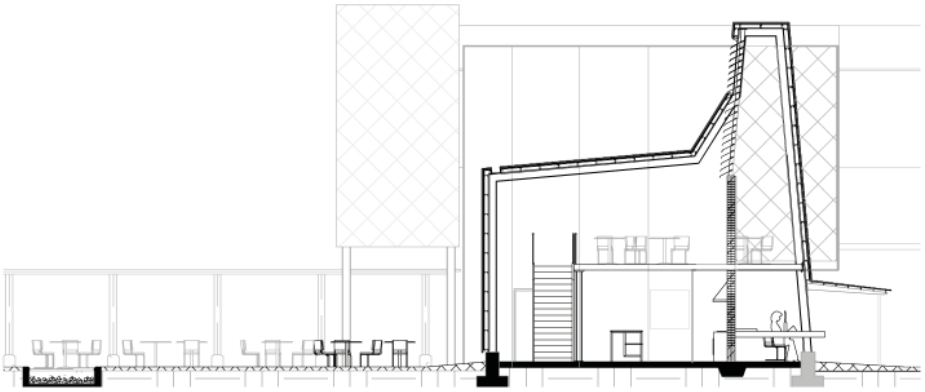


Fig. 6.21 Section through kitchen and restaurant (Author, 2012)

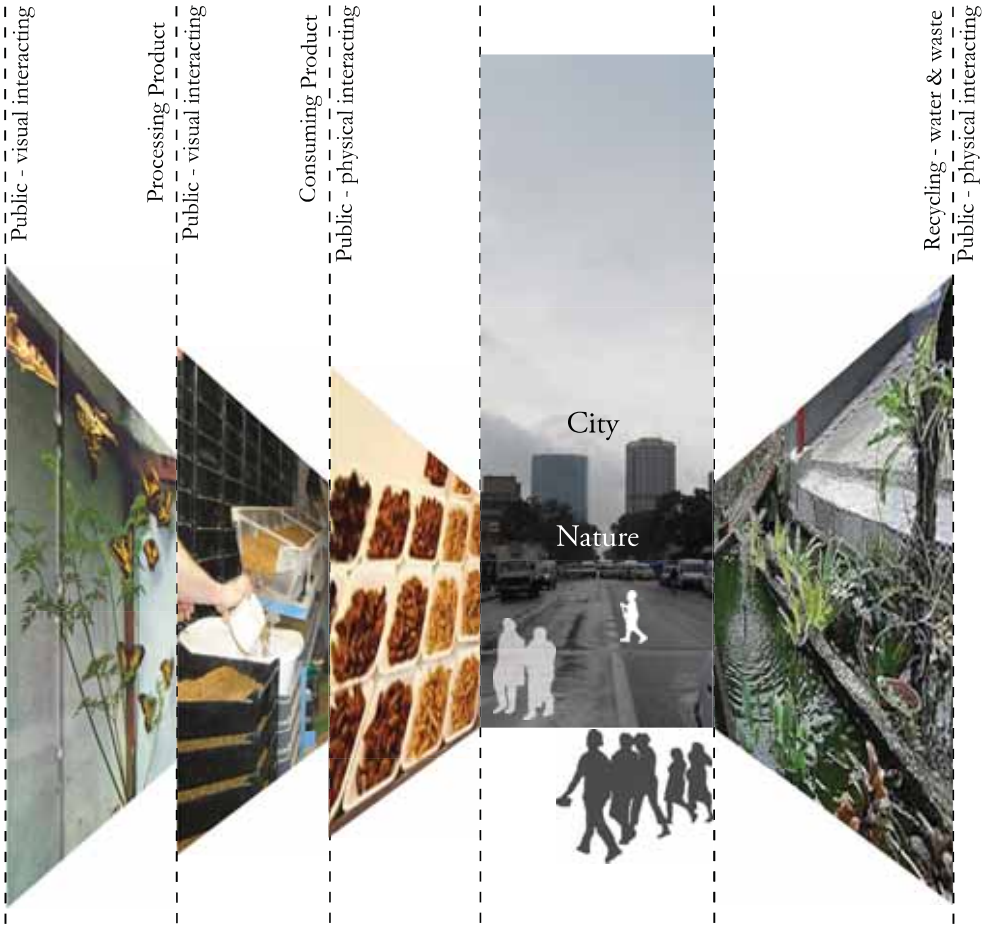


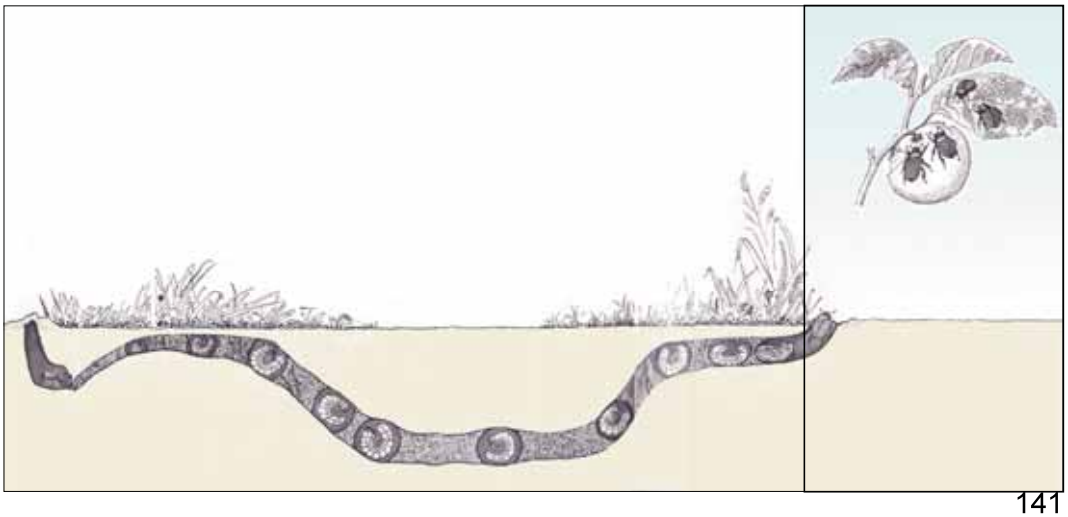
Fig. 6.22 The visual and physical interactions between the product and consumer (Author, 2012)

The user/ product relationship is established by visual and physical interactions. The courtyard threshold articulation is treated accordingly. From a production perspective, the public have direct access to the market area and a visual connection to the insect breeding and food processing areas. From a sustainability point of view, the earthworm tunnels are hidden from public view for practical reasons and stormwater harvesting and treatment forms part of the public courtyards.

Fig. 6.23 Conceptual illustration of one mediating space (Author, 2012)

CHAPTER SEVEN

Technical Investigation



7.1 Technical concept

The tools for design in architecture are floors, walls and roofs. Therefore, it has to be clear how we apply these tools to form meaningful buildings. The floor is regarded as the surface on which is scripted how users must move – movement and circulation. The walls form the envelope that creates the interaction between different conditions; inside and outside, natural and artificial, public and worker, underneath and above. The roof is the network that houses all the systems that control the thermal performance of the spaces (of which most are very specific).

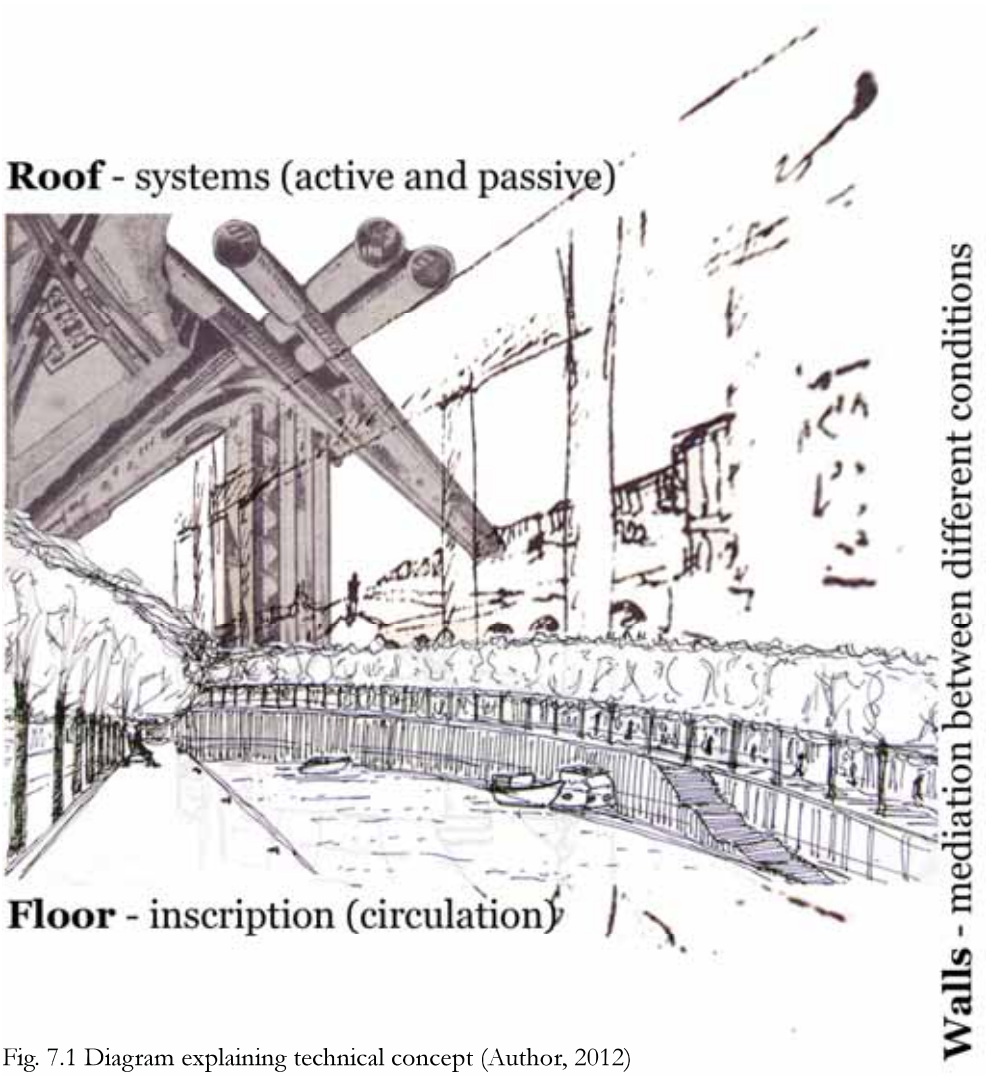


Fig. 7.1 Diagram explaining technical concept (Author, 2012)

7.2 A climatological response

The structure, structural details and materials employed, were decided on with regards to the very specific climatological requirements of each area. There are primarily five areas namely: the mealworm breeding area; the locust breeding area; the areas where food is processed, the worker's amenities and the public user interface. The conditions were divided into two categories.

7.2.1 **Stereotomic –** the anthill

The mealworm breeding area is recessed into the ground to create insulated cool and dark conditions under which these insects naturally live and breed. The brick buildings that sit on the historical houses' positions accommodate the coldrooms and storerooms and therefore have thick brick walls to provide thermal mass that is night-ventilated.
The mealworm breeding area is constructed of a concrete retaining structure, which is moulded to create vertical and horizontal circulation routes.

Fig. 7.2 Anthill (Image from flickr.com, 2012)

7.2.2 **Tectonic** – the exoskeleton

The concept of the roof is that of the exoskeleton. The conceptual formation resulted in a portal frame steel structure over which the roof is stretched. The roof acts as the envelope that protects as well as regulates the internal spaces of the building. It protects from the sun's rays and rain. It regulates the internal environment thermally - by allowing the building to ventilate and by avoiding heat gain – and naturally – by embracing daylighting. The roof accommodates the arteries that feed the building. Therefore it becomes responsible for the systems and services.

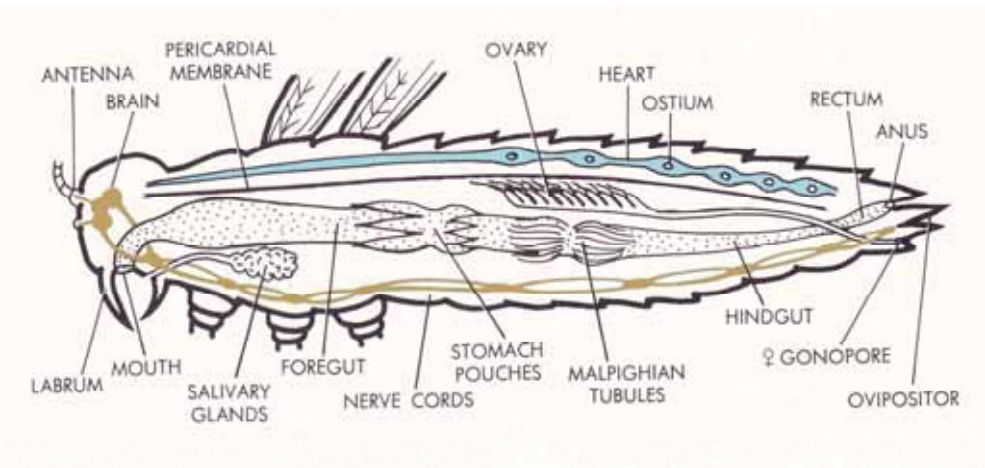


Fig. 7.3 The exoskeleton of a locust (Newmann, 1965:56)

The locust cage

Brown locusts breed under specific conditions which include: 40% relative humidity (which is normal in Pretoria); a temperature range between 28-35 degrees Celcius (which is created by the materials used); and natural ventilation.

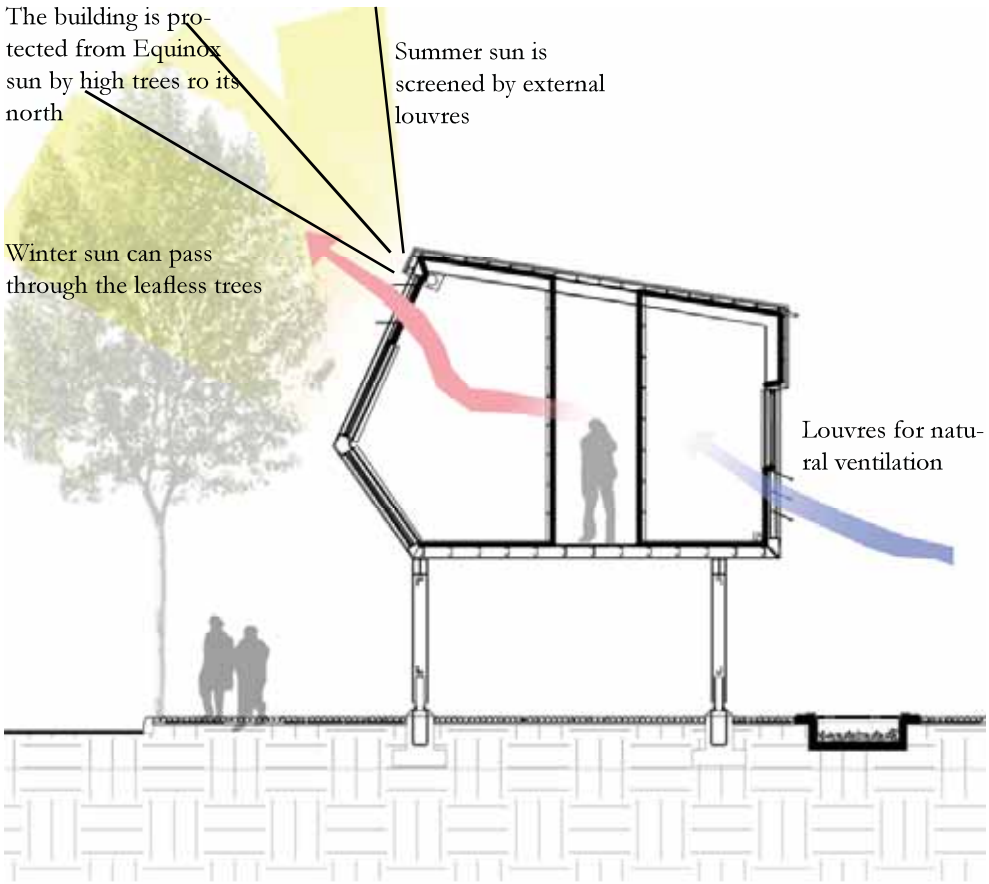


Fig. 7.4 The locust cage (Author, 2012)

7.2.3 The air-extraction chimneys

The chimney is designed around passive and active principles. The highest point of each roof flows into the chimney to allow hot air to exit by means of the stack effect. The chimneys are located in a manner to also be indicative of the service corridors of the building – circulation routes and service ducts are located along these corridors. The concept of the chimneys also refers to the trageoli (openings for breathing) in the exoskeleton of an insect.

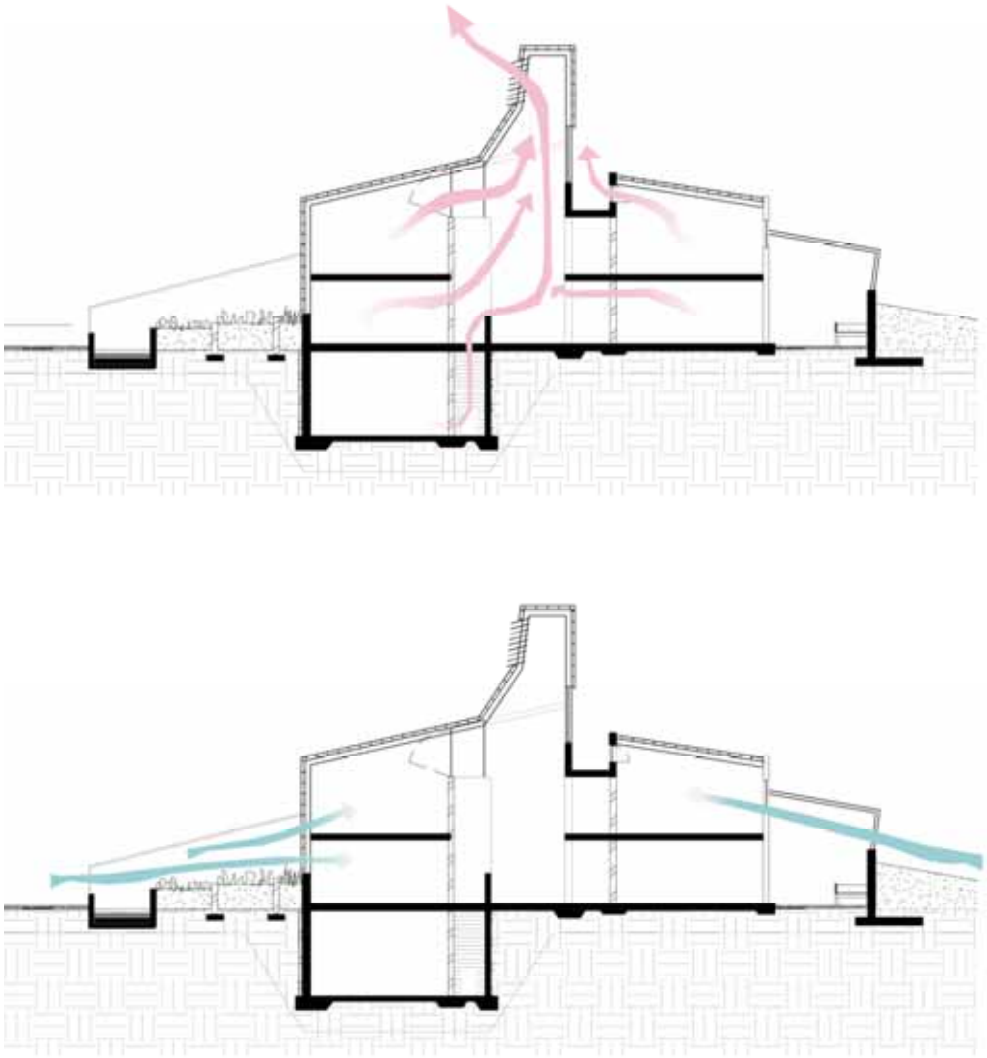


Fig. 7.5 Natural ventilation through the main building (Author, 2012)

Southern light

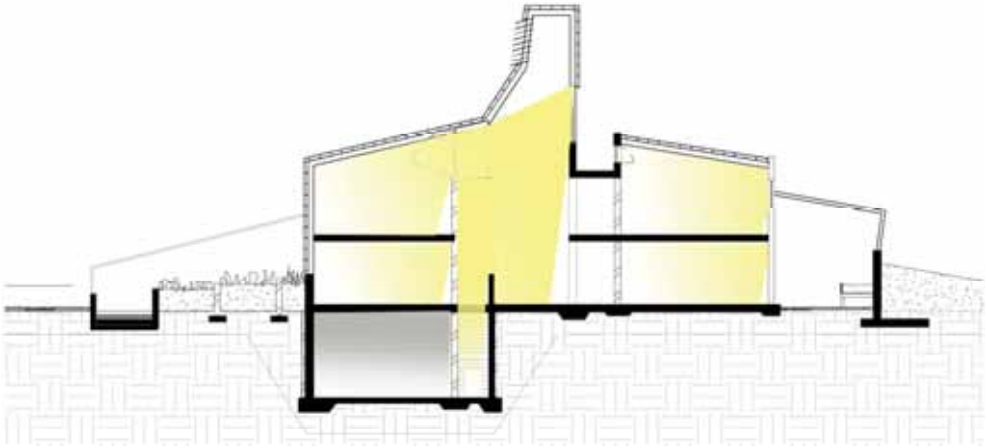


Fig. 7.6 Natural daylighting (Author, 2012)

7.3 Technical Precedents

7.3.1 Community eco-village, Stellenbosch, Western Cape, South Africa

Description

"The most significant aspect of the Lynedoch case from a sustainable design and construction point of view is that it provides a working example of an integrated sustainable development: integrated because it connects social, economic, and ecological objectives and because it incorporates technologies that span the energy, water, sanitation, and building material fields; sustainable because of the commitment to a long-term vision of social, economic and ecological sustainability; and developmental because of the anti-poverty and local economic development objectives" (Annecke & Swilling, 2006:2)

Relevance

The focus of this precedent is on its efficient ecological sustainability which is briefly discussed below.

Ventilation

- Wind scooping ventilation ducts (windcatchers, solar chimneys and Whirlybirds): to optimise the natural airflow through the hall by taking advantage of the direction of the prevailing winds.
- Rooflights: acts as convection ventilators for hot air extraction.

Space heating and cooling

- Large roof overhangs and vine-covered pergolas.
- Rock chambers: river boulders from a local river are used. In winter, sun incidence through roof sheeting creates warm air in the roof cavity which is pumped through the rockstore and into the spaces that require heating. The rockstore holds the heat and releases it at night so that the spaces are warm the next morning. In summer cool night is drawn from outside to flow over the rocks to cool it down. Warm daytime air is then pumped from outside , cooled through the rockstore and circulated into the spaces.
- Adobe bricks and concrete blocks are manufactured on site.

Recycling

- Biolytix system processes all local sewage effluent for reuse: irrigation of indigenous plant species
- Rainwater-harvesting and recycling of greywater.
- Open-channel stormwater run-off planted with kikuyu grass.
- 90% of waste produced on the site is recycled.
- Energy: - minimal use from national grid (ESKOM)
- Solar power for water heaters
- LP gas for cooking

7.3.2 ARC Quarantine facility near the Hartbeespoortdam

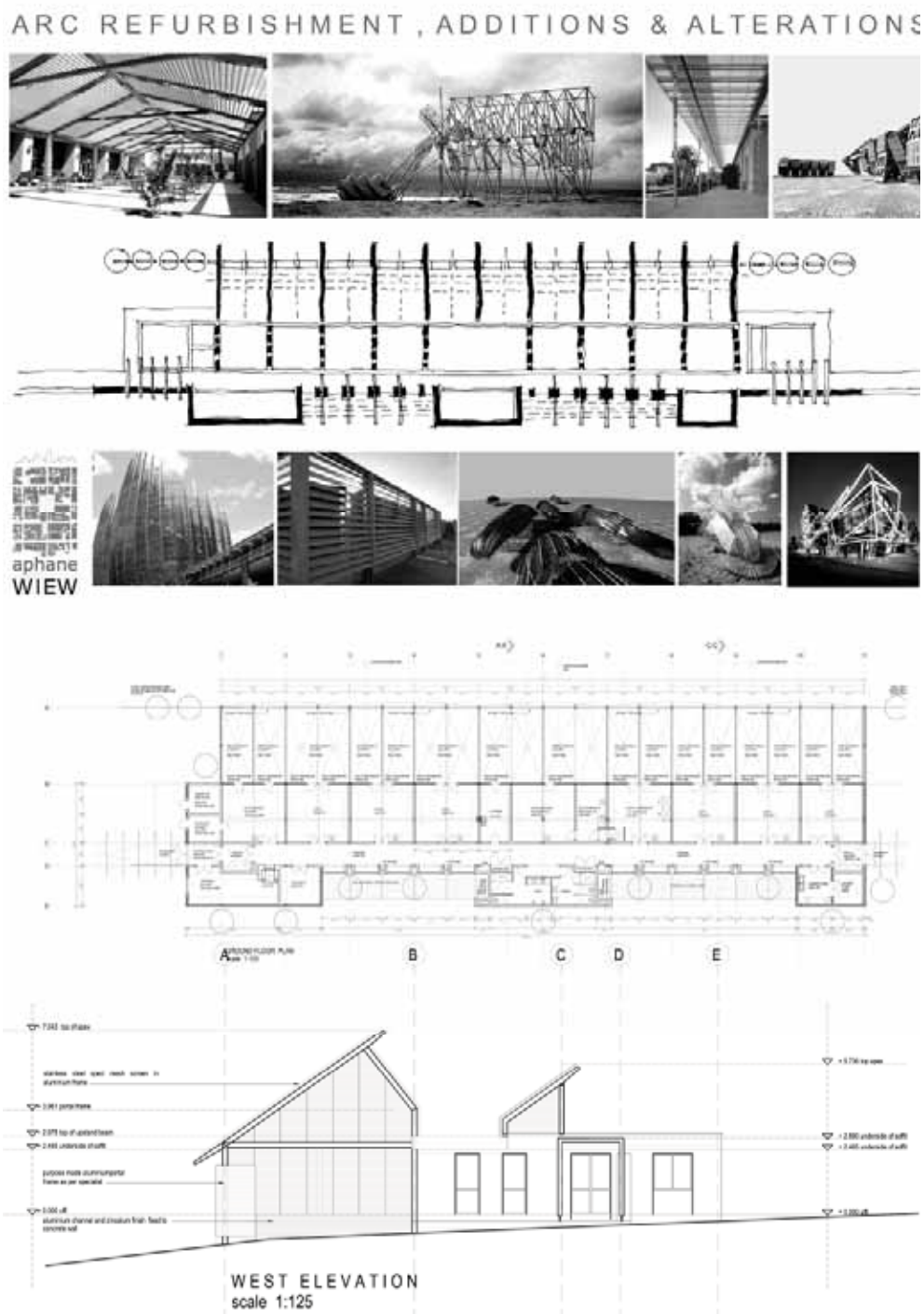


Fig. 7.7 Concept and development drawings of architect (Aphane View Architects, 2012)

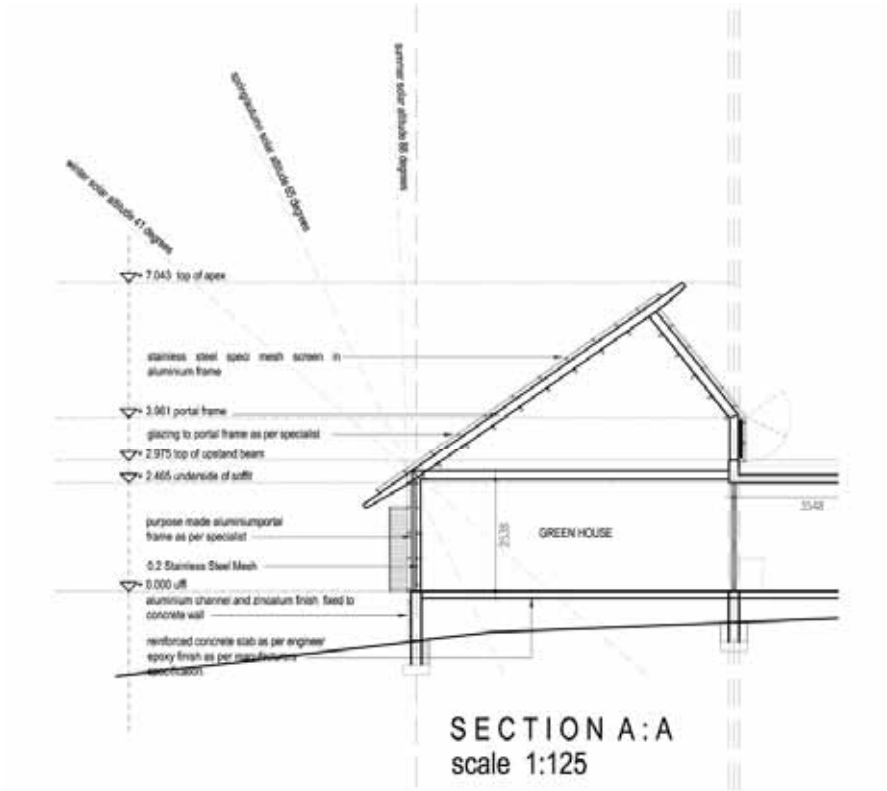
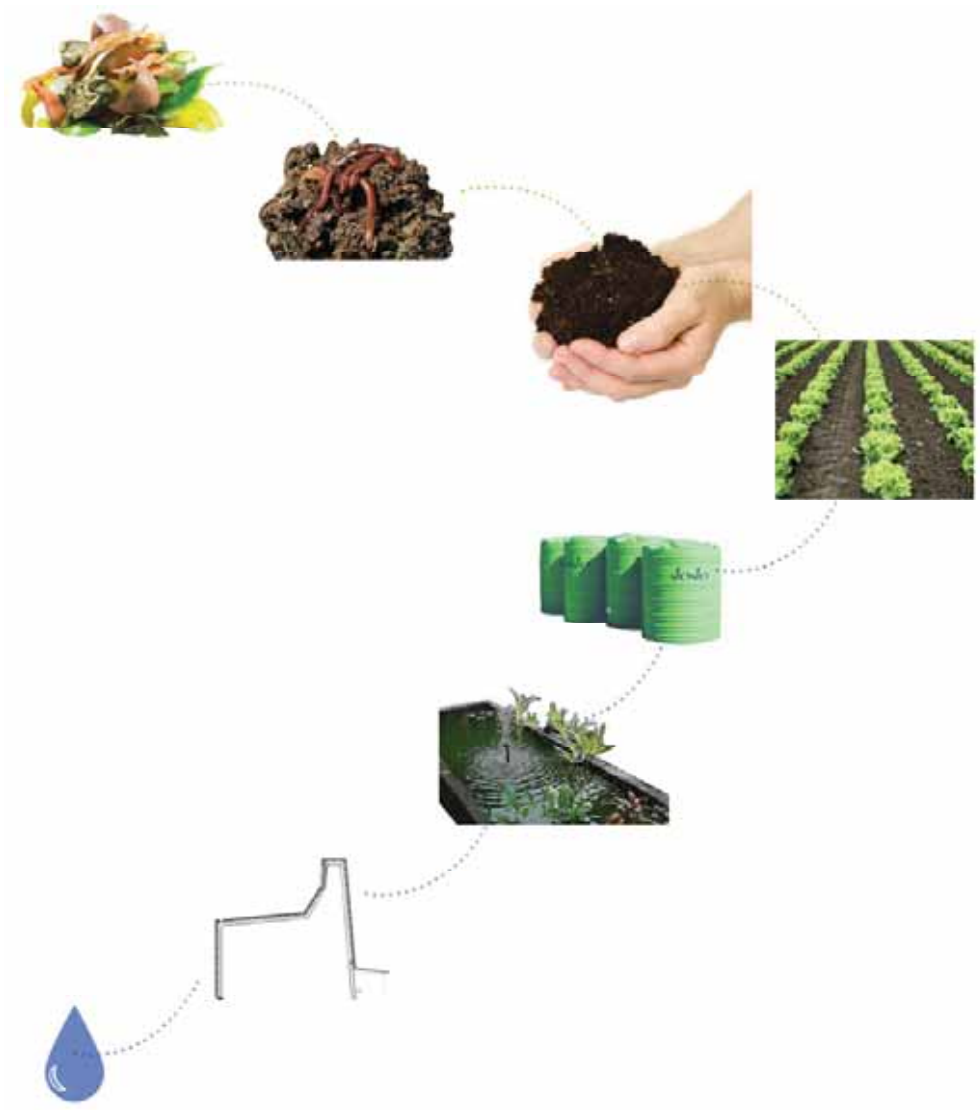


Fig. 7.8 Detail section to show temperature control (Aphane View Architects, 2012)

The construction of the greenhouse was studied as the internal requirements are also of a specific nature. The structure comprises a steel portal frame, protected glass panels and a layer of steel specimesh over it to protect from the elements.

7.4 Systems

Earthworm tunnel composting



Rainwater harvesting and treatment

Fig. 7.8 Diagram of two recycling systems (Author, 2012)

7.4.1 Rainwater treatment

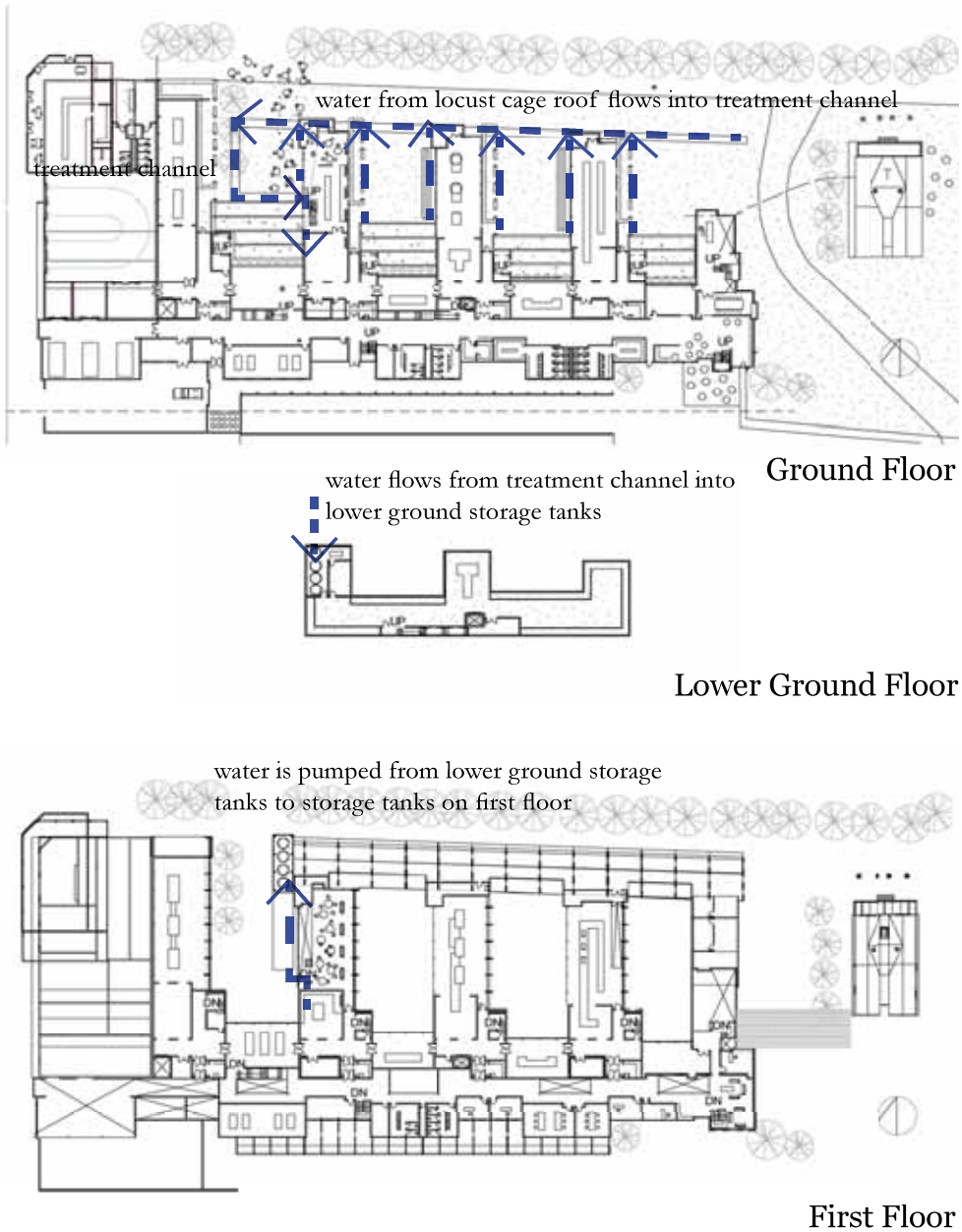


Fig. 7.9 Rainwater harvesting and storage (Author, 2012)

7.4.2 Earthworm composting

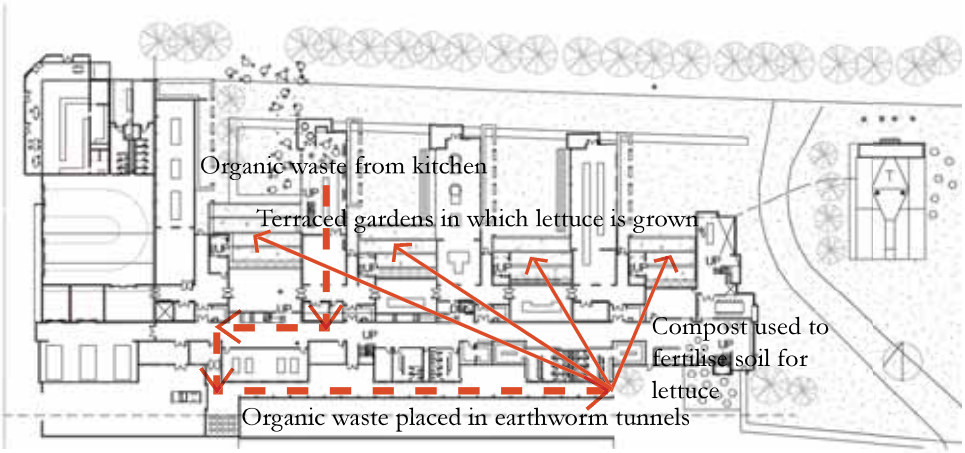
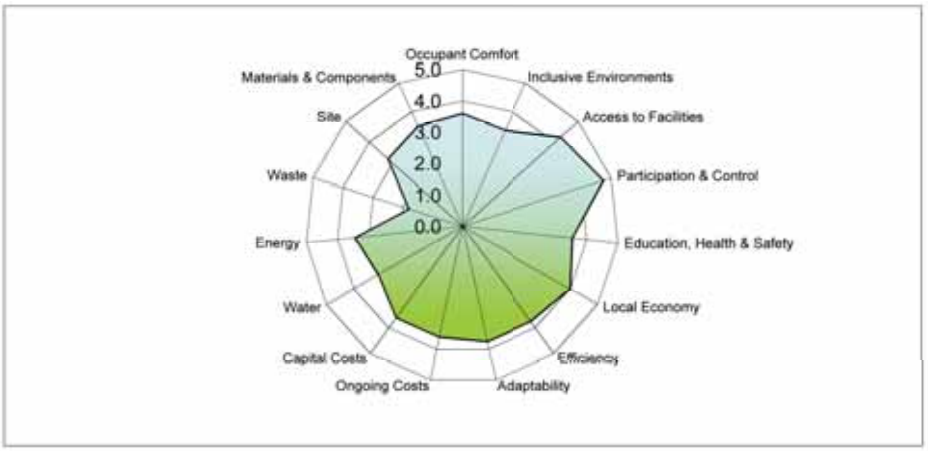


Fig. 7.10 Cycles of earthworm composting (Author, 2012)

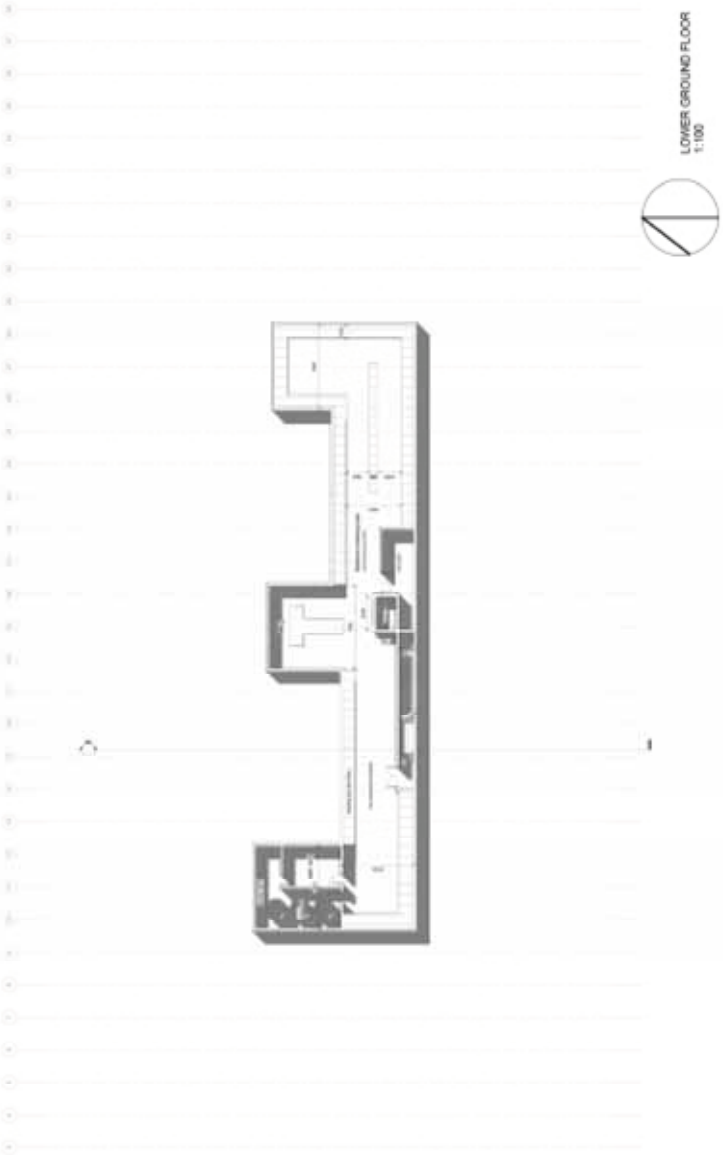
SBAT rating tool

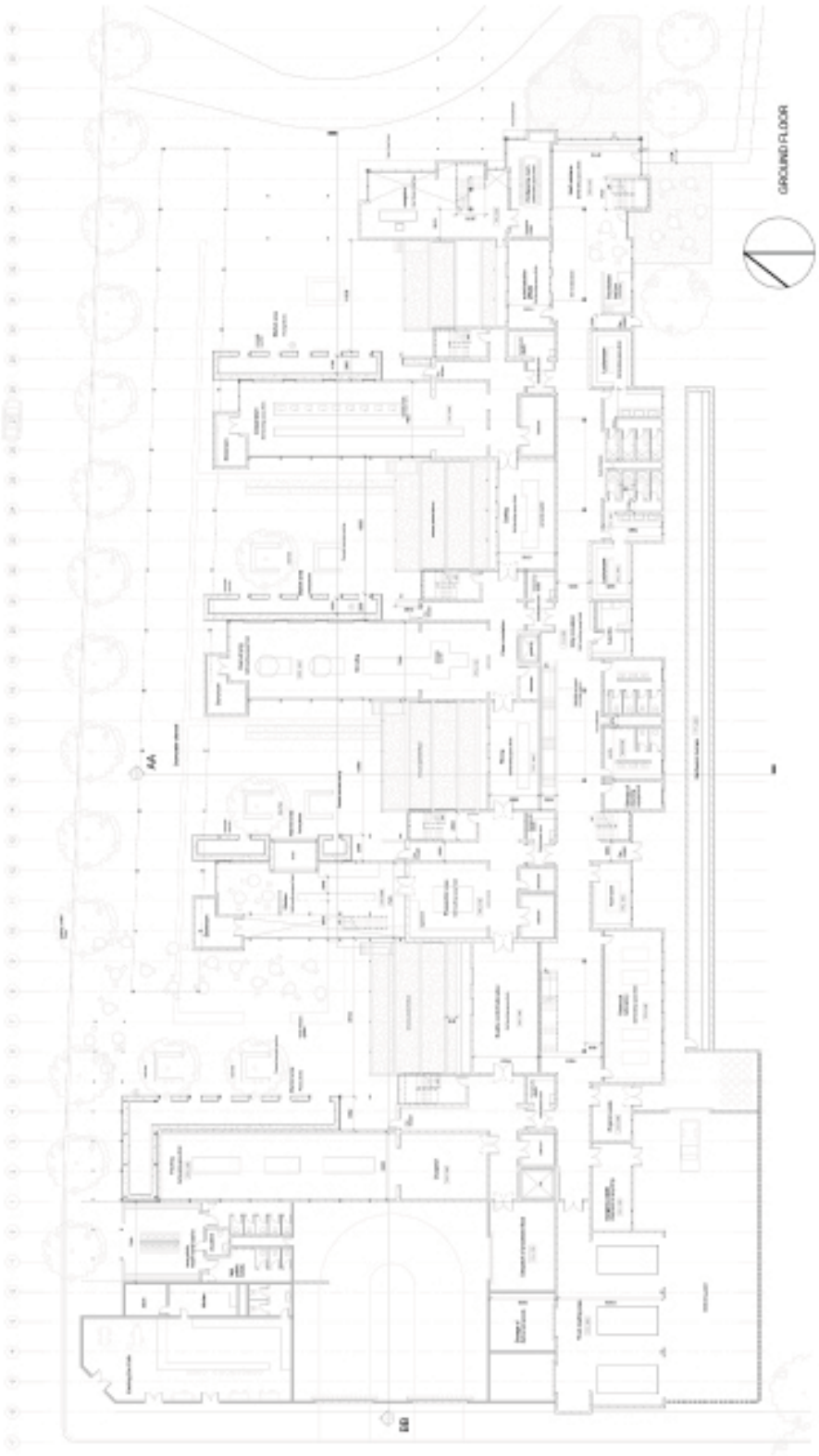


Social	3.9	Economic	3.7	Environmental	3.0

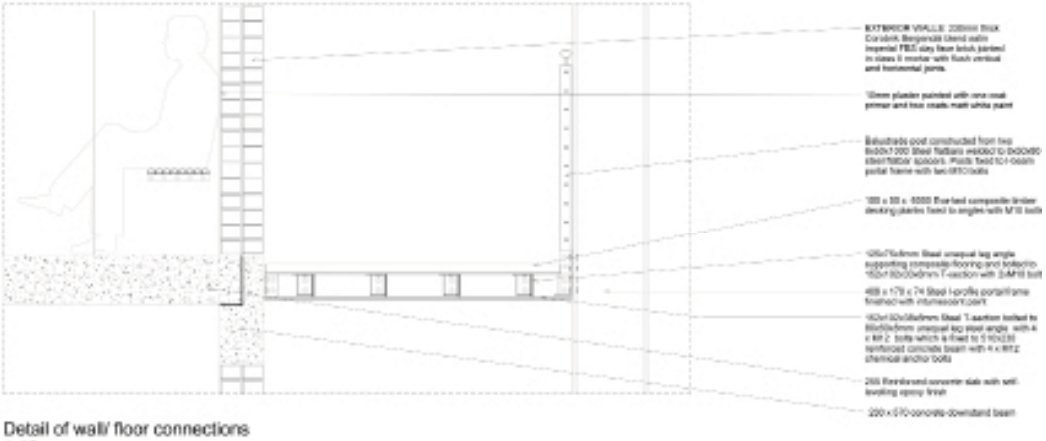
Overall	3.6

Final drawings

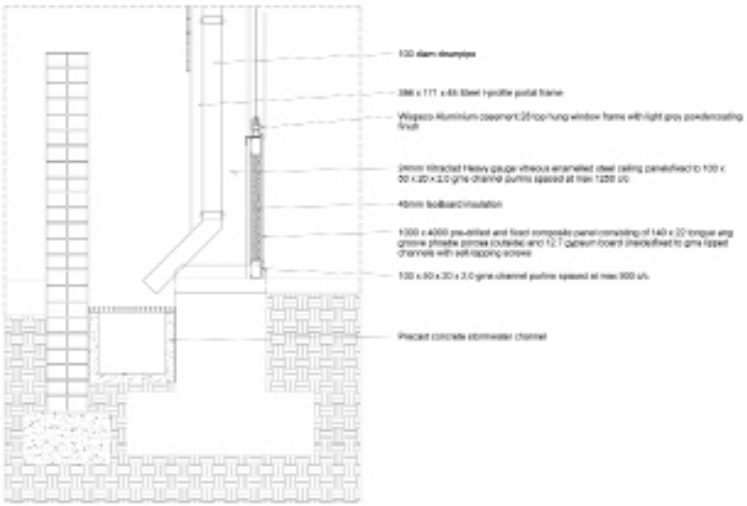

LOWER GROUND FLOOR
1:100


GROUND FLOOR


FIRST FLOOR
1:100
A
B



Detail of wall/ floor connections
1:10



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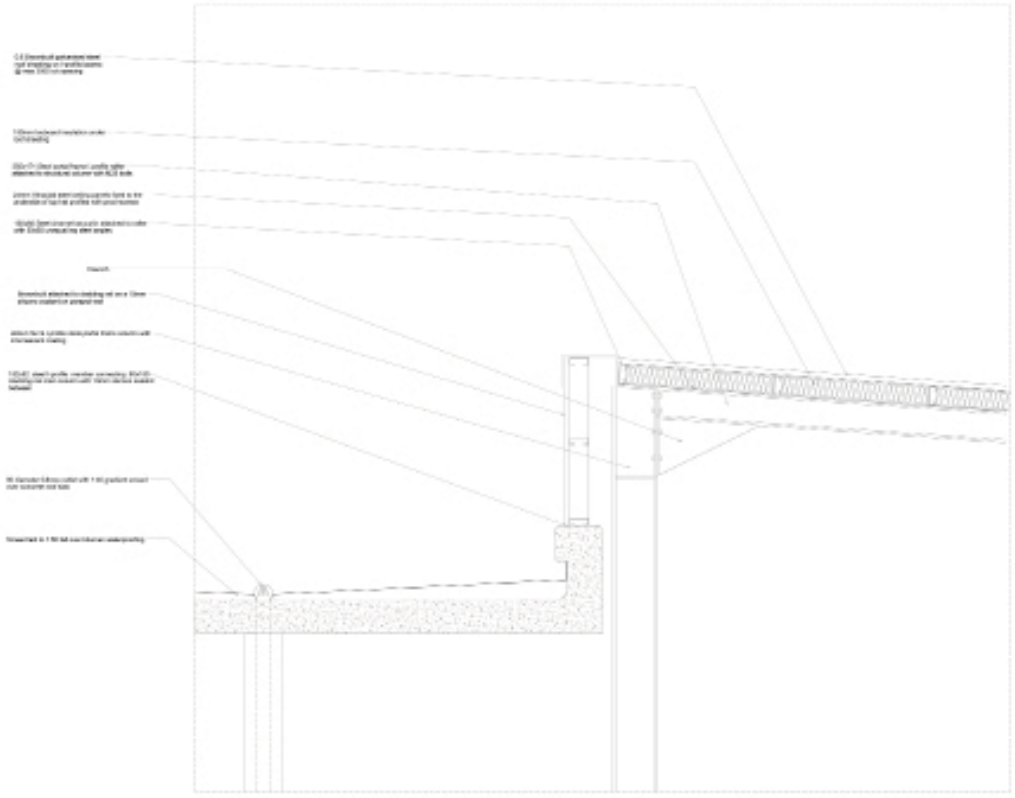
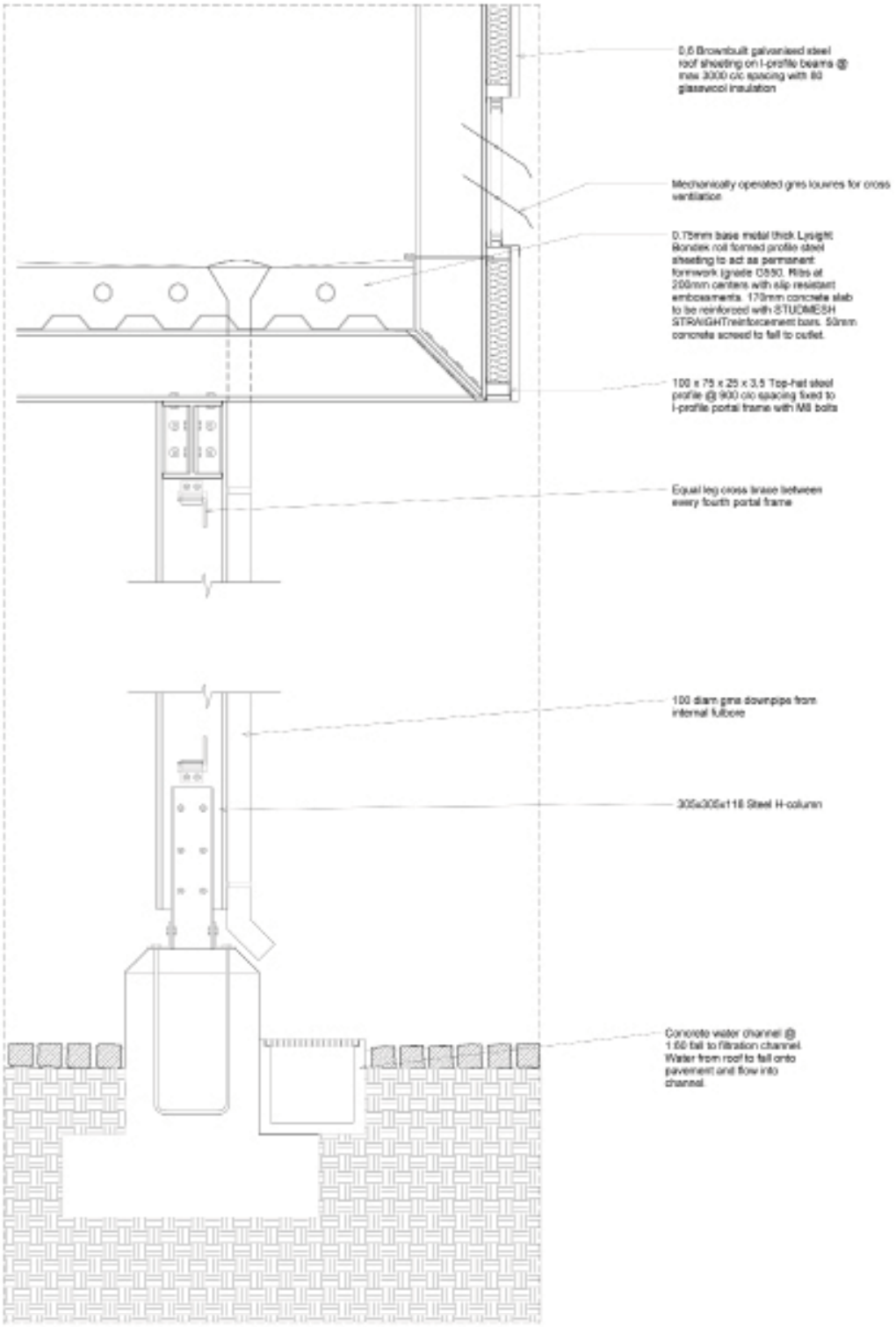
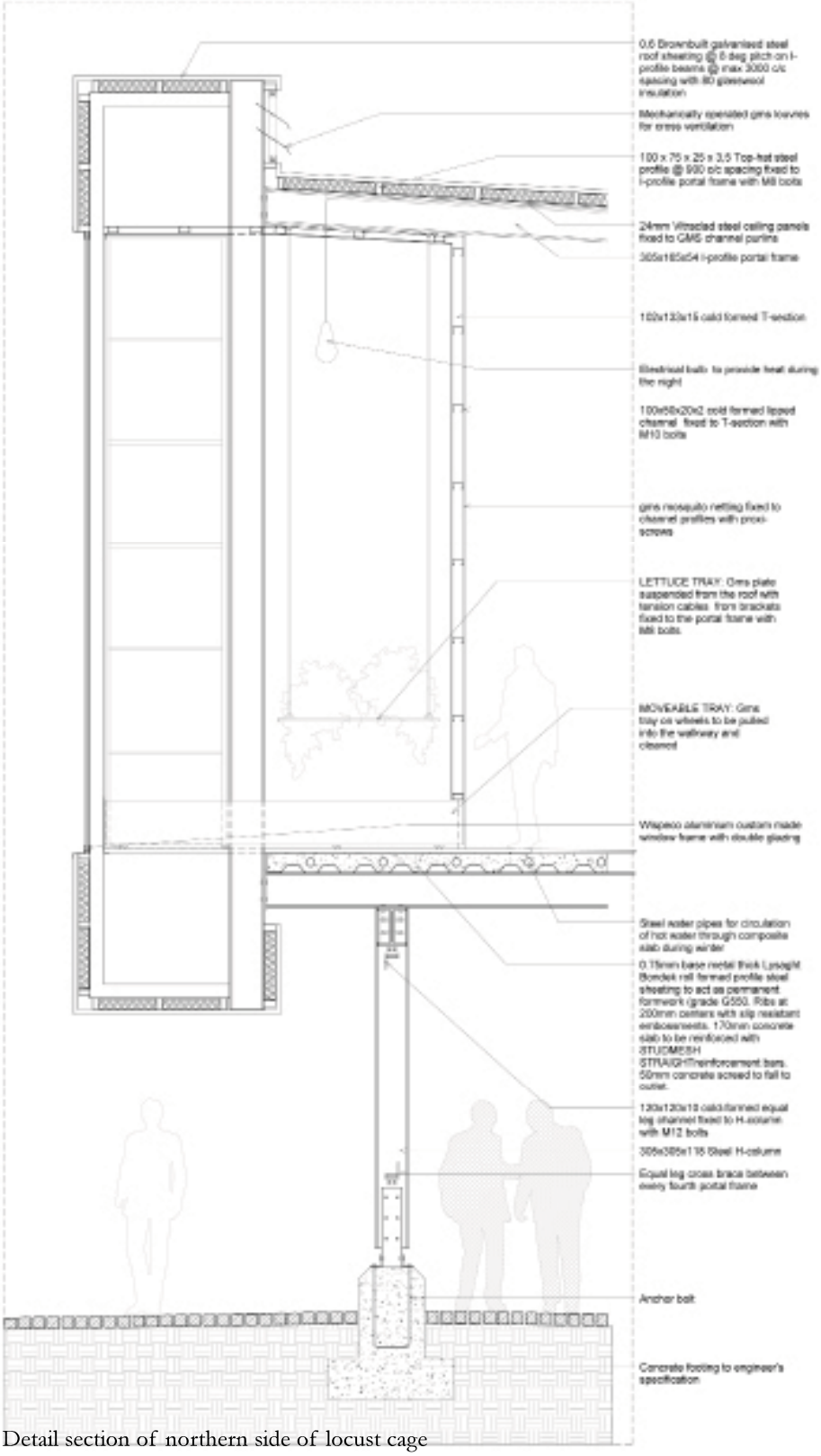


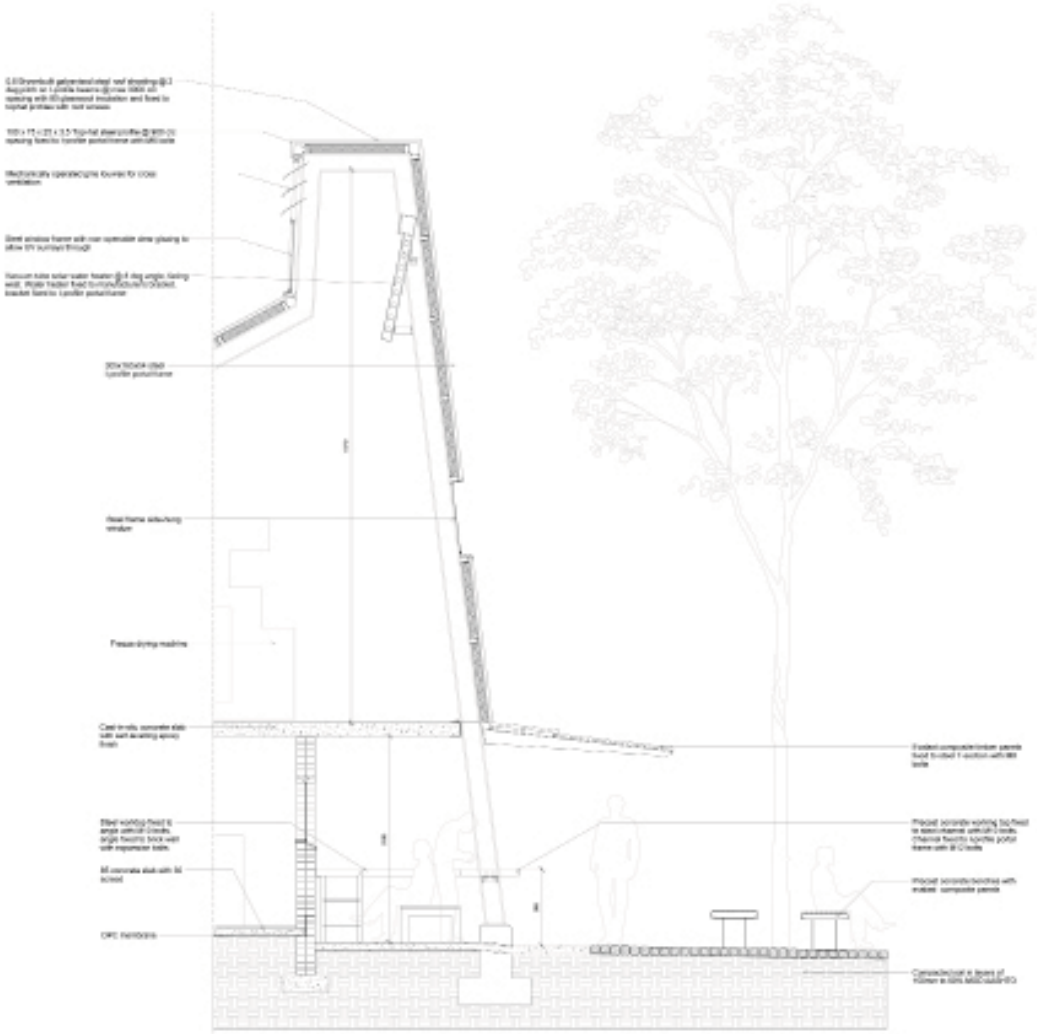
Detail BB



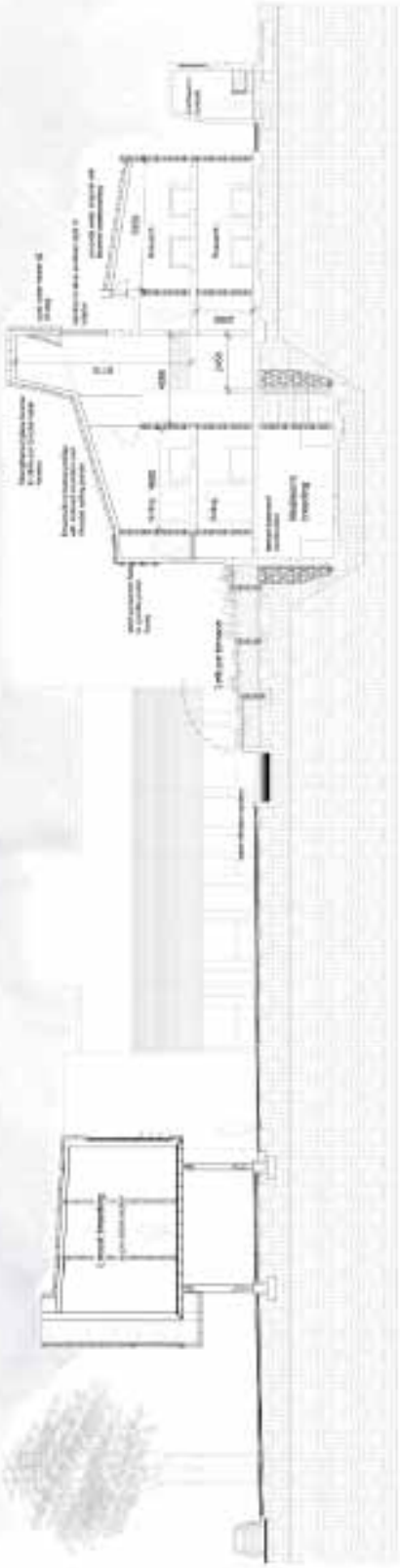
Detail of locust cage footing



Detail section of northern side of locust cage

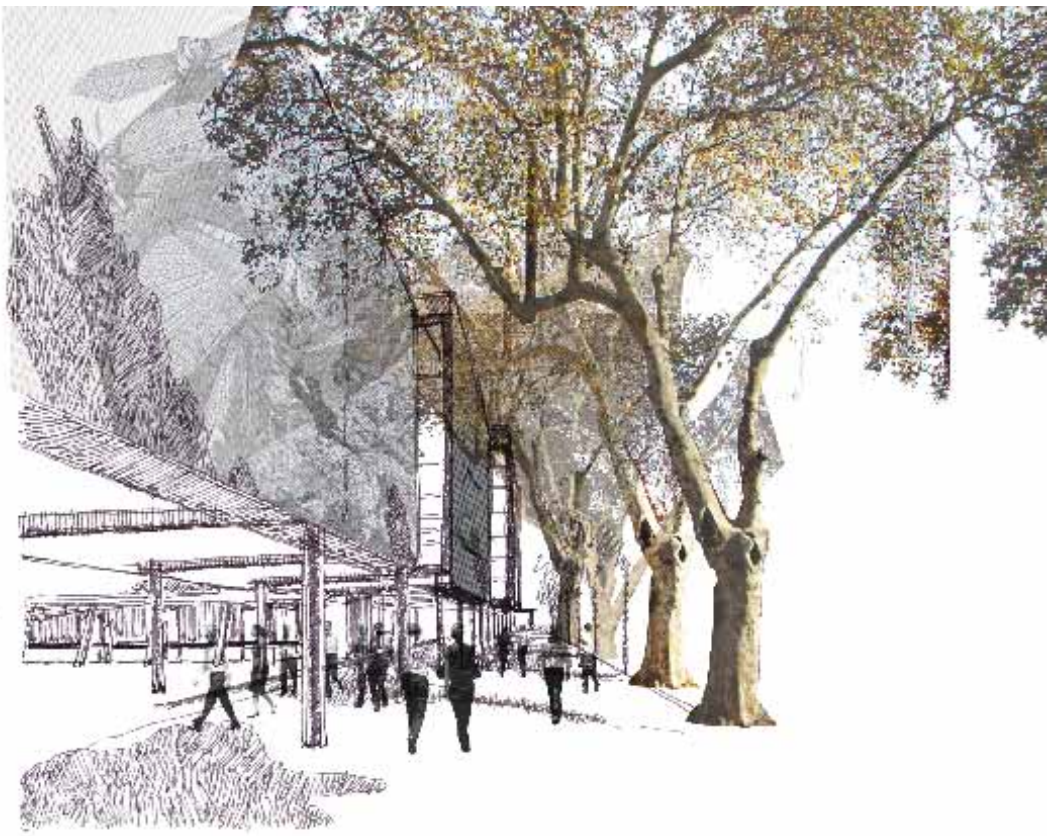


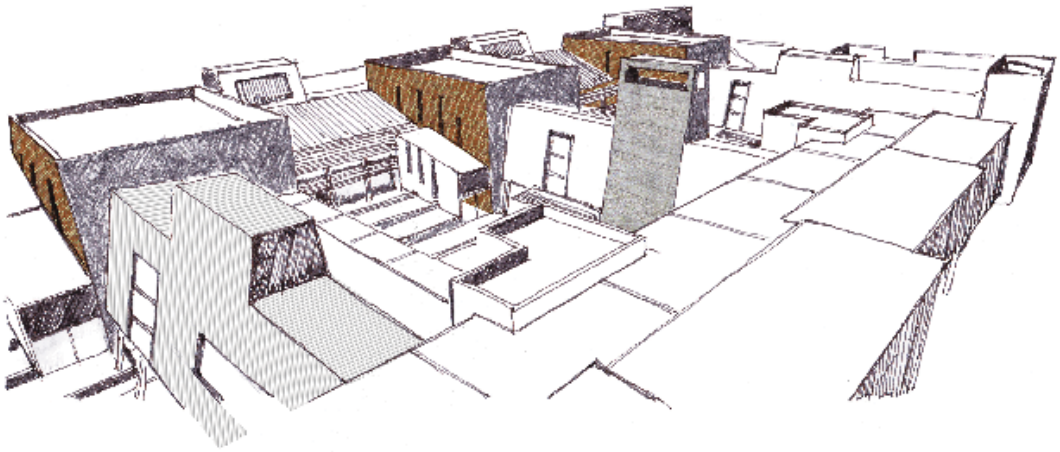
Detail section of market area

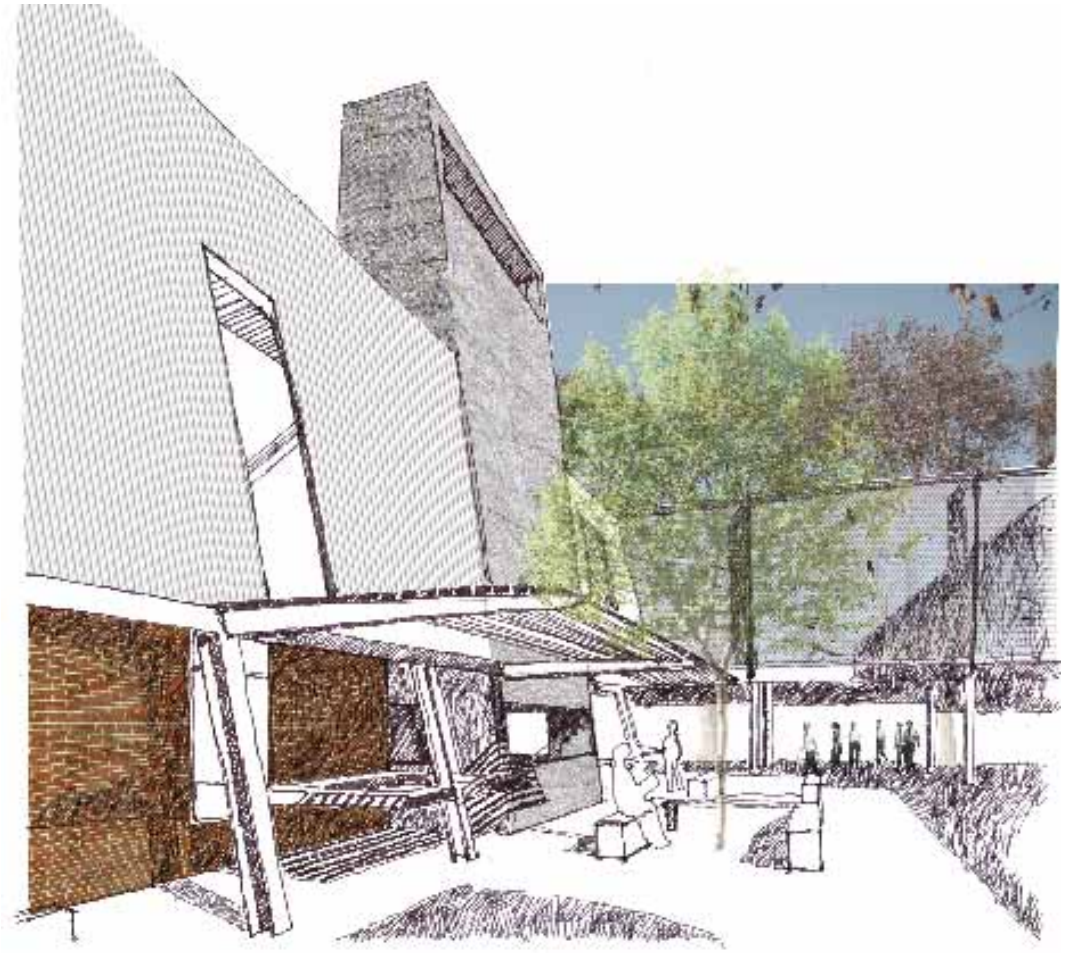


Section AA

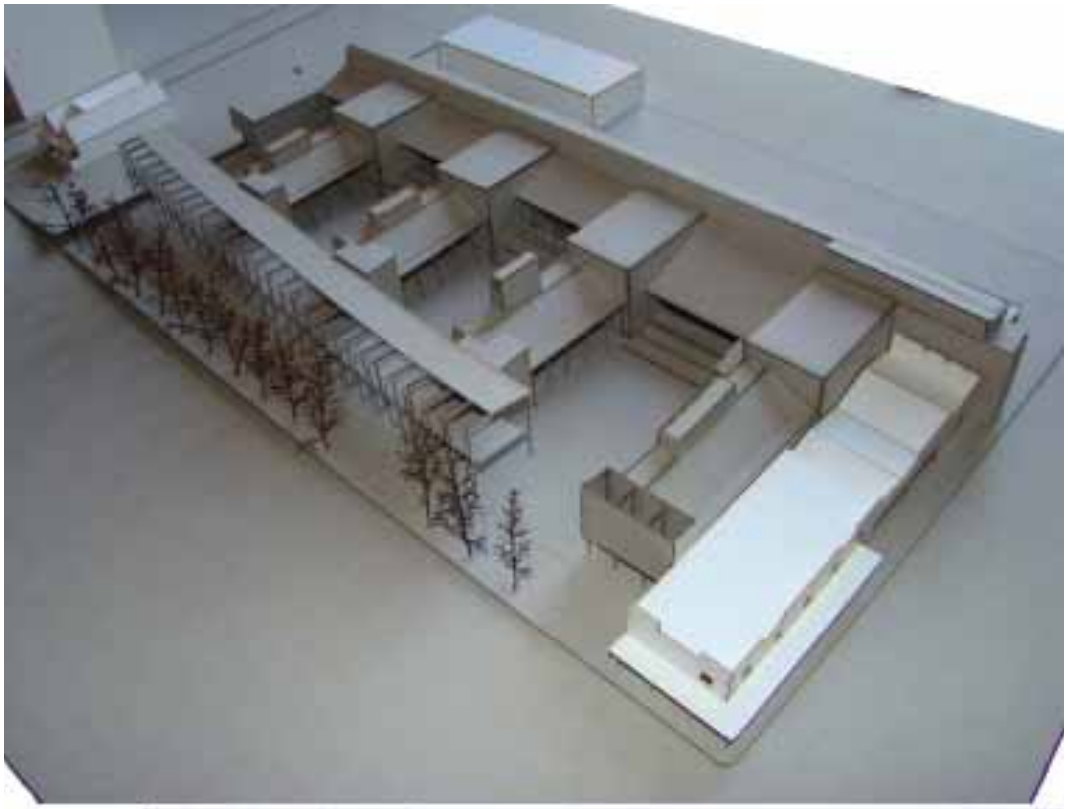
Section BB

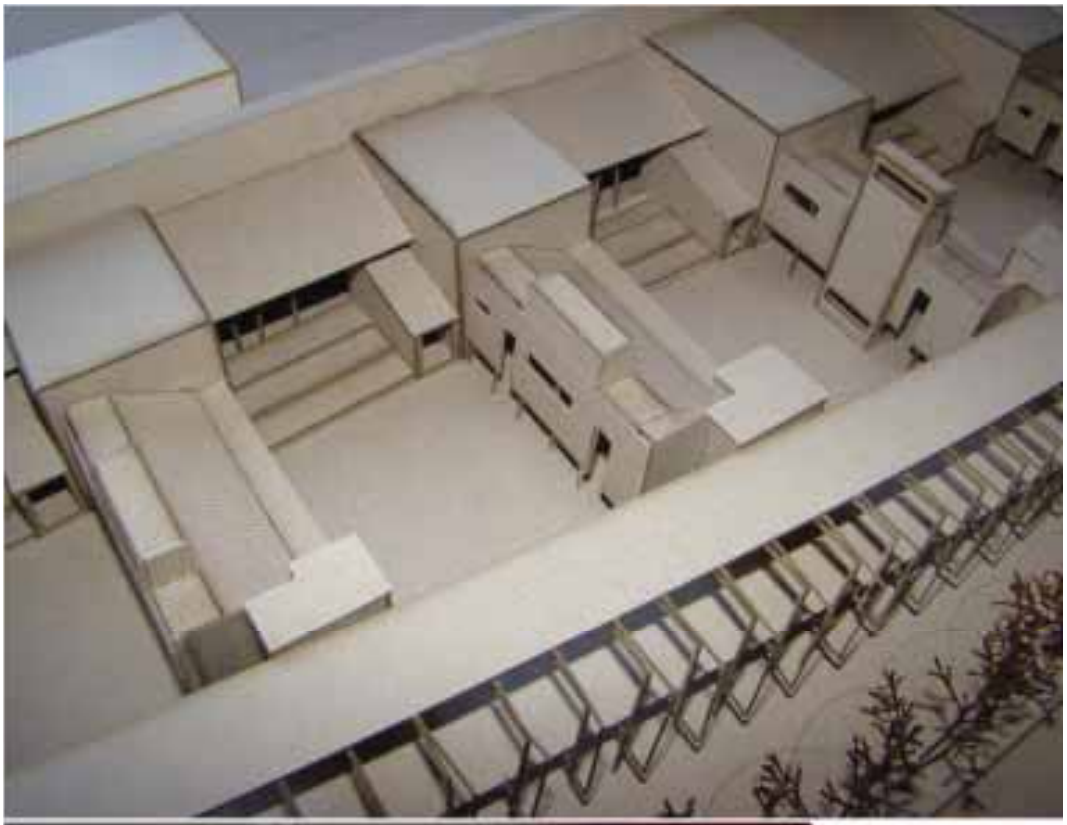






3D images (Author, 2012)





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