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Chapter 8 focuses on the technical resolution of the theoretical and programatic requirements within the historical context on Magazine Hill

Chapter 8 – Technical investigation



Figure 8.1: Bunker view showing the stereotomic character of existing fabric (Author, 2011)

8.1 Structural tectonic

The structural investigation of the proposed foundry focuses on the theoretical premise of Gottfried Semper (1803-1879) that explores the tectonic relationship of architectural materiality. In his *Die Vier Elemente der Baukunst* (Four Elements of Architecture), the German architect argues that architectural composition can be divided into two opposite material procedures: the stereotomic that relates to solidity, and the tectonic that defines dematerialisation (1995:3). Kenneth Frampton (1990: 518) states that these inherent opposites in architectural materiality forms cosmological opposites of each other, where the stereotomic mass symbolises earth, while the tectonic forms an analogy for the sky. It is argued that the transition from the materiality of the stereotomic, to the immateriality of the tectonic, constitutes the basic poetics and essence of construction (ibid).

As previously discussed in chapter 7, the veiled military architectural aesthetic present on Magazine Hill relates to the stereotomic, a structural typology of stone and concrete, submerged into the hilltop landscape. It is within this theoretical premise that the relationship between existing and proposed fabric is technically explored and resolved in the historical context of Magazine Hill.

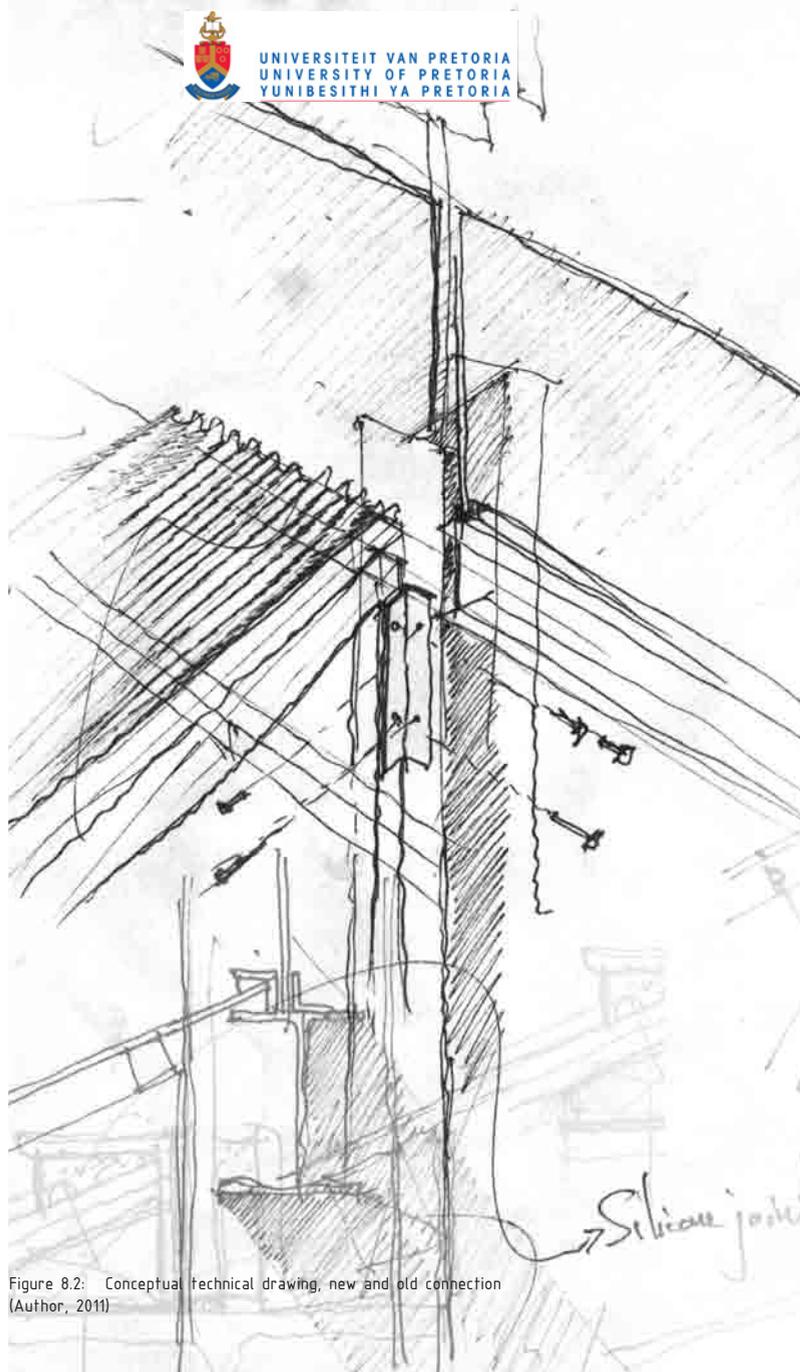


Figure 8.2: Conceptual technical drawing, new and old connection (Author, 2011)

8.2 Technical concept

The technical investigation explores two main structural concepts, where the first deals with the stereotomic and tectonic poetics of architecture. The proposed fabric is expressed through the use of several analogies for the existing typology on Magazine Hill. All existing materiality on site is caught in a timeless play of revealing and concealing, where the submerged military typology produces secretive and mysterious spaces that appear haunted. Because of the character of the submerged typology with its intimate relation to the landscape, all existing architecture is defined by stereotomic mass. The existing stereotomic relates to that which belongs to the site. The proposed foundry addresses the same gravitational qualities that function within a submerged landscape. New build fabric forms submerged bunker analogies that weave together existing stereotomic elements with new tectonic fabric. This technical concept guides all interventions in the sensitive context of Magazine Hill.

The second structural concept is grounded within the theoretical argument of architecture's persistence and existence in time, through the process of ruination and weathering. Proposed materiality and detailing is resolved to anticipate the inevitable process of deterioration. This structural concept integrates existing ruination with accelerated weathering of contemporary fabric, strengthening old and new building materials' existence in time. As the inevitable process of ruination dissolves the proposed tectonic building elements over time, the stereotomic elements persists as scars in the landscape of Magazine hill, forming an addendum to the existing submerged bunker spaces.

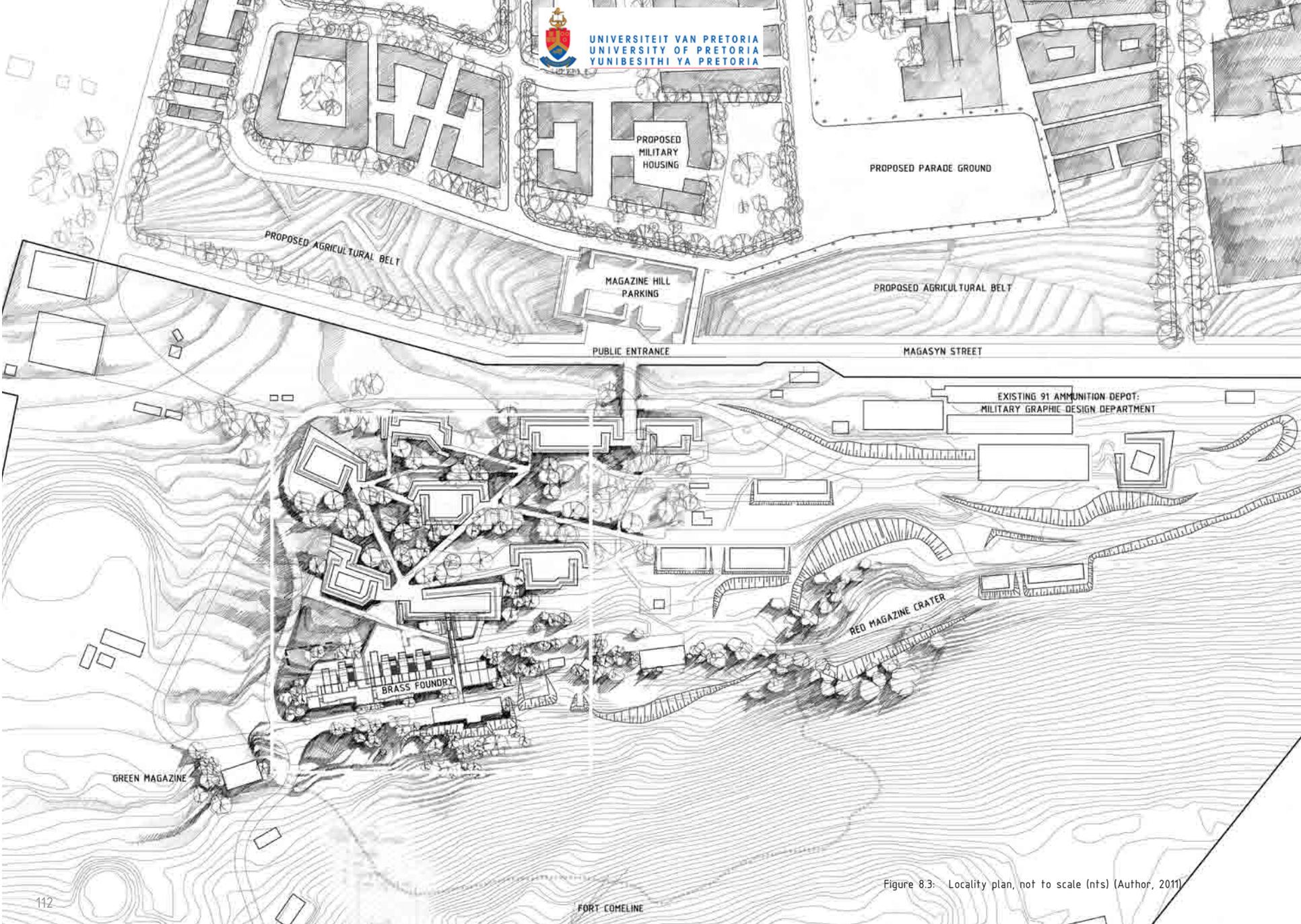


Figure 8.3: Locality plan, not to scale (nts) (Author, 2011)



8.3 Circulation

The proposed building functions as a superimposed node on the site, weaving together existing and new circulation routes through Magazine Hill. The existing wagon routes which formed distribution platforms between production lines in the submerged bunkers, now serve as pedestrian routes that guide the visitor through the series of exhibition bunkers. It is within this integration of existing and new circulation routes that the history of ammunition production on Magazine Hill is experienced and commemorated in the new context of ammunition reduction. The previous use of the site is therefore celebrated through the reuse of existing circulation corridors.

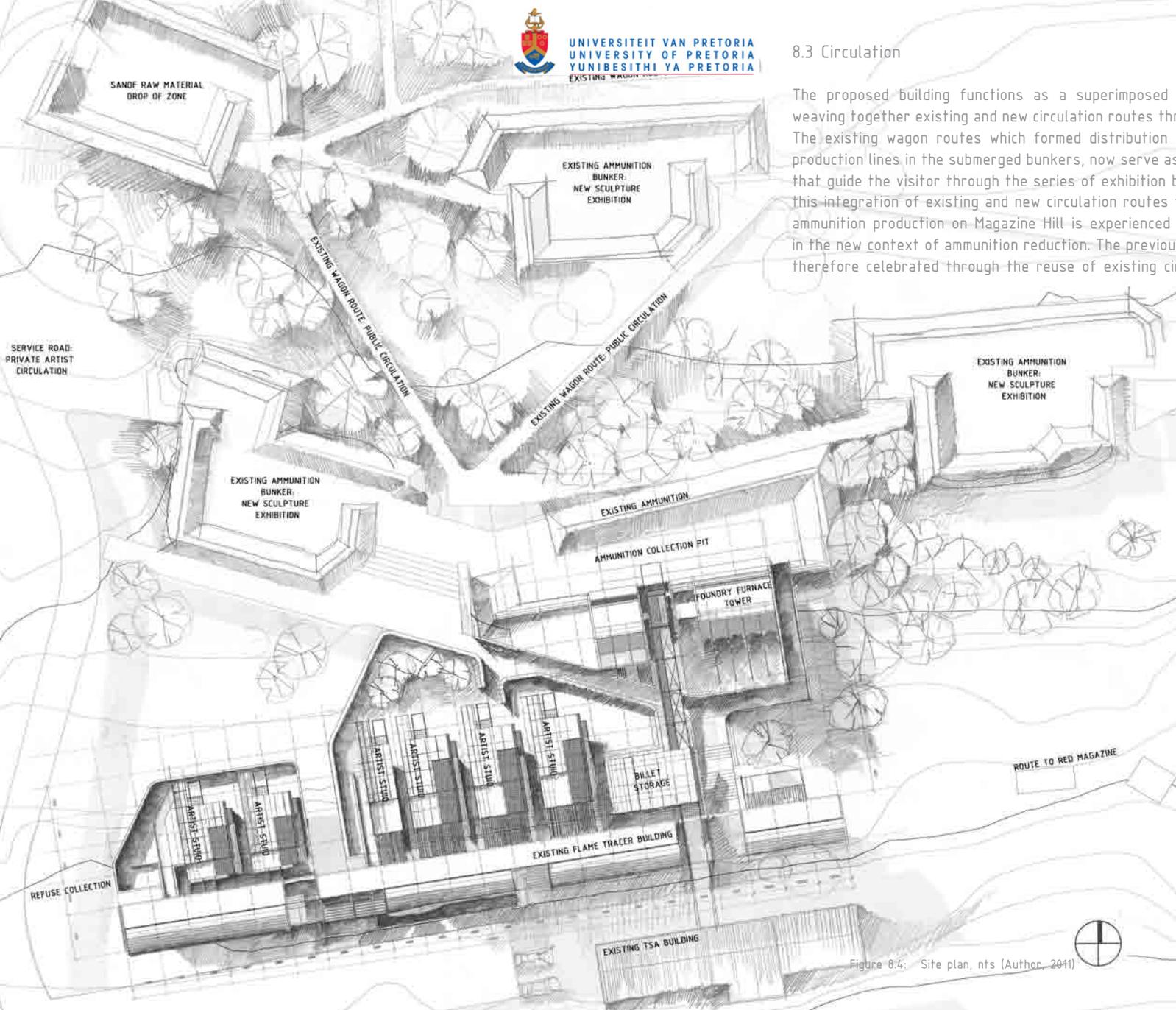


Figure 8.4: Site plan, nts (Author, 2011)

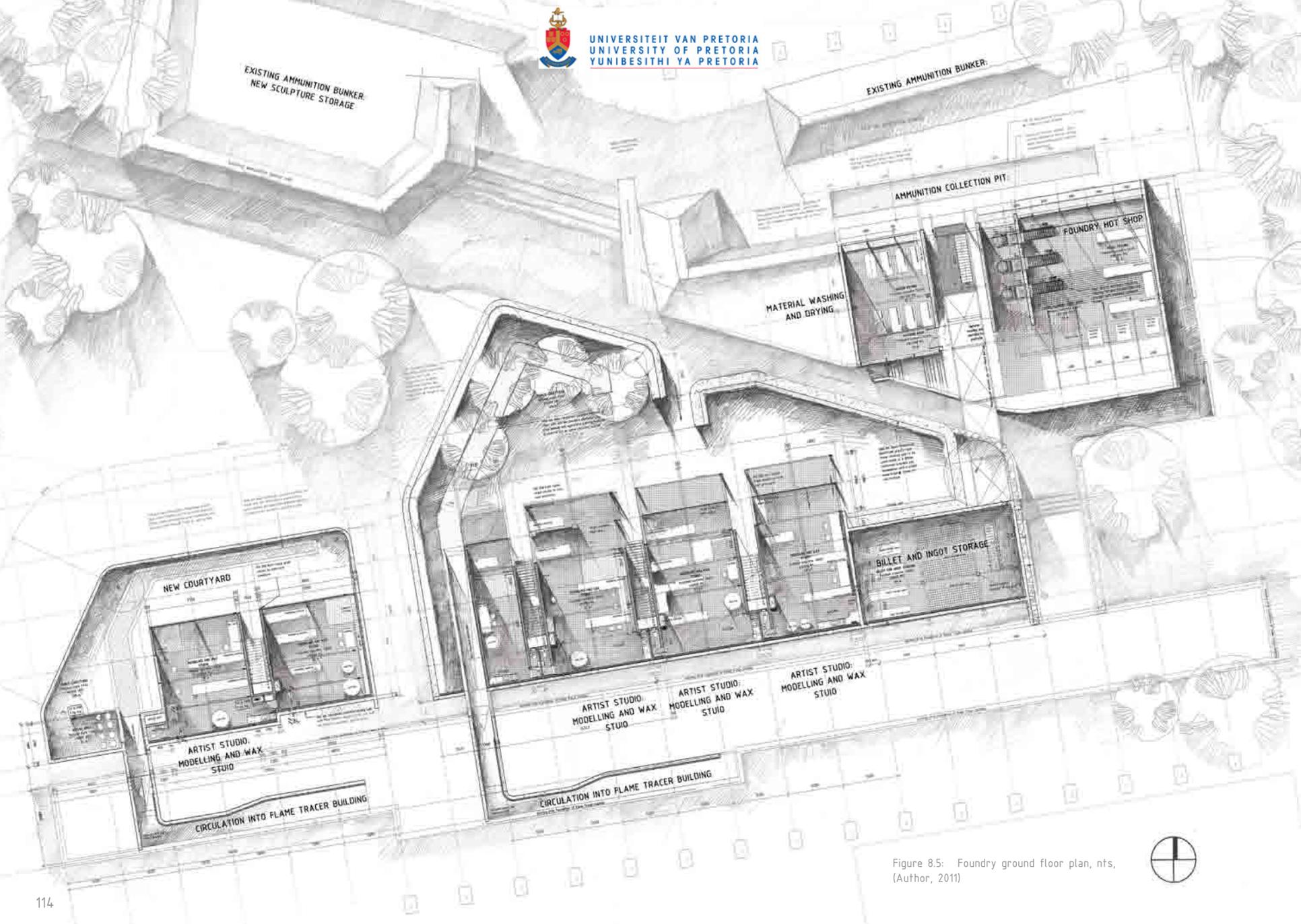


Figure 8.5: Foundry ground floor plan, nts,
(Author, 2011)



Figure 8.6: Foundry first floor plan, nts
(Author, 2011)

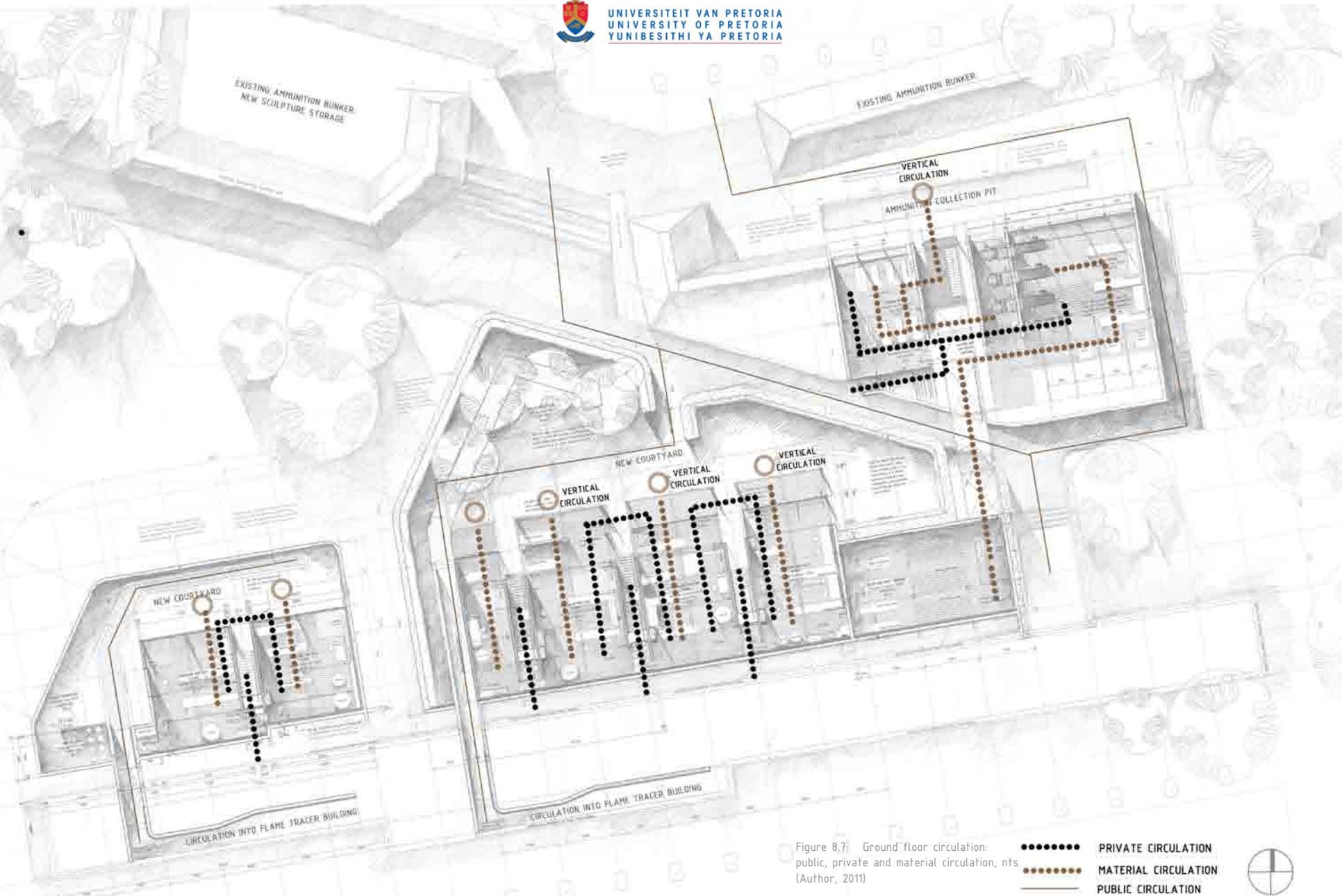


Figure 8.7: Ground floor circulation: public, private and material circulation, nts (Author, 2011)

- PRIVATE CIRCULATION
- - - - - MATERIAL CIRCULATION
- — — PUBLIC CIRCULATION



In the design, public circulation is not reduced to a set of predetermined routes, but is rather open for individual exploration and discovery. The visitor could either enter the foundry from the new courtyard spaces at the artist studios, or enter through the submerged tunnel at the main foundry tower. In both cases the order of foundry experiences function as a linear process. In the existing Flame Tracer building the public circulation route is set out in accordance with safety concerns, fire regulations and experiential quality.

Private circulation on site is also incorporated into the design by means of privatised bridges and corridors. The artists' and foundry workers' circulation routes function in accordance to foundry processes, material distribution and handling. Private vehicular access is provided at the eastern and western perimeters of Magazine Hill, serving the artists and the military respectively.

The third main circulation consideration deals with the distribution of raw material on site. The military would enter Magazine Hill at the western gate, disposing all raw material at a drop of zone provided in the western submerged ammunition bunker. From this point, raw material (empty ammunition cartridges) is distributed via the existing wagon routes that now serve as a public circulation platform. In this instance, the integration of public and material circulation strengthens experiential quality in terms of sensory experience (sound of empty cartridges dumped in bunker and visually distributed through the site).

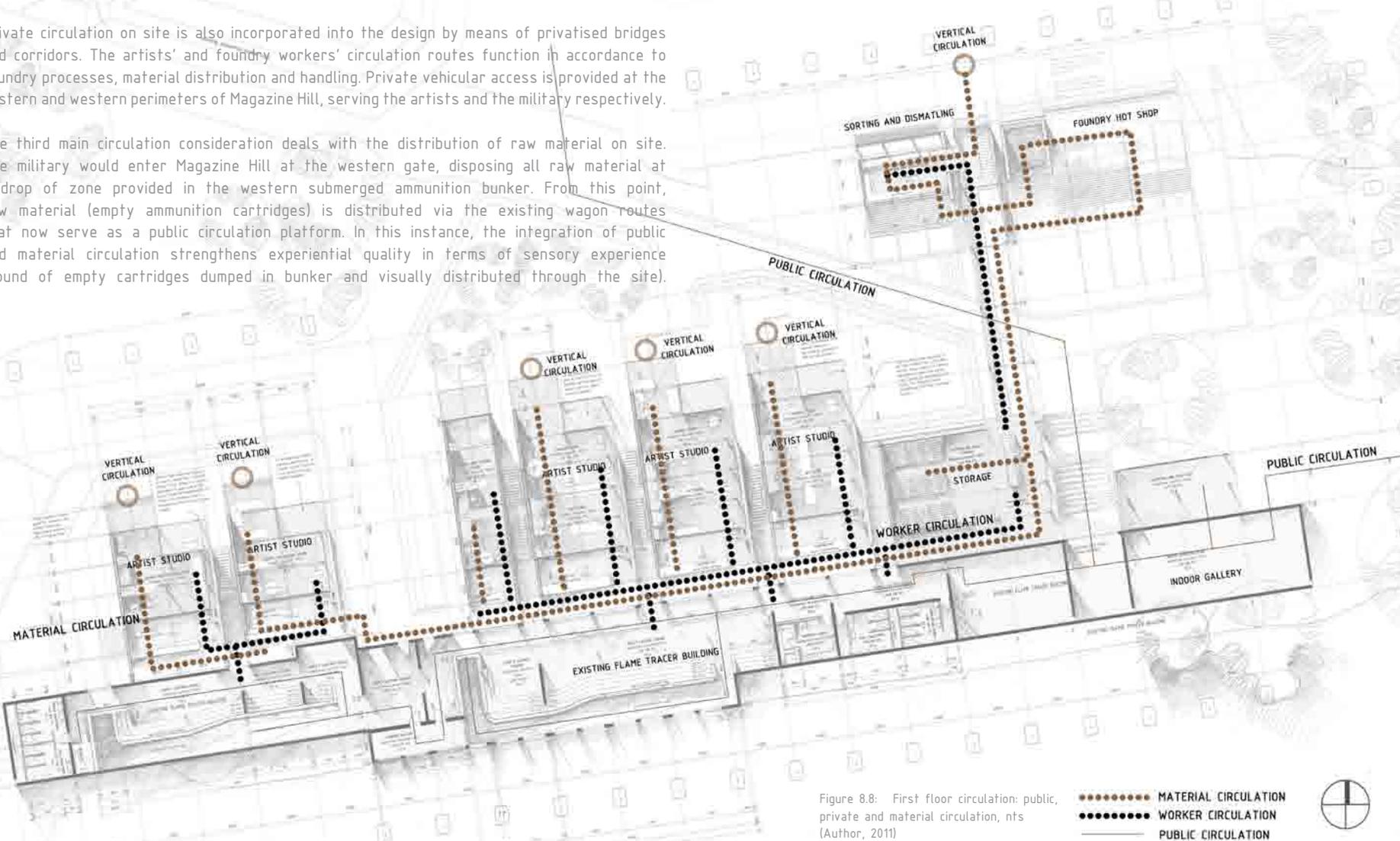


Figure 8.8: First floor circulation: public, private and material circulation, nts (Author, 2011)

- MATERIAL CIRCULATION
- - - - - WORKER CIRCULATION
- PUBLIC CIRCULATION



8.4 Structural systems

The structural system of the proposed intervention is discussed as three interdependent structural entities that constitute the building syntax, namely substructure, superstructure and layered skins.

8.4.1 Substructure

This construction element does not only support the lateral imposed loads of the superstructure, but also serves as the main connection platform between the existing submerged bunker spaces, the foundry and the existing Flame Tracer building floor level. The slope of Magazine Hill introduces great level differences between existing structures, allowing for a 3 meter change in level between the 2 reused buildings in the design. This topographic disruption is bridged by the foundry courtyard substructure, which acts as the first vertical threshold against the slope. The substructure excavation allows for the alignment of workable levels between the reused bunker and the existing Flame Tracer building, by introducing a series of reinforced concrete ramps and precast concrete stairs into the substructure. These circulation platforms in the new excavation also serve as outdoor storm water channels that distribute excess runoff over a large area on the site. The stereotomic quality of the new substructure forms an analogy of the existing construction typology, allowing for structural integration between the stereotomic existing and the new tectonic artist studios which is perceived as hovering over the stereotomic courtyard. The sub structure forms the support frame for the artist studios, providing the different work spaces with a continuous basement for sculpture storage. The northern slanted basement wall consist of hand packed precast interlocking concrete block that is laid on a slanted angle of retention to allow for larger sculptures to slide into basement storage.

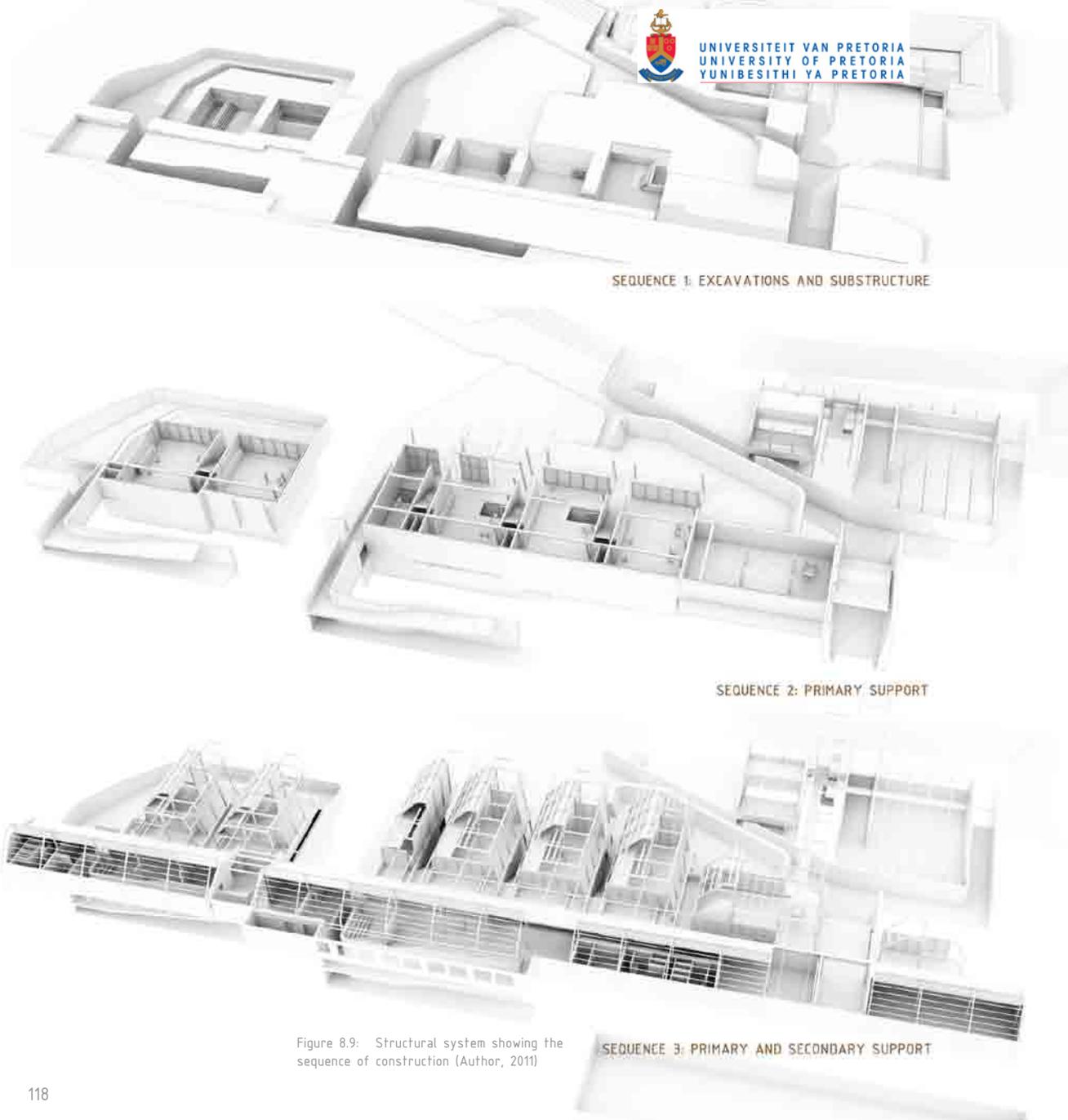


Figure 8.9: Structural system showing the sequence of construction (Author, 2011)

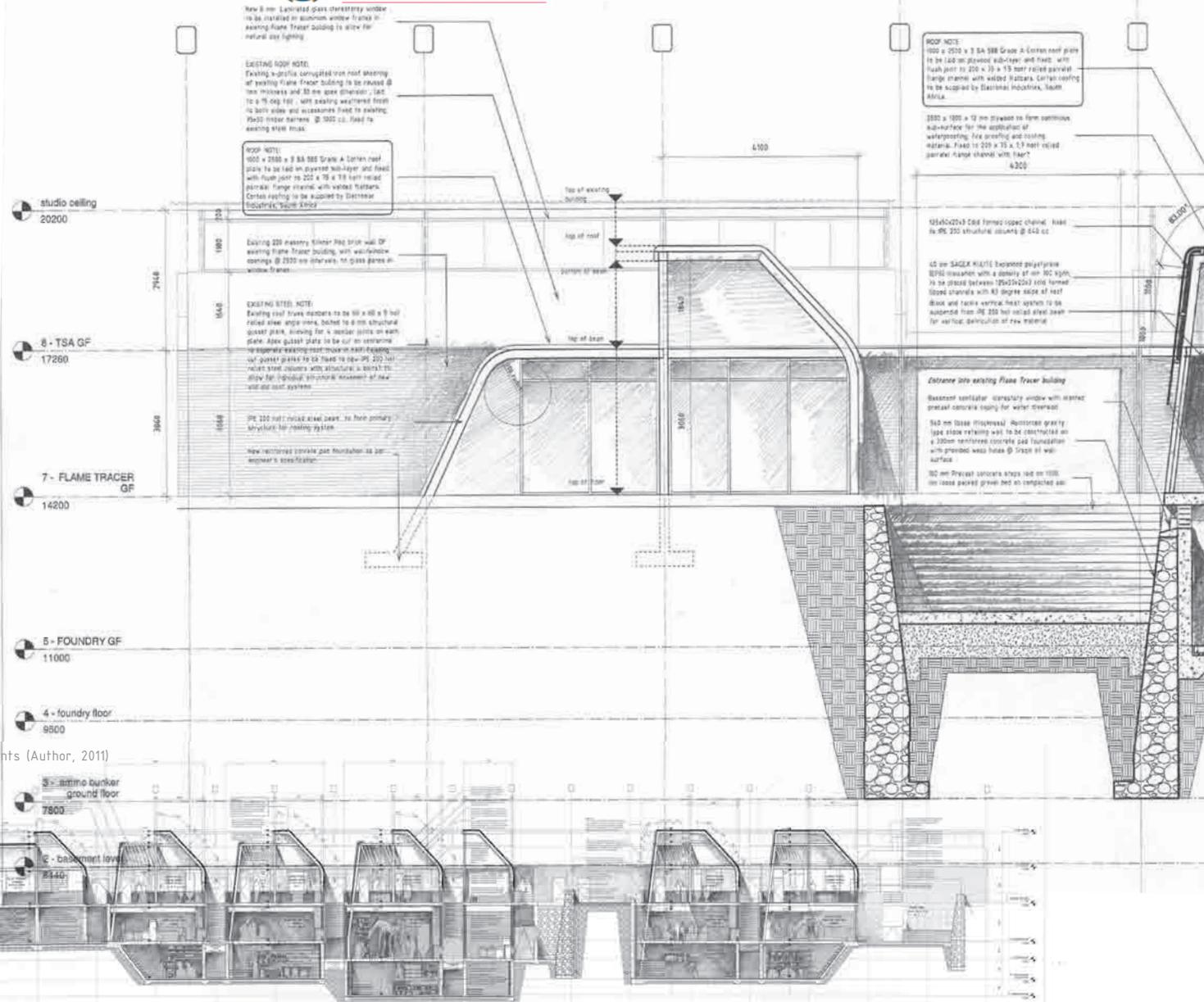
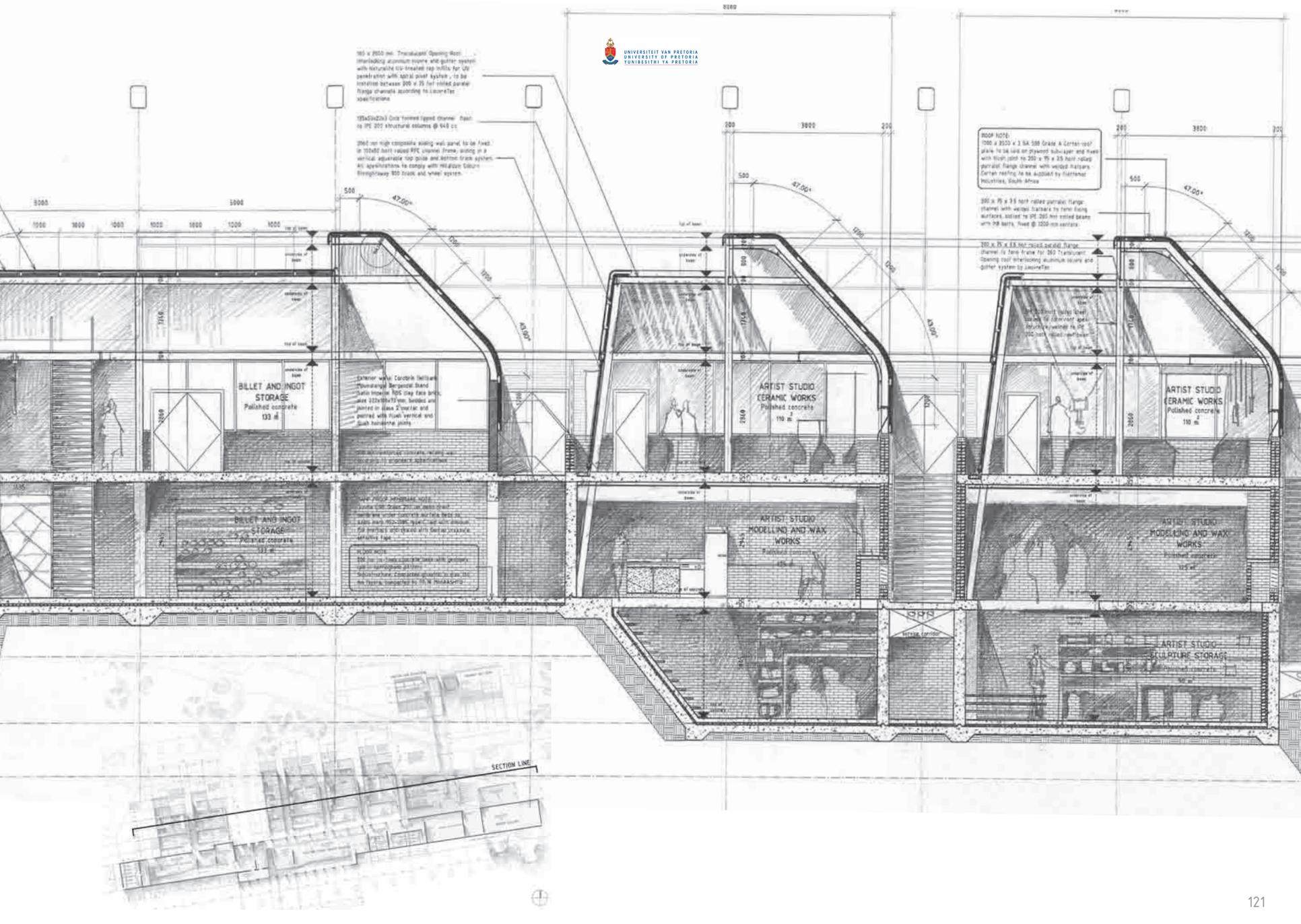


Figure 8.12: Technical section through artist studios, (Author, 2011)



180 x 2500 mm. Translucent Clearing Roof
 (interlocking aluminum eaves and gutter system
 with horizontal 100 treated rag rolls for UV
 protection with 200 g pond system - to be
 installed between 200 x 250 for added service
 flange channels according to LouverTec
 specifications)

150x150x250 Cold formed light channel - then
 to 175 200 structural columns @ 543 cc

2000 mm high composite metal wall panel to be fixed
 to 150x250 light gauge RPS channel frame, using in a
 vertical separate 100 gauge and approx frame system.
 All applications to comply with Millatex Colour
 Finishesway 800 finish and wheel apron.

ROOF NOTE
 1500 x 2500 x 3 SA 500 Grade A Certain roof
 plate to be laid on ground sub-layer and fixed
 with strap bolt to 200 x 250 x 25 light gauge
 parallel flange channel with welded flanges.
 Certain roofing to be supplied by Hiltner
 Industries, South Africa

200 x 75 x 3.5 light galv parallel flange
 channel with welded flanges to form facing
 surfaces, bolted to 100 200 mm cold beam
 with 20 bolts, fixed @ 1200 mm centres.

200 x 75 x 3.5 hot rolled parallel flange
 channel is frame for 200 Translucent
 Clearing roof interlocking aluminum eaves and
 gutter system to be supplied

BILLET AND INGOT
 STORAGE
 Polished concrete
 133 m²

Exterior walls: Corobrik Hellspan
 (Reinforced Fibre concrete Block
 with Impure RPS clay face brick,
 size 220x100x75 mm, bonded and
 pointed in 1:1 mortar and
 pointed with flush vertical and
 flush horizontal joints)

BILLET AND INGOT
 STORAGE
 Polished concrete
 133 m²

NEW FLOOR CONSTRUCTION NOTE
 1. FLOOR TO BE 200 mm thick cast
 concrete with 100 mm concrete
 slab and 100 mm concrete
 for drainage and 100 mm concrete
 drainage layer

ROOF NOTE
 1500 x 2500 x 3 SA 500 Grade A
 Certain roof plate to be laid on
 ground sub-layer and fixed
 with strap bolt to 200 x 250 x 25
 light gauge parallel flange channel
 with welded flanges

ARTIST STUDIO
 CERAMIC WORKS
 Polished concrete
 110 m²

ARTIST STUDIO
 MODELLING AND WAX
 WORKS
 Polished concrete
 110 m²

ARTIST STUDIO
 CERAMIC WORKS
 Polished concrete
 110 m²

ARTIST STUDIO
 MODELLING AND WAX
 WORKS
 Polished concrete
 110 m²

ARTIST STUDIO
 SCULPTURE STORAGE
 Polished concrete
 110 m²

SECTION LINE



The structural aesthetic on Magazine Hill combines a series of building materials. For the purpose of the dissertation, it was not only important to study the composition and arrangement of existing materiality on site, but also the weathered state of building elements that contribute to the mysterious and abandoned quality of the terrain. In the opinion of the author all new proposed building materials should not compromise the unique deteriorated state of the site, but rather enhance this quality, expressing architecture's mortality through the process of ageing. The use of contemporary materials is therefore specified to form analogies of deteriorated fabric, where structural detailing is executed to promote weathering and staining of contemporary materials. By implementing this technical concept, the new foundry does not only commemorate the history and past of Magazine Hill, but also the site's inherent physical qualities of the present.

Proposed brickwork in the use of the super- and substructure had to comply with existing Kirkness and red brickwork aesthetic of Magazine Hill, therefore a Firelight Travertine Imperial FBX brick by Corobrik is specified. This face brick is manufactured in Gauteng, therefore minimising transportation costs of material distribution. The Firelight Travertine brick has a slight efflorescence rating which means that a white crystallised deposit occurs on the surface of the brick as water evaporates and the salt is trapped in the brick pores (Corobrik, 2011). This quality of the brick implies that the Travertine is semi porous, therefore the material can absorb the oxidation deposits of the weathering steel roof, promoting staining and weathering of the new foundry building.

The existing ammunition bunkers consist of 3 m high hardened cement bags (petrification process) to form submerged stone walls, which is hand packed on a mortar less natural stone core. These stereotomic walls define the submerged bunker space in the natural landscape. New landscaping walls are constructed from loose packed natural stone, therefore forming an analogy of the existing bunkers walls. Proposed reinforced gravity type retaining walls define the new courtyard, further incorporating the existing structural syntax.

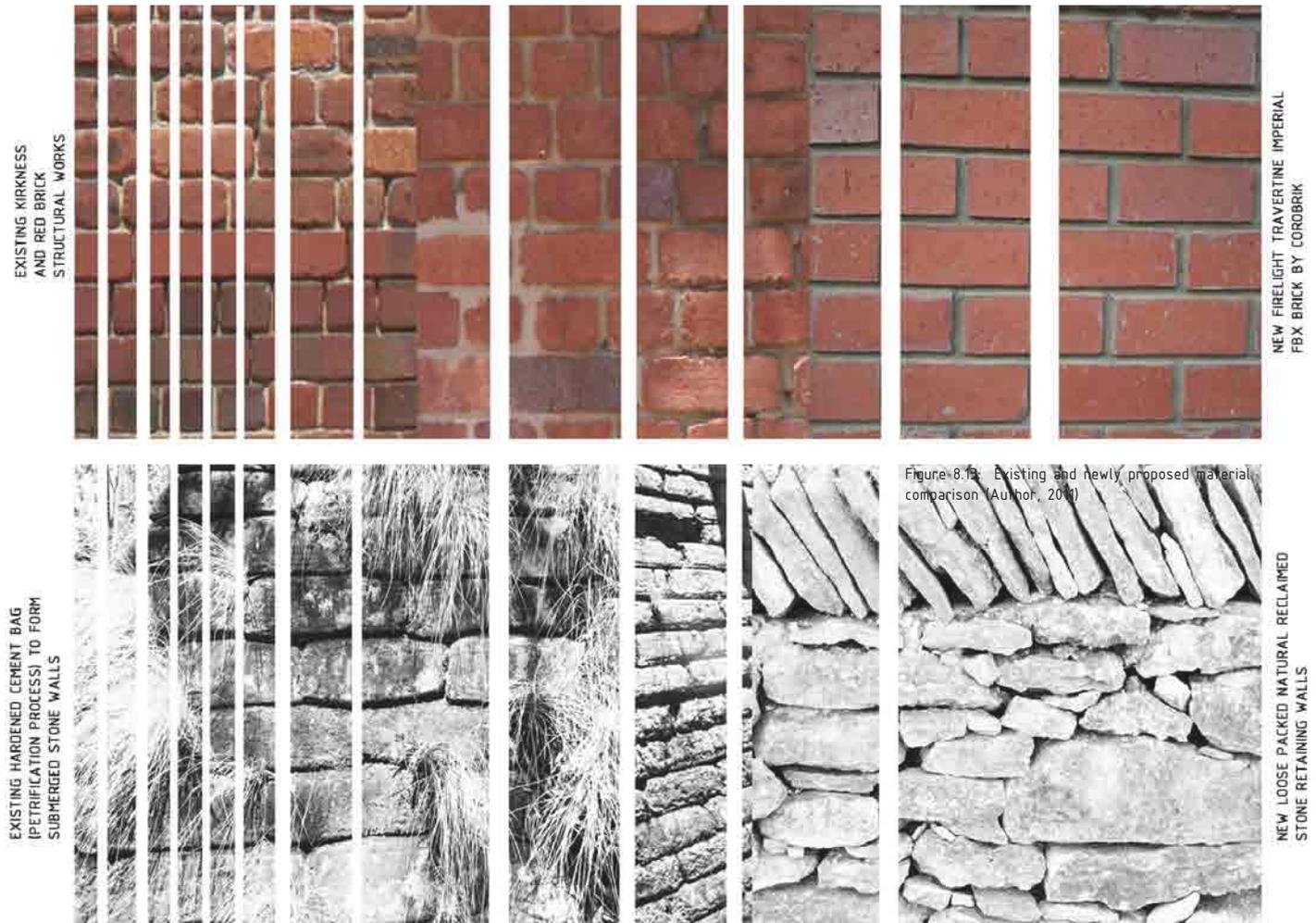


Figure 8.13: Existing and newly proposed material comparison (Author, 2011)

The existing Flame Tracer building roofing system consists of s-profile corrugated iron roof sheeting, laid to a 15 degree fall, fixed to 75x50 timber battens. This building is to be reused in the foundry design as public circulation space, where artist metal castings can be viewed from a confined existing space. The corrugated iron sheets are severely weathered, with oxidised deposits covering the exterior surface. A 3mm SA 588 grade A corten steel roofing system is proposed to be installed on the adjacent artist studios, symbolising an extension of the existing weathered roof. The weathering steel produces an oxidised deposit that stains the porous substructure, creating the illusion of a building bleeding into the landscape.

Many existing buildings on Magazine Hill, including parts of the Flame Tracer building, are in a critical condition due to the removal of the roofing material. This aspect results in exposed roof trusses that cast deep shadows into interior spaces. This interior light quality of existing buildings on site is translated into the design by means of a translucent roofing system, defining studio and foundry spaces vertically. The Translucent Opening Roof interlocking aluminium louvre and gutter system with Naturelite UV treated top infills is proposed to be fixed to the primary support frames. When closed, the roof forms a weatherproof surface, while allowing for light penetration through the Naturelite panels (LouvreTec: 2010). This design element integrates existing and new spatial and light qualities while adhering to programmatic requirements

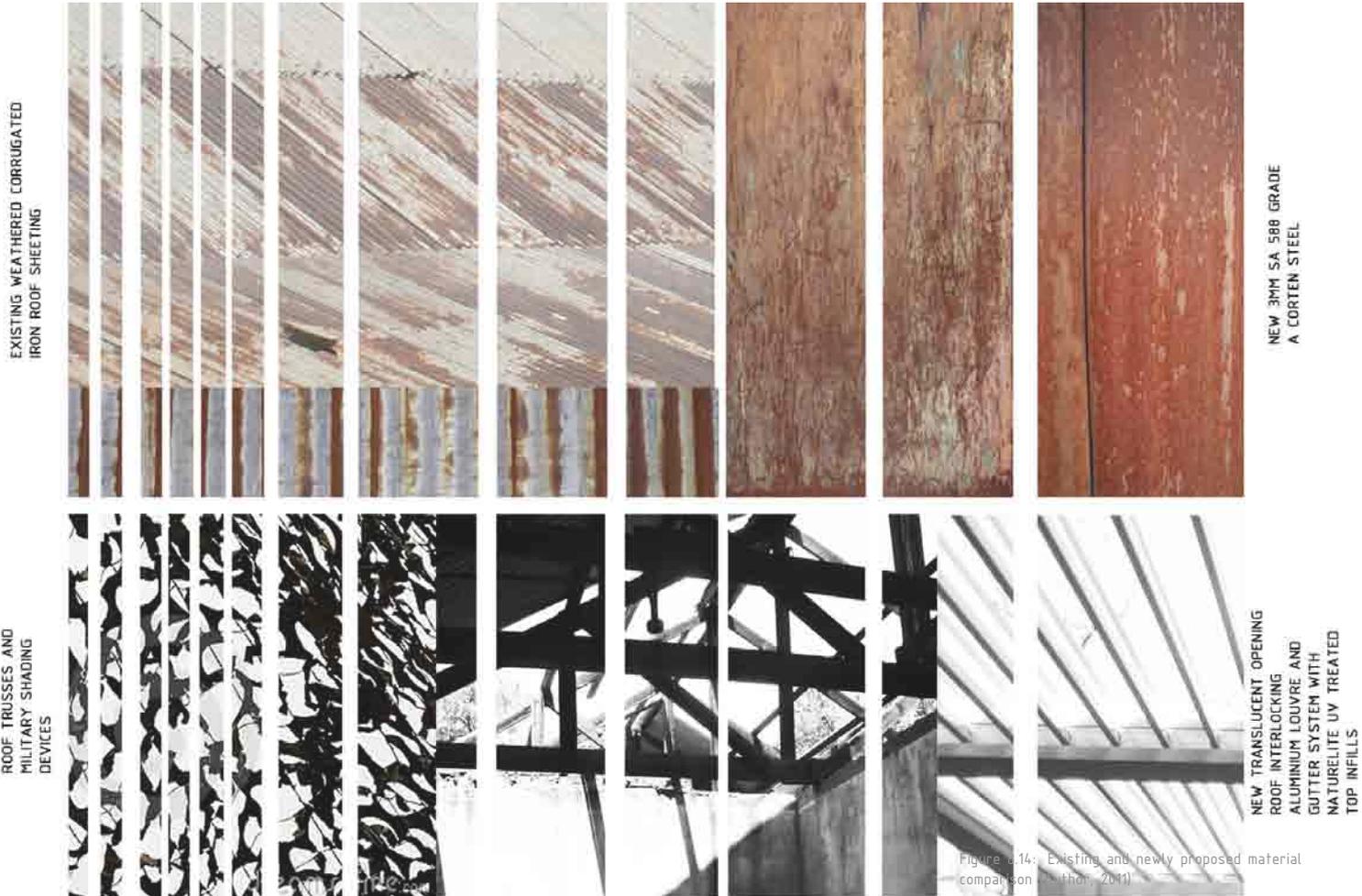


Figure 3.14: Existing and newly proposed material comparison (Author, 2011)

8.6 Building components and systems

8.6.1 The furnace tower

Water management

As mentioned in Chapter 7, the foundry tower process incorporates the sorting, dismantling, washing, drying, melting and casting foundry procedures. All mentioned processes functions as separate systems that form integrated water harvesting, heat transfer and ventilation strategies. The first recycling system focuses on water management, where the spent ammunition cartridges are washed in soap less water to dispose of cordite remnants in casing cavities. A series of washing tables also serve as drying baths as bottom plugs are removed for water drainage. These multi functional tables alternate between washing and drying processes within the production period of 60 minutes, based on the processing time of the melting furnaces.

As the plugs are removed, water accumulates down a screed to fall into a grey water storage tank, located in the basement. From this point grey water is distributed through a biofilter system located in the existing ammunition bunker, which comprises of natural boulders and nitrate absorbing hydrological vegetation. As water filters through the system, rising water levels trigger the submersible pump to distribute recycled water to the storage tank located on the stair apex. Water is recycled three times before it is utilised for secondary purposes on site. Recycled water is only utilised for washing and sanitary purposes.

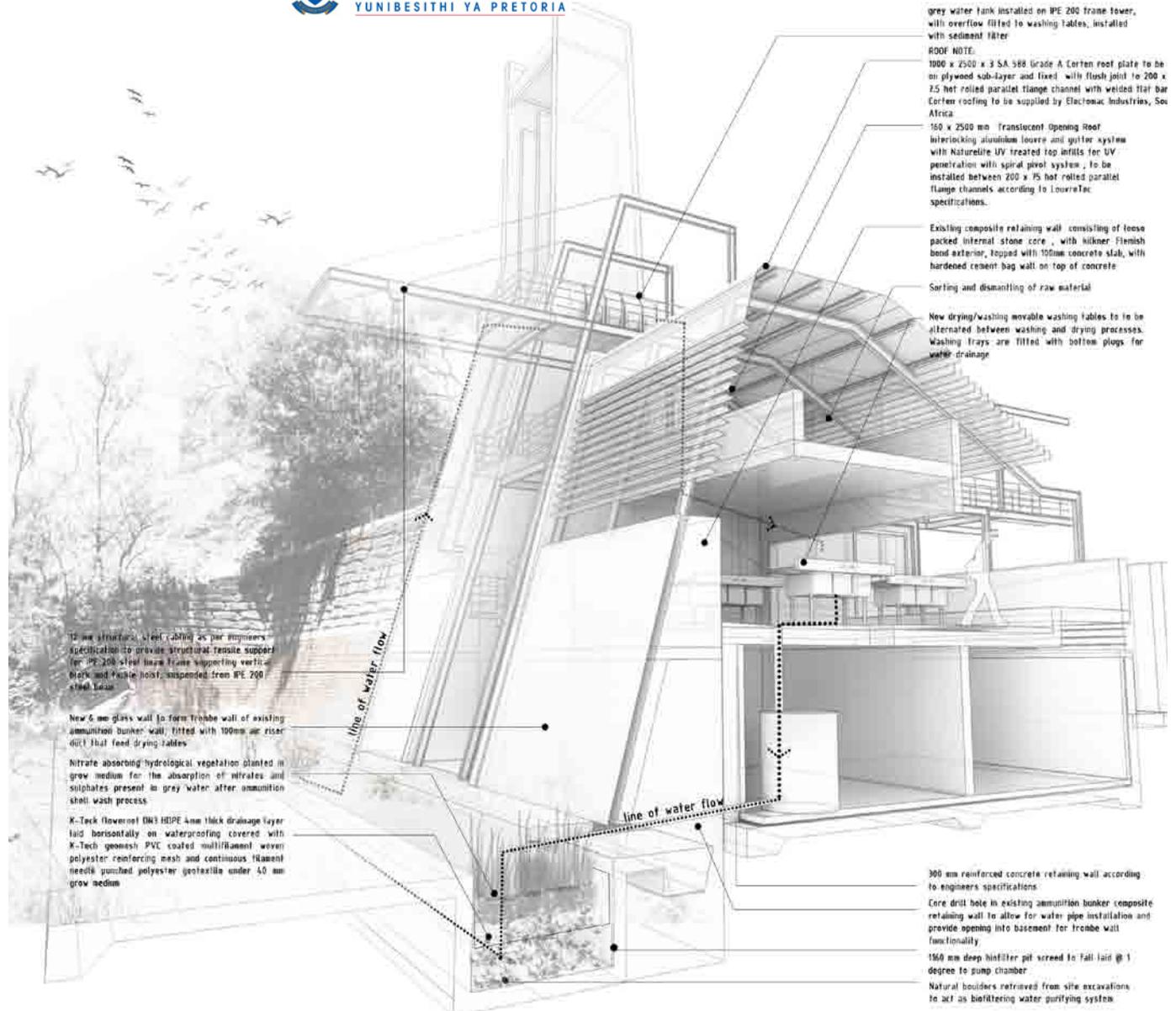


Figure 8.15: Water management system in furnace tower (Author, 2011)

Heat transfer

A heat transfer strategy is incorporated to enhance the drying process of raw material after washing. The existing composite retaining wall is adaptively reused as a trombe wall system because of the wall's northern orientation and massive characteristic. A 7 meter wall strip is fitted with a clear glass facade to form a pressure cavity between the glass and existing wall. Openings that connect the cavity with the adjacent basement interior are core drilled through the existing bunker wall. External openings are provided in the basement for fresh air intake. As the trombe wall heats up, air pressure differences allows air to circulate from basement interior into trombe wall cavity where the air temperature rises drastically, therefore ventilating the basement while providing hot air that is utilised in the drying process.

Foundry ventilation

Foundry space is ventilated through the Translucent Opening Roof interlocking louvre system, which allows for natural day lighting of workspace, while providing direct vertical heat extraction. Therefore cross and stack ventilation are alternated options, depending on weather and climatic conditions.

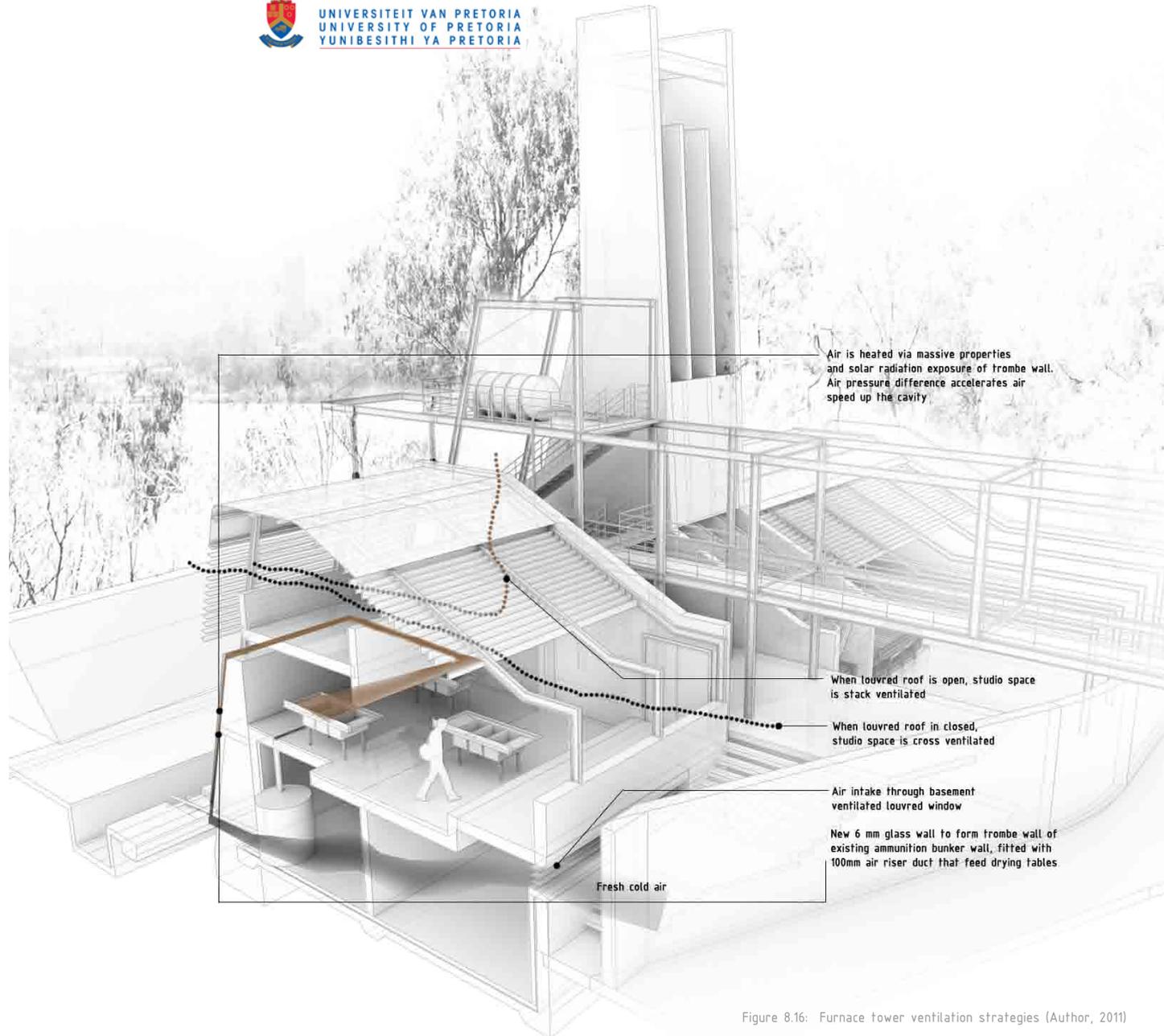


Figure 8.16: Furnace tower ventilation strategies (Author, 2011)

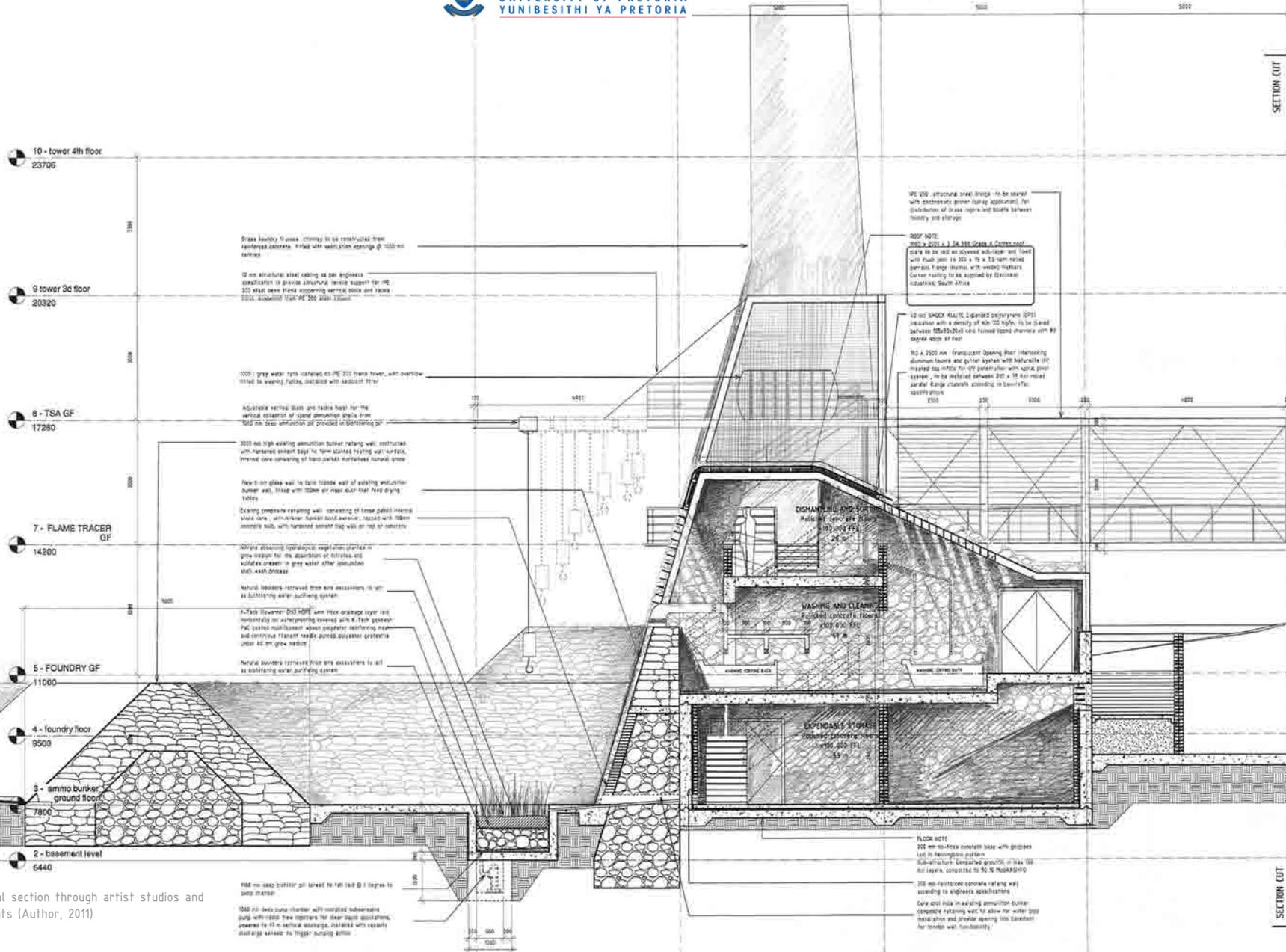


Figure 8.17: Technical section through artist studios and the furnace tower, nts (Author, 2011)

Adaptability

The artist studios function as independent work spaces that could be occupied on a rental basis by different local artists. This series of artist foundries has the adaptive ability to function as double units when companies amalgamate for larger scale sculpting projects. Individual structural adaptability is achieved by the incorporation of removable Mentis grating flooring panels that allow for larger foundry machinery and kilns to be placed on the foundry ground floor level. An opening louver roof system allows the foundry worker to adjust light quality and UV penetration of the non-structural roofing system. The western facade is defined by a stereotomic edge that blocks western solar penetration, while the eastern facade forms an adjustable typology that alternates according to user needs.

Studio and basement ventilation

Eastern composite sliding walls, modelled on the Hillaldam Coburn Straightaway 900 track and wheel system allows for adjustable options, optimising passive cross ventilation, natural day lighting and extending spatial qualities beyond the limited workshop space. Studio basement ventilation is achieved by introducing light and air shafts into the western facade that form worktop modelling space on the foundry ground floor level. These shafts contain openings with adjustable interlocking louvers, therefore recycling air through cross ventilation.

Services

Service ducts are provided between artist studios, therefore shared between adjacent work spaces. Water supply enters the foundry from the eastern servitude, located next to the service road, through a horizontal excavation between the artist studios and existing Flame Tracer building. Municipal water supply is considered as the primary source of water, where secondary sources consist of rain water, recycled from the slope of Magazine Hill, harvested in the Red Magazine crater. The four main service shafts connect to the municipal servitude located to the north of the foundry next to Magasyn Street.

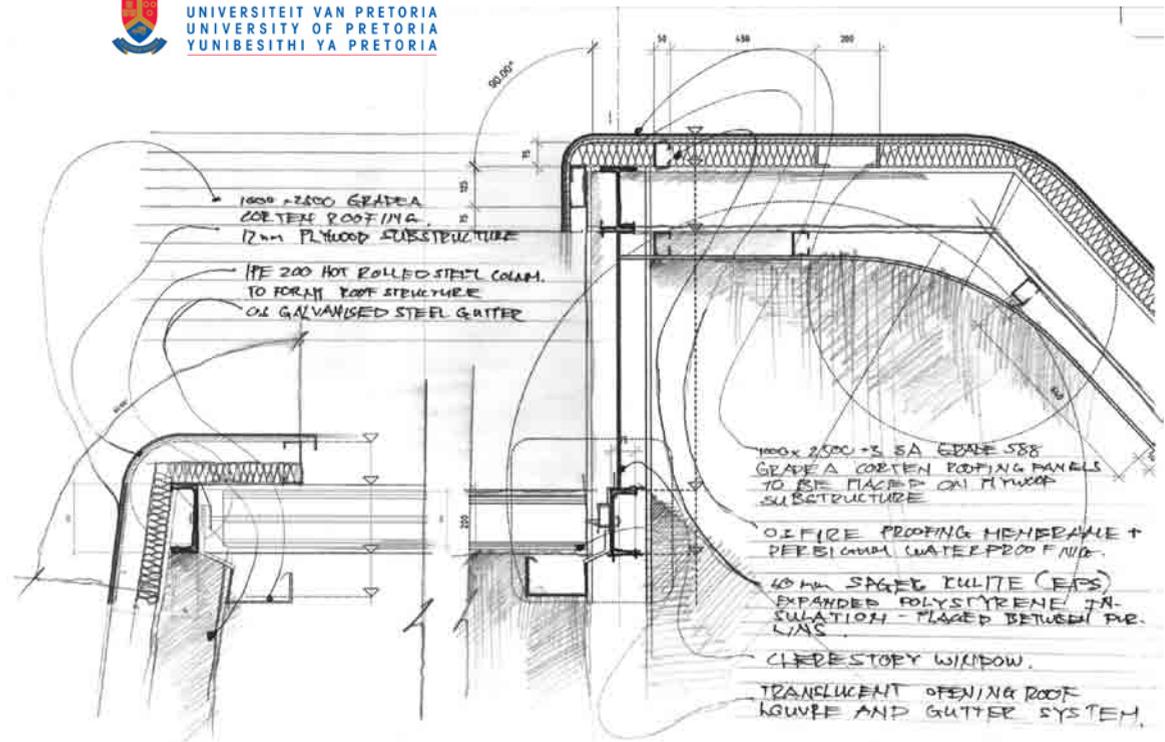


Figure 8.18: Detail of roofing system, nts (Author, 2011)

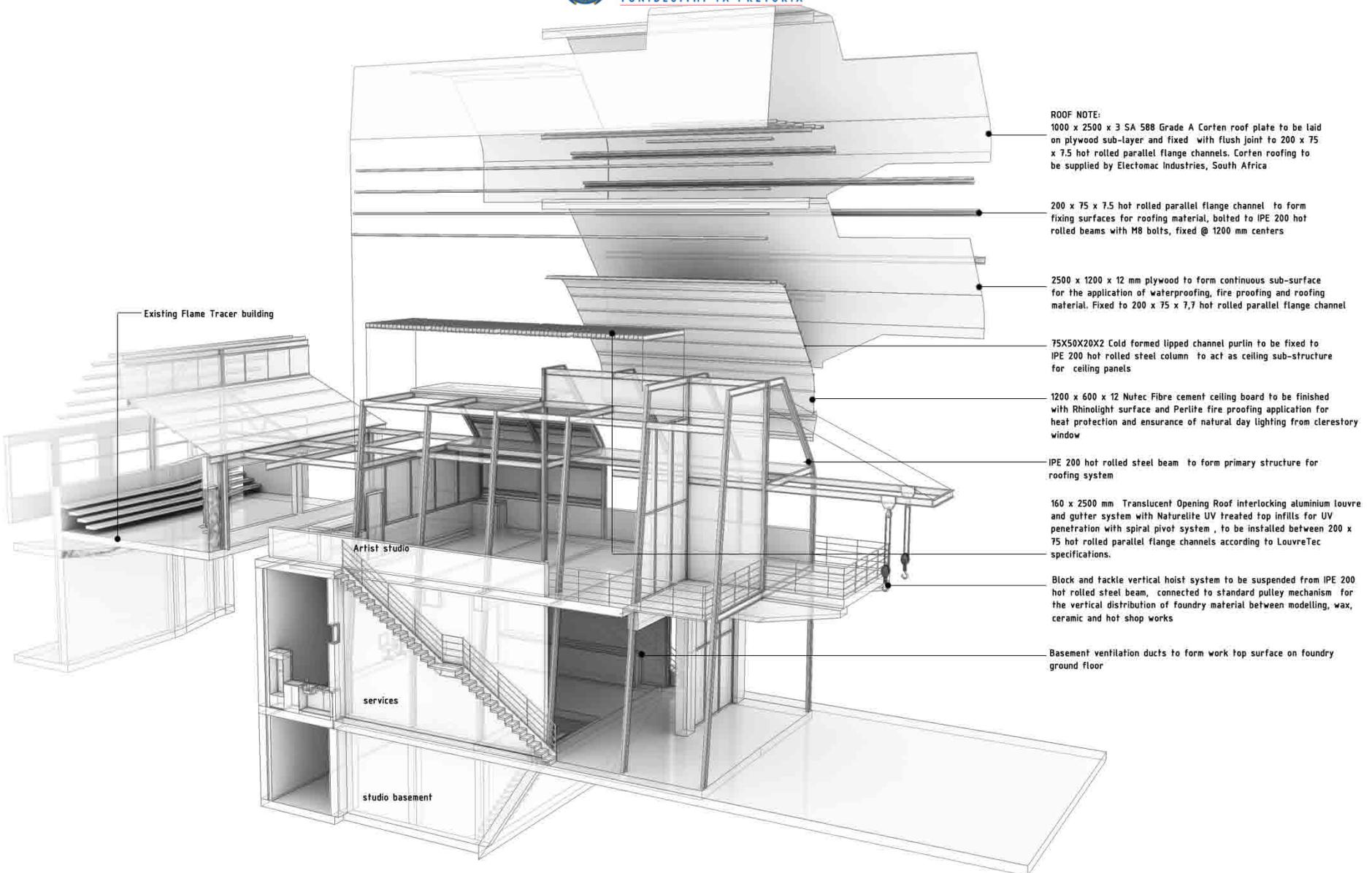


Figure 8.19: Structural exploded view of artist studios (Author, 2011)

8.8 Existing Flame Tracer building

Structural integration of new and existing fabric

In the design, the Flame Tracer building serves as a public circulation route, where the process of ammunition reduction is viewed in the artist studios, from within a context of ammunition production (existing Flame Tracer building). It is within this seamless integration of existing and proposed programme that the structural tectonic of new and existing fabric also amalgamate to form a continuous aesthetic. A newly introduced roof is proposed over parts of the existing structure, thus alternating spatial experience between existing and new fabric. An IPE 200 hot rolled steel apex column frame is introduced into the existing building. The structure allows for a 1 meter clear glass clerestory window to be installed on the existing building roof apex. Existing hot rolled composite angle iron steel roof truss members are bolted to 6 mm structural gusset plates that allow 4 member joints on each fixing surface. Apex gusset plates are to be cut on centrelines to separate the existing roof truss in half, which is then fixed to the new IPE roof apex column.

EXISTING ROOF NOTE:

Existing s-profile corrugated iron roof sheeting of existing Flame Tracer building to be reused @ 1mm thickness and 30 mm apex dimension , laid to a 15 deg fall , with existing weathered finish to both sides and accessories fixed to existing 75x50 timber battens @ 1000 c.c., fixed to existing steel truss

Existing 75 x 50 timber battens

IPE 200 Hot rolled steel column to form new roof structure,

New 6 mm Laminated glass clerestory window to be installed in angle iron frame window frames in existing Flame Tracer building to allow for natural day lighting

Existing steel roof truss of Flame Tracer building

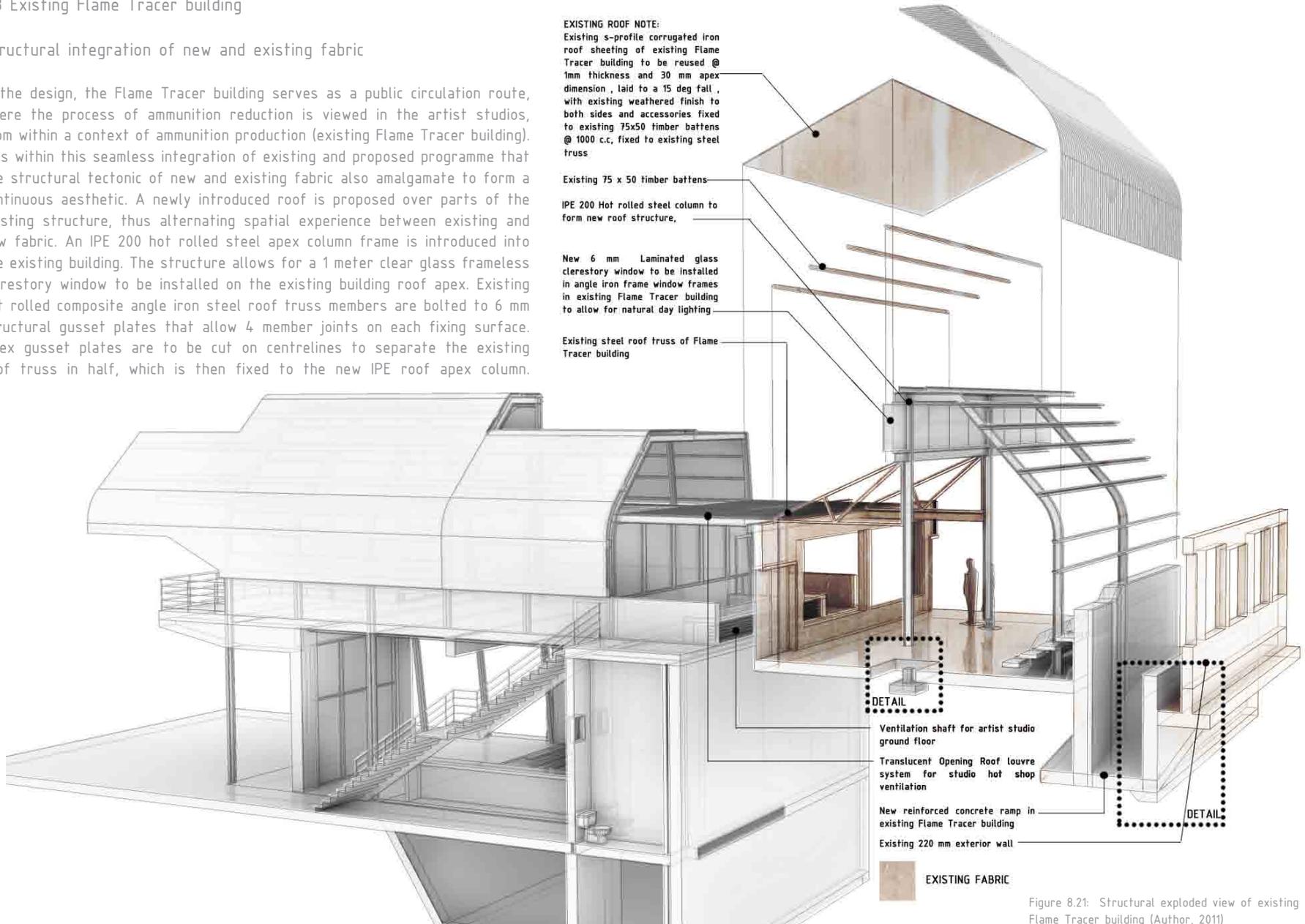


Figure 8.21: Structural exploded view of existing Flame Tracer building (Author, 2011)

All new structural columns are to be fixed to stub column foundations that are located in excavations in the existing Flame Tracer building. The IPE 200 roof apex columns transfer into smaller hot rolled sections that imply a subtle connection with existing fabric. IPE 200 columns are therefore bolted to 100 x 50 x 5 hot rolled parallel flange channels on both sides of IPE flanges to ensure efficient roof load distribution.

New reinforced concrete ramps connect the Flame Tracer building interior with new courtyards, providing an additional circulation platform in the substructure. The ramp is located inside the existing building, where the excavations respect original strip foundation boundaries and structural integrity of the existing exterior wall. The reinforced concrete ramp transfers into a solid balustrade that hides lighting fixtures. At night, directional lighting behind the concrete wall illuminates the weathered interior walls of the Flame Tracer building, emphasising architecture's mortality through contemporary detailing.

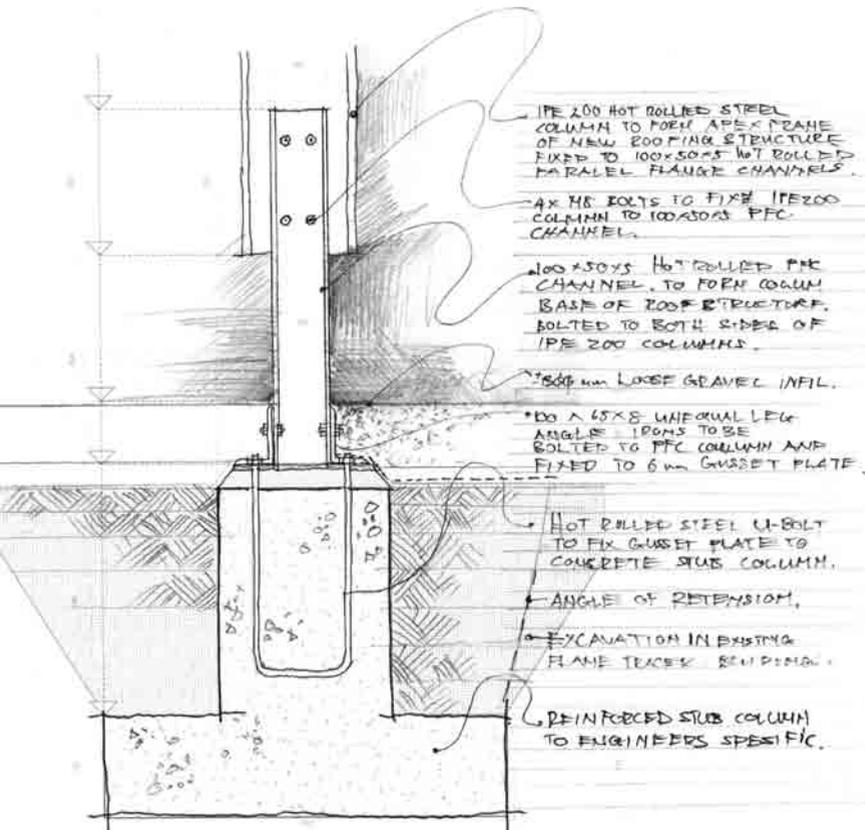


Figure 8.22: New roof column foundation detail, nts (Author, 2011)

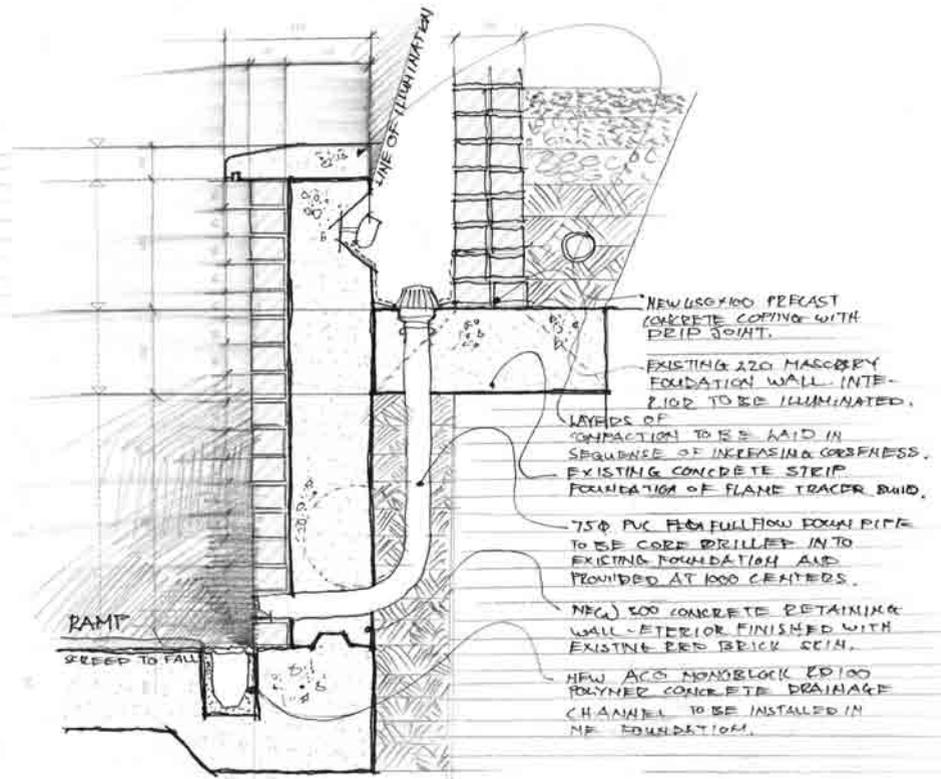


Figure 8.23: New ramp detail illumination the existing weathered interior walls, nts (Author, 2011)