Chapter 7

Techné

07 Technical concept

Inversion as concept

The technical concept developed as a result of a comprehensive understanding of the current conditions at the Old Johannesburg Gasworks and the reasons for its demise and inability to be resilient in terms of its industrial processes.

The need for a drastic different approach to the way in which industries are operated and designed became evident.

The existing structures on site lend little interaction between the interior spaces and the landscape. The structures consist of elaborate tectonic steel cores enveloped in brick skins.

The concept of 'inversion' could be explored on various levels pertaining to the design and implementation of a new kind of industry. Figure 7.2 illustrate the current conditions as well as how the inversion thereof could provide solutions to the issues raised by this dissertation.

Accessibility

Restitution of the severed relationships is at the forefront of the site's urban vision. Inverting the previously inaccessible site to become accessible for city dwellers to utilize as educational and recreational spaces could be conducive to restoring the severed relationship caused by orthodox hazardous industries.

Process & approach

In order to allow interaction between industry and humans, the industrial processes need to be inverted from a previously degenerative status to a more regenerative one. For this to occur, a radically different approach is needed to transform industrial practices from linear to closed loop systems. Closed loop systems allow for minimum waste and also attempts to eradicate pollution of the natural environment.

Figure 7.1. Left: Retort 2 Interior (Author 2017)

TECHNICAL CONCEPT IN VERSION

: a reversal of position, order, form, or relationship
: the condition of being turned inward or inside out
(Merriam-Webster 2017)

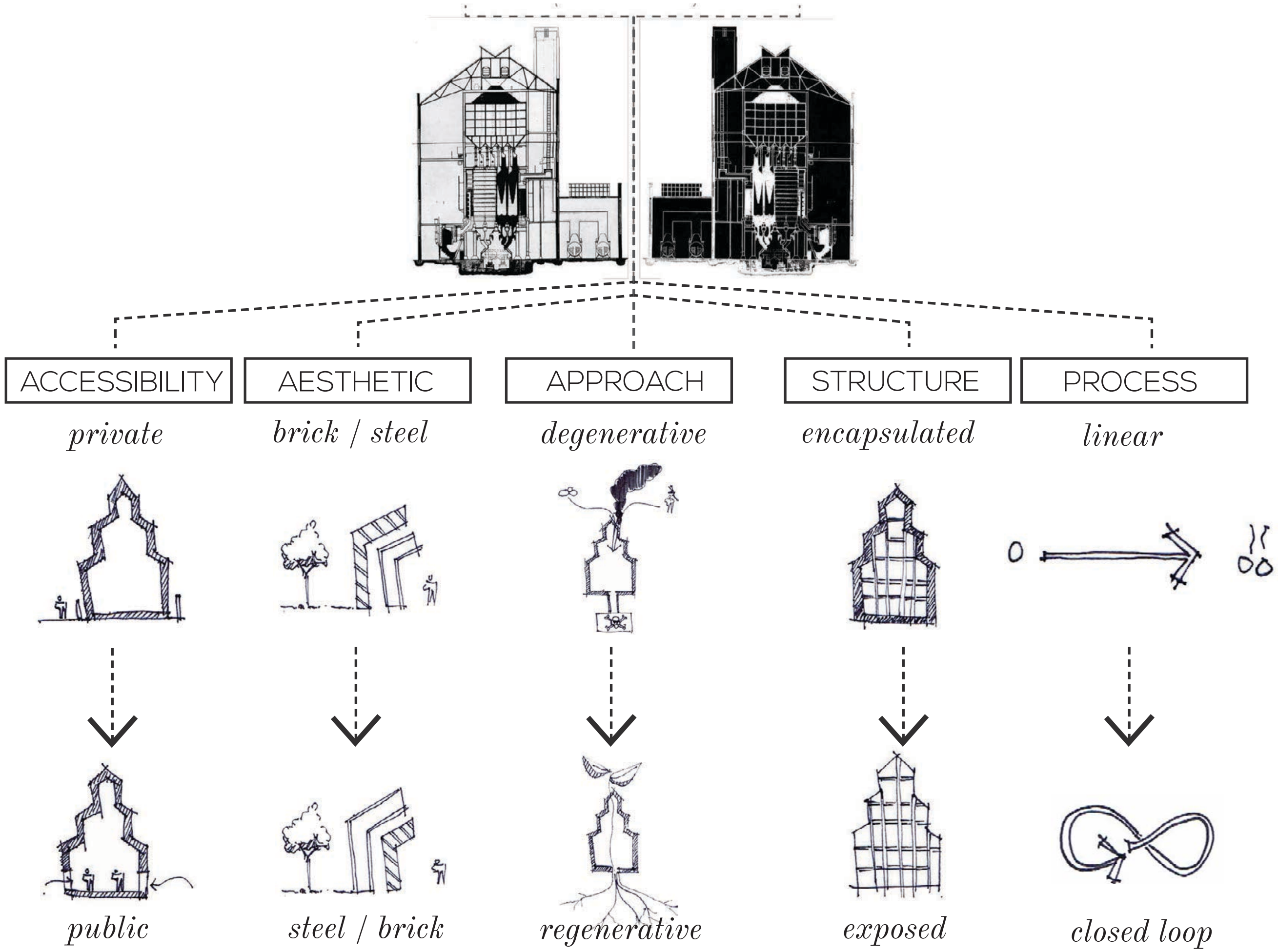


Figure 7.2: Technical concept diagram (Author 2017)

Regenerative projects have a close relationship with the natural environment. The natural environment can often be utilised to achieve favourable climatic conditions within a building. This has often been replaced by mechanical strategies. The new dye house, studios, offices and workshops will be ventilated passively through the use of stack ventilation and earth tubing.

As mentioned in the programme chapter, the textile industry is synonymous with dramatic consumption of water sources and the pollution thereof. Making use of all natural plant and herbal dyes along with natural mordants[5], allows for the possibility of water to be purified and re-used. This is exposed by placing it on the northern edge of the building, to solidify the new established relationship between industry and nature. Although the industry makes use of the natural elements similar to conventional industries, the difference lies in the sources that are used as well as in the manner in which they are used. Where conventional industries often make use of depletable resources like coal, the new industry proposed in this dissertation, makes use of renewable resources and ensures that the natural resources used in the process such as water, is purified after use through natural methods of purification. Implementing this type of industry also allows for the remediation of the site scarred by previous parasitic and polluting industrial practices.

Aesthetic & structure

In terms of conventional, industrial buildings' aesthetic, more often than not, the buildings have an encapsulated structure. In the case of the old Johannesburg Gas Works the buildings are comprised of steel structures enveloped by a brick skin. This allows for little or no interaction between the process and the landscape. In the quest to establish a new relationship between industry and nature, the manner in which the building interacts with the landscape becomes critical. In cases where industries are dependent on the natural environment to function and vice versa, the aesthetics of industrial buildings need to change in order to allow for this interaction to occur.

In the case of the natural dye house, the inversion of a building's structure could allow for it to become infrastructure for the growing of plants needed for the natural dyes. In cases where the soil is polluted, the structure becomes a catalyst for living system regeneration on a site that would otherwise be unable to catalyse prosperity for the natural environment.

The concept of inversion is explored in the new building in terms of the relationship of the steelwork to the brick work. Figures 7.3-7.5 explore the conceptual application of 'inversion' in terms of structure.

The new building is cut into the landscape on the southern edge. It is at this point that the illusion of a heavy mass is created through enveloping the steelwork in between two single brick skins (see Fig. 7.3). As one moves closer to the existing structure, the steelwork emerges from the brick (Fig.7.4) to where it is finally completely released from the brickwork (see Fig. 7.5) and at this point allows for the steelwork to become the infrastructure for the plants in the form of planter boxes.

Structural concept diagrams

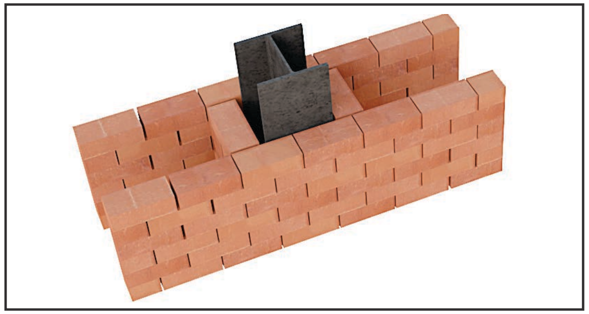


Figure 7.3: Steel enveloped in wall (Author 2017)

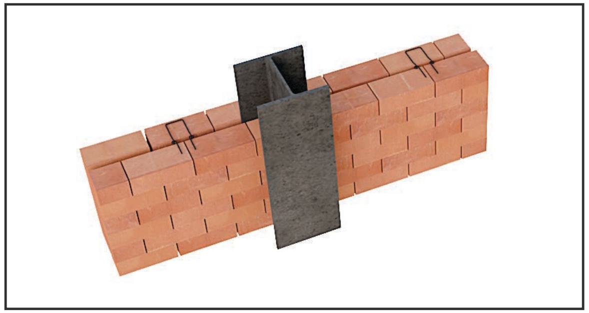


Figure 7.4: Steel emerging from wall (Author 2017)

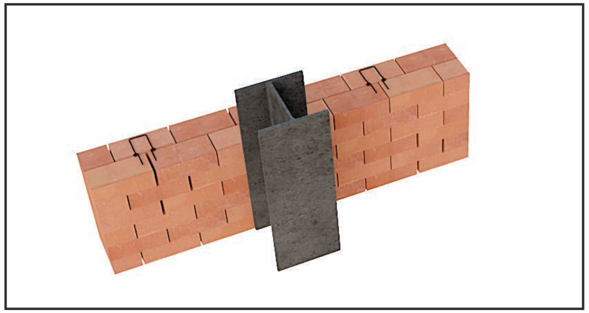


Figure 7.5: Steel emerged from wall (Author 2017)

How inversion aids mediation

The reasoning behind the inversion of structure is to enable the use of the structure as infrastructure for the growing of plants needed in the dye process. This enables the architecture to facilitate mediation between industry and nature. By inverting the structure for the growing of plants, the dye house (industry) now has a direct connection to nature which is responsible for feeding the dye process. Inversion allows for better interaction between the building programme (industry) and the landscape that surrounds it.

Inverting previously degenerative industrial processes, allows for a new, more mutually beneficial relationship between industry and nature, one in which industry inspires environmental prosperity.

Structural concept diagram on plan

Structural concept diagram section

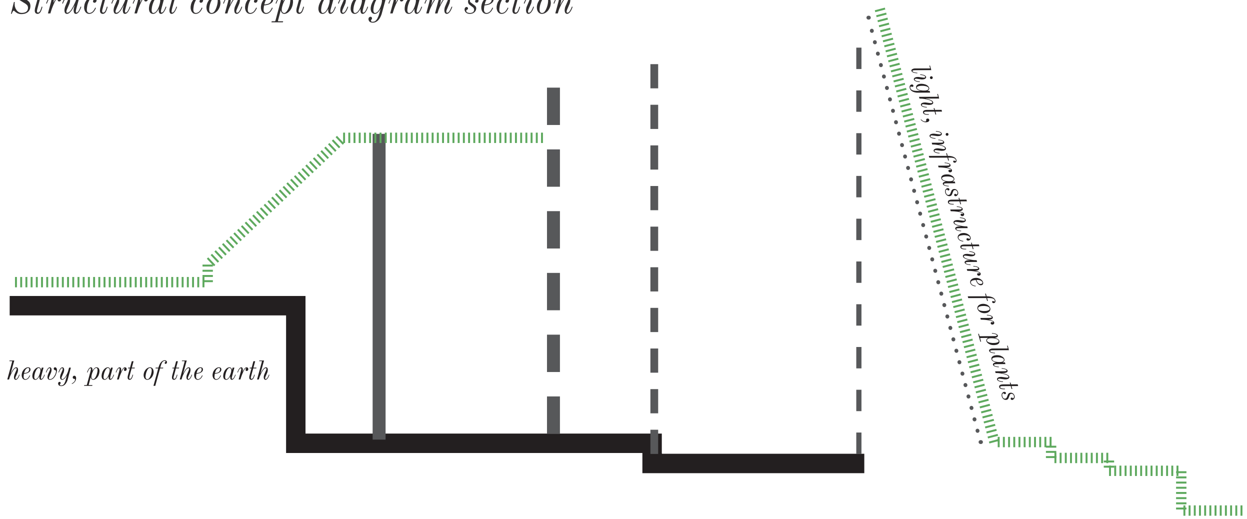


Figure 7.6: Structural concept diagrams (Author 2017)

Material palette

Existing materials on site

Weathered timber doors

Clay bricks

White washed clay bricks

Weathered steel

Rusted steel

Corrugated steel roller shutter doors

Rusted painted steel

Rusted painted steel

Weathered steel

Weathered clay bricks

Clay bricks

Weathered painted steel

Figure 7.7: Existing material palette on site (Author 2017)

Proposed material palette

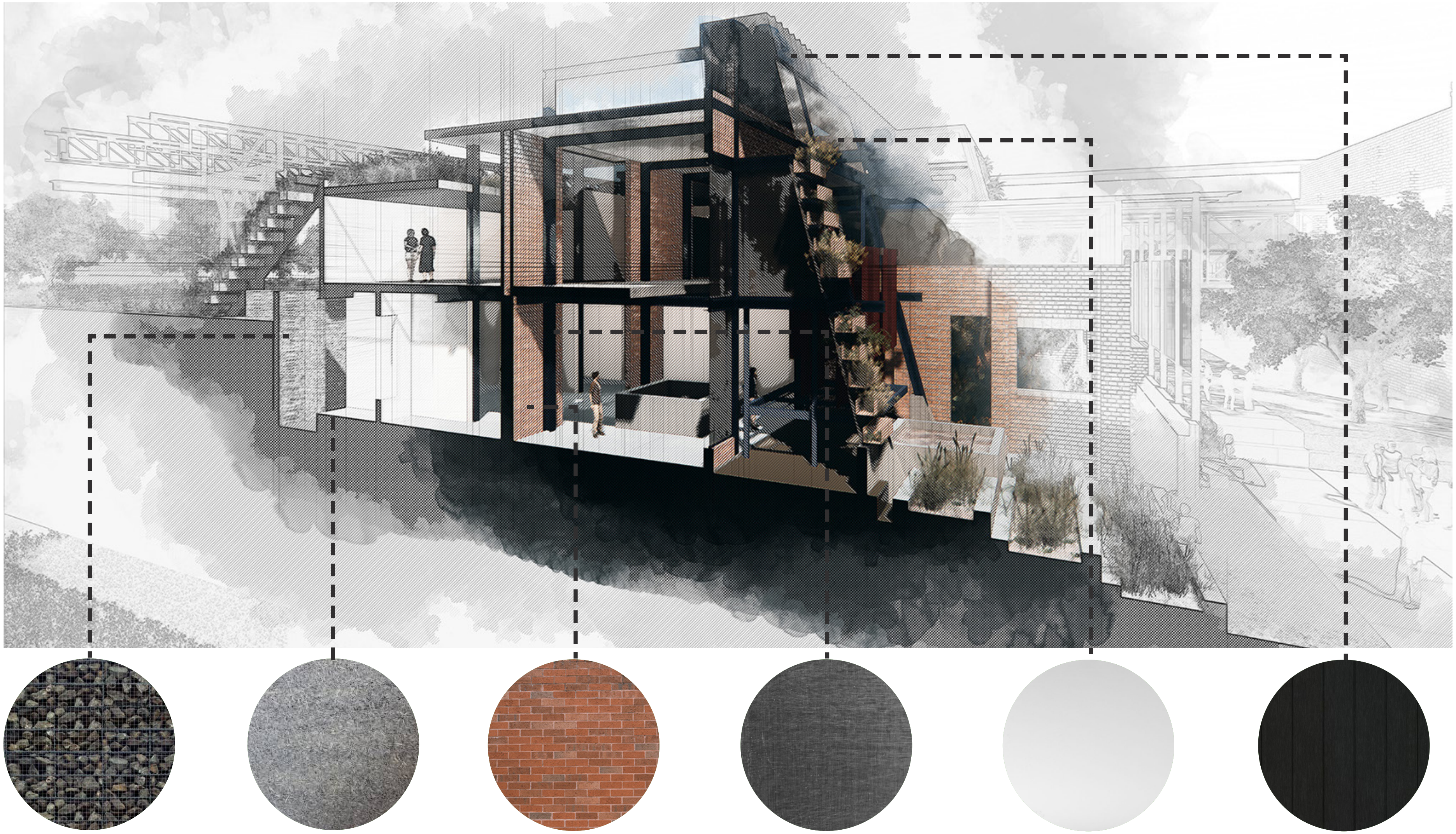


Figure 7.8: Sectional perspective of dye house (Author 2017)

Material choice motivation

There are numerous advantages to using hempcrete as a building material. These include energy efficiency, the ability to maintain a steady temperature, its breathable and hygroscopic qualities, its ability to increase in strength over time and its versatility as it can be used in the construction of floors, walls and roofs, to name but a few (Cowell 2015). According to Flahiff (2009), hempcrete can also be classified as a carbon negative building material as the growing and harvesting process of hemp, locks in more CO_2 than that which the process of producing the lime binder releases.

Steel was chosen as building material due to the abundance of steel in the existing retort house. In order to allow for the new programme to be inserted into the existing retort house, some of the steel work will need to be stripped down. It is proposed that this steel then be re-used in the structure of the new building.

Brick was chosen as a building material to respond to the existing architectural language present on site. The use of a darker brick will be explored in order to create a distinction between the existing and the new and to assert the principles of philological restoration by creating a distinguishable architectural language from the existing heritage fabric.

Aluminium frame glazing is proposed for the new building. This is to allow a more transparent approach to industry, allowing interaction between the public and industry, reinforcing the intention of the urban vision while allowing for the new and old buildings to have a stronger connection to nature in the form of visual connections as well as daylighting.

Sheet metal is proposed as a building material in order to resonate with the existing materials on site. However, the colour proposed is a dark grey in order to create a distinction between the old and the new.

Natural stone is proposed for the southern edge of the building in order to reinforce the relationship of the new building to the landscape while providing the necessary strength to retain the soil that will be cut back. Gabions will also be used in the constructed wetland as a means of purifying the water. This reinforces nature's role in purifying the dye house effluent and establishes a new counter dependant relationship between industry and nature.

All materials proposed in the construction of the new building can be sourced within a 37km radius from the old Johannesburg Gasworks site, contributing to lower embodied energy.

Structure

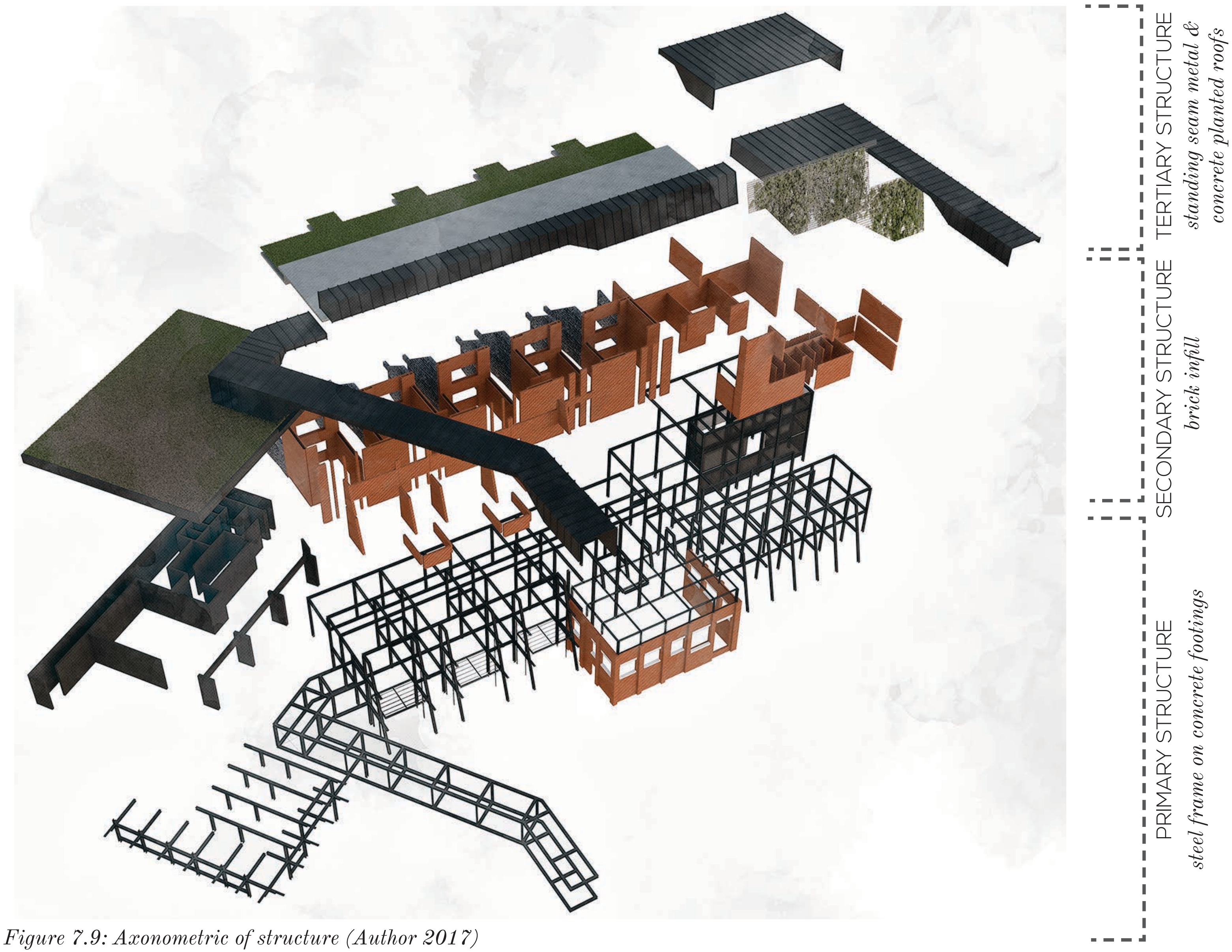


Figure 7.9: Axonometric of structure (Author 2017)

Structure concept details

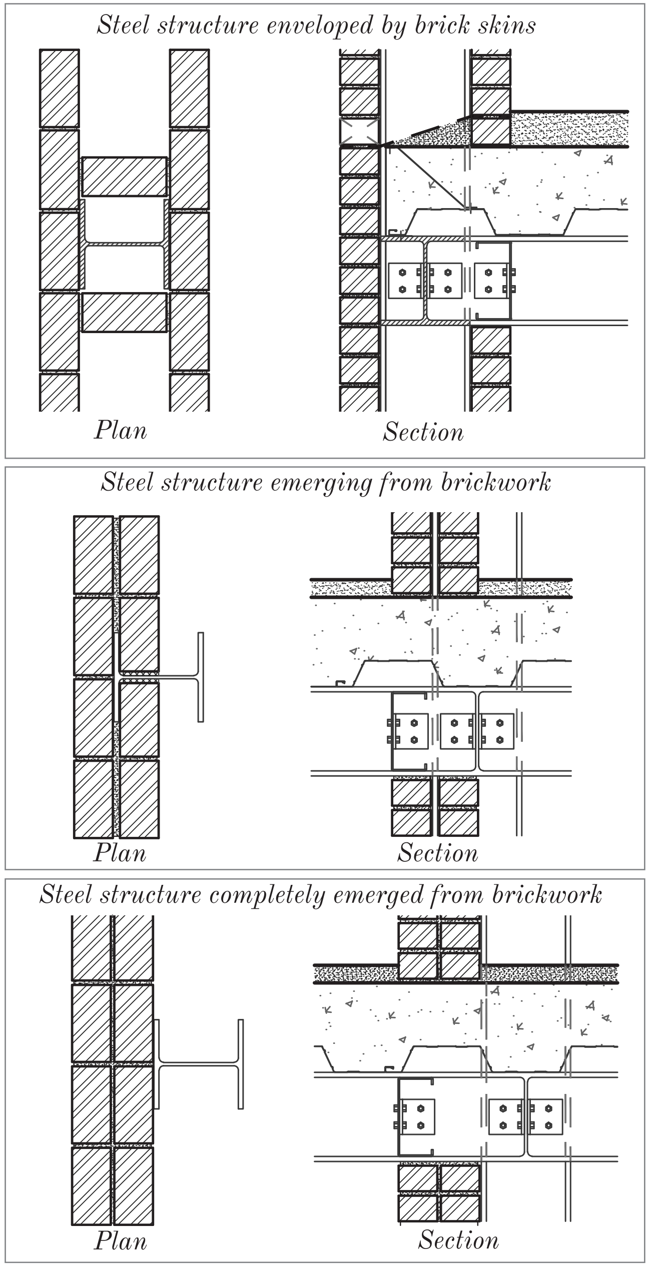


Figure 7.10: Structural concept details (Author 2017)

Sectional perspective

Figure 7.11: Sectional perspective (Author 2017)

Services - Water purification systems

The storm and grey water treatment strategy involves the collection of site runoff into underground storage tanks where it will be purified and used for the watering of vegetation used in the dye process as well as for use in the water closets. The first step in the process is to ensure that large debris is prevented from entering the storm water channel. This is achieved by covering the channel with a mentis grid. From the channel the water is directed to and underground grease trap. All water from basins and showers are also piped to this tank. The grease trap prevents all grease or oil from entering the weir. From here the water is pumped to another tank for use in water closets and for irrigation purposes.

The rainwater collection strategy involves collecting water from all roof surfaces of the old retort as well as the new proposed design. Before water enters the storage tanks, it goes through a first flush diverter that ensures that the initial water, which may be contaminated, is flushed away in order to collect the cleaner rainwater that follows. The rainwater is then used in the natural dyeing process. Some of the rainwater will be purified by sending it through a bio-filter, comprising a sand, plant, gravel and stone filter. Water that has been sent through the filter can then be stored underground from where it can be pumped through a UV filter to kill all pathogens still present in the water so that it can finally be used as drinking water, water for wash hand basins, and again to feed the dye house.

Dye water purification

The dye runoff water purification strategy involves similar steps to the rainwater purification strategy. The purification system is placed directly adjacent to the dye house in order to strengthen the conceptual approach of a new mutually beneficial relationship between industry and nature, as nature aids in the purification of the water.

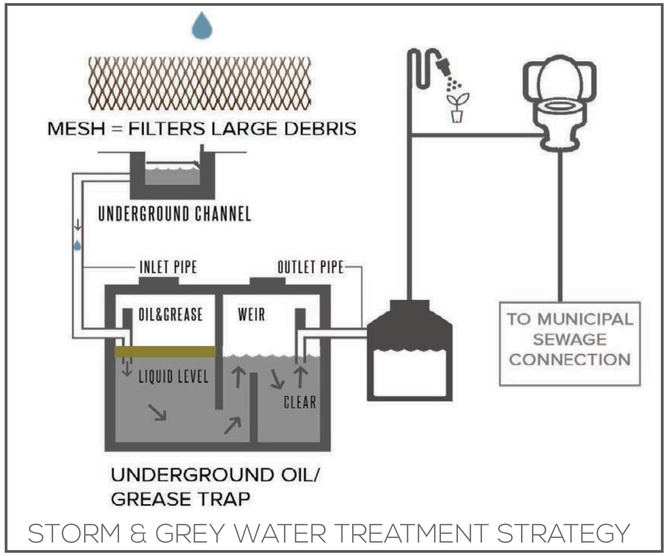


Figure 7.12: Stormwater purification (Author 2017)

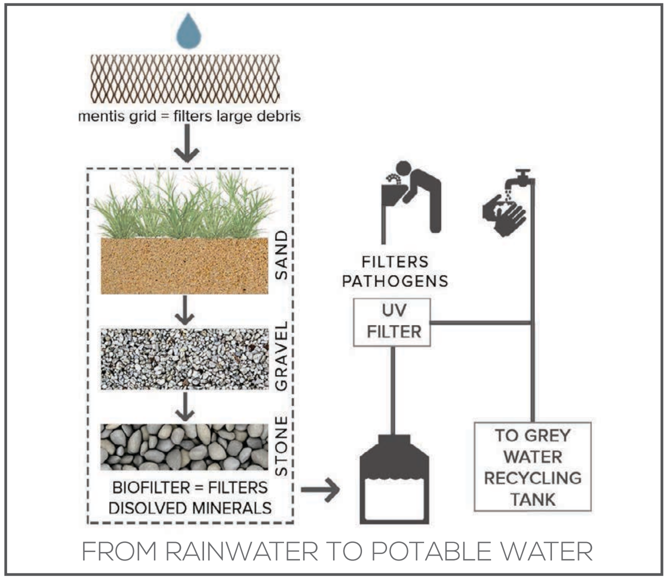


Figure 7.13: Rainwater purification (Author 2017)

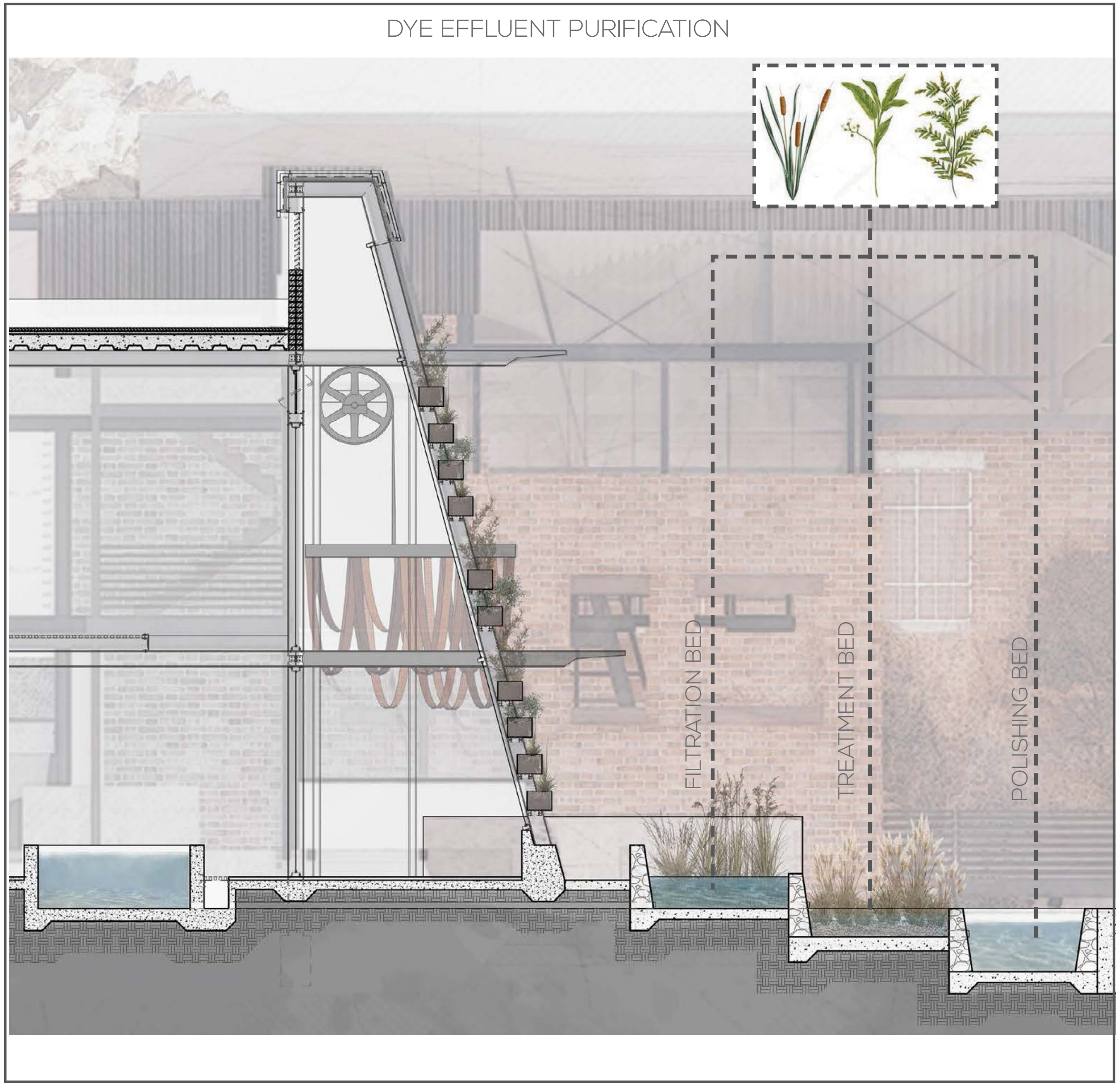


Figure 7.14: New structure water system section (Author 2017)

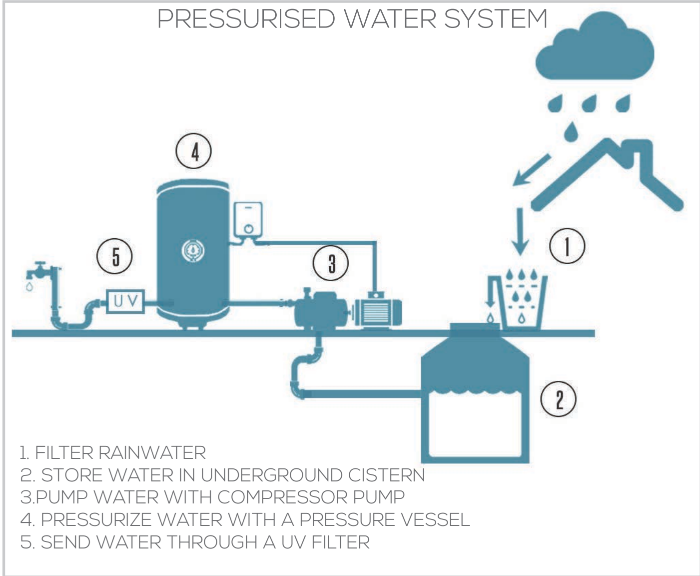


Figure 7.15: Pressurized water system diagram (Author 2016)

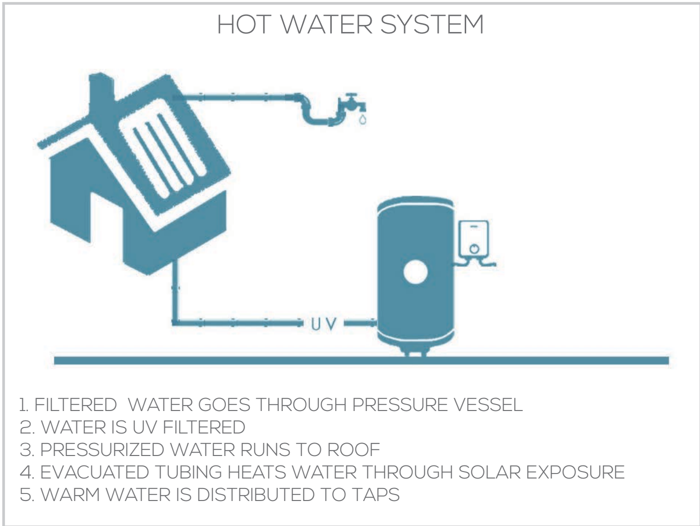


Figure 7.16: Hot water system diagram (Author 2016)

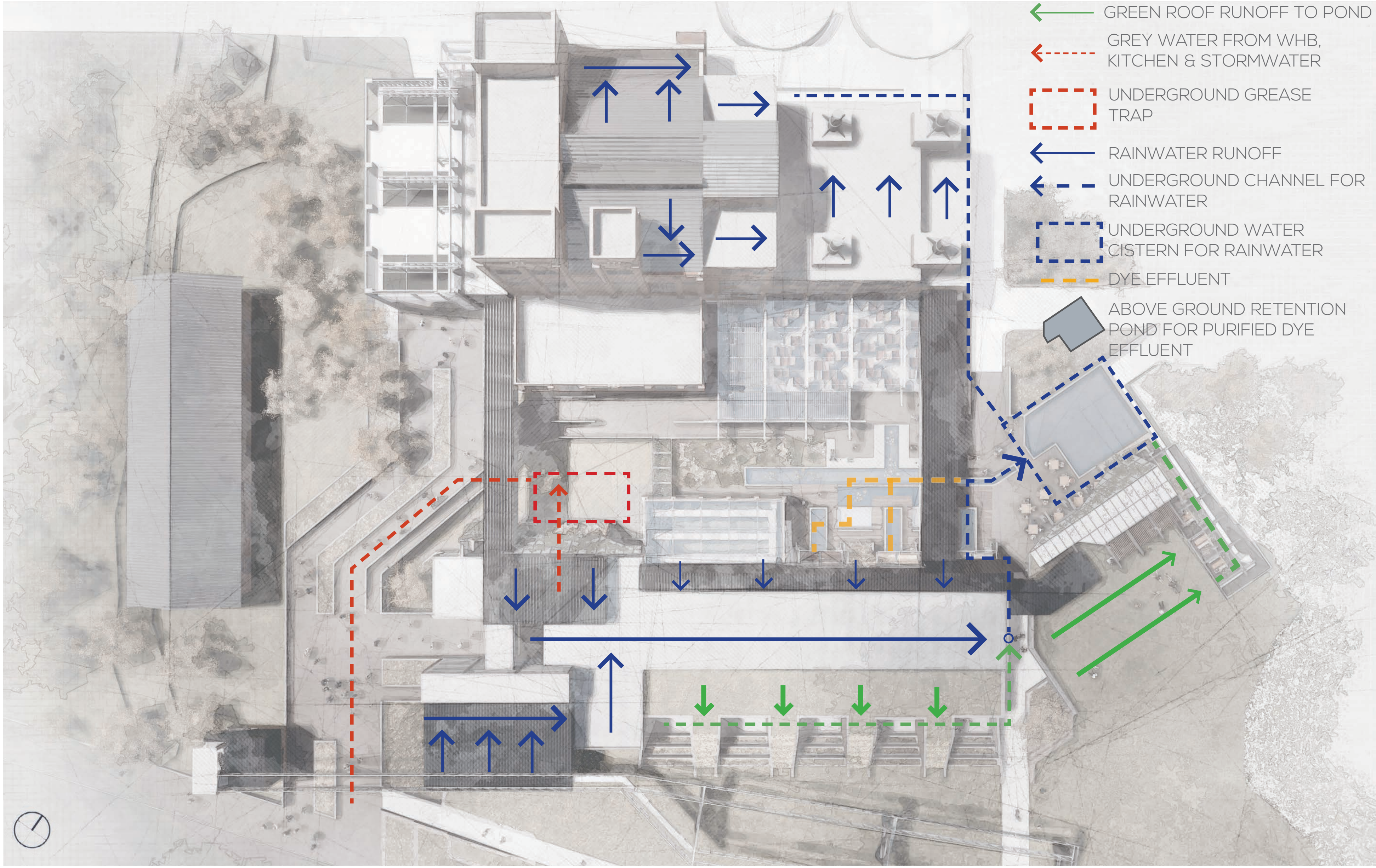


Figure 7.17: Water catchment strategy (Author 2017)

IRRIGATION & DOMESTIC DEMAND

IRRIGATION DEMAND

	Planting Area (m²)	Irrigation Depth per week (m)	Irrigation Depth per month (m)	IRRIGATION DEMAND (m³)
January	591 m²	0,040 m	0,177 m	105 m³
February	591 m²	0,040 m	0,160 m	95 m³
March	591 m²	0,040 m	0,177 m	105 m³
April	591 m²	0,030 m	0,129 m	76 m³
May	591 m²	0,020 m	0,089 m	52 m³
June	591 m²	0,020 m	0,086 m	51 m³
July	591 m²	0,020 m	0,086 m	51 m³
August	591 m²	0,020 m	0,089 m	52 m³
September	591 m²	0,030 m	0,129 m	76 m³
October	591 m²	0,040 m	0,177 m	105 m³
November	591 m²	0,040 m	0,171 m	101 m³
December	591 m²	0,040 m	0,177 m	105 m³
YEAR	**591 m² (Average)**	**0,032 m (Average)**	**1,646 m (Total)**	**973 m³ (Total)**

DOMESTIC DEMAND

	Number of Individuals	Water / capita / day (Litres)	Total Water / month (Liters)	DOMESTIC DEMAND (m³)
January	115	25 l	89 125 l	89 m³
February	115	25 l	80 500 l	81 m³
March	115	25 l	89 125 l	89 m³
April	115	25 l	86 250 l	86 m³
May	115	25 l	89 125 l	89 m³
June	115	25 l	86 250 l	86 m³
July	115	25 l	86 250 l	86 m³
August	115	25 l	89 125 l	89 m³
September	115	25 l	86 250 l	86 m³
October	115	25 l	89 125 l	89 m³
November	115	25 l	86 250 l	86 m³
December	115	25 l	89 125 l	89 m³
YEAR	**115 (Average)**	**25 l (Average)**	**87 208 l (Total)**	**1 047 m³ (Total)**

Figure 7.18: Workers water demand (Author 2017)

TOTAL DEMAND

	IRRIGATION DEMAND (m³)	DOMESTIC DEMAND (m³)	TOTAL WATER DEMAND
January	105 m³	89 m³	**194 m³**
February	95 m³	81 m³	**175 m³**
March	105 m³	89 m³	**194 m³**
April	76 m³	86 m³	**162 m³**
May	52 m³	89 m³	**141 m³**
June	51 m³	86 m³	**137 m³**
July	51 m³	86 m³	**137 m³**
August	52 m³	89 m³	**141 m³**
September	76 m³	86 m³	**162 m³**
October	105 m³	89 m³	**194 m³**
November	101 m³	86 m³	**188 m³**
December	105 m³	89 m³	**194 m³**
YEAR	973 m³ (Total)	1 047 m³ (Total)	**2 019 m³ (TOTAL)**

Figure 7.19: Total water demand (Author 2017)

YIELD (m³) = P x A x C

P = precipitation (m), A = area (m²), C = run-off coefficient

Per surface (Per surface)	Area (m²)	Run-off Coefficient
Roofing	1 834,00 m²	0,9
Paving	12 331,00 m²	0,8
Veldgrass & Planting	3 595,00 m²	0,4
TOTAL:	**17 760,00 m²**	0,73

Month	Precipitation Average Monthly (mm)	Area	Run-off Coefficient	YIELD P(m) x A(m²) x C
January	125 mm	17 760 m²	0,73	1 619 m³
February	90 mm	17 760 m²	0,73	1 166 m³
March	91 mm	17 760 m²	0,73	1 179 m³
April	54 mm	17 760 m²	0,73	699 m³
May	13 mm	17 760 m²	0,73	168 m³
June	9 mm	17 760 m²	0,73	117 m³
July	4 mm	17 760 m²	0,73	52 m³
August	6 mm	17 760 m²	0,73	78 m³
September	27 mm	17 760 m²	0,73	350 m³
October	72 mm	17 760 m²	0,73	933 m³
November	117 mm	17 760 m²	0,73	1 516 m³
December	105 mm	17 760 m²	0,73	1 360 m³
YEAR	**713 mm**	**17 760 m²**	0,73	**9 236 m³**

Figure 7.20: Total water yield (Author 2017)

WATER BUDGET

	YIELD from onsite runoff (m³)	DEMAND total onsite water demand (m³)	Monthly Balance	Water in Tank/Reservoir (m³)
January	1 619 m³	194 m³	1 425 m³	**3 920 m³**
February	1 166 m³	175 m³	991 m³	**4 910 m³**
March	1 179 m³	194 m³	985 m³	**5 895 m³**
April	699 m³	162 m³	537 m³	**6 433 m³**
May	168 m³	141 m³	27 m³	**6 459 m³**
June	117 m³	137 m³	- 20 m³	**6 439 m³**
July	52 m³	137 m³	- 85 m³	**6 354 m³**
August	78 m³	141 m³	- 64 m³	**6 290 m³**
September	350 m³	162 m³	188 m³	**6 478 m³**
October	933 m³	194 m³	739 m³	**0 m³**
November	1 516 m³	188 m³	1 328 m³	**1 328 m³**
December	1 360 m³	194 m³	1 166 m³	**2 494 m³**
YEAR	**11 255 m³ (Total)**	**2 019 m³ (TOTAL)**		

Greatest volume of water in tank/reservoir at any time is the minimum capacity of the tank	**6 478 m³**

Safety Factor:	**1,5**	**Final Tank/Reservoir Size:**	**9 717 m³**

Figure 7.21: Water budget (Author 2017)

Ventilation system - Stack Ventilation

Stack ventilation is proposed as a means of ventilating the new building. Stack ventilation makes use of the differences in air temperatures to move air (Autodesk Sustainability Workshop 2013). It is proposed that geo-thermal pipes be used to introduce cool air at low inlets in the dye house and that outlets be placed at the highest point in the structure because of hot air's low pressure which causes it to rise and to escape. It is at this point that a form of solar chimney will be used to incite the process. The solar chimney comprises a north-west facing glazed facade and thermal mass in the form of a brick wall.

As the solar radiation penetrates the glazed façade, it heats up the thermal mass which stores the heat to allow the chimney to work even after the sun has set. By optimising solar radiation at a high level in the building, the temperature increases at this point, and this in turn increases the rate of the acceleration in air movement.

Geo-thermal system

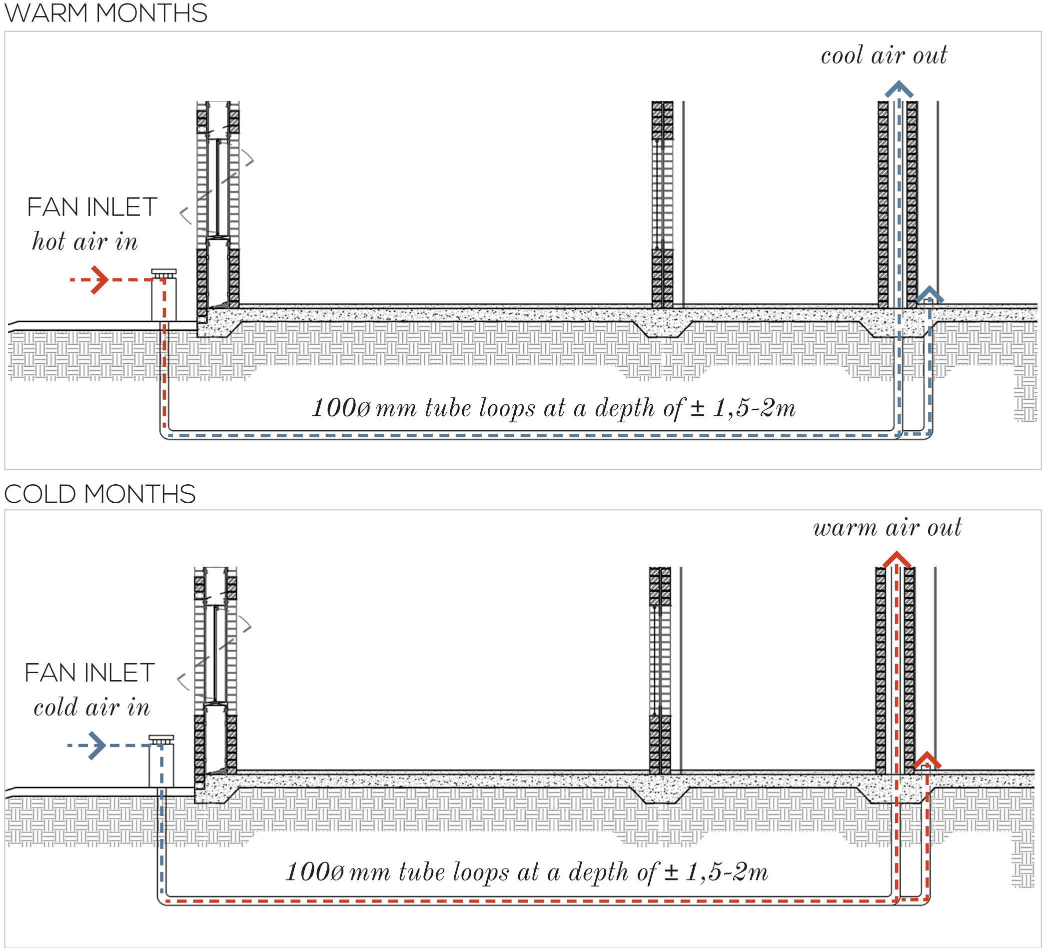


Figure 7.22: Geo-thermal system diagrams (Author 2017)

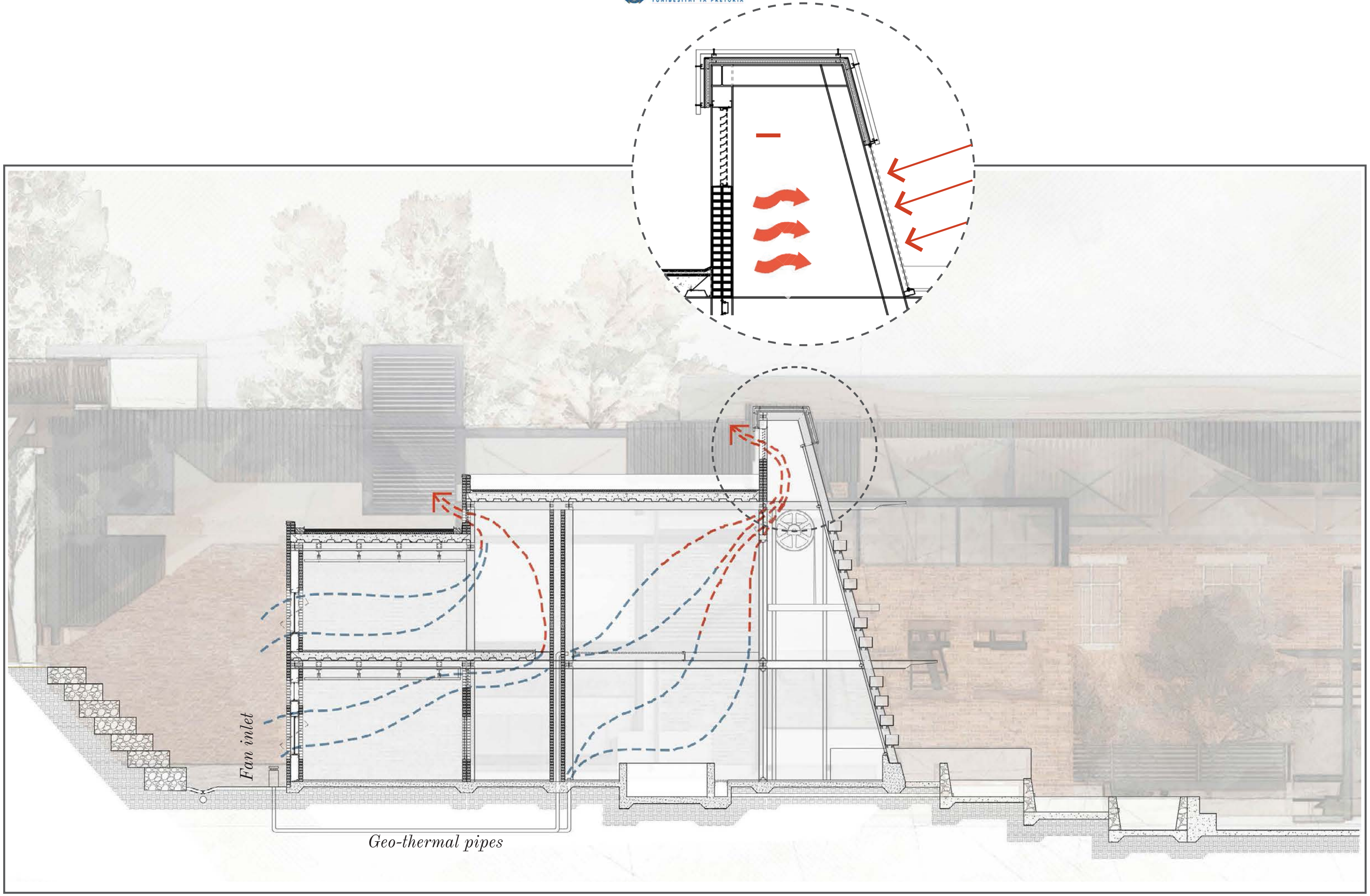


Figure 7.23: Section through proposed ventilation system in new structure (Author 2017)

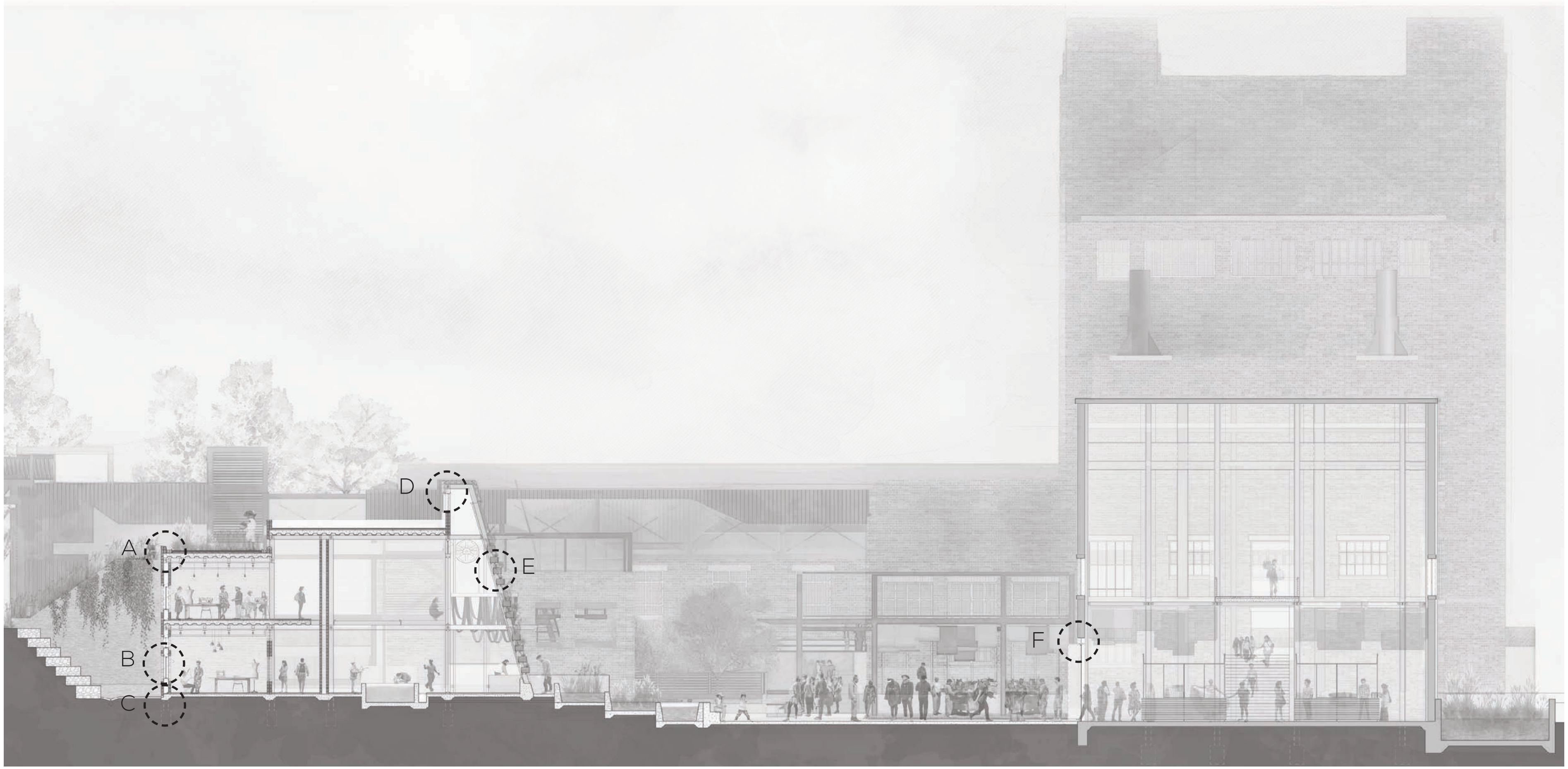
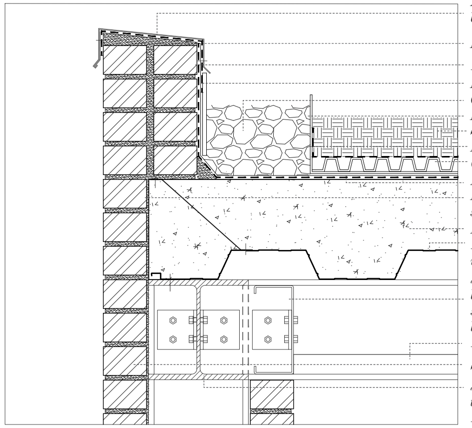
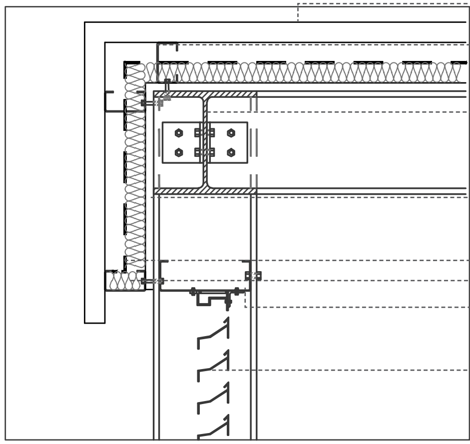


Figure 7.24: Section A-A (Author 2017)

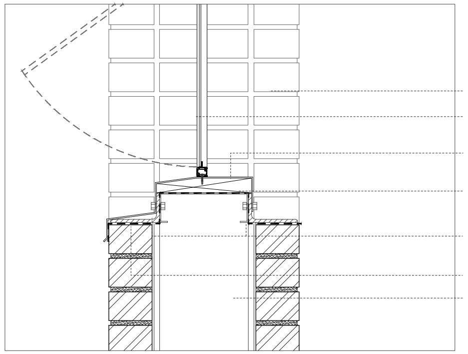
Detailing



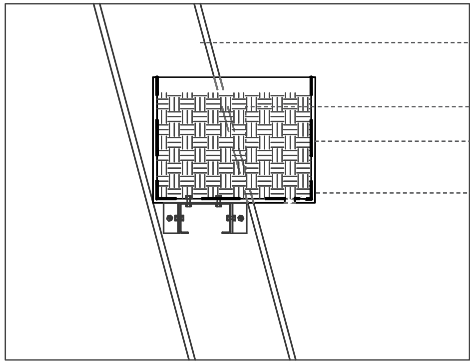
Detail A: Green roof detail



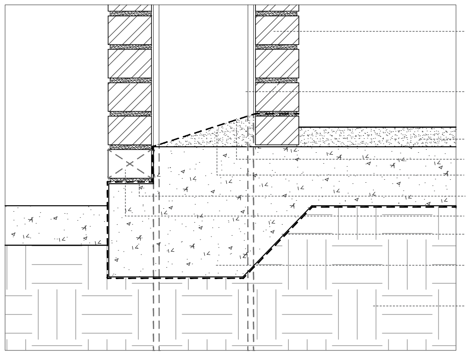
Detail D: Roof detail



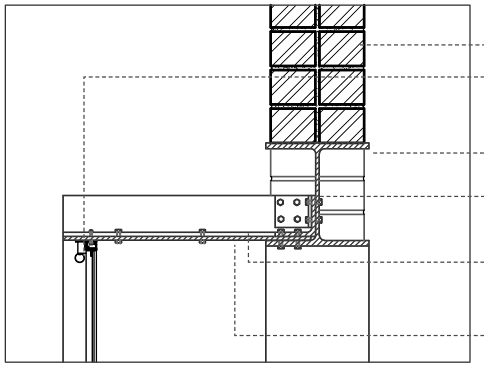
Detail B: Window sill detail



Detail E: Planter detail



Detail C: Floor detail



Detail F: Heritage connection detail (Retort 2)

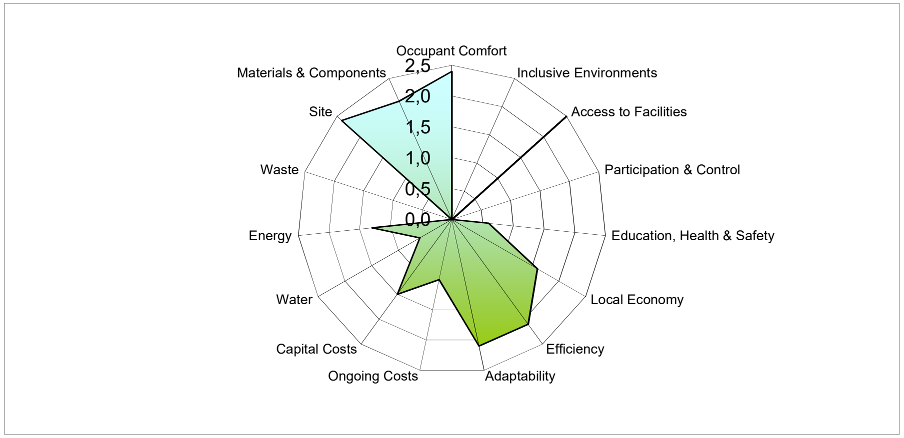
Figure 7.25: Detail A-F (Author 2017)

SBAT rating

Before intervention

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT	
Project title:	Eco-textile Emporium	Date:	15 -Oct-17
Location:	Braamfontein, Johannesburg	Undertaken	Renée Minnaar
Building type (specify):	Textile Mill & Dye house	Company:	Student
Internal area (m2):		Telephone:	Fax:
Number of users:	50-70	Email:	
Building life cycle stage (specify):	Design		



Social	1,1	Economic	1,7	Environmental	1,3
		Overall	1,3		

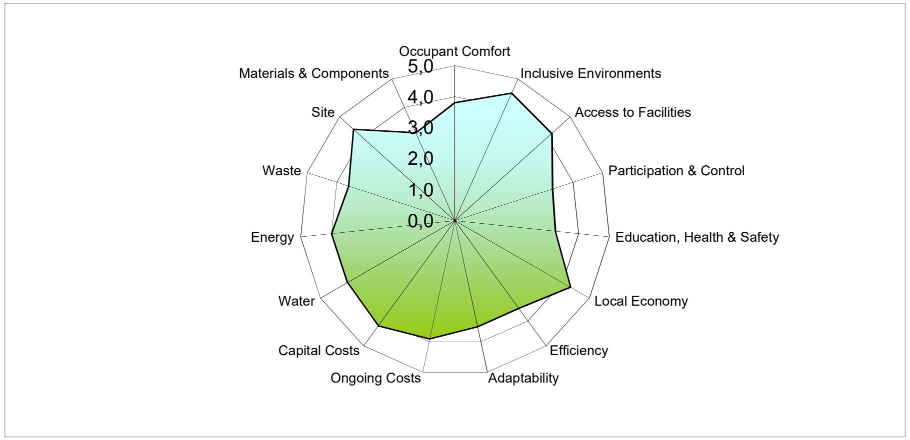
Figure 7.26: SBAT analysis before intervention (Author 2017)

From the SBAT analysis it is clear that before intervention, the site and existing buildings were lacking in terms of their social, economic and environmental contribution to society. The site was further lacking in terms of inclusive design, health and safety and in terms of its waste, water and energy management.

After intervention

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT	
Project title:	Eco-textile Emporium	Date:	15-Oct-17
Location:	Braamfontein, Johannesburg	Undertaken	Renée Minnaar
Building type (specify):	Textile Mill & Dye house	Company / organisatior	Student
Internal area (m2):		Telephone:	Fax:
Number of users:	50-70	Email:	
Building life cycle stage (specify):	Design		



Social	3,8	Economic	3,9	Environmental	3,8
		Overall	3,8		

Figure 7.27: SBAT analysis after intervention (Author 2017)

The SBAT analysis after the intervention, illustrates a great improvement in terms of the site's social, economic and environmental contribution. As well as creating an inclusive environment; waste, energy and water management have also shown a great improvement.

Sefaira testing

Daylighting

Terminology

Spatial daylight autonomy [sDA]:
Is a factor used to measure the amount of usable daylight a space receives throughout a year (Schoen 2015).

Annual Sun Exposure [ASE]:
This factor helps to identify whether a space is overlit (Schoen 2015), which might lead to glare and visual discomfort.

Benchmark

The Leadership in energy and environmental design (LEED) and the Green Building Council of South Africa benchmarks were used to assess the daylight performance of the existing retort house.

	Benchmark Value
sDA	> 75%
ASE	< 10%

Figure 7.38: Benchmark table (Author 2017, adapted from LEED 2017)

Results

The sDA underperformed 11% under the desired benchmark of 75% and the ASE exceeded the maximum 10% benchmark by 30%.

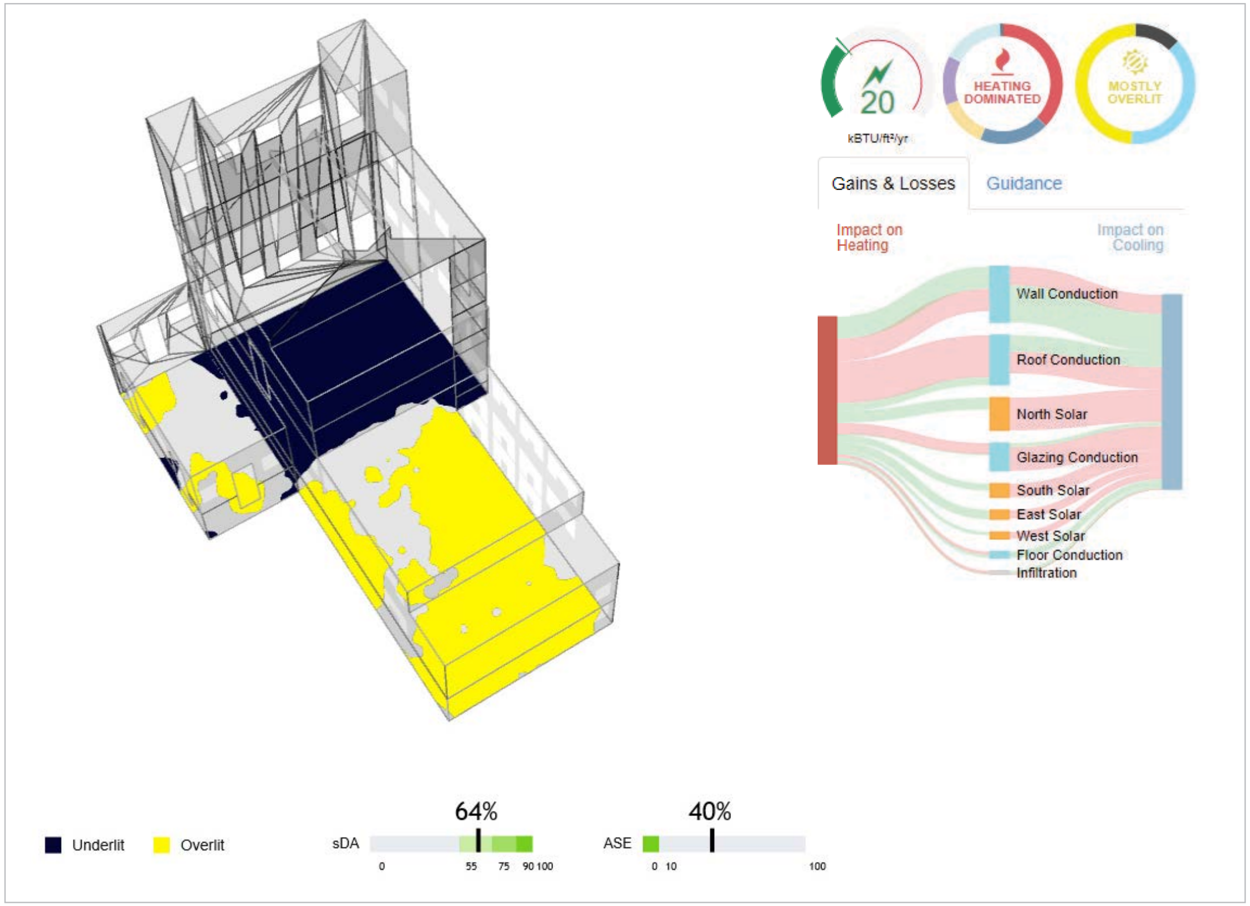


Figure 7.28: Sefaira daylight analysis (Sefaira 2017)

	Benchmark Value	Existing building performance	Strategy
sDA	> 75%	64%	Increase
ASE	< 10%	40%	Decrease

Final model

Figure 7.29: Final model view 1 (Minnaar 2017)

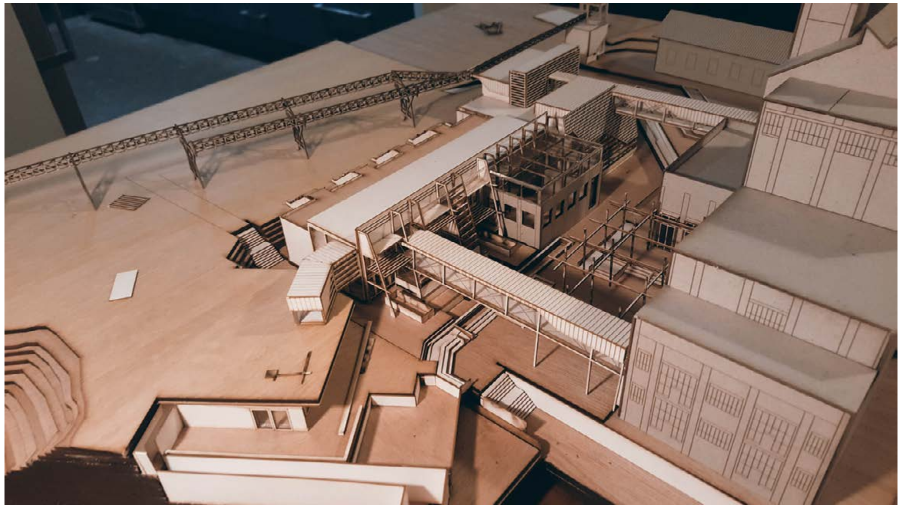


Figure 7.30: Final model view 2 (Minnaar 2017)

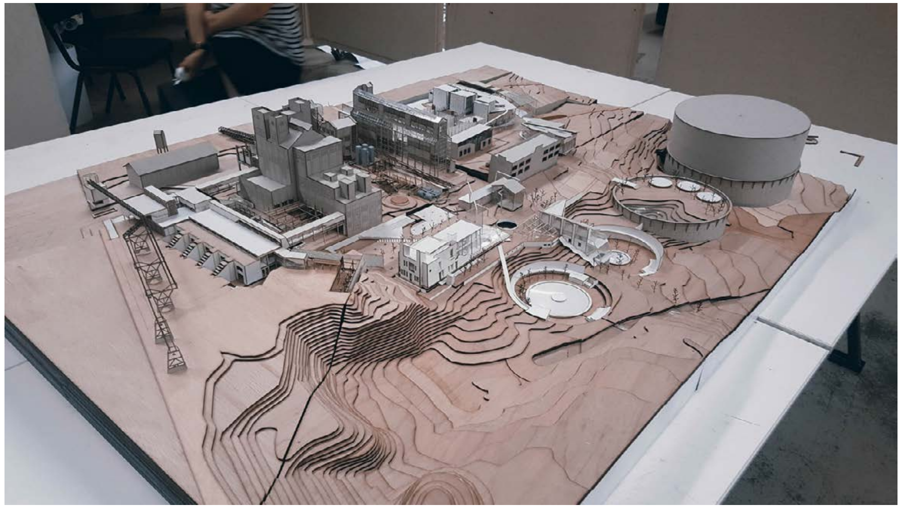


Figure 7.31: Final group model (Minnaar 2017)

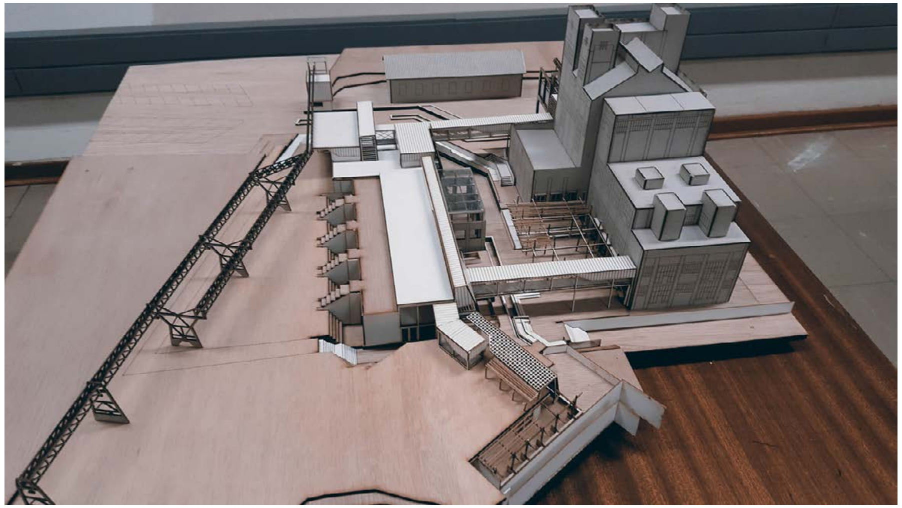


Figure 7.32: Final model view 3 (Minnaar 2017)

Final presentation - 22 November

Figure 7.33: Verbal presentation (Minnaar 2017)

Figure 7.34: Visiual presentation (Minnaar 2017)

Figure 7.35: Final model & presentation (Minnaar 2017)

Figure 7.36: Gasworks Group - exhibition night (Minnaar 2017)