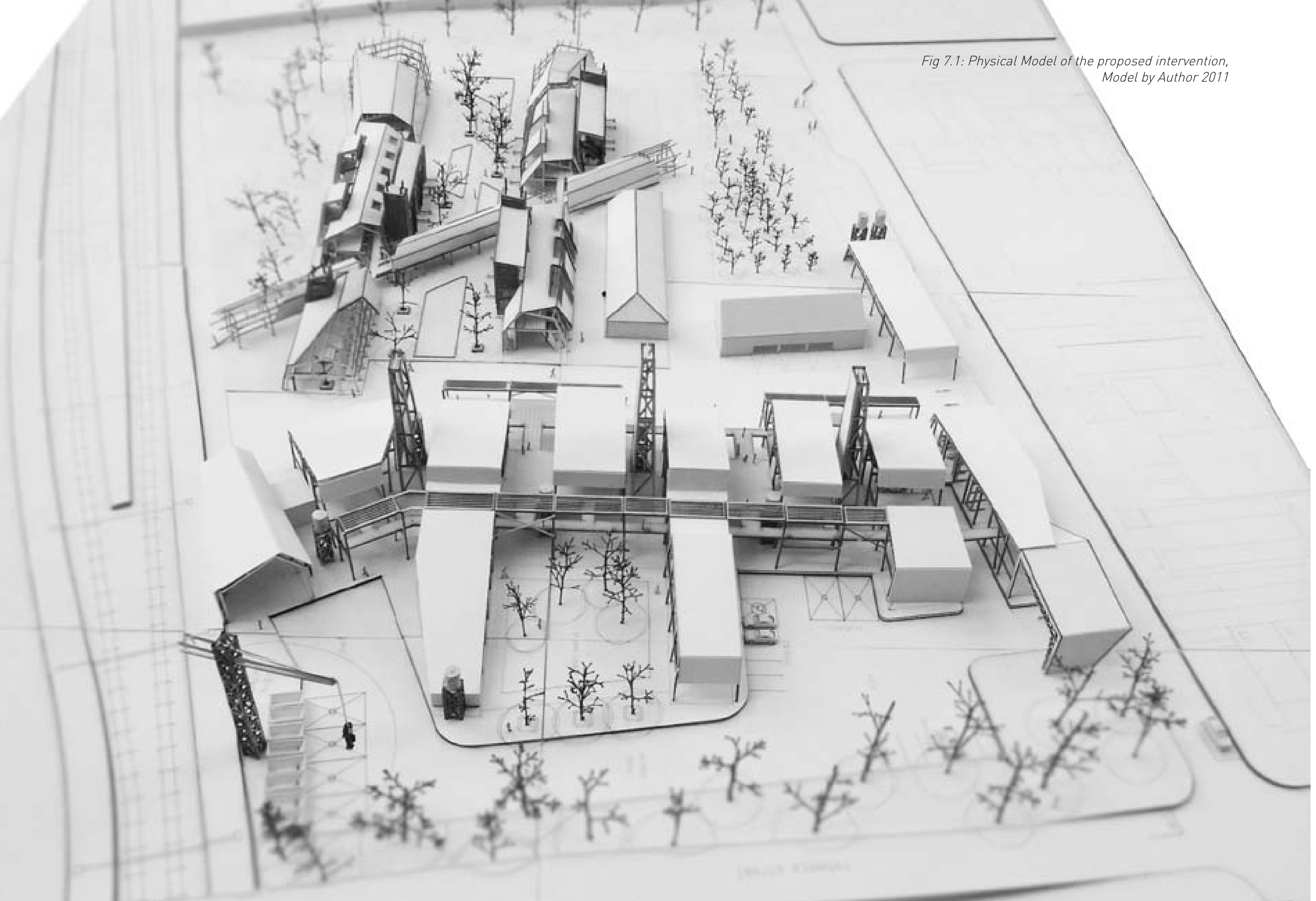


Fig 7.1: Physical Model of the proposed intervention,
Model by Author 2011

07 design solution & technical development

7.1 Design Solution

In this chapter the design of *Concept Model 3* will be developed further into a structure that presents the industrial and tectonic characteristics of the plant.

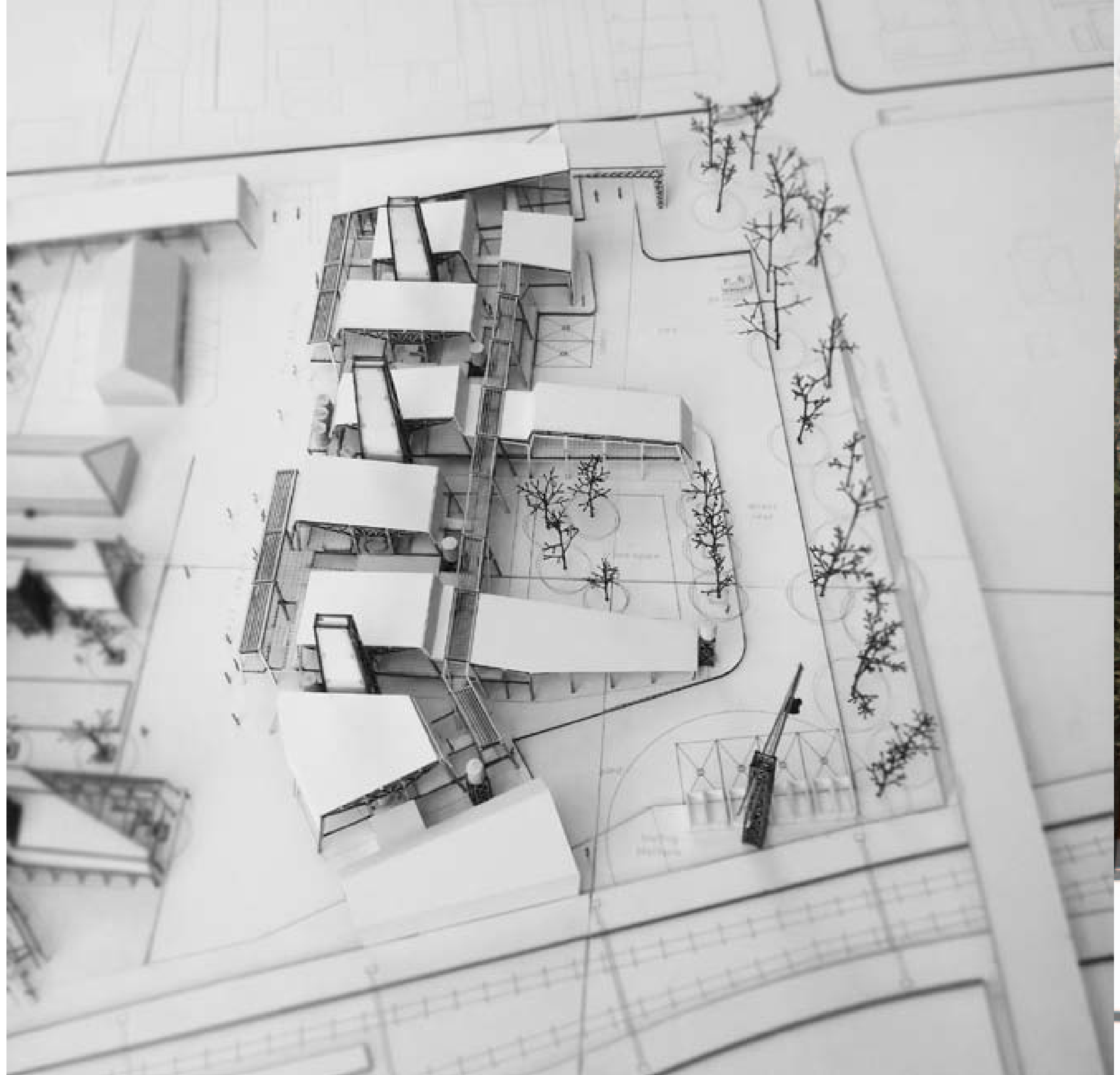


Fig 7.2: Physical Model of the proposed intervention, Model by Author 2011

3: Perspective view of the market area, Illustrated by Author 2011

Fig 7.4: Physical Model of the proposed intervention, Model by Author 2011

Fig 7.3: Proposed Vehicle Disassembly Plant within the surrounding context, Illustrated by Author 2011

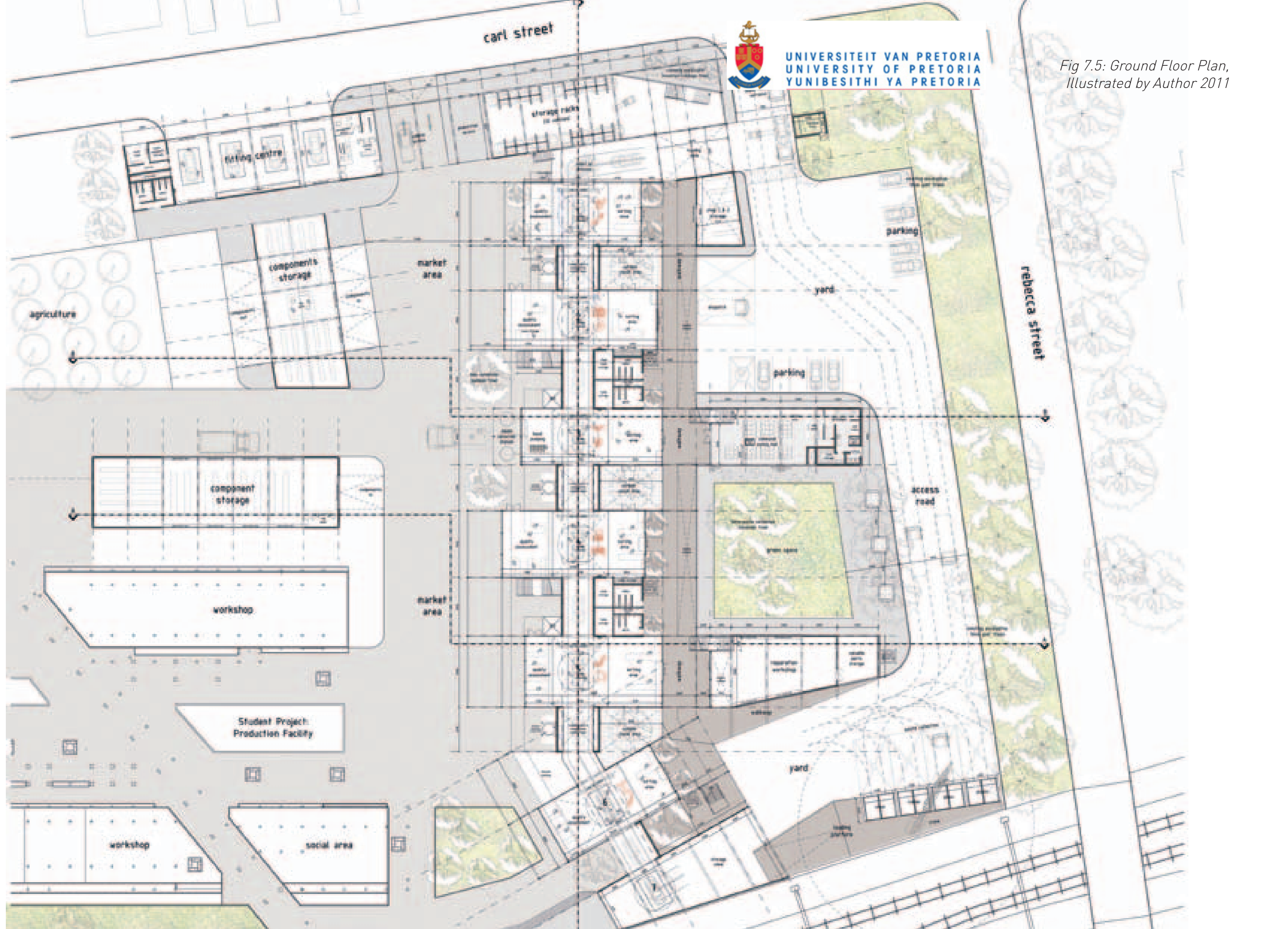


Fig 7.5: Ground Floor Plan, Illustrated by Author 2011

7.2 Technical Investigation

This investigation aims to illustrate the technical concept and how the structure and materials relate to the concept of disassembly. The focus during the technical investigation phase of the study was the following:

- Material choice and application
- Composition of the primary, secondary structural and ventilation (tower) systems
- Building systems - Sustainable active / passive systems
- Construction technology and detailing

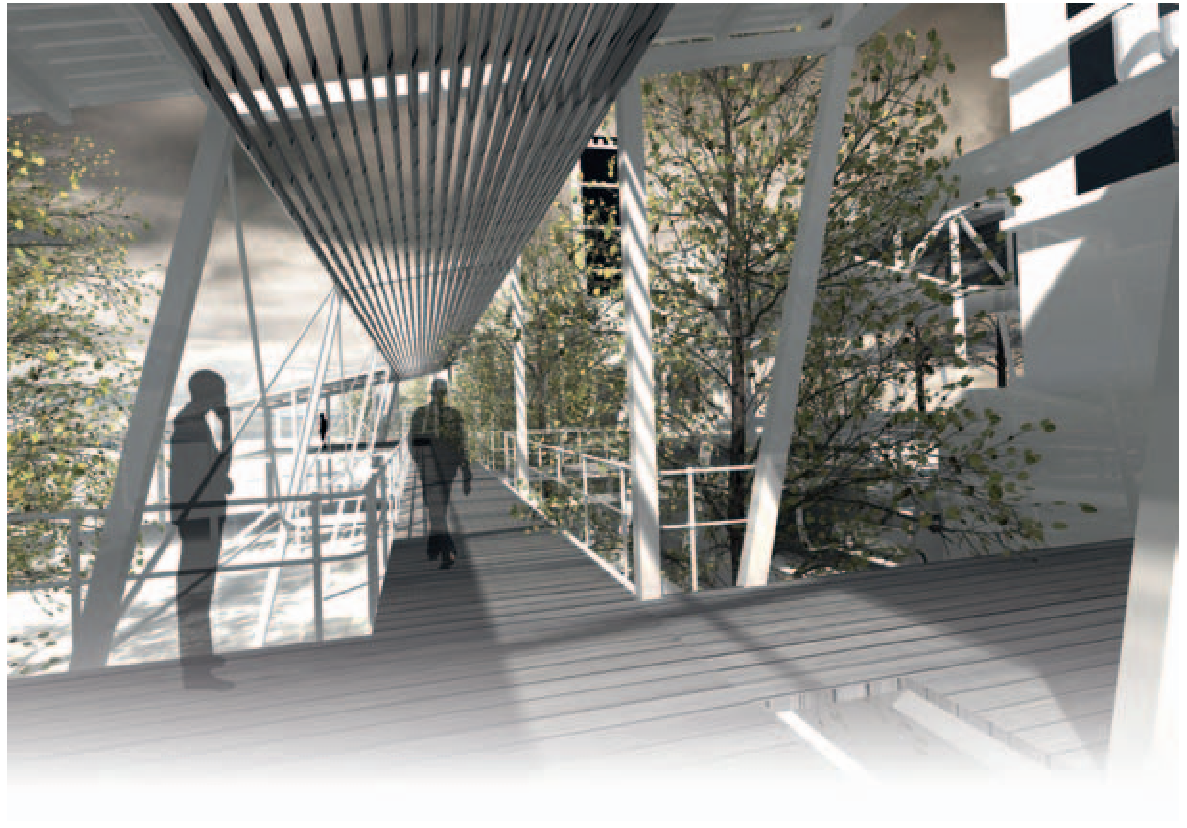


Fig 7.6: Perspective view of the circulation walkway, Illustrated by Author 2011

7.3 Technical Concept

The term, 'assembly', can be described as a group of machine parts that fit together to form a self-contained unit.

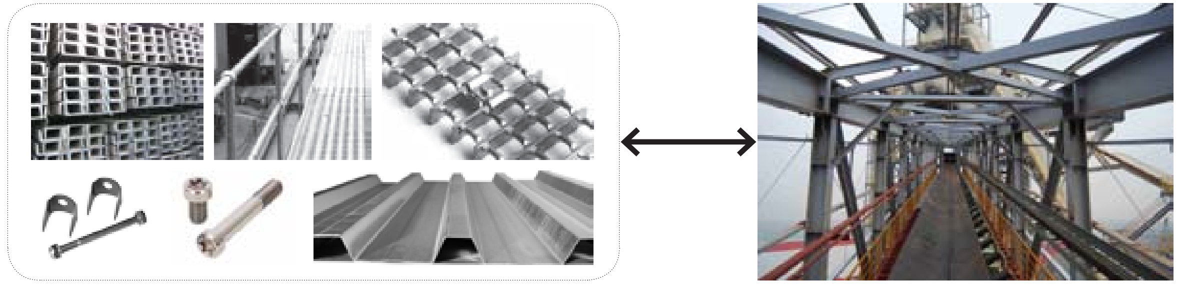
The technical concept is derived from the process of assembly, and disassembly, of a product (automobile/machine). Even though the definition of assembly is true for any building, the proposed structure aims to be disassembled with ease once the building reaches the end of its life-span.

Similar to an automobile, the proposed building is constructed by a series of elements, forming different components which function together as a whole.

The technical concept aims to tie in with the building program and the sustainability of project.

{assembly}

Fig 7.7: Supply chain with sub-tiers (Kieran and Timberlake 2004), Illustrated by Author 2011



{assembly} {disassembly}

Fig 7.8: Technical Concept of assembly and disassembly of the proposed structure (Andrew Mentis 2006), Illustrated by Author 2011

7.4 Material Choice and Finish

The material choice for the disassembly plant was determined by: the robust nature and durability, materials which can be re-used and assemble/disassembly with ease.

7.4.1 Steel:

Steel will be utilised as the primary load-bearing structure. The following attributes of steel substantiates its use in the proposed building:

• Steel is a product of service - It can be re-used in the same capacity once the building's life-span is complete.

• Steel is an economic building method, it has the following positive impacts on an industrial building when compared to a brick-and-mortar alternative: reduced construction time, reduced logistical costs due to the increasing fuel prices and a drastic reduction of rubble on building sites (Bernard 2008).

• Steel is sustainable and energy efficient - light steel frame buildings are considerably more energy-efficient than heavy construction methods with regard to embodied energy of the materials and components, operational energy relating to heating and cooling of the building over its life-span. While the embodied energy of high strength steel is significantly higher per kilogram than conventional building materials, a considerably lower mass of steel is used, resulting in low-steel construction to be vastly superior in this regard (Barnard 2008).

7.4.2 Timber:

Timber will be used to distinguish between the disassembly process and the socially related programs. The timber aims to incorporate a softer finish in contrast to the extensive use of steel.

Existing sleepers, used for the railway tracks in the abandoned train shunting yard, will be utilised as floor boards. The sleepers are cut into smaller planks and treated to increase durability.

7.4.3 Concrete and Masonry:

The two service cores of the disassembly line as well as sections of the worker's facilities wing consists of pre-cast, hollow-core concrete slabs with masonry infill. The slabs are laid on top of the steel structure and can be removed with the disassembly of the building.

The use of masonry has been kept to the minimum to accommodate the disassembly process of the structure.

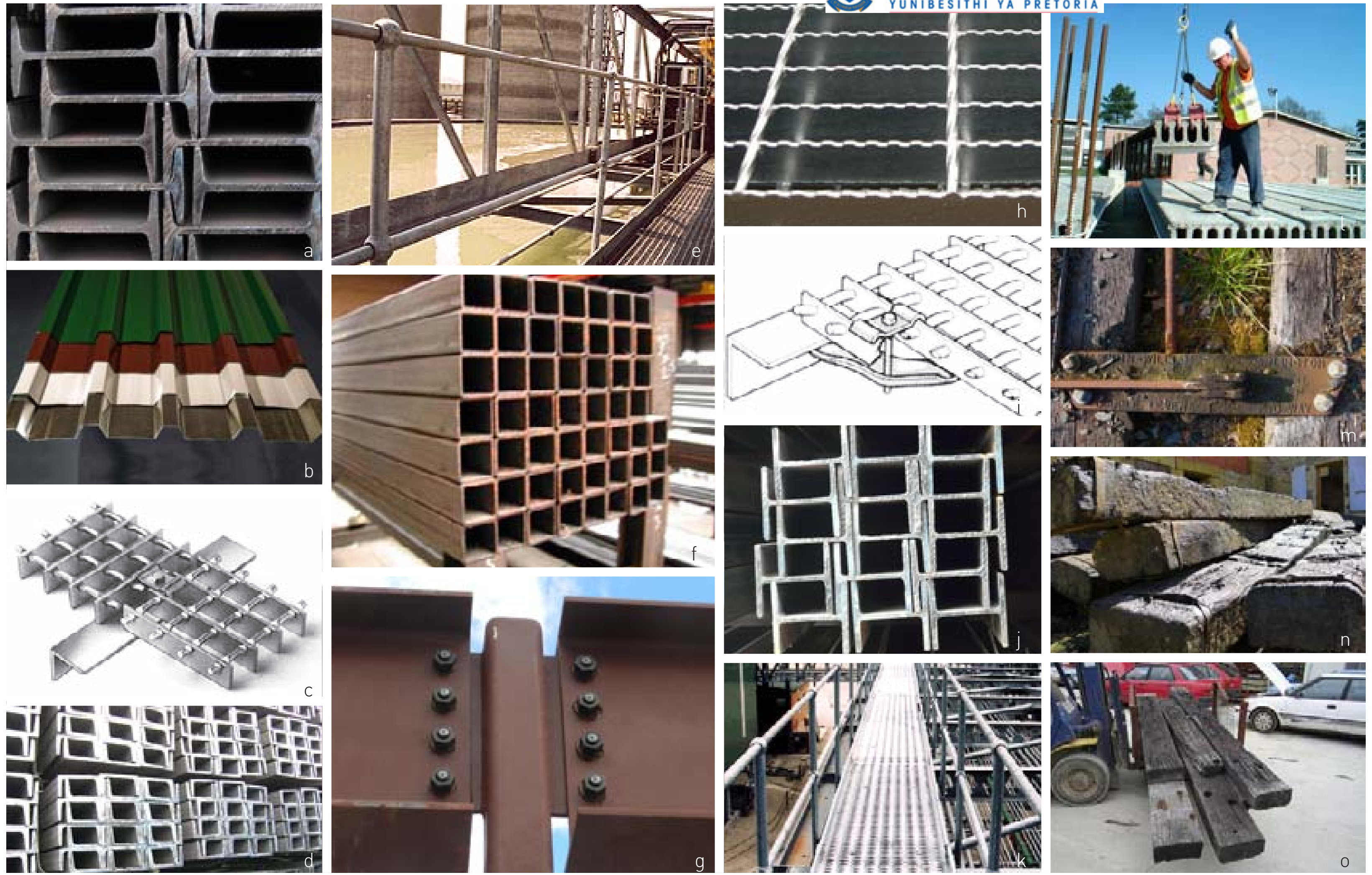


Fig 7.9: (a-k) Photo Collage of proposed steel elements (Andrew Mentis 2006)

Fig 7.10: (l) Pre-cast Conrete Slabs (British Precast 2007)

Fig 7.11: (m-o) Re-use of existing timber sleepers (Our French Garden 2010)

7.5 Structural Systems

The proposed structure consists of three main systems: the primary and secondary structural systems, and the ventilation tower structures (7.5).

7.5.1 Primary Structural System:

The primary structure acts as the core of each disassembly workshop. The roof structures of the disassembly workshops form the primary structural system. All the roof sections carry their loads independently.

However, these structures share the loads imposed by the disassembly line.

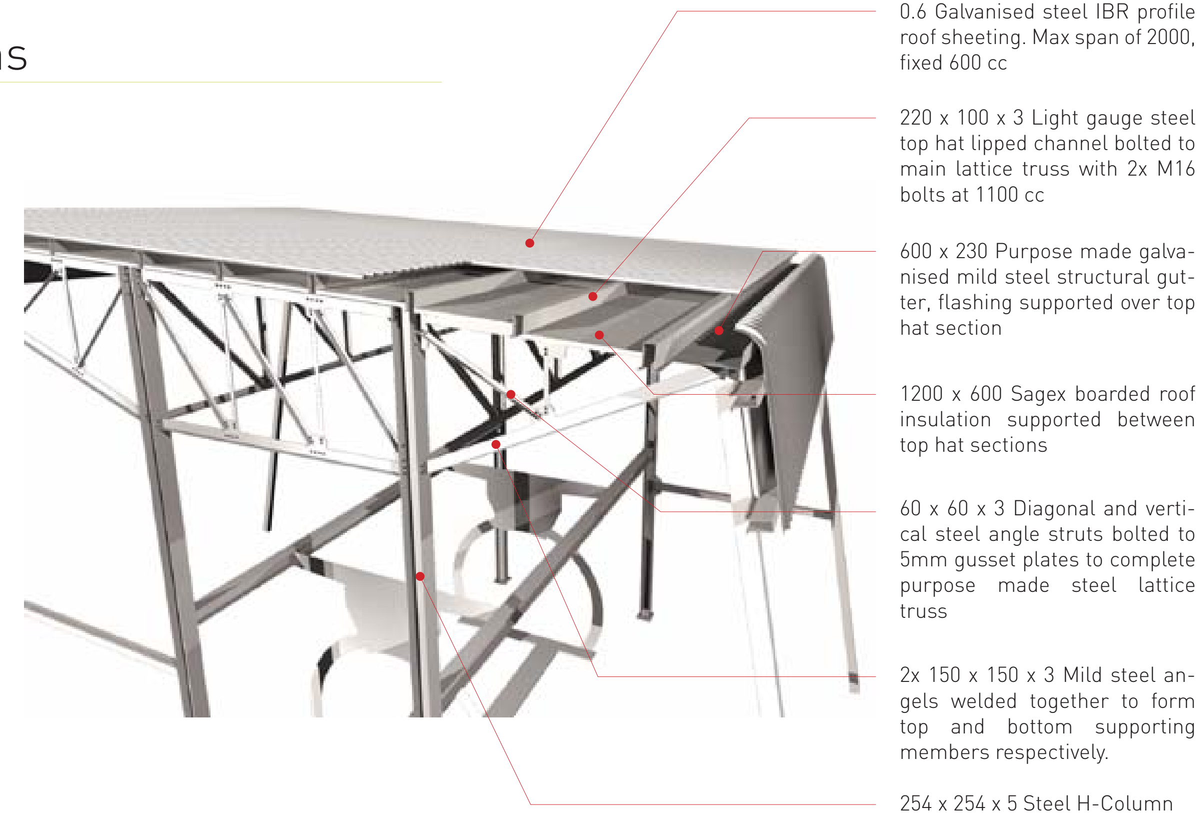


Fig 7.12: Perspective view of the primary structure's composition, Illustrated by Author 2011

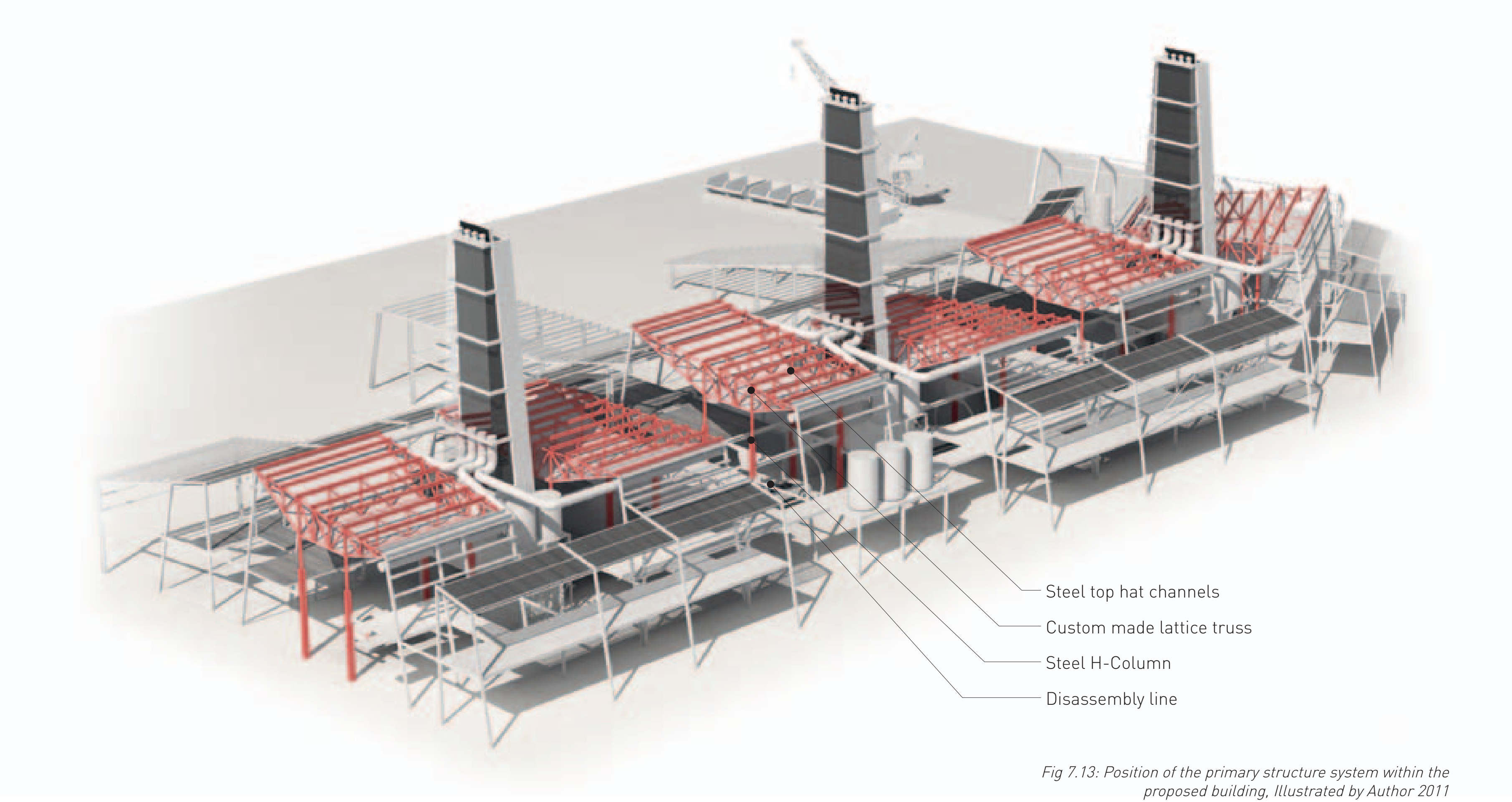


Fig 7.13: Position of the primary structure system within the proposed building, Illustrated by Author 2011

7.5.2 Secondary Structural System:

The secondary structure consists of a transparent light weight steel construction which latches onto the primary structure. The structure acts as a circulation space, provides areas for technical assistance and parts shops, and serves as a shading device for the building's eastern and western façades.

The secondary structure, or skin, wraps around the different workshops, binding the different stages of disassembly together as a whole. The skin structure is a composite system - steel, timber, mentis grating and polycarbonate sheeting.

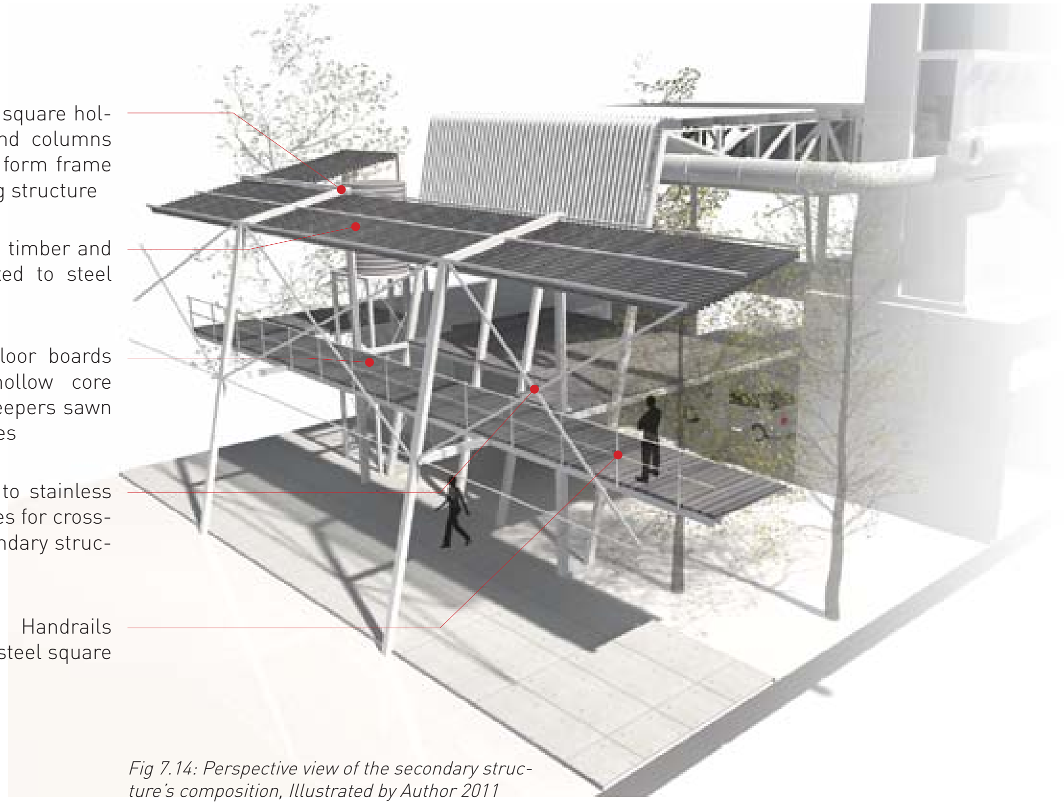


Fig 7.14: Perspective view of the secondary structure's composition, Illustrated by Author 2011

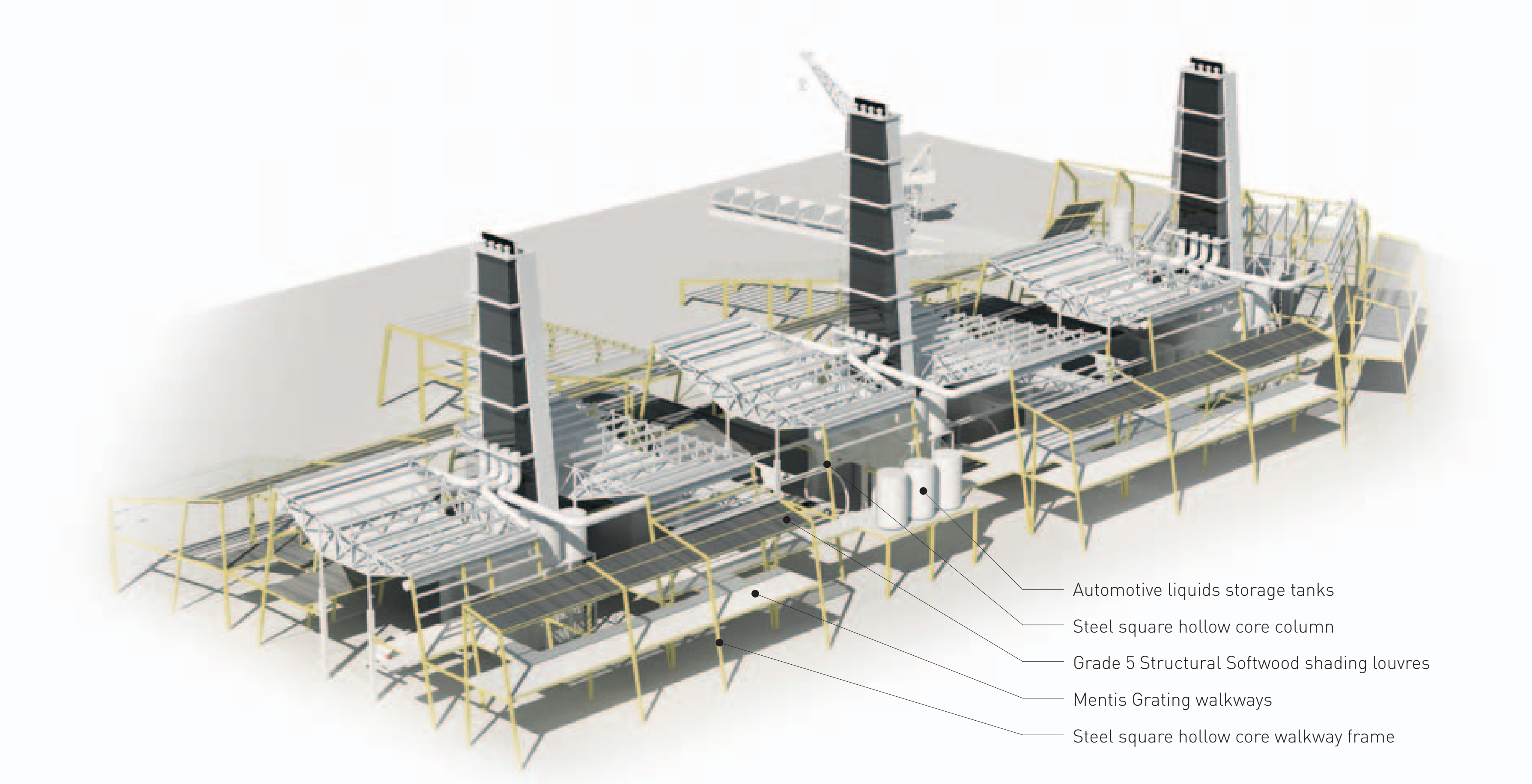
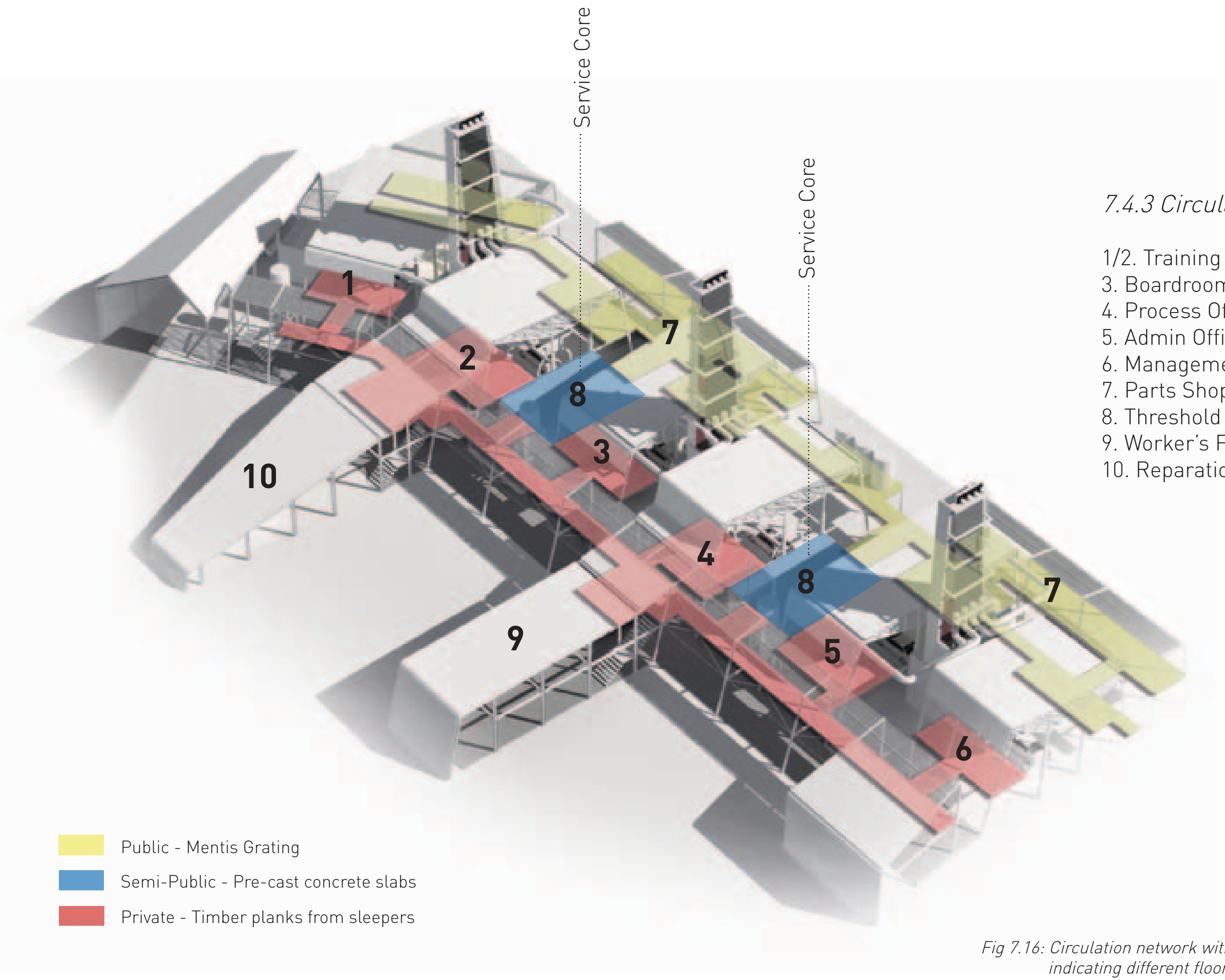


Fig 7.15: Position of the secondary structure system within the proposed building, Illustrated by Author 2011



7.4.3 Circulation Network (first floor)

1/2. Training Facilities
3. Boardroom
4. Process Office
5. Admin Office
6. Management Office
7. Parts Shops & Assistance
8. Threshold Space
9. Worker's Facilities
10. Reparation Workshop

Fig 7.16: Circulation network within the secondary structural system indicating different floor finishes, Illustrated by Author 2011

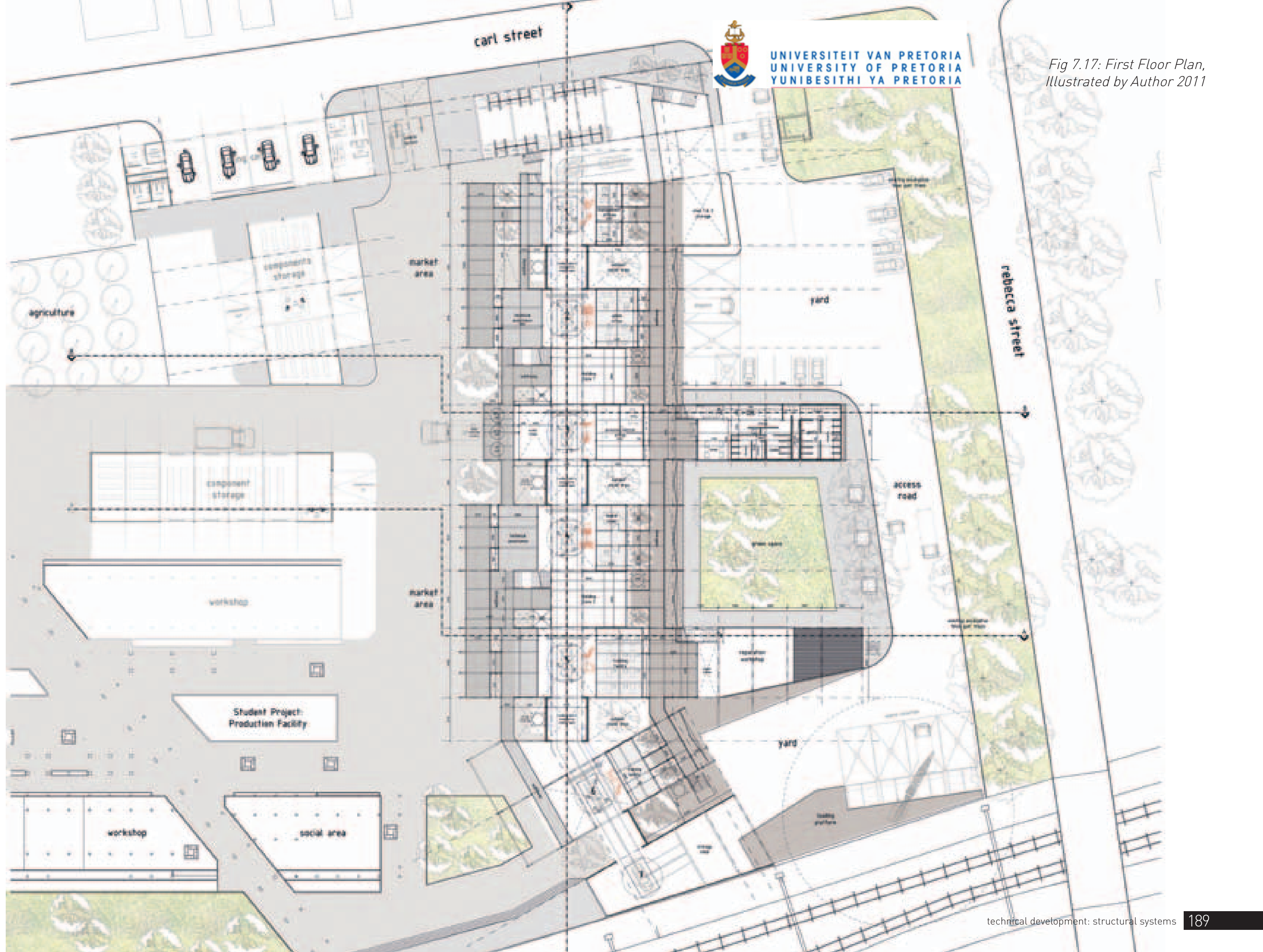


Fig 7.17: First Floor Plan, Illustrated by Author 2011

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7.6 Sustainable Active/Passive Systems

7.6.1 Ventilation Tower Structures:

Each of three towers ventilates two workshops. The ventilation system is a combination of active and passive systems:

• *Passive System*: The extraction of warm air is driven by a passive trombé stack system, which utilise the solar gain in the summer months. The system is situated on the northern face of the tower structure to ensure maximum exposure to the sun.

The system consists of a glass box where solar radiation is utilised to heat up the air in the northern face of the tower structure, causing the warm air to rise, which creates a negative air pressure (suction) in the workshops.

• *Active System*: The distribution of cool air is caused by an indirect evaporative cooling system, where ambient air is introduced into the building from the top of the tower (south) by a wind scoop and fan. The air is then cooled down by the evaporative cooling system and circulated through the workshops, creating a positive air pressure.

The two systems are designed to function together in order to achieve efficient ventilation throughout the building.

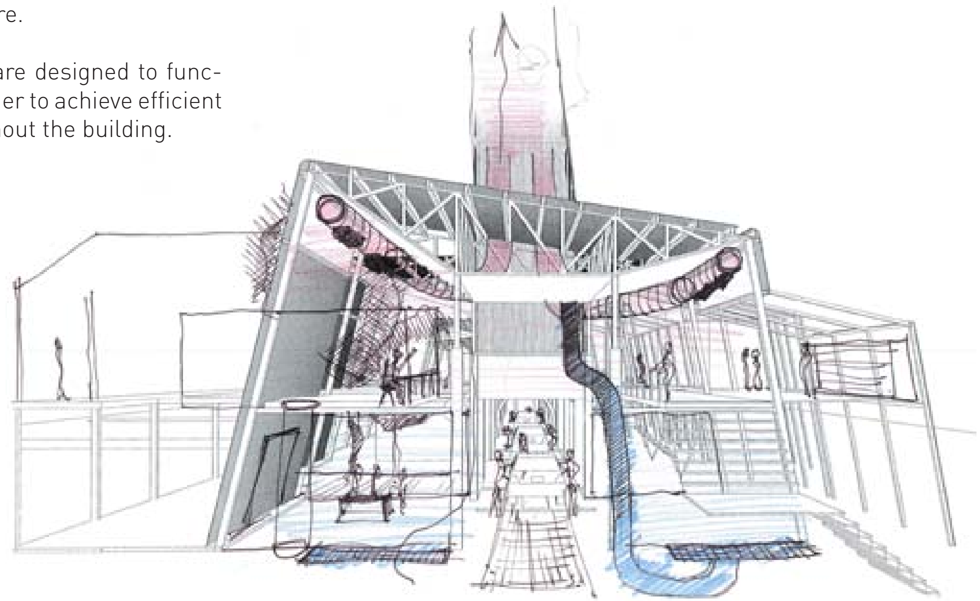


Fig 7.18: Conceptual section investigating the ventilation system, Illustrated by Author 2011

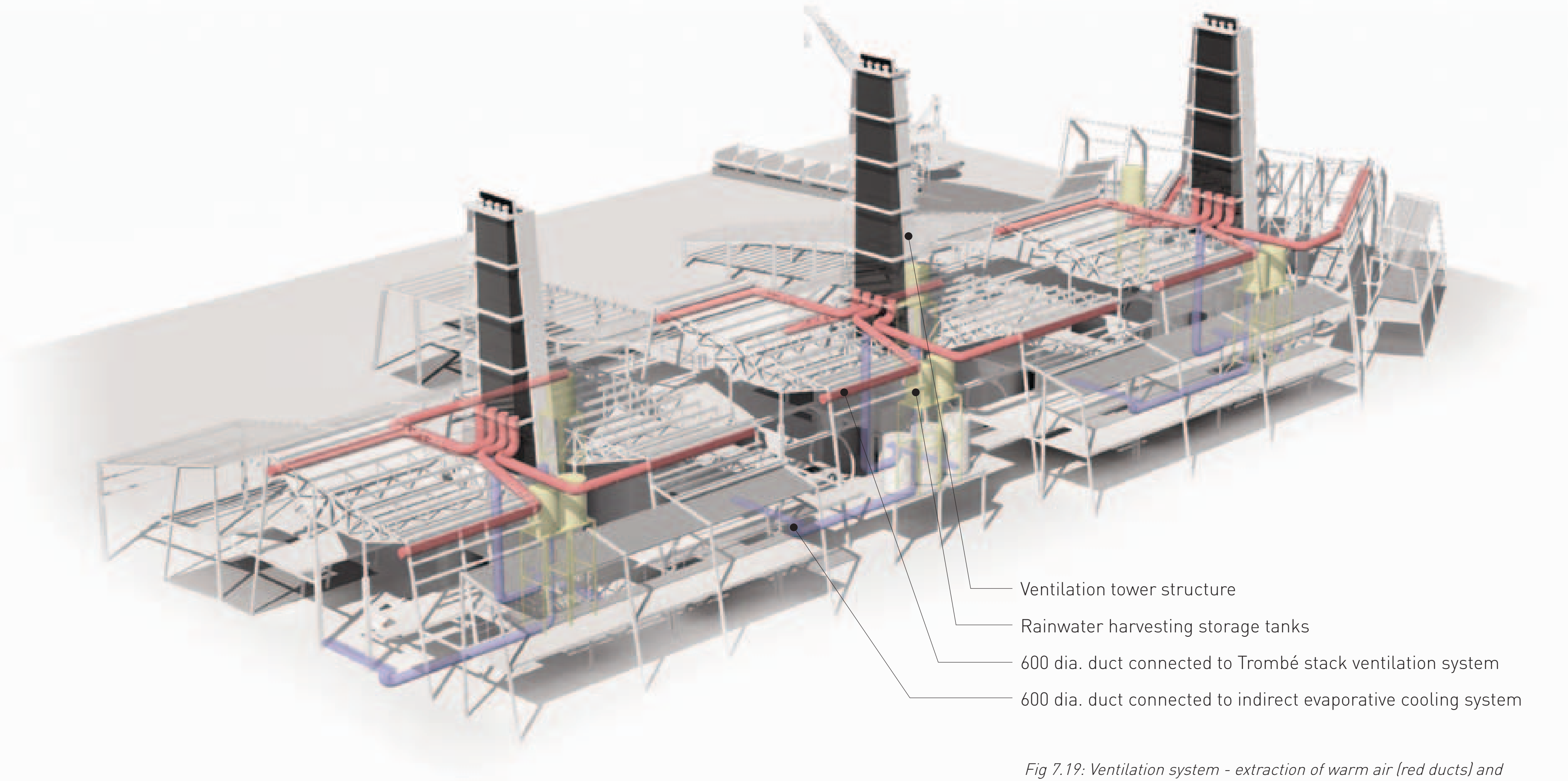


Fig 7.19: Ventilation system - extraction of warm air (red ducts) and distribution of cold air (blue ducts), Illustrated by Author 2011

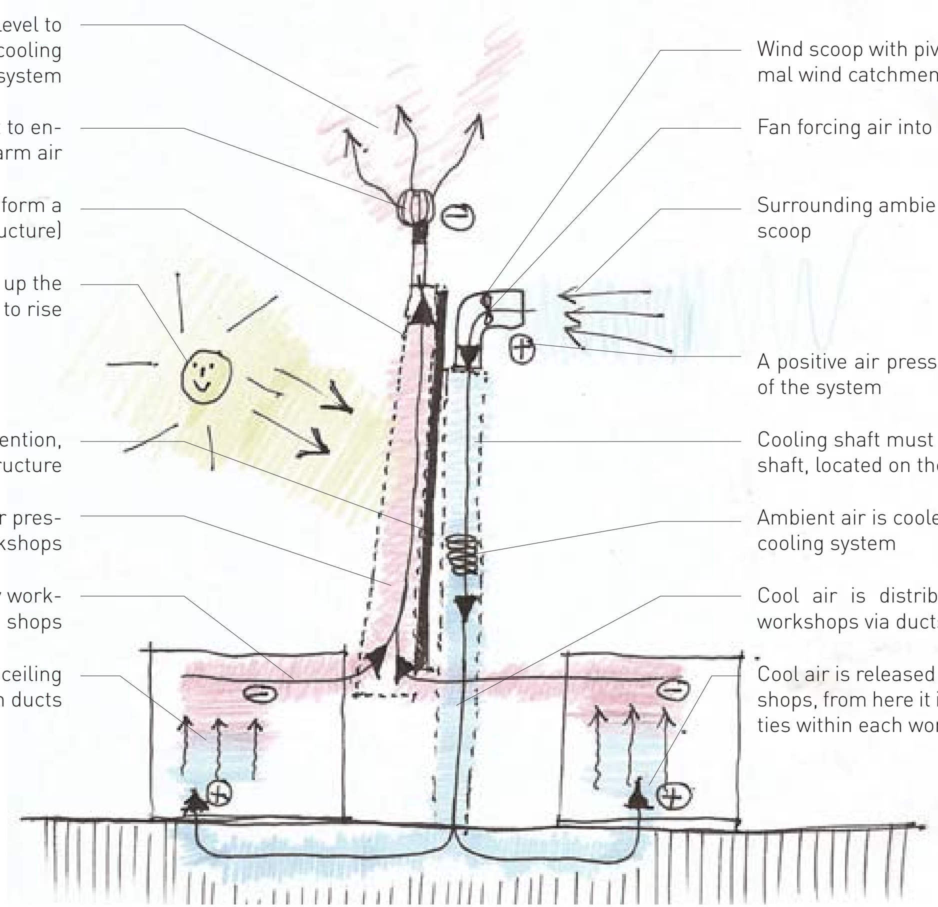


Fig 7.20: Diagram of the ventilation system and tower structure, Illustrated by Author 2011

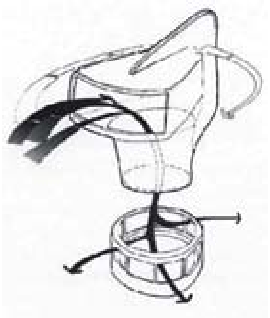


Fig 7.21: Wind scoop with pivot mechanism and fin (HVAC Systems 2001)

Fig 7.22: Whirlybirds mounted on top of shaft to encourage extraction of warm air (VentaNation 2005)

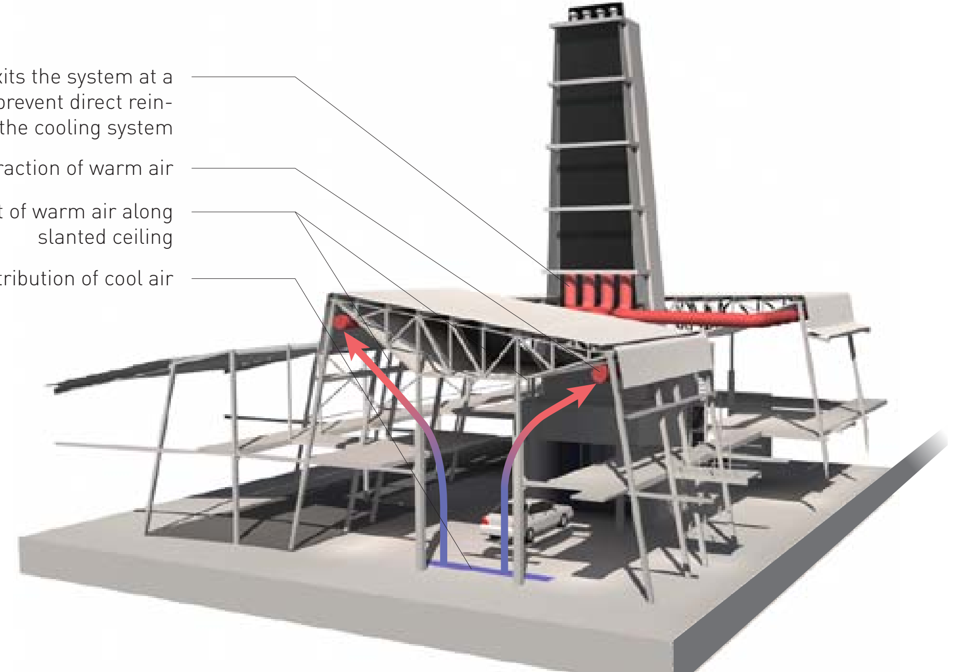


Fig 7.23: Circulation of air in a typical disassembly workshop, Illustrated by Author 2011

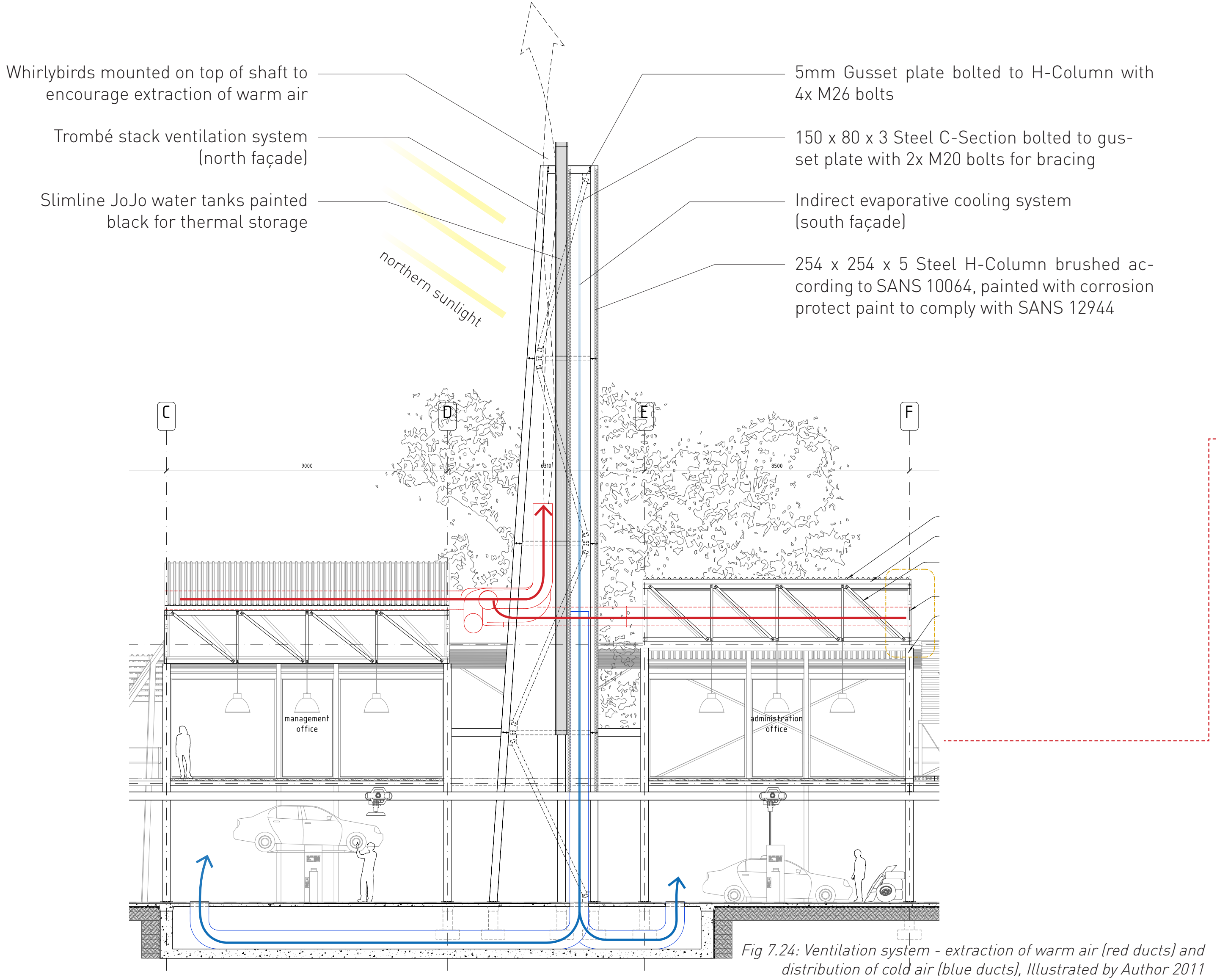


Fig 7.24: Ventilation system - extraction of warm air (red ducts) and distribution of cold air (blue ducts), Illustrated by Author 2011

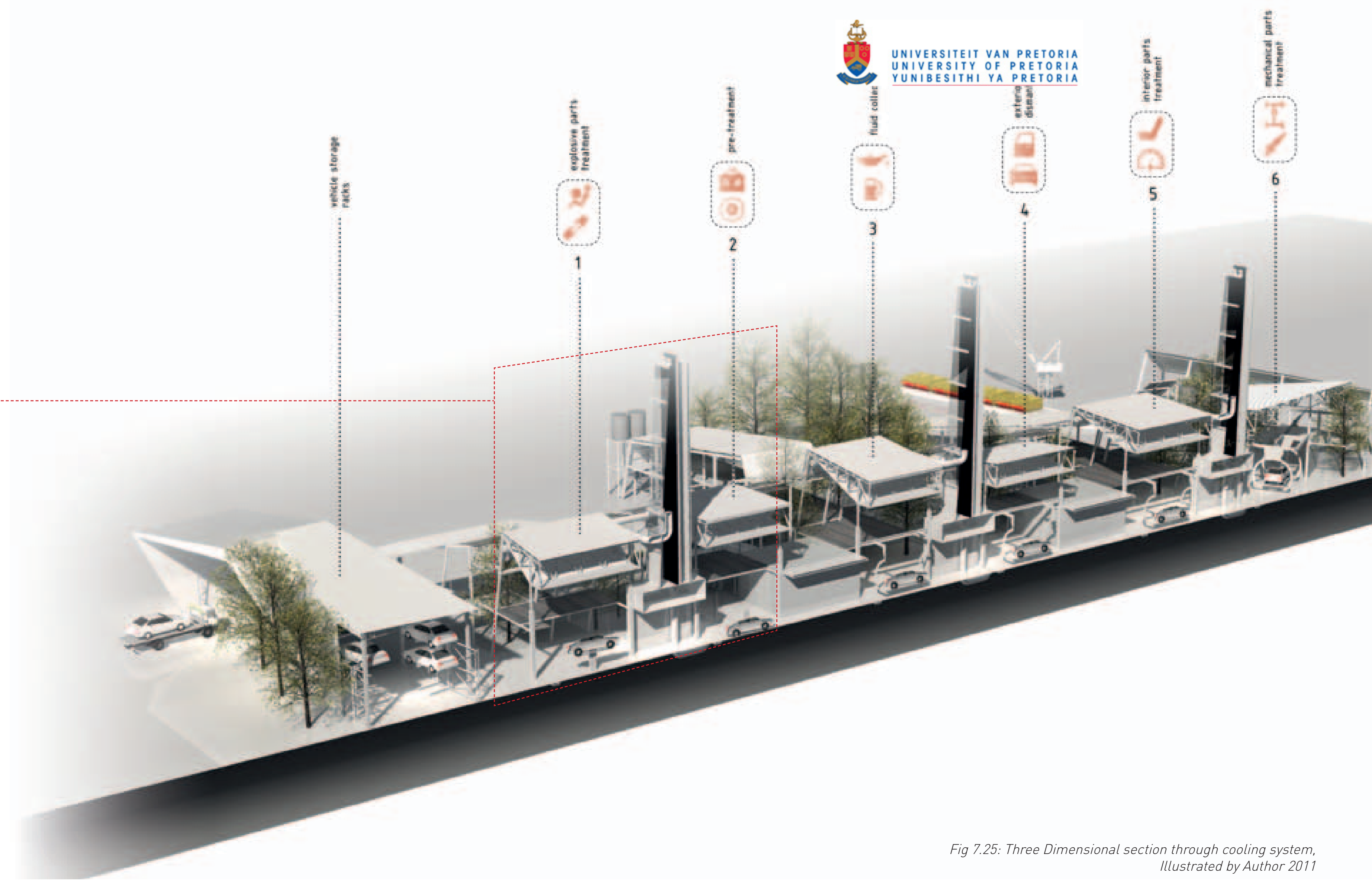
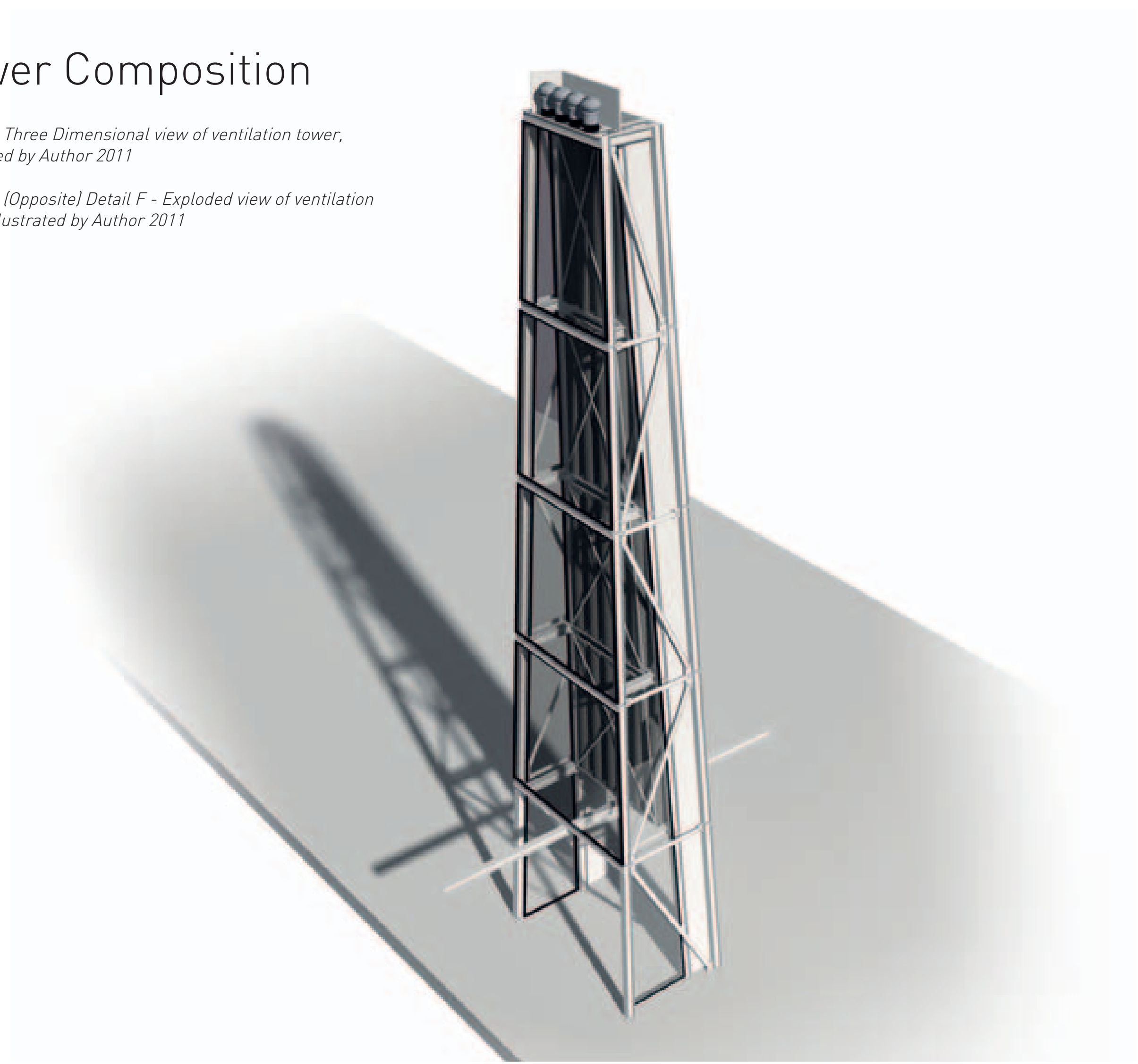


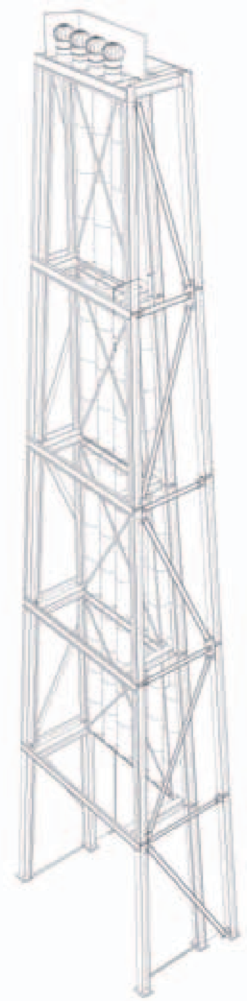
Fig 7.25: Three Dimensional section through cooling system, Illustrated by Author 2011

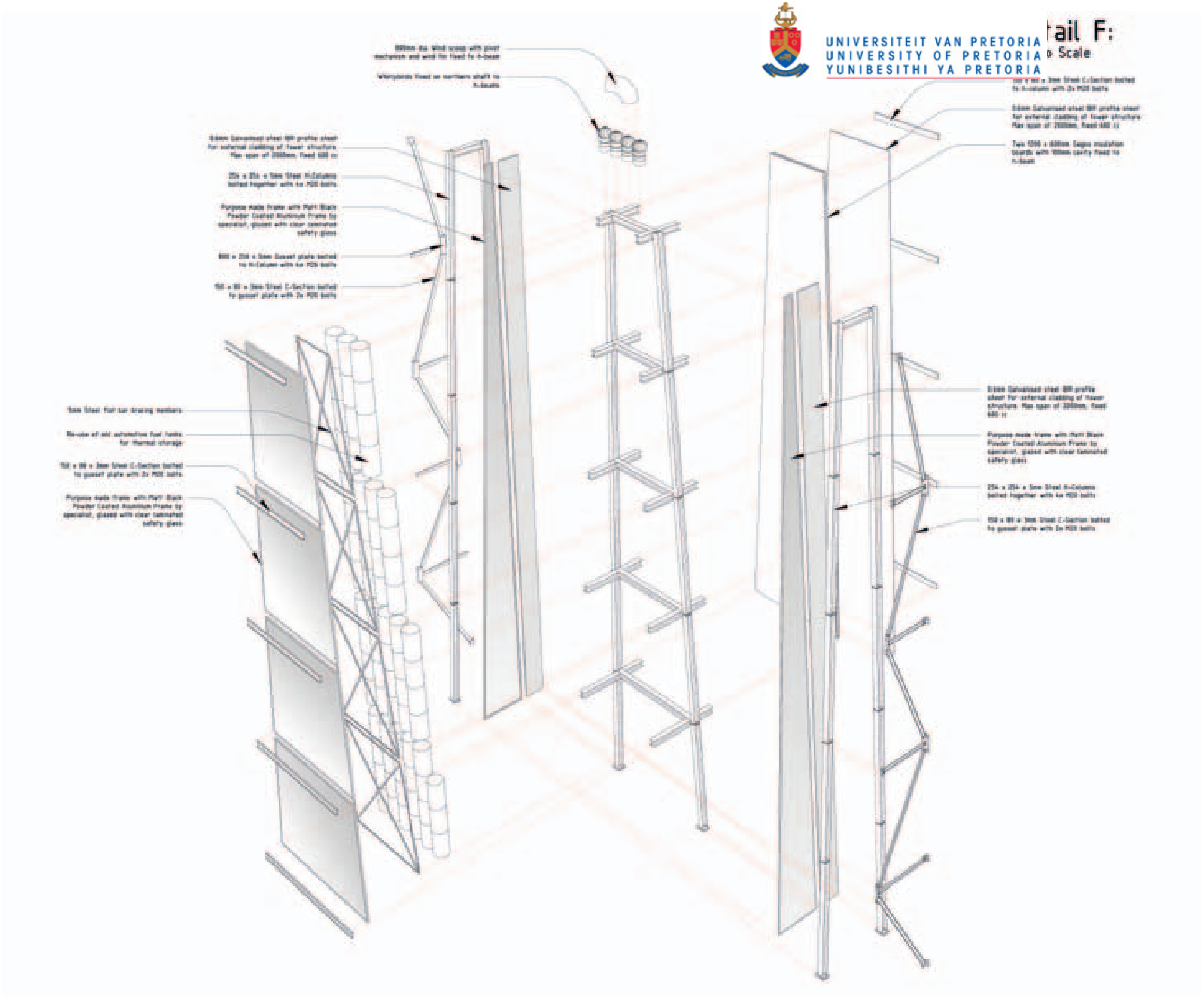
Tower Composition

Fig 7.26: Three Dimensional view of ventilation tower, Illustrated by Author 2011

Fig 7.27: [Opposite] Detail F - Exploded view of ventilation tower, Illustrated by Author 2011







7.6.2 Rainwater Harvesting:

Rainwater is collected to serve several purposes:

- As irrigation for all the planted trees and landscaping.
- In the cooling and heating systems of the disassembly workshops.
- To service all the toilets of the plant.
- In the workshops: cleaning and rinsing.

The total roof area is 1890m^2, according to Jeremy Gibbert (2009) 90% of the total rain water can be harvested. Several water storage tanks are located across the site, serving specific functions, rather than using a central storage system. The tanks are positioned to be in close proximity to down pipes leading from roofs as well as the systems it serves, preventing the pumping of water of longer distances.

Month	Rain Fall (mm)	Harvest (90%)
January	136	231336 L
February	75	127575 L
March	82	139482 L
April	51	86751 L
May	13	22113 L
June	7	11907 L
July	3	5103 L
August	6	10206 L
September	22	37422 L
October	71	13419 L
November	98	166698 L
December	110	20790 L

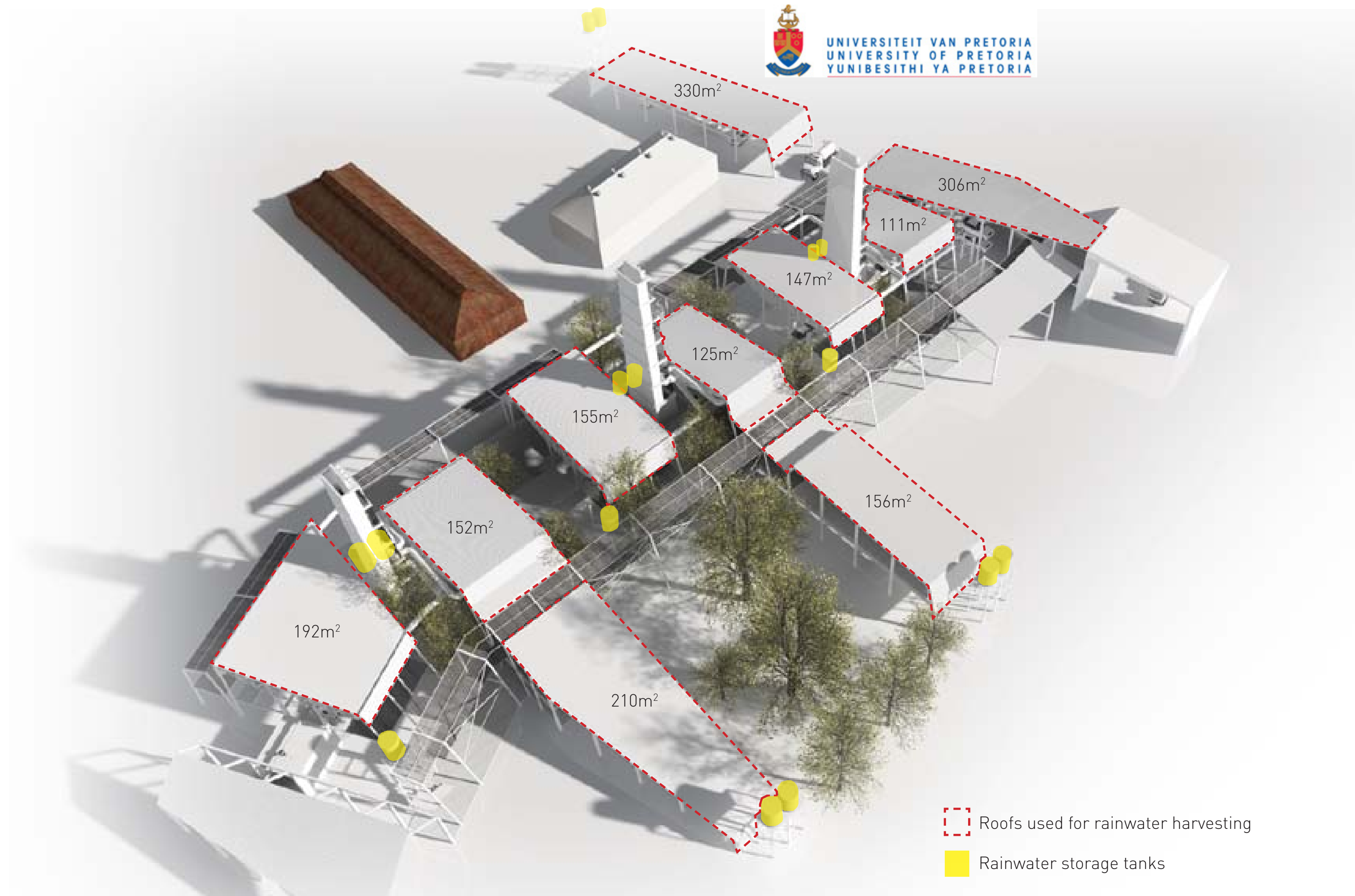


Fig 7.28: Roof areas (m^2) used for rainwater harvesting and storage tanks , Illustrated by Author 2011

7.6.3 Natural Lighting:

The two main issues regarding natural daylight exposure were: the building's north-south orientation and the need for connections (visual) between the work spaces and the outdoors.

Exposing the workshops to adequate daylight ensures that less artificial lighting is used during the day. By pulling the workshops away from each other, enables sunlight to diffuse into each disassembly stage, also providing the staff with constant views of the outdoors.

The eastern and western façades are shaded by the louvres of the circulation walkways which form part of the secondary structure. Trees area planted in the double volumes the walkways create, forming green social spaces in-between the workshops for the workers to retire to during breaks.

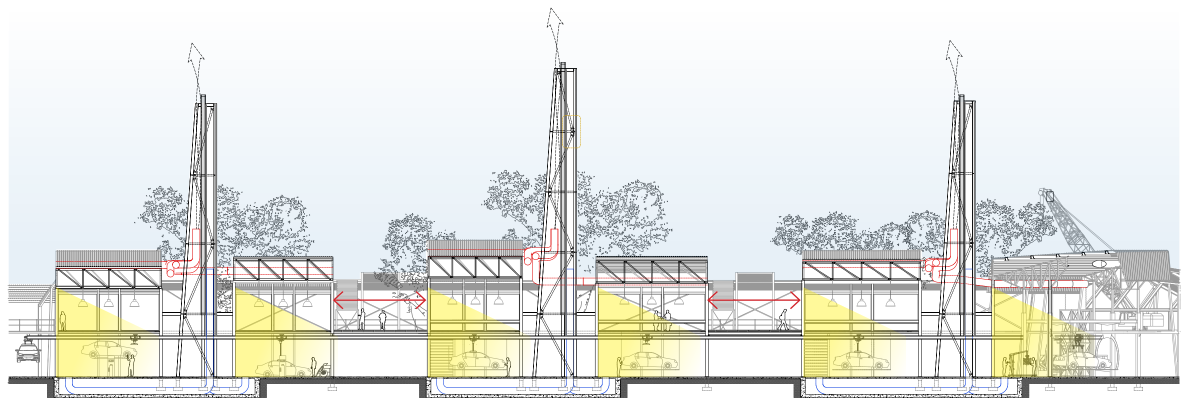


Fig 7.29: Penetration of daylight into the disassembly workshops, Illustrated by Author 2011

The worker's facilities and reparation workshop has been positioned next to the disassembly line as separate extruding volumes. This orientation enabled the social programs in the worker's facilities wing to be exposed to adequate daylight.

7.6.4 Solar Water Heater:

Solar water heaters in combination with electrical geysers are used to heat the water for the workers' shower facilities. Glass heat evacuating solar water collectors are proposed to be installed above the ablution facilities (worker's facilities).

Water consumption of the shower facilities are controlled with by only allowing a five minute shower with controlled water valves and limiting the flow rate (10 litres per minute) (Gibbert 2009: 131).

Fig 7.30: Worker's facilities and reparation workshop, position next to the disassembly line, are exposed to daylight, Illustrated by Author 2011

Fig 7.31: (a-c) Heteropyxis Natalensis, Lavender Tree (Witkoppen Wildflower Nursery 2010)

Fig 7.32: (d-f) Dais Cotinifolia, Pompon Tree (Fernkloof Nature Reserve 2011)

Fig 7.33: (g-i) Cussonia Paniculata, Mountain Cabbage Tree (Dave's Garden 2011)

7.7 Habitat and Vegetation

Industrial precincts are often characterised by hard concrete and steel surfaces. The proposed building aims to soften these surfaces by introducing vegetation in between the structure's steel elements.

As discussed under *Natural Lighting*, the trees aim to act as shading elements in summer months while allowing light to filter through in winter months (deciduous trees).

The species and the placing of the trees are important to ensure that the trees will fit in between the structure, and to keep the trees healthy.

A

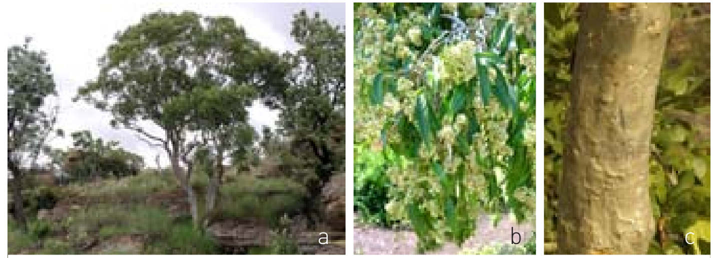
Heteropyxis Natalensis
(Lavender Tree)
Location on site: Outside Social Area
Application: To create shaded spaces for workers to socialise and rest

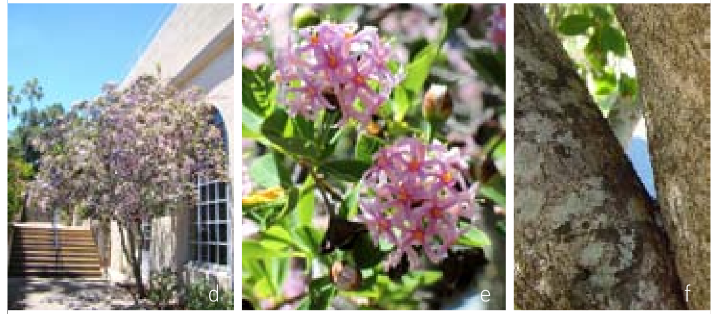
B

Dais Cotinifolia
(Pompon Tree)
Location on site: In-between workshops and walkways
Application: To supply the workshops of constant views of colourful vegetation

C

Cussonia Paniculata
(Mountain Cabbage Tree
Location on site: Sidewalk - Carl Street
Application: To provide shaded spaces on street level before entering the market area





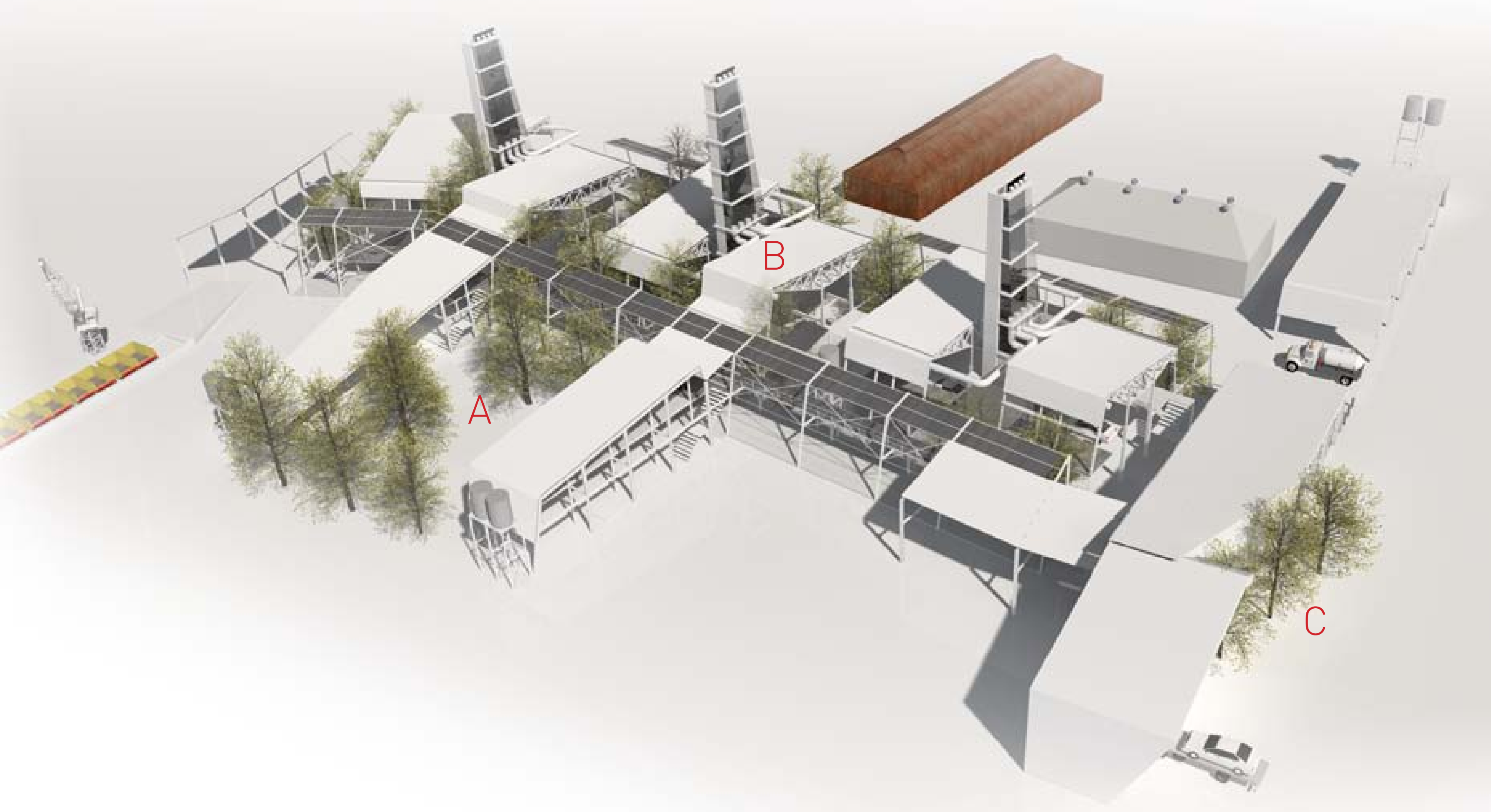


Fig 7.34: Positioning of new tree species on site, Illustrated by Author 2011

7.8 Construction Technology & Detailing

The composition of the structure will be illustrated by three sections, each focussing on different details:

- Section A-A:
  Detail Portion 1: Shaded Walkway
  Detail Portion 2: Disassembly Line
- Section B-B:
  Detail Portion 3: Worker's Facilities
- Section C-C:
  Detail Portion 4: Disassembly Workshop

Fig 7.35: Proposed Vehicle Disassembly Plant within the surrounding context, Illustrated by Author 2011

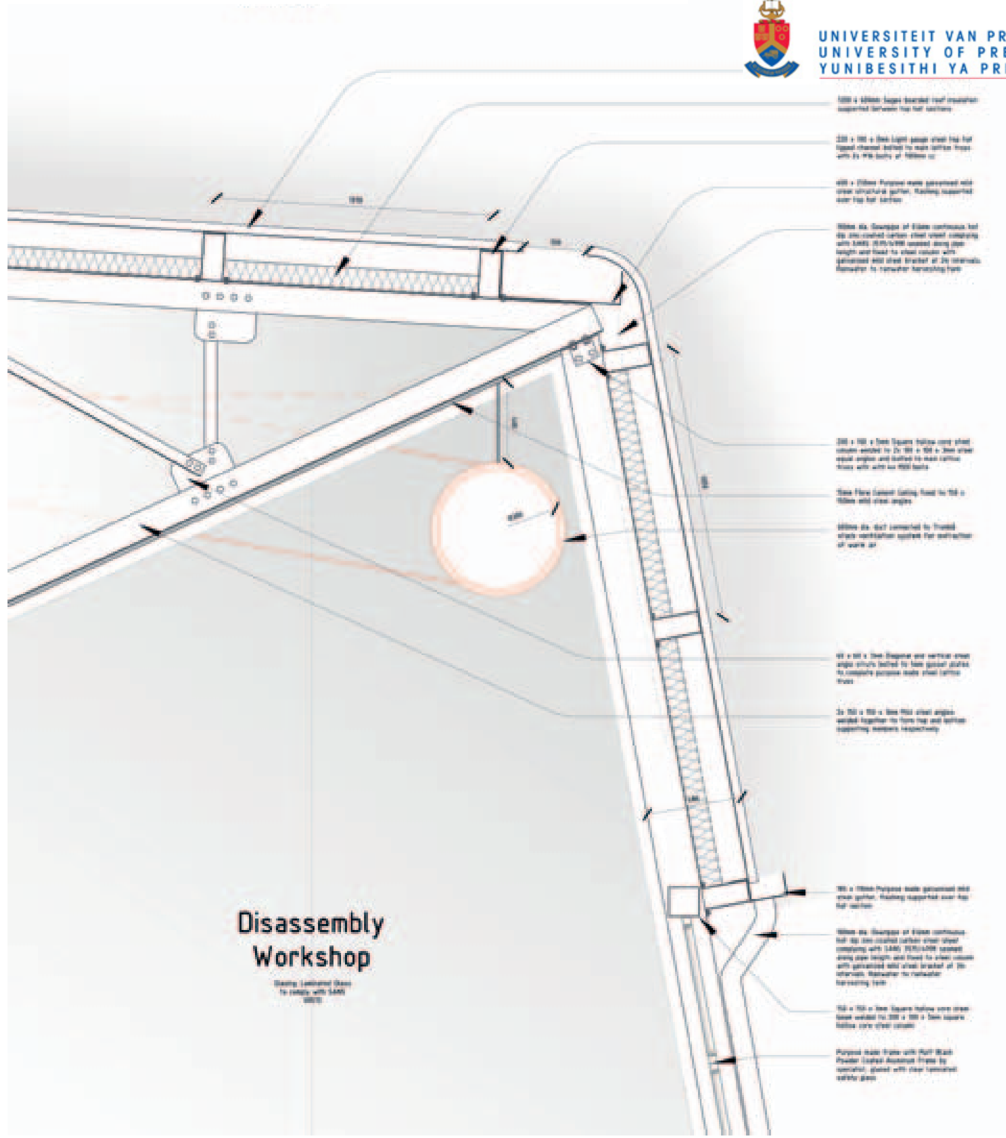
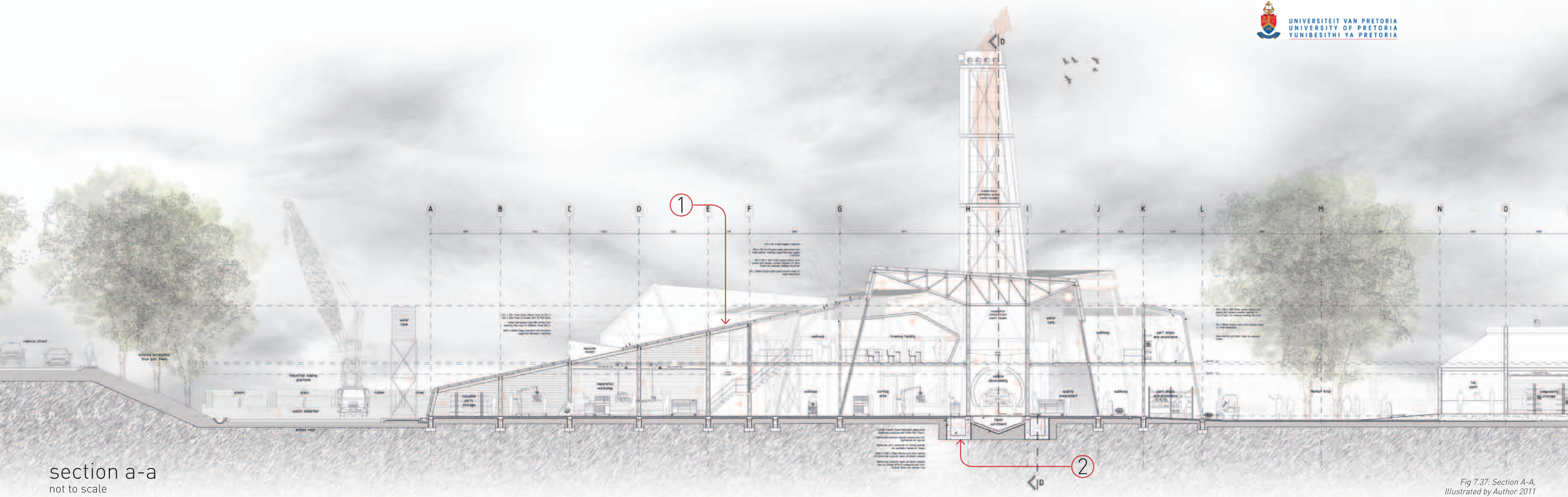


Fig 7.36: Detail A - Main roof structure, Illustrated by Author 2011



section a-a
not scale

Fig 7.37: Section A-A, Illustrated by Author 2011

Detail Portion 1: Shaded Walkway

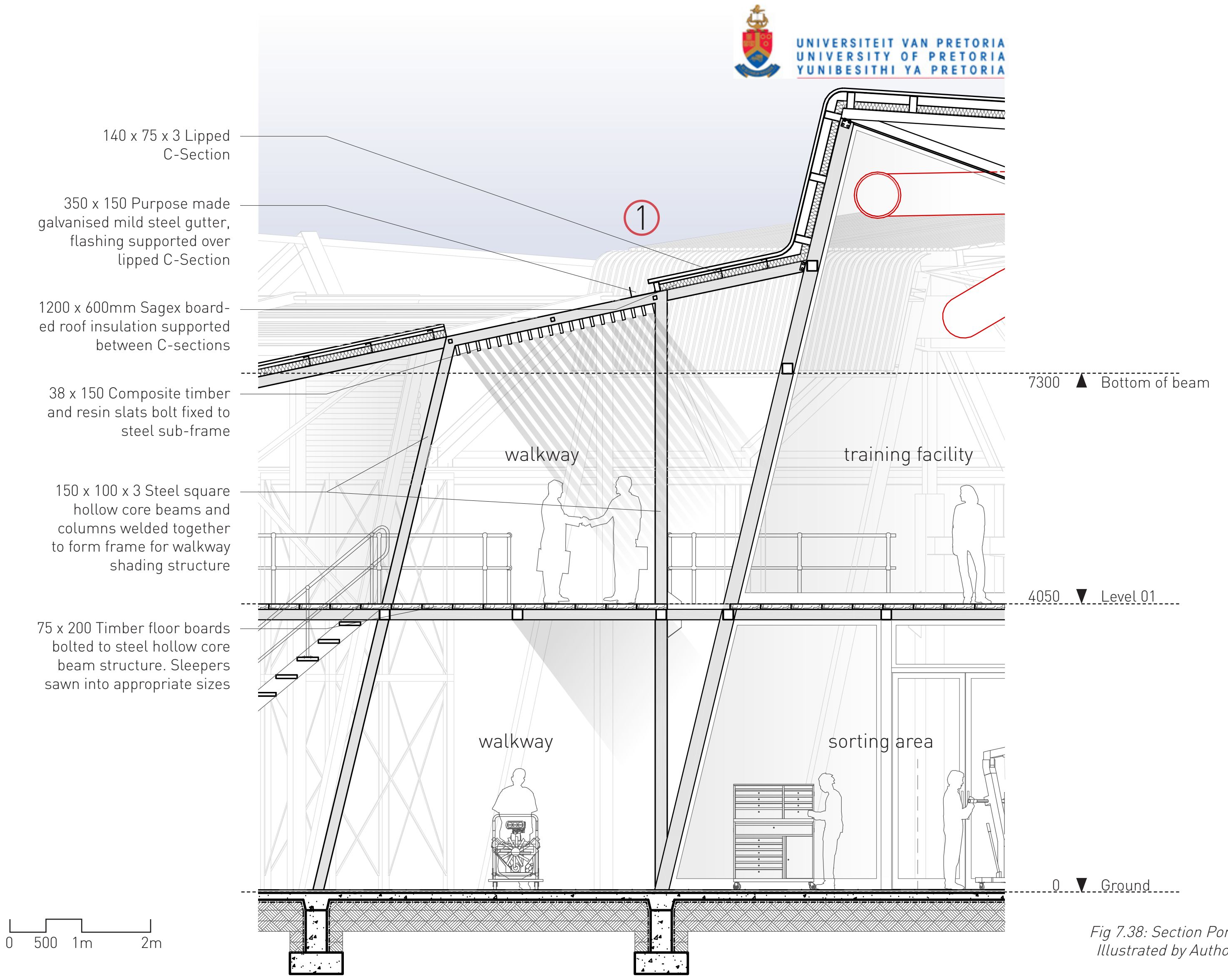


Fig 7.38: Section Portion 1, Illustrated by Author 2011

Detail Portion 2: Disassembly Line

2x 150 x 150 x 3 Mild steel angels welded together to form top and bottom supporting members respectively. 60 x 60 x 3 Diagonal and vertical steel angle struts bolted to 5mm gusset plates to complete purpose made steel lattice truss

600 dia. duct connected to Trombé stack ventilation system for extraction of warm air

Fibre cement ceiling fixed to bottom of main lattice truss

254 x 254 x 5 Steel H-Column

600 dia. duct connected to cooling system on southern façade of tower

254 x 254 x 5 Steel H-Beam

C-Arm mechanism fixed to H-Beam as per engineer's specifications

5000 x 4200 x 50 Mentis grid floor resting on reinforced concrete liquid catchment channel

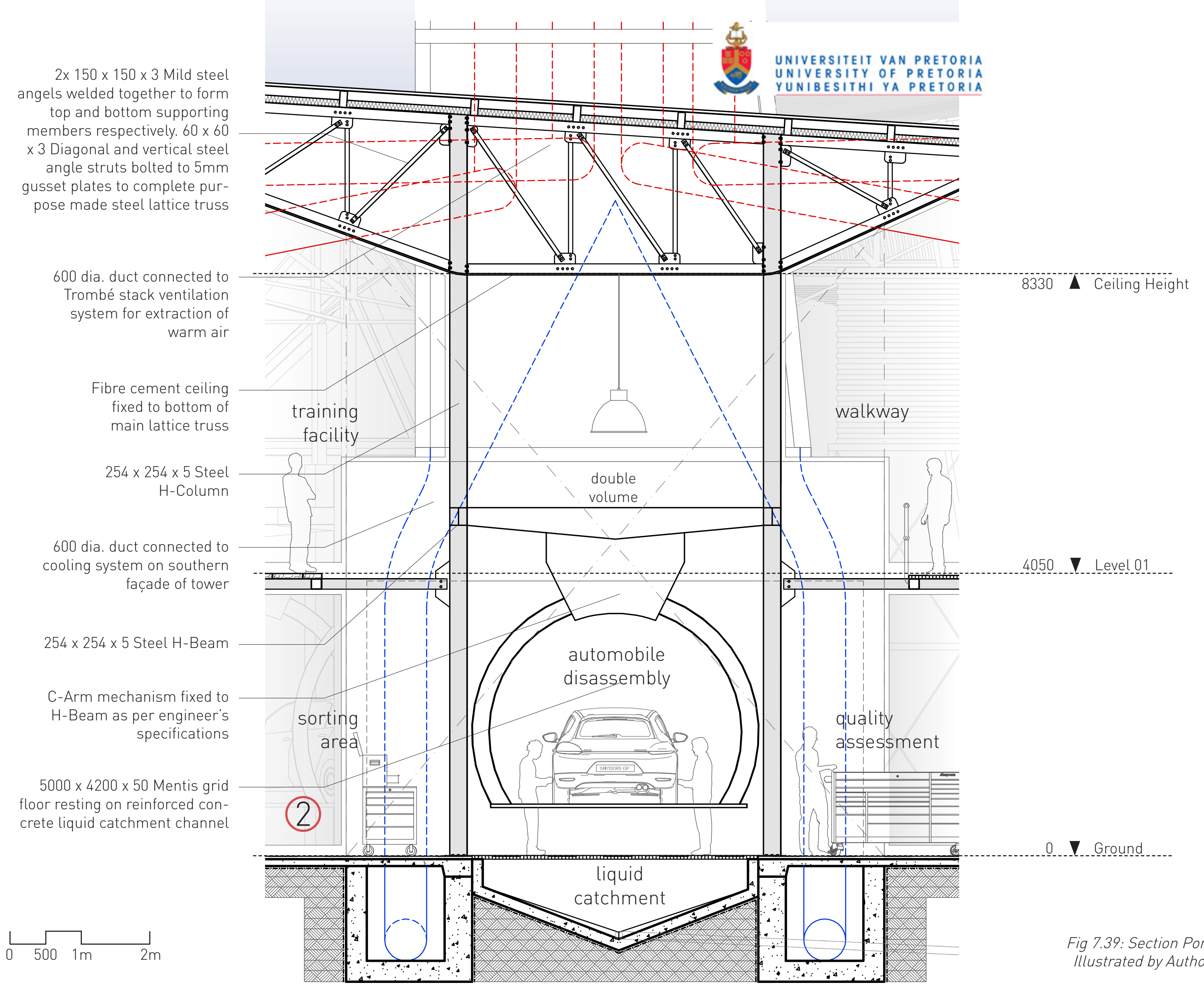
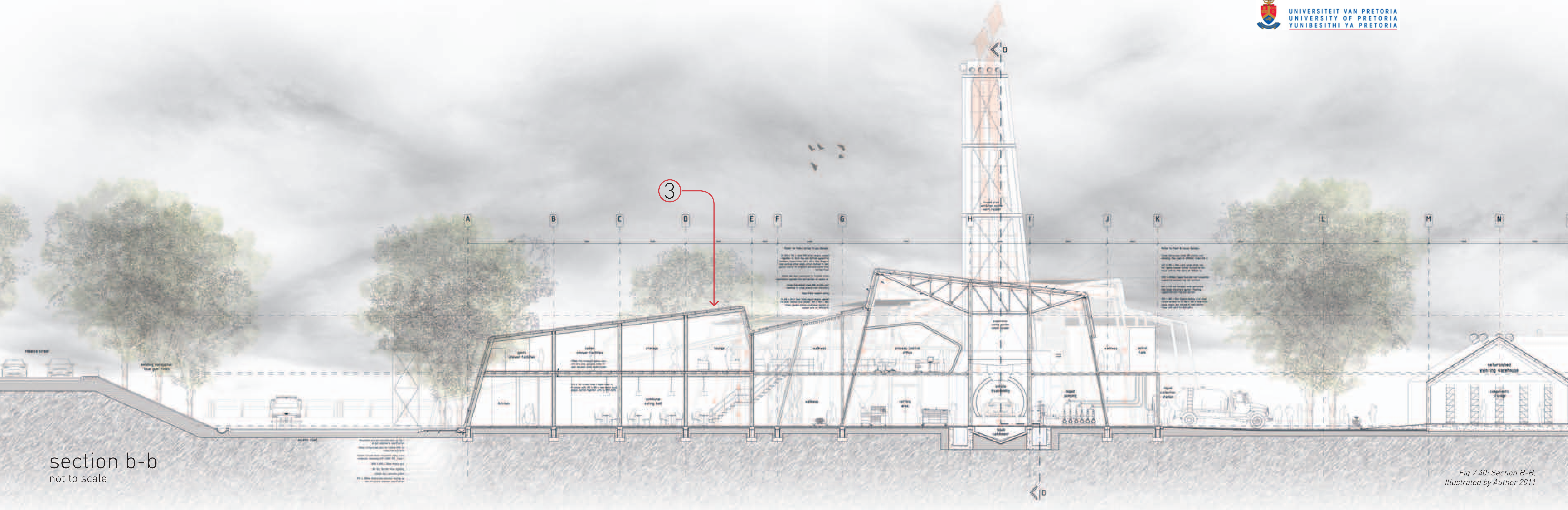


Fig 7.39: Section Portion 2, Illustrated by Author 2011



section b-b
not to scale

Fig 7.40: Section B-B,
Illustrated by Author 2011

Detail Portion 3: Worker's Facilities

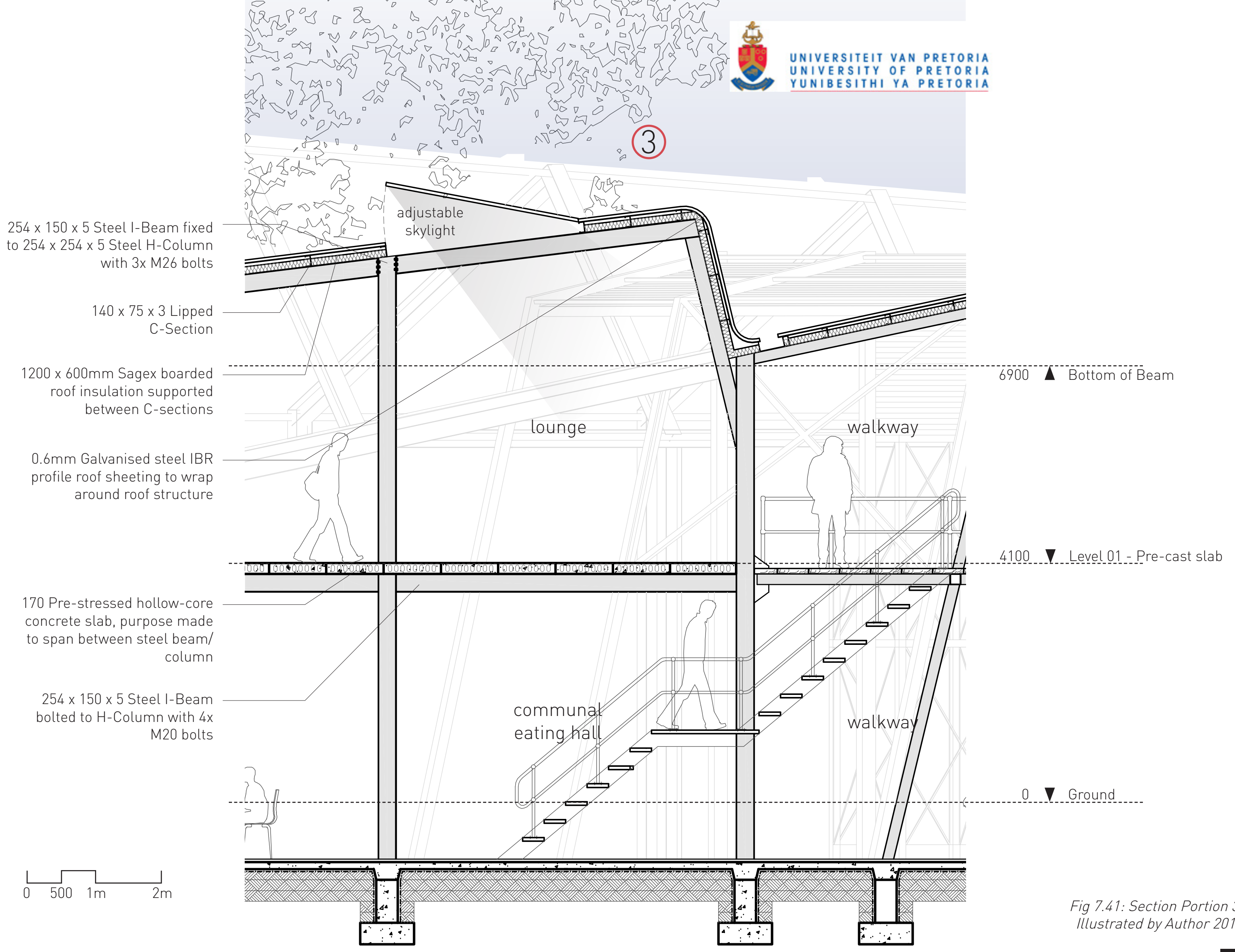


Fig 7.41: Section Portion 3, Illustrated by Author 2011

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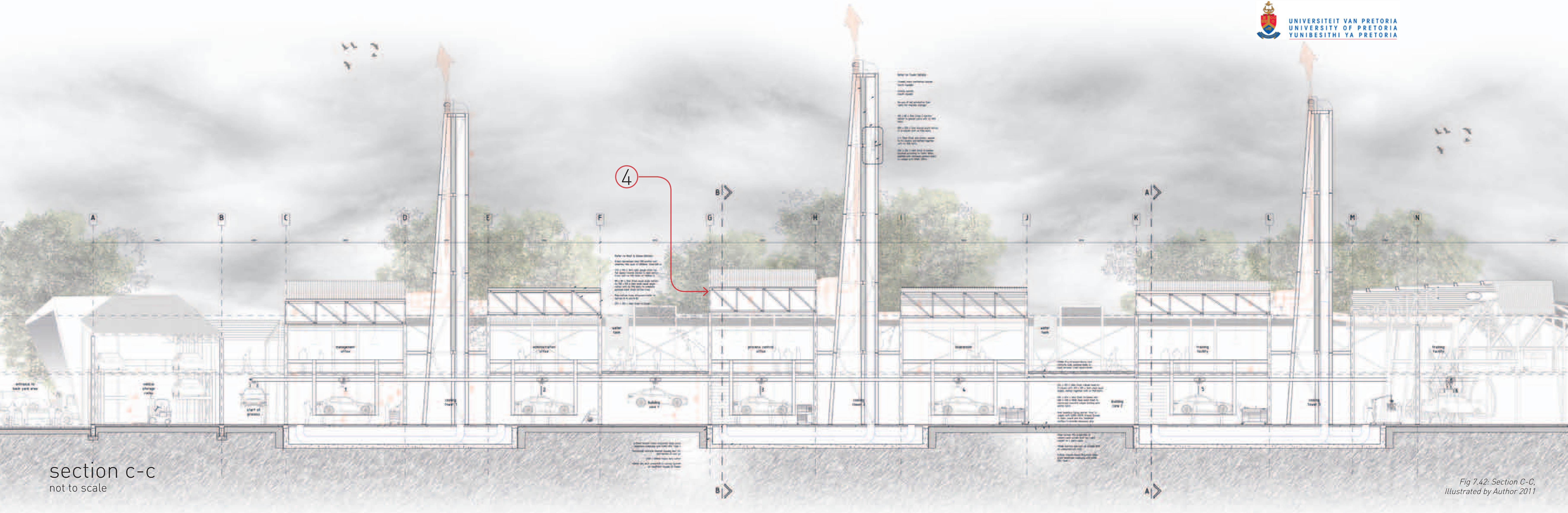

section c-c
not to scale

Fig 7.42: Section C-C,
Illustrated by Author 2011

Detail Portion 4: Disassembly Workshop

Fig 7.43: Section Portion 4,
Illustrated by Author 2011