Fig 7.1 Render of the new steel walkway and steel details (Author, 2018)

CHAPTER

07

technification

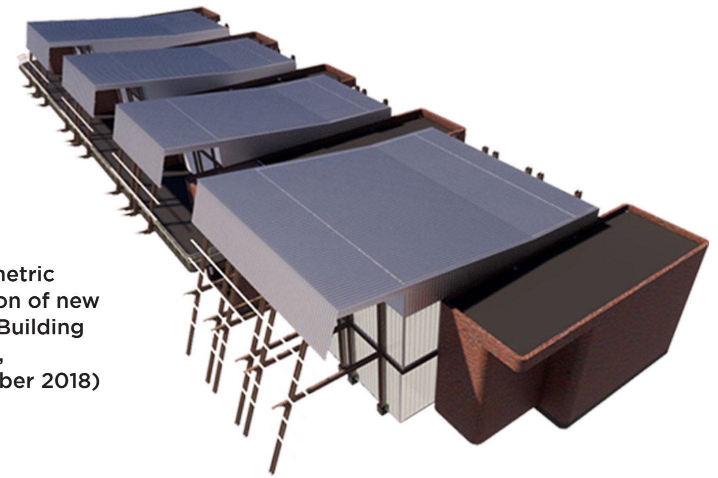


Fig 7.2 Axonometric Explosion of new School Building (Author, September 2018)

07.1 INTRO

Architecture can have more than mere functional meaning, as the architecture critic and writer Deyan Sudjic suggests in his book *The Edifice Complex:* "...we need to consider whether architecture is an end itself, or a means to an end." (Sudjic, 2005:9).

Architecture differs from other scientific disciplines that are free of ideology and expression, it can convey a message or be an artistic expression, from concept to built form. (Sudjic, 2005:9).

This chapter explores this expression through the use of technology and systems while paying homage to the site's industrial heritage. Theory, context, analysis and precedents influenced design and technical decisions.

07.2 CONCEPT

The very nature of the site was grounded in an industrial narrative that sought to exploit the natural resources for economic gain - an unsustainable model. This dissertation sought to reinterpret the materials used and found on site towards a more symbiotic relationship between the building and the landscape. The building responds to its landscape driven program while respecting the industrial setting. Thus a play with thresholds and light vs. heavy to illustrate this narrative.

The tectonic approach taken is one that honours industrial heritage and the context of the site. While the previous buildings are respected by utilising footprints and leftover building material to incorporate into the new buildings, the new architecture is a contrast and departure from the factory that precedes it.

All the proposed buildings have a similar design language with repeating brick service cores binding the new architecture together. The buildings differ due to the differences in their programmatic requirements and response to solar angles.

Fig 7.3 Existing farmland north of the site. (Google Earth, 2018) (Author, 2018)

07.3 SITE SCALE SYSTEMS

After the establishment of this dissertations' program it became important to test the viability of an agricultural school on the site. With further investigation and mapping it became clear that the site sits in a large green belt running along the banks of the *Moretele* River (See figure 7.3).

The river flows north / north-east past the site eventually flowing into the *Roodeplaat* Dam. Along this flow a couple of small scale farms are visible. Around the dam the scale and frequency of farms increase.

As stated in chapter four, a suggestion made by Bridgette Botha, in her 2015 dissertation, is to channel the two rivers around the site into the existing ponds on site, This premise has been adopted and applied to this dissertation to make the program more viable,

As seen in figure 7.4 the intention is that the site serves all the communities surrounding it. The opportunity for farmland expansion to the whole site is made more plausible

Fig 7.4 Initial Urban Design (Author, 2018)

Fig 7.5 Latest Urban Design (Author, 2018)

through new irrigation opportunities. Parcels of land can now be leased and farmed on by anyone, with entrances and roads all over the site,

The need for water is then supplemented from excess runoff and surplus rain water collected off the new roofs designed in this dissertation. The final suggested farmland scheme would then resemble figure 7.5.

07.4 EXPLORATION & DEVELOPMENT OF STRUCTURE

The brick cores of the building house the services that make the building function. These cores are constructed from a concrete frame and filled in by bricks found on site. The spaces in between these stereotomic blocks are constructed from lightweight materials that depend on the *brick-cores* for services and additional structural stability in the clay soil condition. The following section explains the development of the technologies used in this dissertation.

07.4.1 MATERIALITY

The choice of materials are informed by the site's history, current state and climatic responses.

The stereotomic, brick service cores are made from concrete pile foundations, concrete columns, cast in situ reinforced concrete slabs and with reclaimed brick (found on site) infill façades.

The tectonic, lightweight steel structure between the boxes are constructed from painted steel I-section beams, parallel flange steel columns, bond-deck permanent shuttering floor system, dry walls with *Klip-lok* cladding and a steel sub-frame.

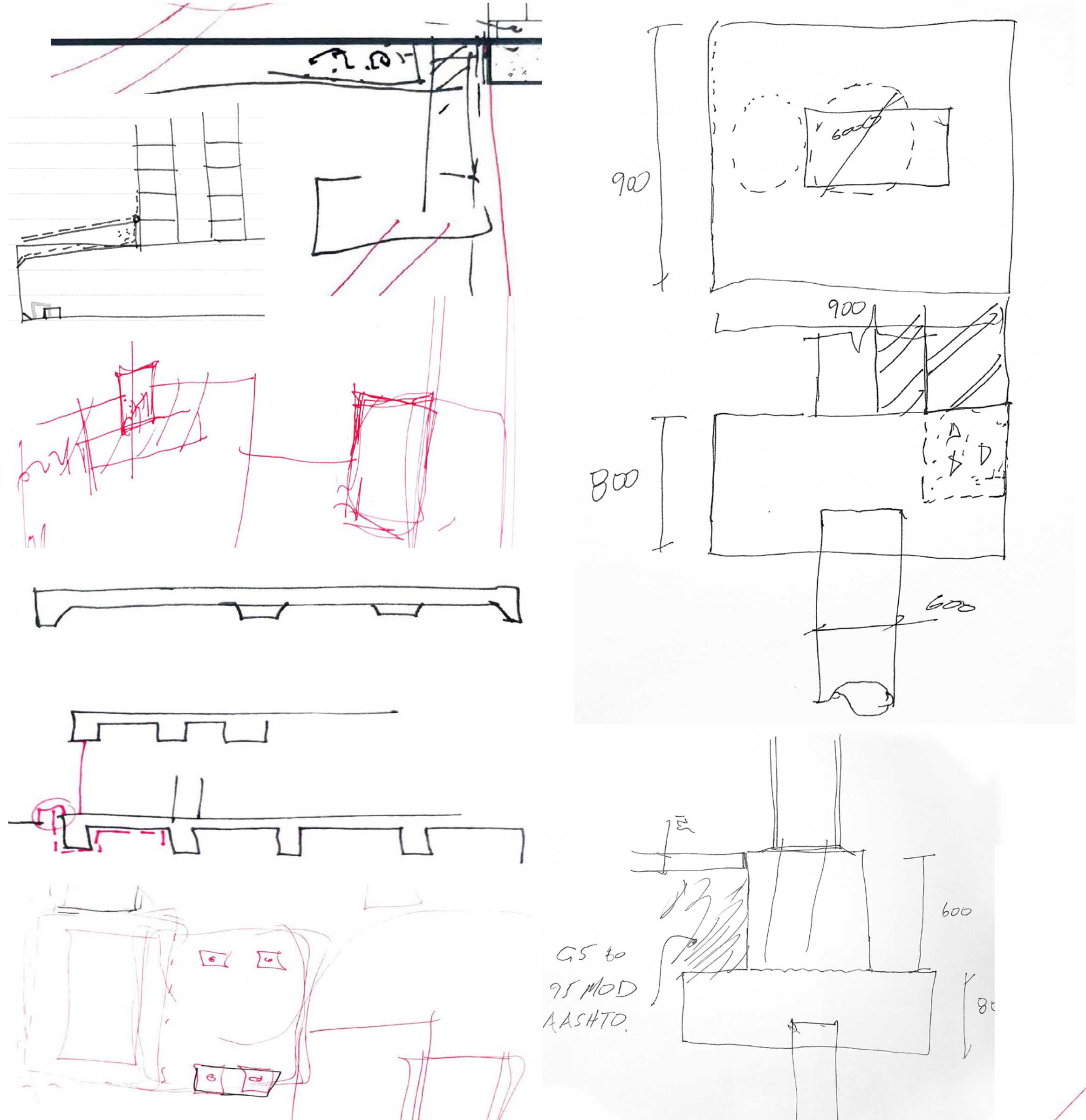
The fenestrations is constructed of two types of *Danpalon* panels. A translucent panel to let direct light into spaces and an opaque one to make light defuse into the spaces.

The roofs is covered with the same *Klip-lok* sheets as the clad walls, with cold-formed C-section purlins.

On the first floor a light-weight steel walkway and handrail surrounds the façade facing the large open courtyard.

A permeable paving used around the building and at the open areas under the class rooms.

Fig 7.6 Materiality Pallet (Author, 2018)



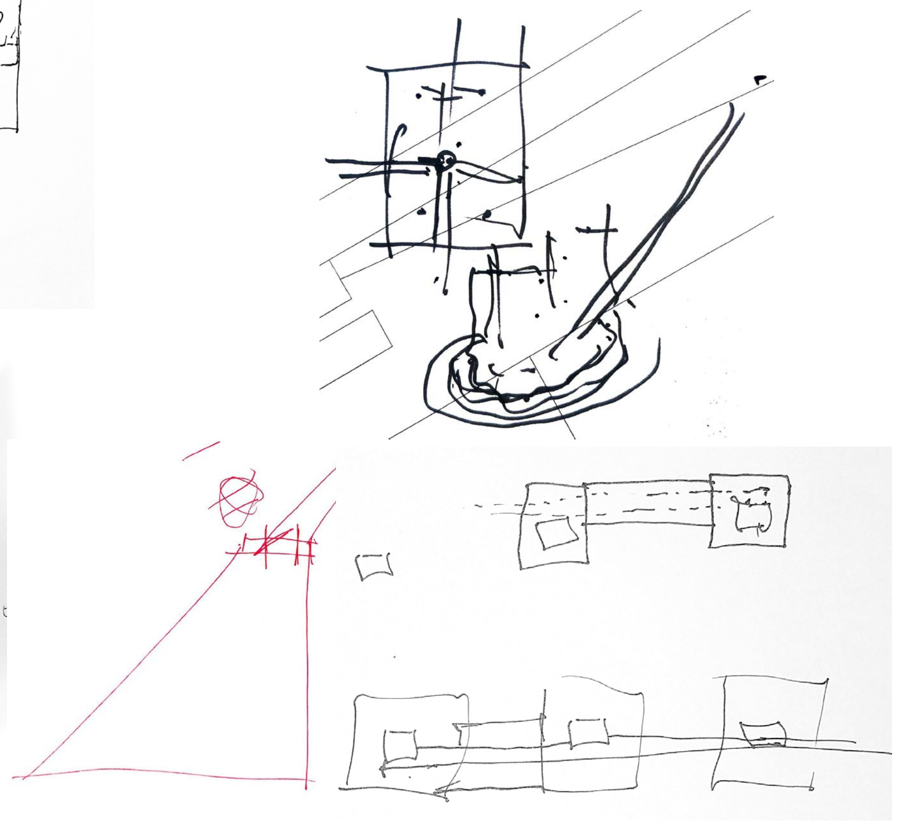


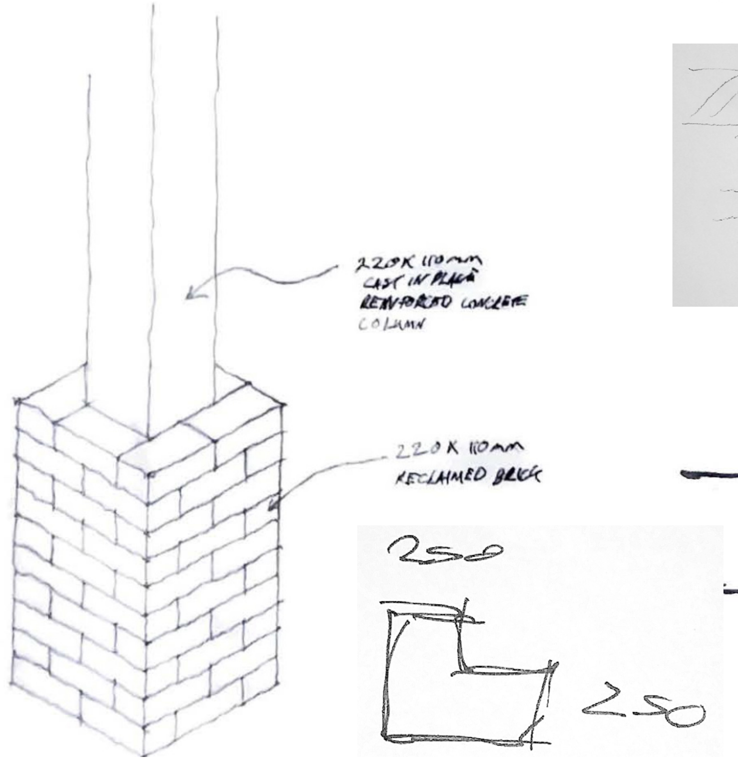
Fig 7.7 Iterative sketches of concrete foundations (Author, 2018)

07.4.2 FOUNDATIONS

The following sketches are an exploration of the buildings foundations, beginning as a raft foundation and later being replace by a pile foundation system. The pile foundation was used under the brick boxes and under the parallel steel flange columns of the tectonic structure.

07.4.3 CONCRETE COLUMNS & SLABS

The following sketches are an exploration of the brick service cores and their concrete slabs and columns. This aspect of the building went thorough many iterations to accommodate the rounded corners of the brick infill and to the services that have to run through these boxes.



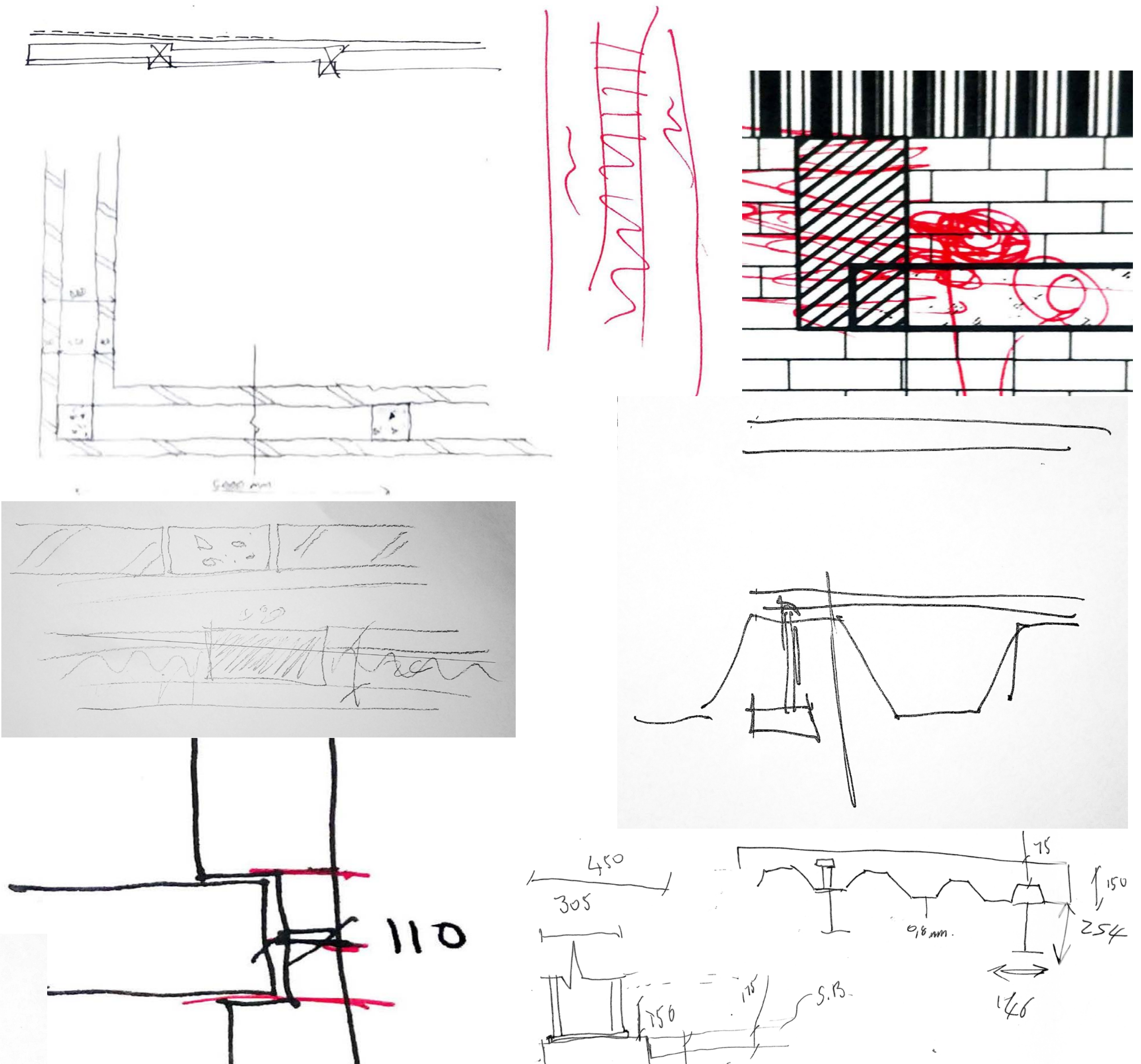
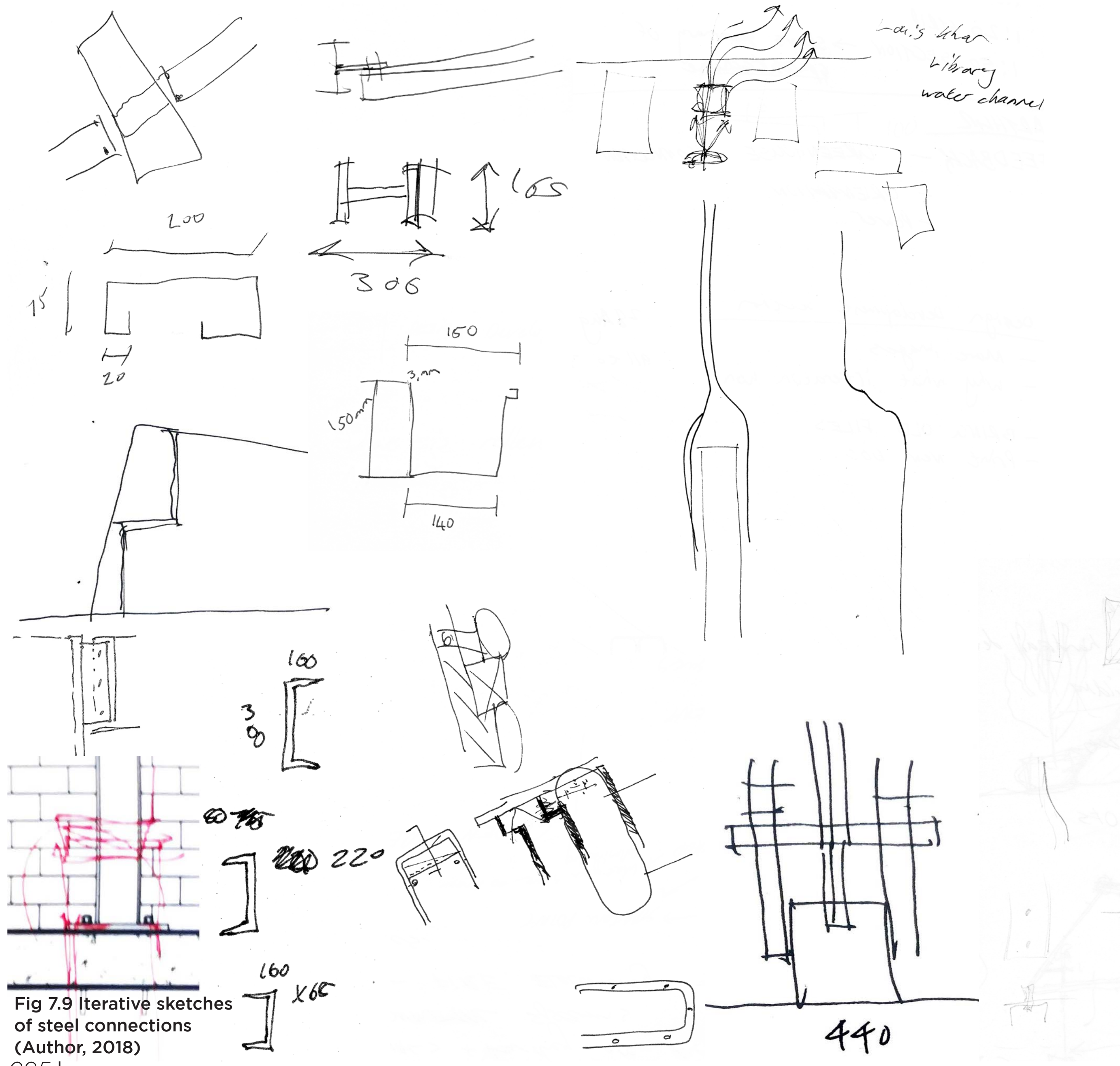


Fig 7.8 Iterative sketches of concrete columns and slabs (Author, 2018)

07.4.4 STEEL CONNECTIONS

The following sketches are an exploration of the steel connections used through the intervention. A mixture of I-sections, parallel flanges and cold-rolled c-channels were used. Previous iterations included steel v-columns, a rigid 5x5m column grid to list a few, before settling on the final iteration.



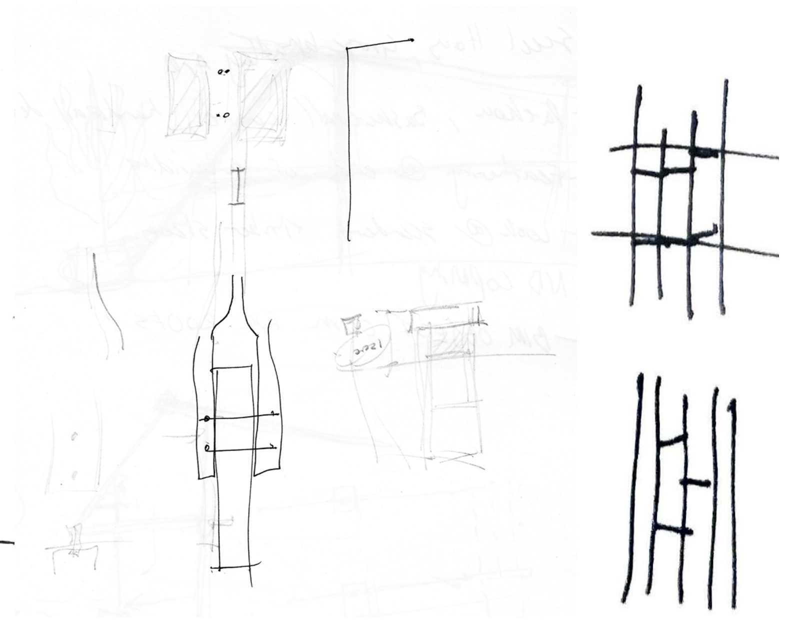


Fig 7.9 Iterative sketches of steel connections (Author, 2018)

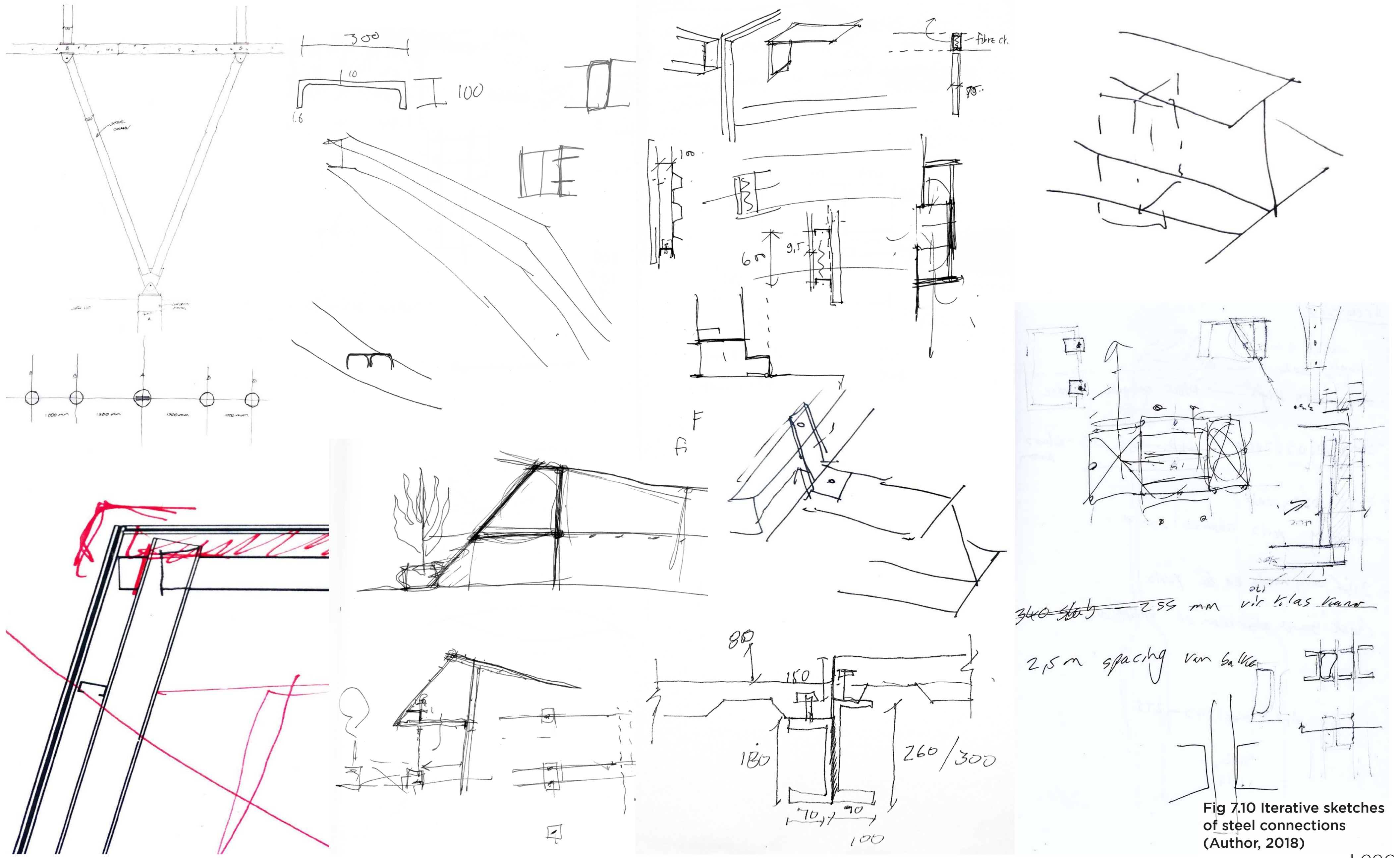
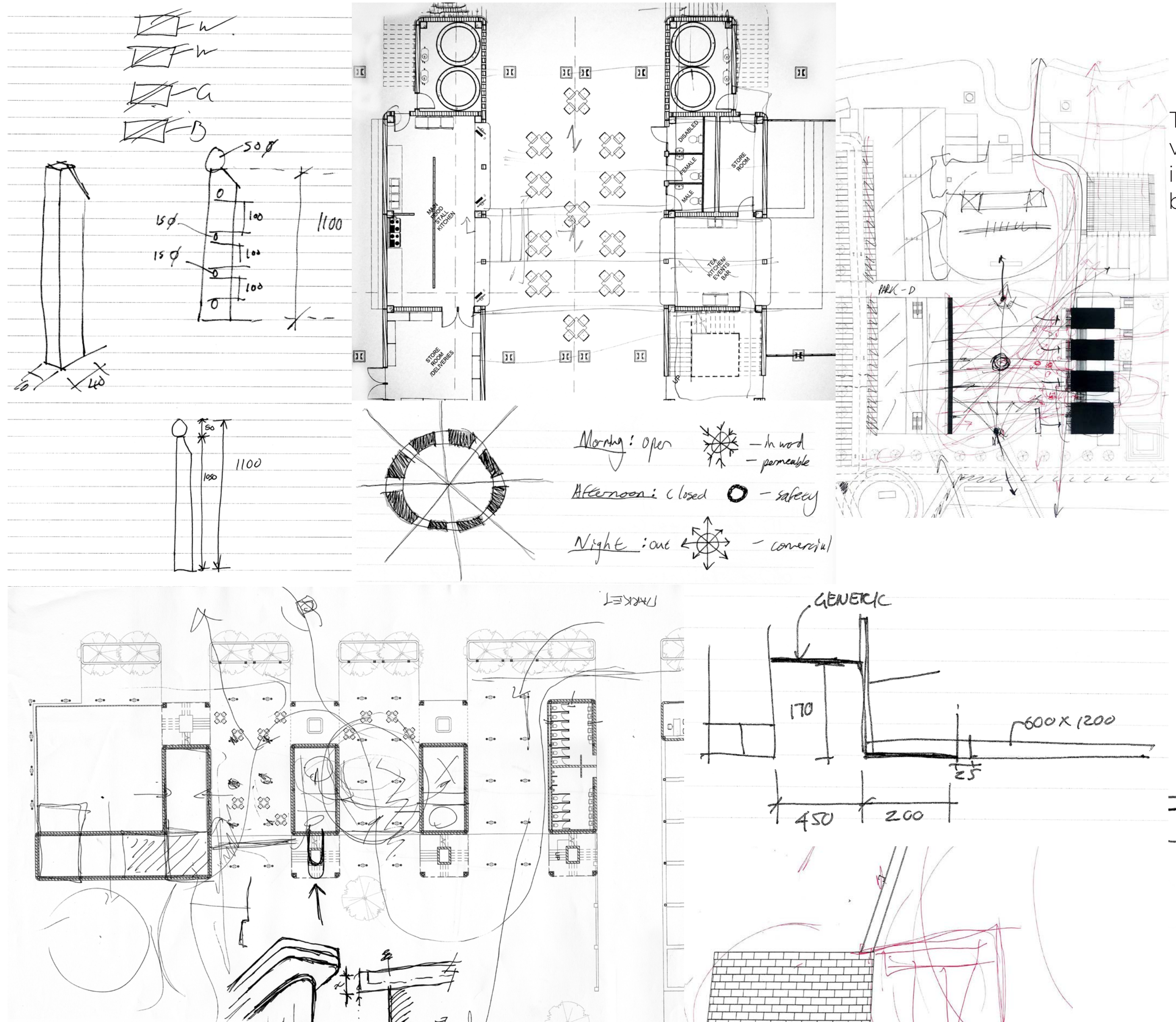


Fig 7.10 Iterative sketches of steel connections (Author, 2018)



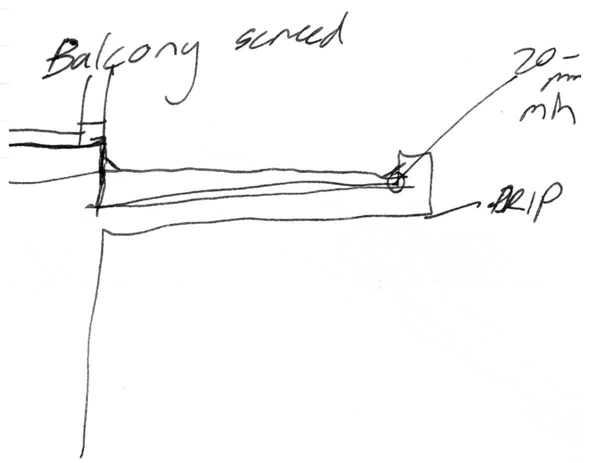


Fig 7.11 Iterative sketches of various design details (Author, 2018)

07.4.5 GENERAL DESIGN CONSIDERATIONS

The following sketches an exploration of various parts of the proposed building, including balcony details, parking layouts, bulkhead details etc.

07.5 SERVICES & SYSTEMS

07.5.1 WATER

Because of the exploitation of natural recourse in the site's past, this dissertation suggests harvesting rain water off of the buildings roofs and utilising the channelised rivers in the site. The harvested water will be used for irrigation and the building's internal water uses, like showers toilets and sinks.

With 3001.5 square meters of roof space to catch rain water, the building can catch an average of 1810 cubic meters of water a year. Irrigating the landscaping, the test grounds and the green house will use at least 5380 cubic meters of water a year. Thus the deficit will be supplemented with the rivers flowing in to the site.

The school building alone will use an estimated 142.3 cubic meters of water a year. Meaning that for plumbing and drinking water needs the harvesting of rain water would be more than ample.

The total capacity of all the water tanks are 557 cubic meters. Extra storage capacity is also possible under the green house in the old brick drying channels.

In each brick-core building 2 water pumps are placed to move water between the channels in the productive landscape and the reserve dam under the green house.

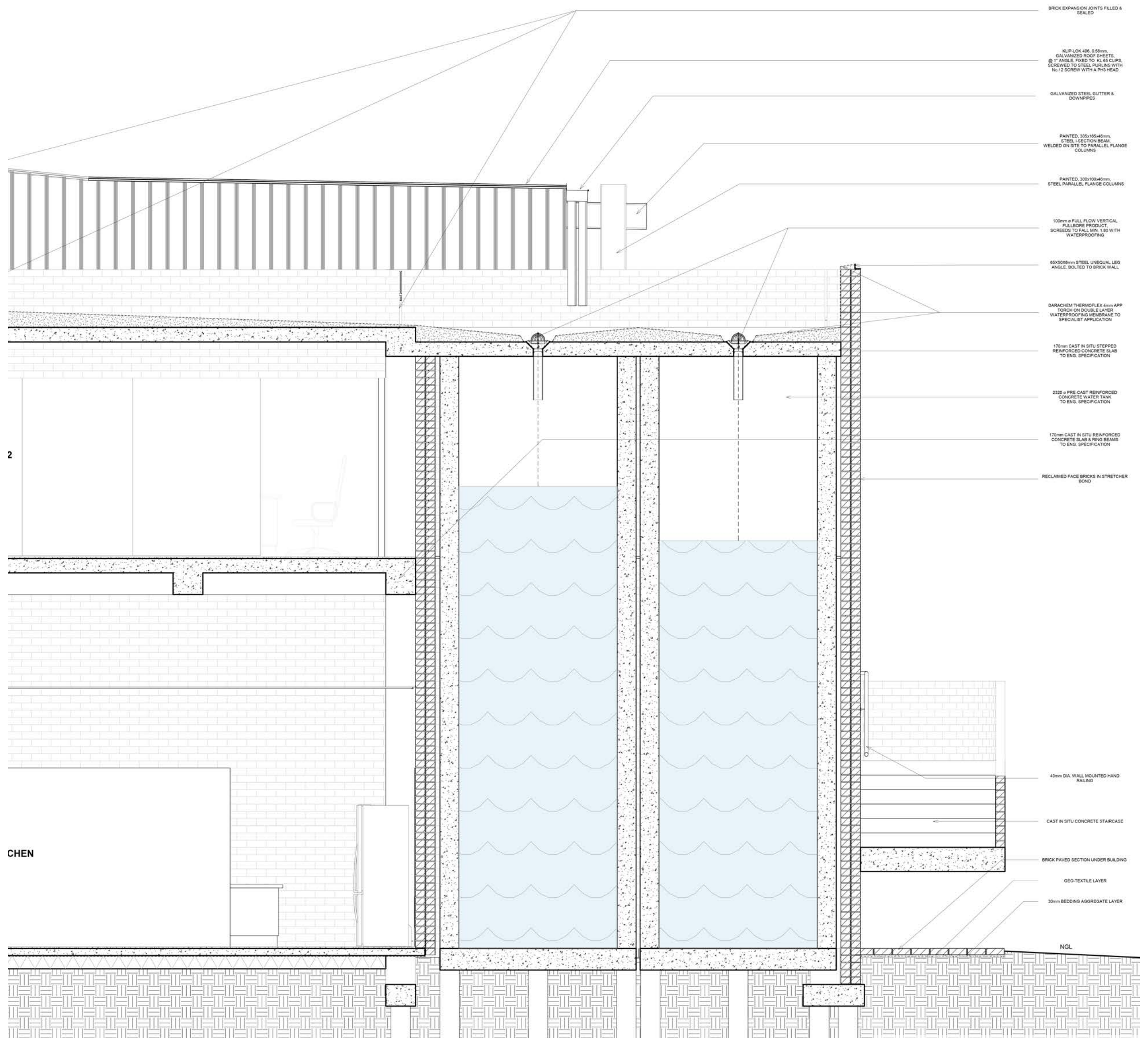


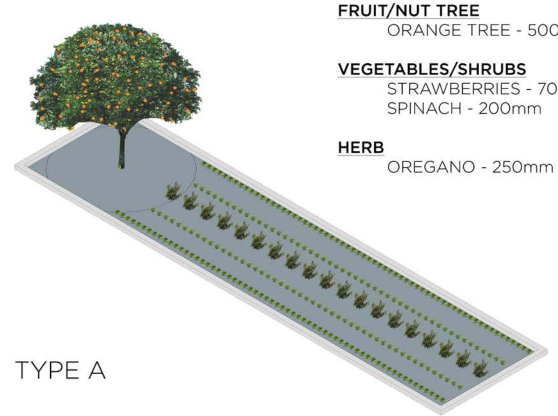
Fig 7.12 Section through a brick core and concrete water tank (Author, 2018)

PLANTS & SIZES

FRUIT/NUT TREE
ORANGE TREE - 5000mm

VEGETABLES/SHRUBS
STRAWBERRIES - 700mm
SPINACH - 200mm

HERB
OREGANO - 250mm



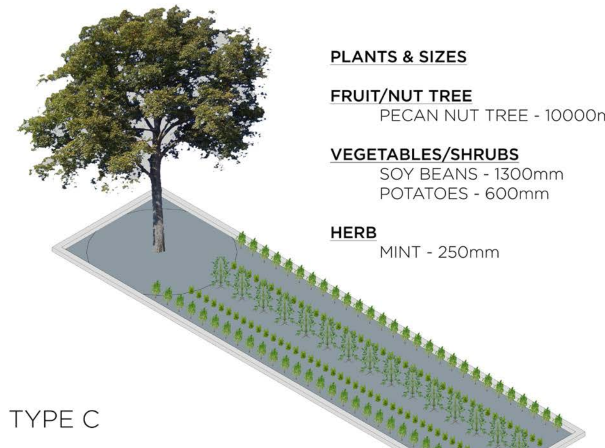
TYPE A

PLANTS & SIZES

FRUIT/NUT TREE
PECAN NUT TREE - 10000mm

VEGETABLES/SHRUBS
SOY BEANS - 1300mm
POTATOES - 600mm

HERB
MINT - 250mm



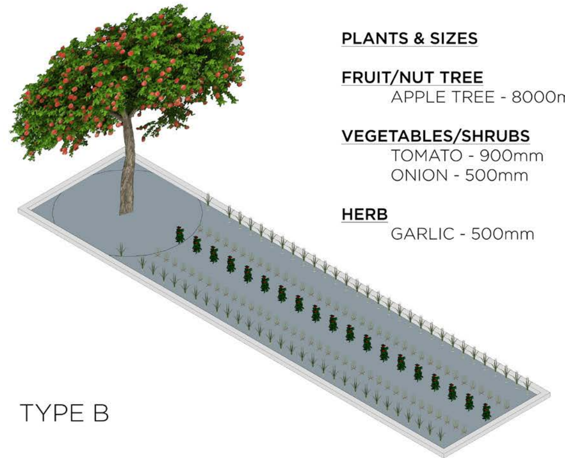
TYPE C

PLANTS & SIZES

FRUIT/NUT TREE
APPLE TREE - 8000mm

VEGETABLES/SHRUBS
TOMATO - 900mm
ONION - 500mm

HERB
GARLIC - 500mm



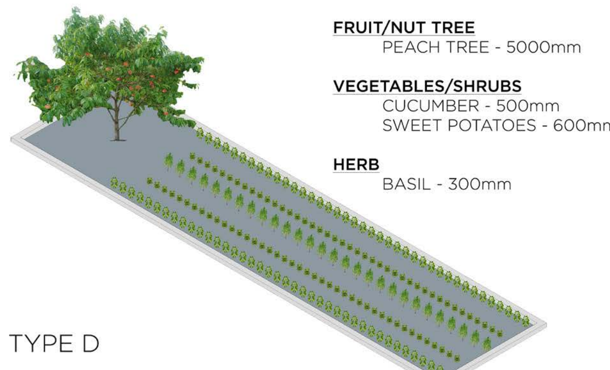
TYPE B

PLANTS & SIZES

FRUIT/NUT TREE
PEACH TREE - 5000mm

VEGETABLES/SHRUBS
CUCUMBER - 500mm
SWEET POTATOES - 600mm

HERB
BASIL - 300mm



TYPE D

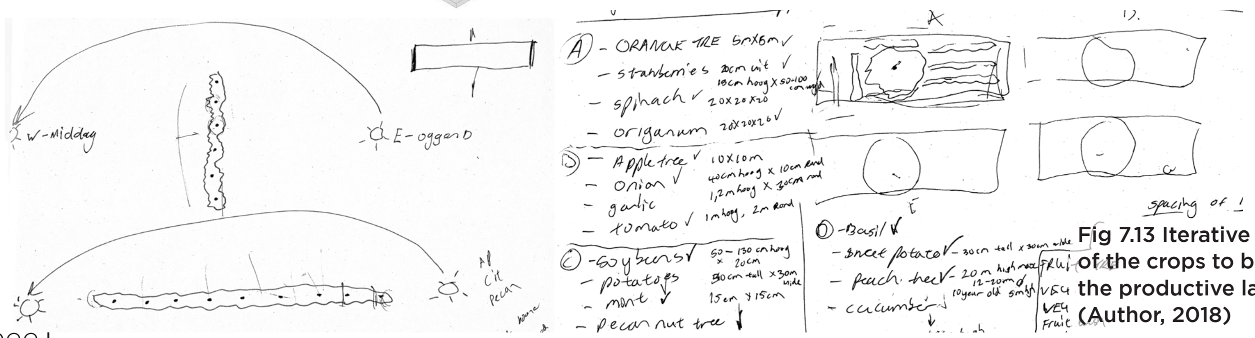


Fig 7.13 Iterative sketches of the crops to be used in the productive landscape (Author, 2018)

07.5.2 FARMING & CROPS

At the test grounds, (*"proef plaas"*), and green house the following crops will be planted together in groups, these plants are listed as complementary to each other as they hold certain advantages to the other.

They are divided in to four groups as follows, A fruit/nut tree, two vegetables or shrubs and a herb.

Group A: Orange tree
Strawberries
Spinach
Oregano

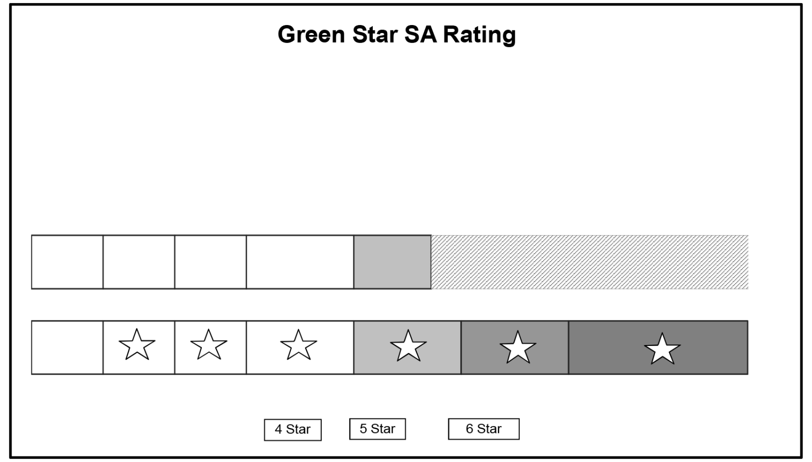
Group B: Apple tree
Tomato
Onion
Garlic

Group C: Pecan Nut tree
Soy Beans
Potatoes
Mint

Group D: Peach tree
Cucumber
Sweet potatoes
Basil

07.5.3 GREEN STAR RATING

This intervention achieved a four star rating, narrowly missing the 5 star mark by a small margin. With more iteration and finer calculations the building can achieve a 5 star rating.



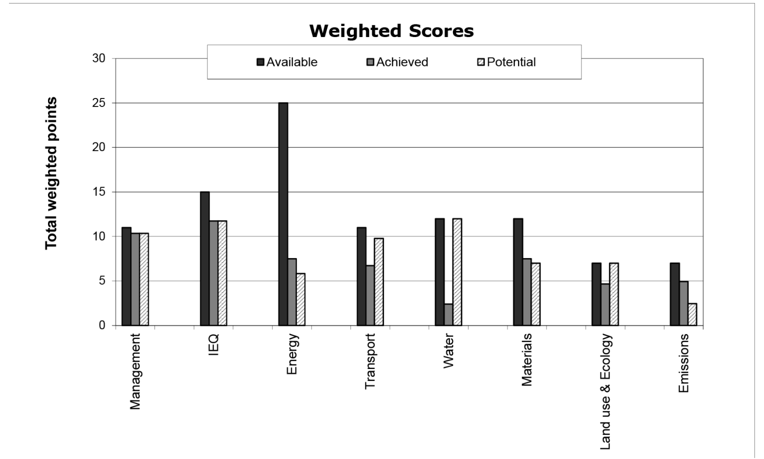
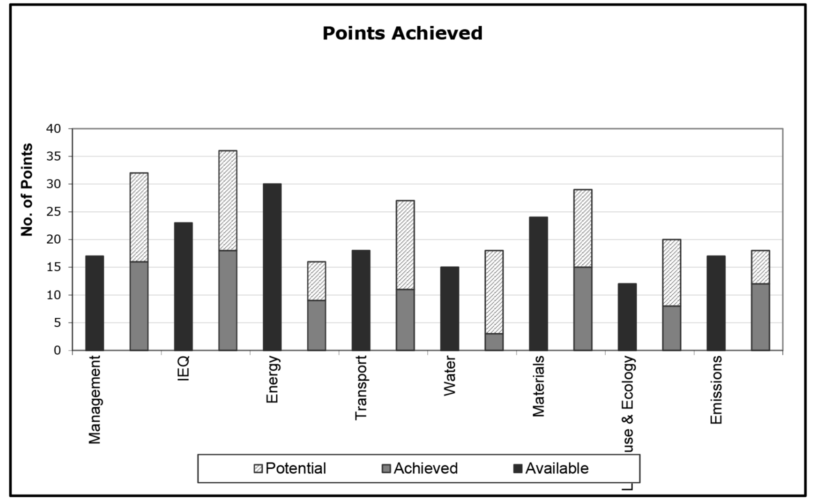
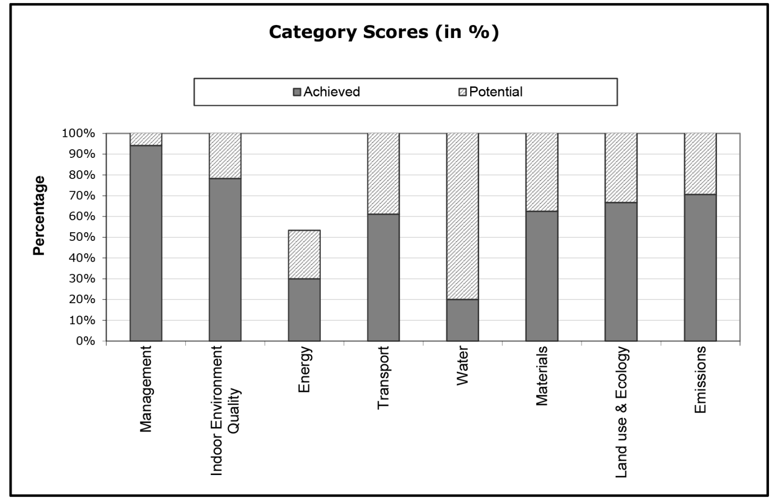


Fig 7.14-17 Graphs depicting the Green-Star scores of this building (GBCSA, 2018)





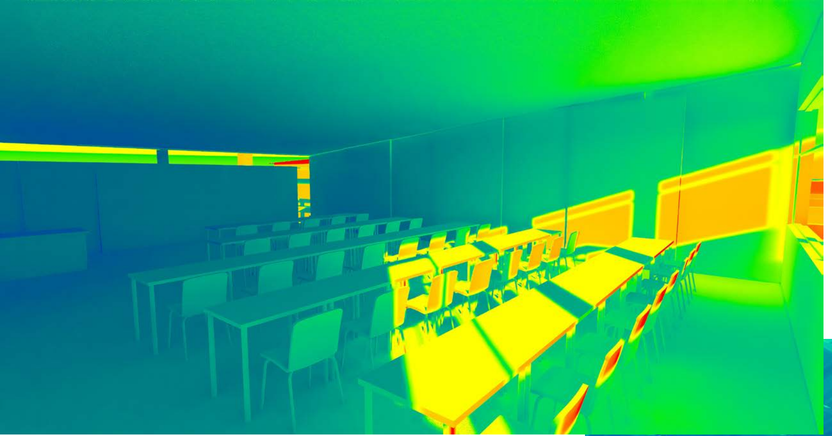


Fig 7.18 First iteration of the class room, severely over-lit and overheating. (Author 2018)

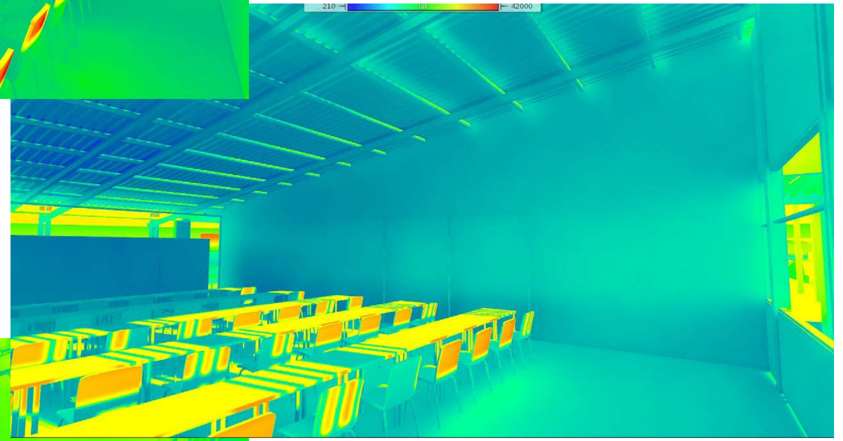


Fig 7.19 Second iteration of the class room, still over-lit and overheating. (Author 2018)

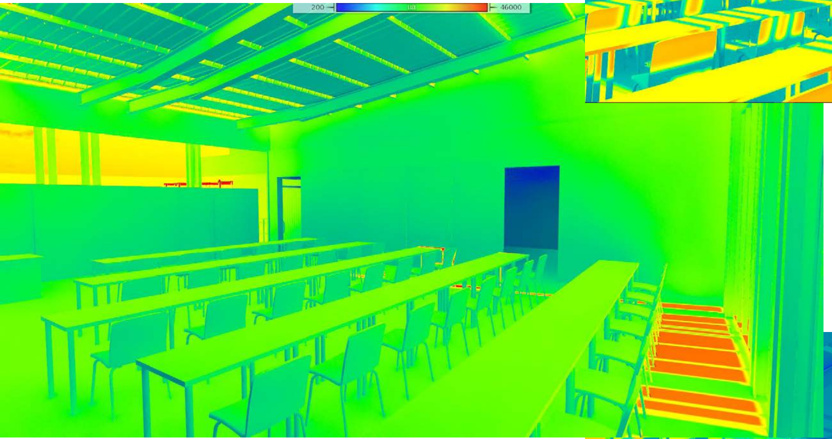


Fig 7.19 Third iteration of the class room, only the back of the class over-lit and overheating. (Author 2018)

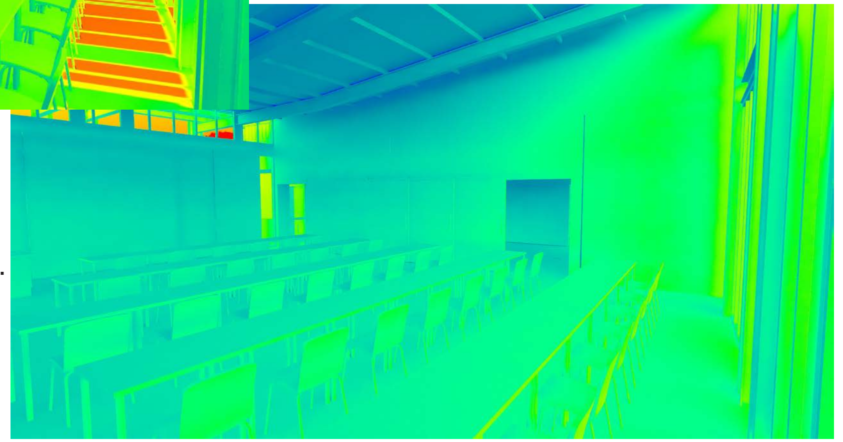


Fig 7.20 Fourth iteration of the class room, uniformly lit. (Author 2018)

07.5.4 DAYLIGHTING

As a response to the heritage fabric the buildings orientation is not directly north-south, the school building is orientated south-west to north-east, making daylighting and solar heat gain control more challenging. This factor more than any other contributed to the shape and size of louvres, overhangs, recesses and roof covers being constructed in a certain way.

The opaque Danpalon panels were used on the south-west facing facade to disperse late afternoon light from making the space over lit. On the north east facing facade a clear Danpalon panel was used so views are possible in to the landscape. A white board on rollers was used as a solar control device for early morning sun.

The four simulations to the left depict the solar exposure at the summer solstice at 17:00, in three different iterations, with each new iteration being closer to being uniformly lit.

The same principals and methods were applied to all three the proposed buildings.

07.5.5 GEO-THERMAL HEAT EXCHANGE

Cool air is supplied to the building through a geo-thermal heat exchange system. Ambient air in the vegetated landscape is blown in to pipes with a mechanical fan, the pipes carrying the air is buried under ground, the pipes are subject to heat exchange, energy from the hot air is absorbed by the soil through the heat conducting pipes. Cooler air can then be pumped into the building through the brick cores.

During colder months the average temperature of the soil will be higher than the air temperature and the system will supply the building with warmer air, heating up the desired spaces.

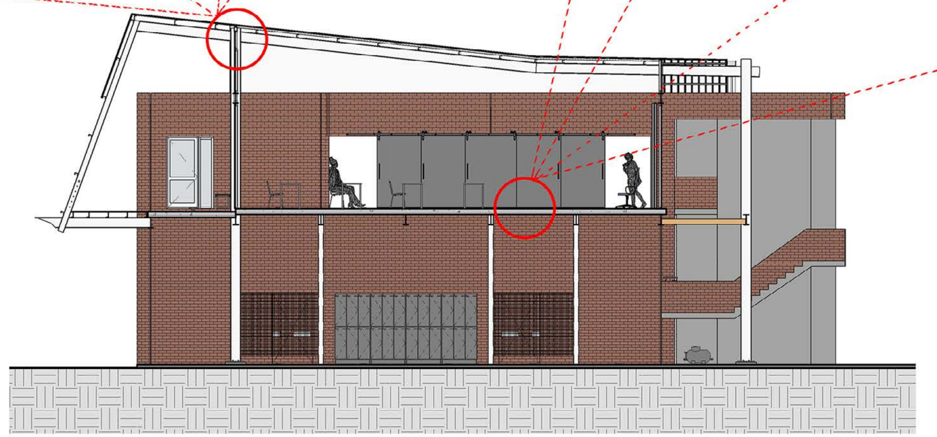


Fig 7.21 Diagrams depicting air flow system. (Author 2018)

07.6 CONSTRUCTION PHASES

The building will be built in phases, the first phase being the concrete slabs and columns of the brick boxes, with the concrete water tanks.

Phase two the brick infill, with expansion joints every 5 meters is built and the boxes are made water proof

Phase three the steel work is installed with the bond deck permanent shutter flooring shortly after.

Phase four includes fenestration, dry walls and klip loc roofing system

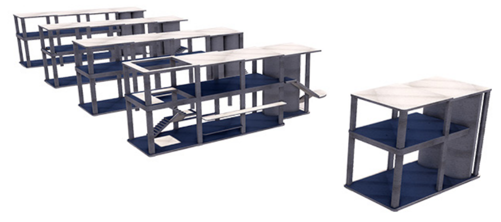


Fig 7.22 PHASE 1 - REINFORCED CAST IN SITU CONCRETE COLUMNS, RING BEAMS & SLABS (Author 2018).

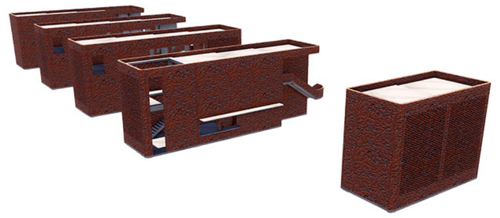


Fig 7.23 PHASE 2 - RECLAIMED BRICK INFILL (Author 2018).

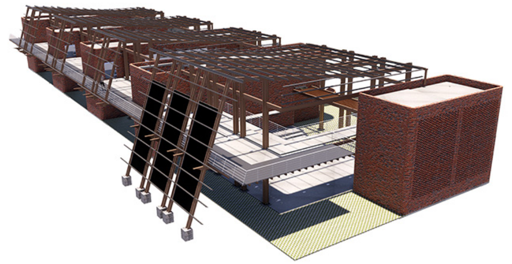


Fig 7.24 PHASE 3 - STEEL BEAMS, COLUMNS & WALKWAY. COMPOSITE BOND-DECK FLOORS. PERMEABLE PAVING AT EXTERIOR SPACES. (Author 2018).

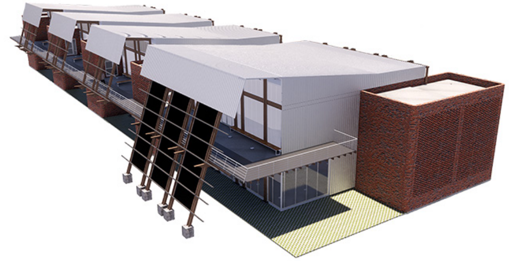


Fig 7.25 PHASE 4 - DANPALON POLLY CARBONATE GLAZING. KLIPLOCK 406 ROOF SHEETING, WITH STEEL SUB-FRAME, DRYWALLS & INSULATION. (Author 2018).

Fig 7.26 PHASE 5 - LANDSCAPING & VARIOUS OTHER SITE ELEMENTS (Author 2018).

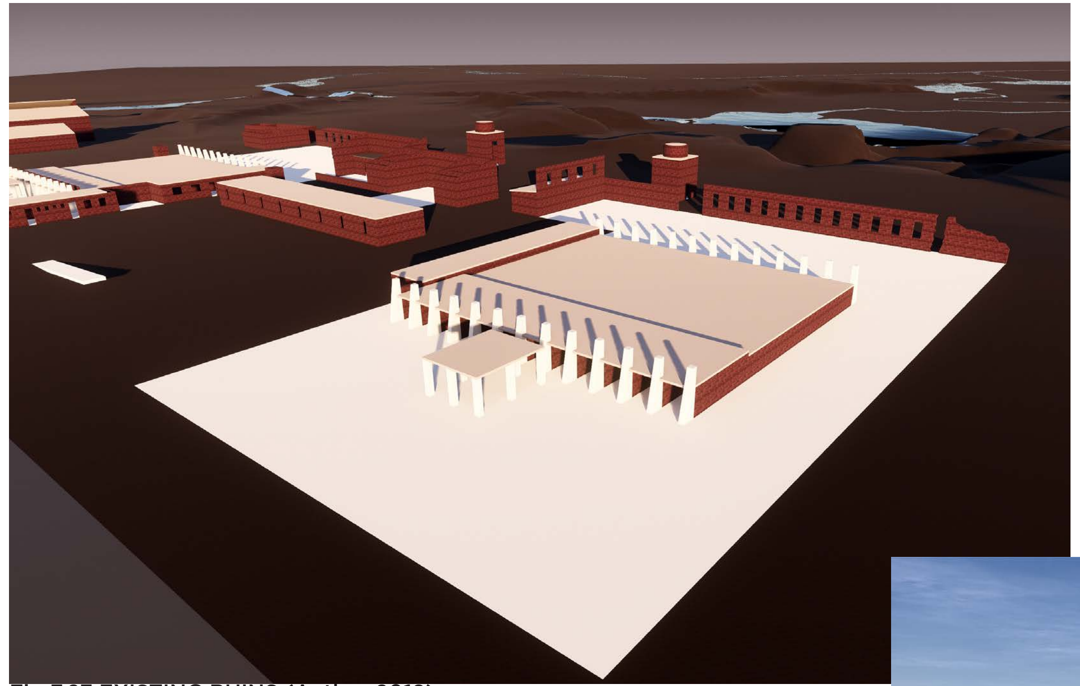


Fig 7.27 EXISTING RUINS (Author 2018).

Fig 7.28 NEW GREENHOUSE BUILT ON EXISTING RUINS (Author 2018).

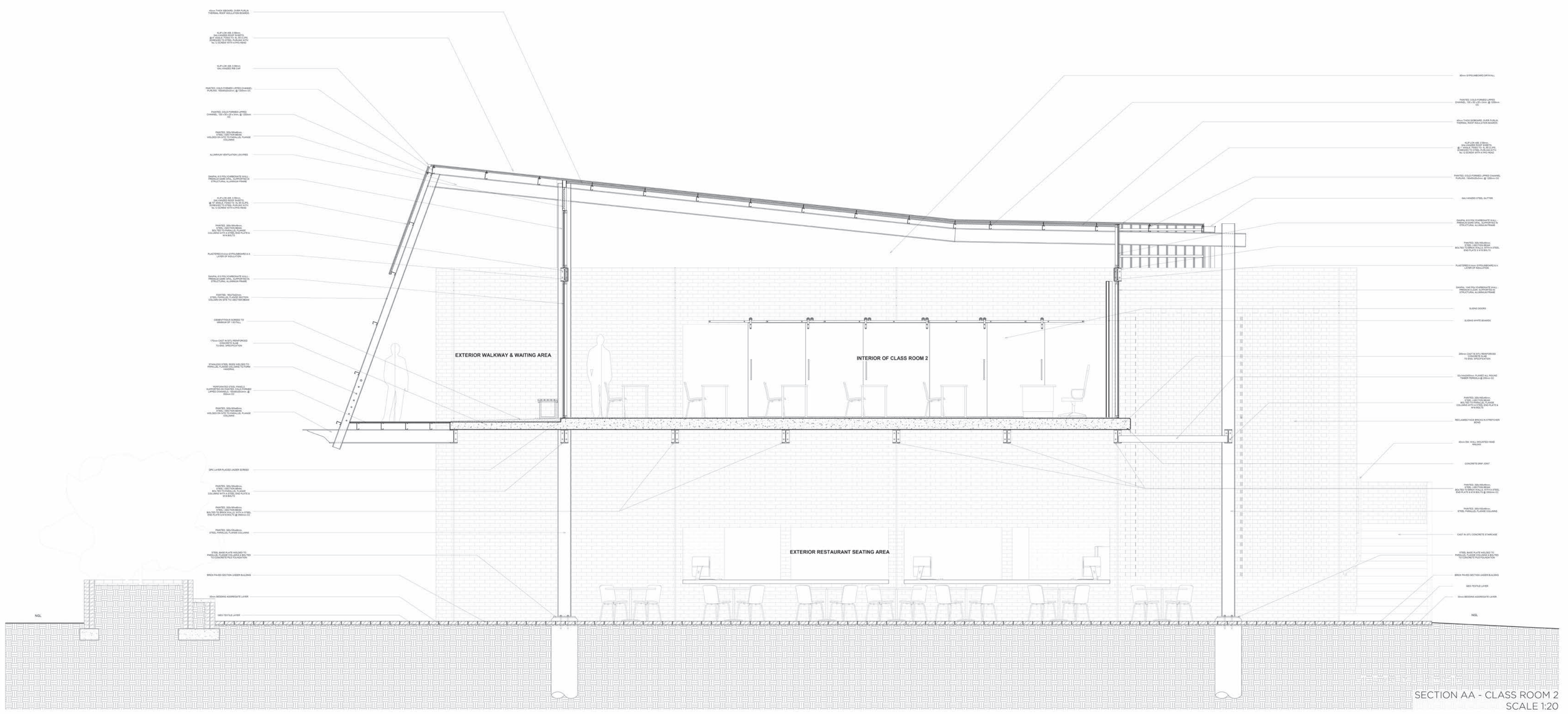


Fig 7.29 September Crit section - AA through class room (Author, 2018)

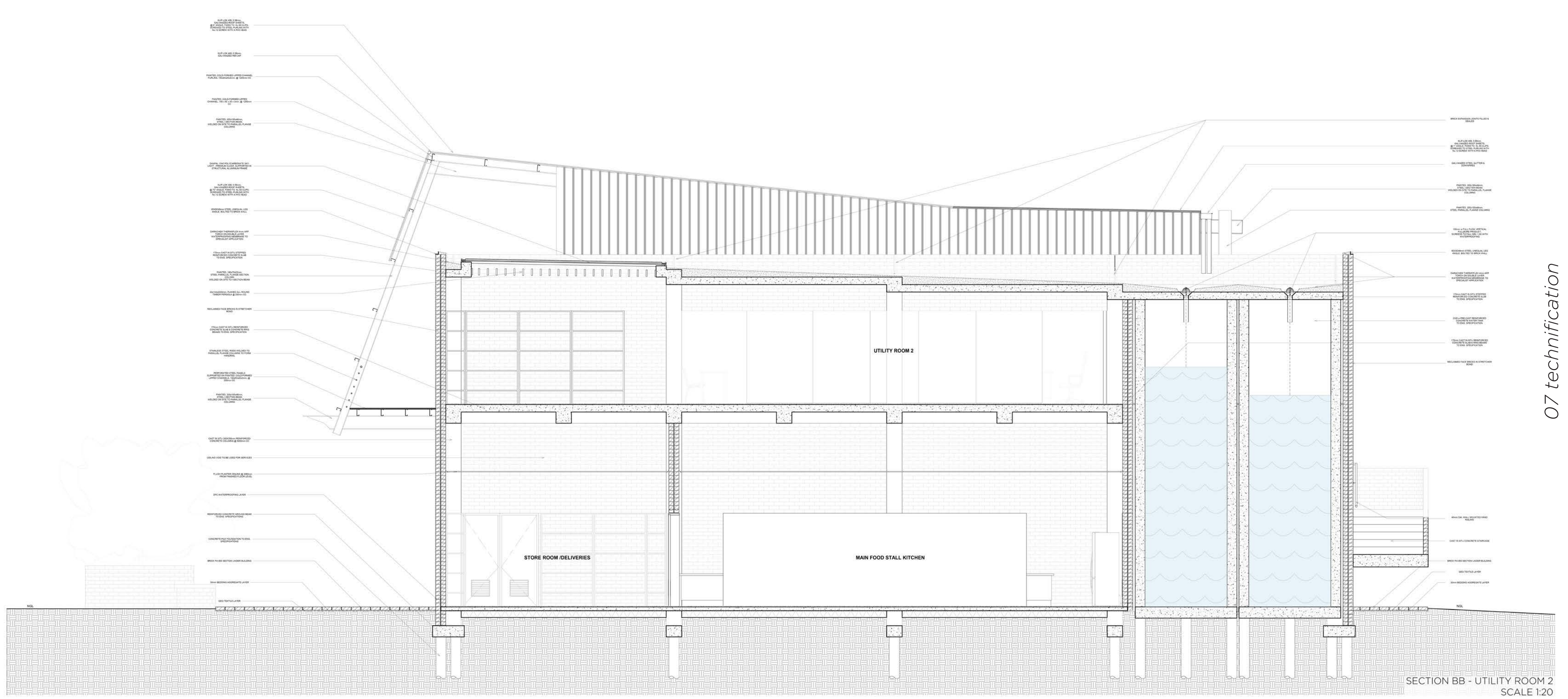


Fig 7.30 September Crit section - BB through Brick box (Author, 2018)

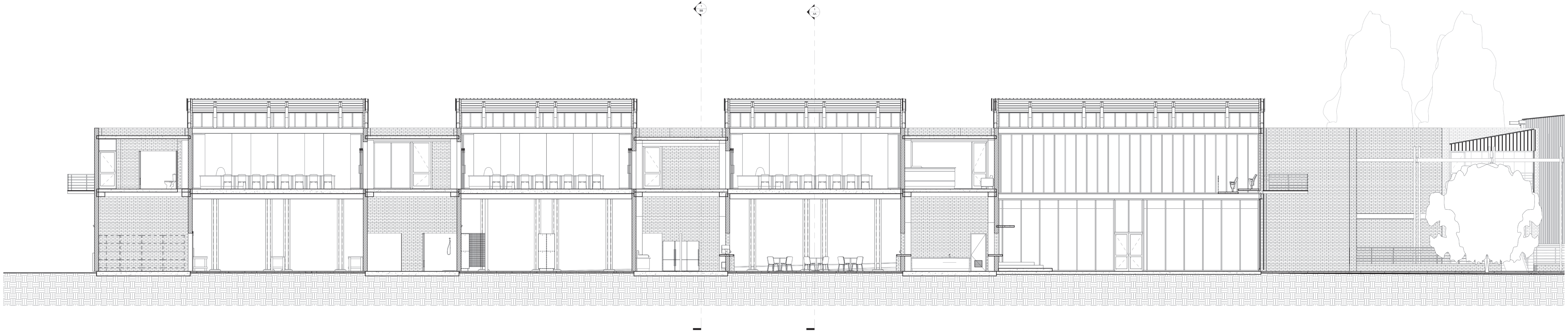


Fig 7.31 September Crit section - CC through Entire school (Author, 2018)