Chapter 9

Technical resolution

Introduction

The following section investigates the decisions and motives that drive the technical level of the proposed project. As such, this section should be read in conjunction with the accompanying set of drawings. The objective of the investigation is to establish an appropriate strategy to achieve effective technical resolution of the proposed building structure. With this in mind, aspects such as a historical study, in conjunction with a technical investigation, informed the design decisions.

With the growing environmental concerns, both locally and internationally, as well as the recent energy shortage in South Africa, the implementation of sustainable principles are elementary. It should however be kept in mind that sustainable design encompasses a myriad of aspects ranging from issues such as passive systems, material sourcing, and construction processes. For this reason, the proposed project selects to focus on solar shading and cooling. The object is to enable energy-independent occupant comfort as far as possible.

9.01 Early photo of Pretoria Station taken at an unknown date (Van der Waal Collection, University of Pretoria)
9.02 Interior of one of the sheds at Pretoria Station. The steel structure is noteworhty (Van der Waal Collection, University of Pretoria)

Historical study

This section of the technical investigation examines the materials used in South African railway architecture as can be found in the old Transvaal Province and as was constructed by the NZASM. According to De Jong, Van der Waal & Heydenrych (1988:83) these old NZASM station buildings are characterised by three distinctive features. Firstly, they draw inspiration from the railway architecture in Europe, and in particular that of the Netherlands. This influence is clearly observed in the use of red brick and white sandstone which reflects the ornamental language of the Dutch Renaissance. Attention is deliberately drawn to the central part of the façade. However, they lack the impression of height that their European counterparts achieve. Secondly, the station buildings reflect an adaptation to local circumstances. As such, many of the station buildings were constructed using locally available stone (sandstone, ironstone (dolerite) and hornstone ("blouklip"). Brick was used where it is either more readily available or cheaper. Corrugated iron was used as roofing material as opposed to the tiled roofs of their European counterparts. A third distinctive feature is the use of verandahs, and particularly so on smaller station buildings. The local weather conditions play a large part as it allows for the free movement of passengers (De Jong, Van der Waal & Heydenrych 1988:85).


9.01


9.02

Considerations

Building mass

The investigation on the building mass was conducted on two levels. Firstly, at a mass level, resulting from the identification of public open spaces located in front of the station building and the two internal courtyards on the southern side of the proposed building. The latter two spaces are identified as problem areas due to these spaces being shaded throughout the day in mid-winter. Secondly, each individual unit level was investigated in terms of its indoor light quality, both on the northern façade of the retail and office complex and the eastern façade of the station concourse.

On a mass level, the investigation informs bulk massing, the position of voids, and the height of roofs in order to improve the thermal and natural light quality, as well as to address the street façade in the broader urban scheme.

Orientation

The proposed building's orientation is a direct result of its response to its urban context. As such, the building is aligned to the two streets in front of it, and is thus orientated 5-degrees west off True North. This configuration results in the retail and office complex's main façade predominantly facing northwards, while the main façade of the station concourse primarily faces east. While the northern and eastern orientation is advantageous for natural light and dominant north-eastern summer wind for ventilation purposes, the southern side of the building, which opens onto internal courtyards, is exposed to the direction of prevailing wind and rain.

Form

The shallow depth of the proposed building, being informed by its urban context, allows for good natural cross ventilation and natural light penetration into the interior spaces. As such, it is suited for office and other uses. The south-facing courtyards are open and allows for ventilation of the building interior spaces. The primary circulation bridge to the south of the building is exposed to the direction of prevailing winds and rain, and will need to provide protection from these.

Scale

The 3-storey large structure of the proposed building requires that elements be introduced to have to the building respond to the human scale. This is achieved with the introduction of horizontal elements. On the northern façade, this translates into a large overhang that provides both shelter from natural elements, shading from the sun, and defines the circulation space.

Technical investigation

Natural ventilation

The proposed building is designed to make use of natural ventilation. This is achieved through windows and doors on the northern façade. The station concourse is an open structure and therefore allows for ample natural ventilation.

Storm water

Storm water is drained off the roofs and connects with the storm water drainage system that currently exists in the site. Currently, this system drains to the railway line.

Fire protection

Fire protection of the proposed building is achieved through the installation of two fire hoses on each of the floor levels, along with four fire extinguishers. This is done in compliance with Table 2 of Part T of the SABS 0400, which requires one fire hose per 500m² and one fire extinguisher per 200m². These are accommodated in a vertical shaft on the southern façade.

In addition, the Multiservice Chilled Beam System (MSBC) that is discussed later in this chapter, has to capasity to house sprinkler systems in their design.

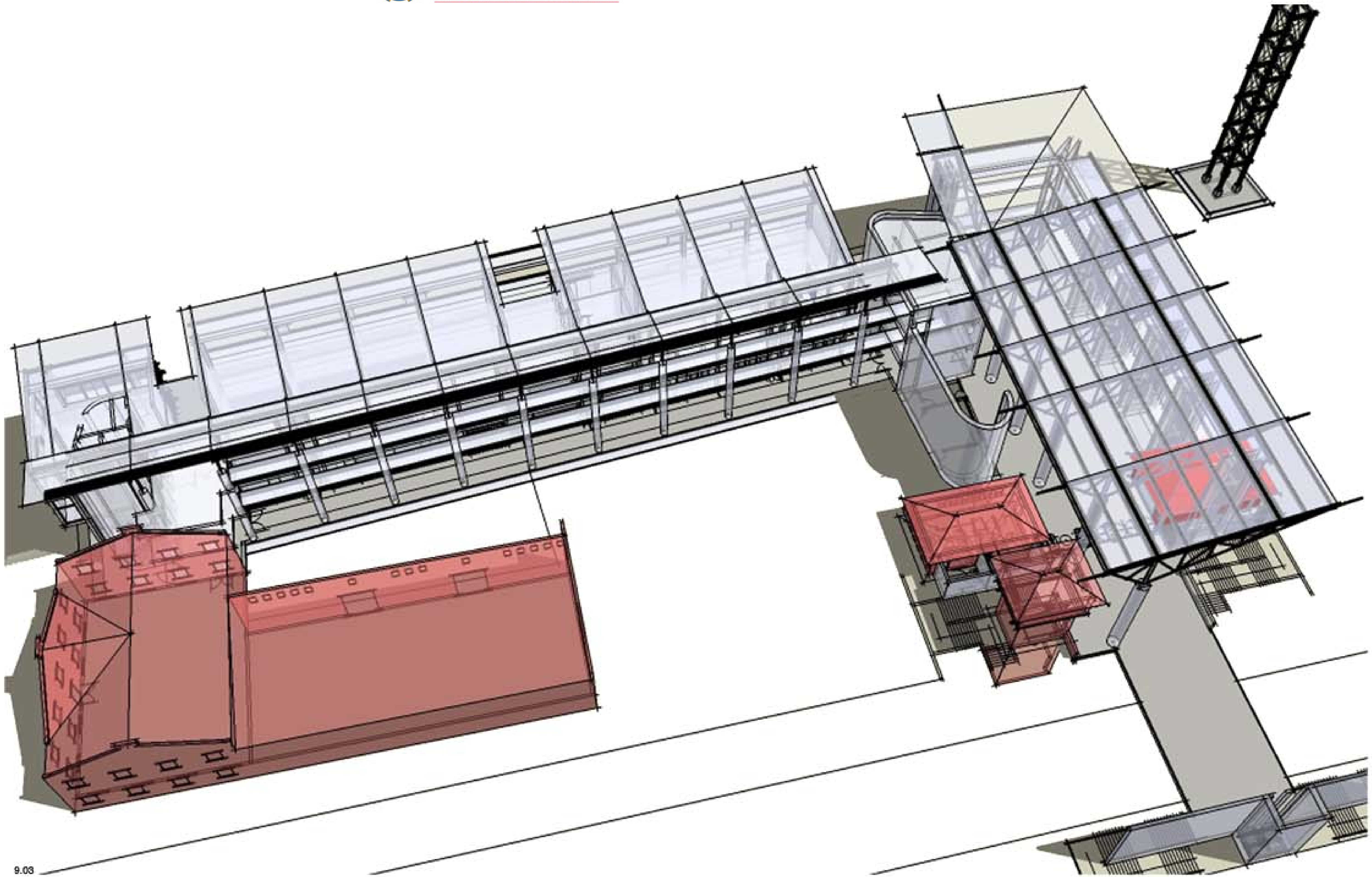
Facilities for the disabled

Facilities for the disabled are provided by the provision of elevators that allow for easy access to both the platforms at the railway line. Elevators are also provided to gain access to the offices on the first and second floor levels. All ablution facilities also provide facilities for the disabled.

Artificial light

Artificial light is to be introduced to ensure consistent lighting levels with increasing room depth. It is suggested that an automatic lighting and sensor system be installed.

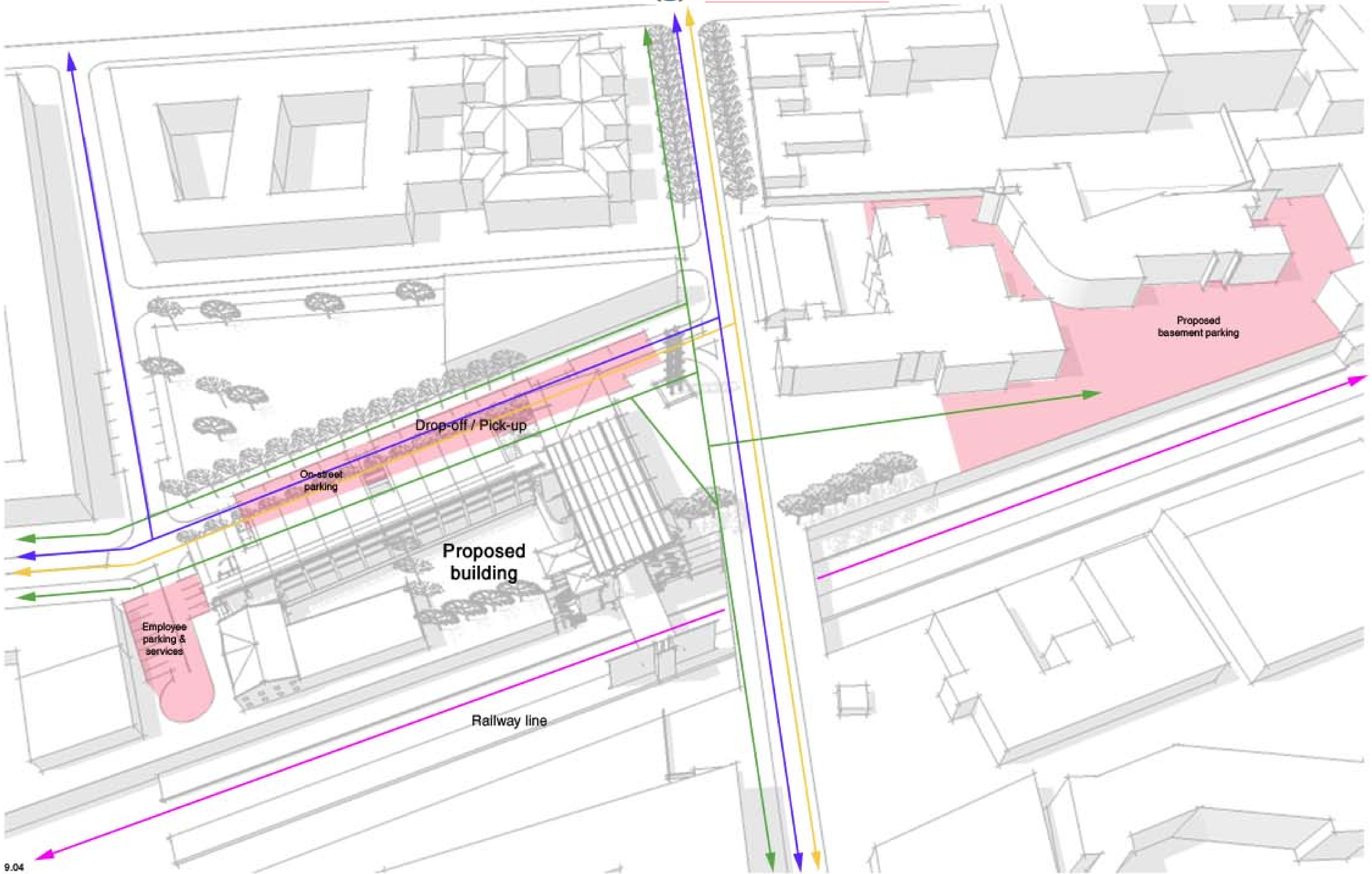
Existing & new structures



9.03

9.03 Existing structures are in red

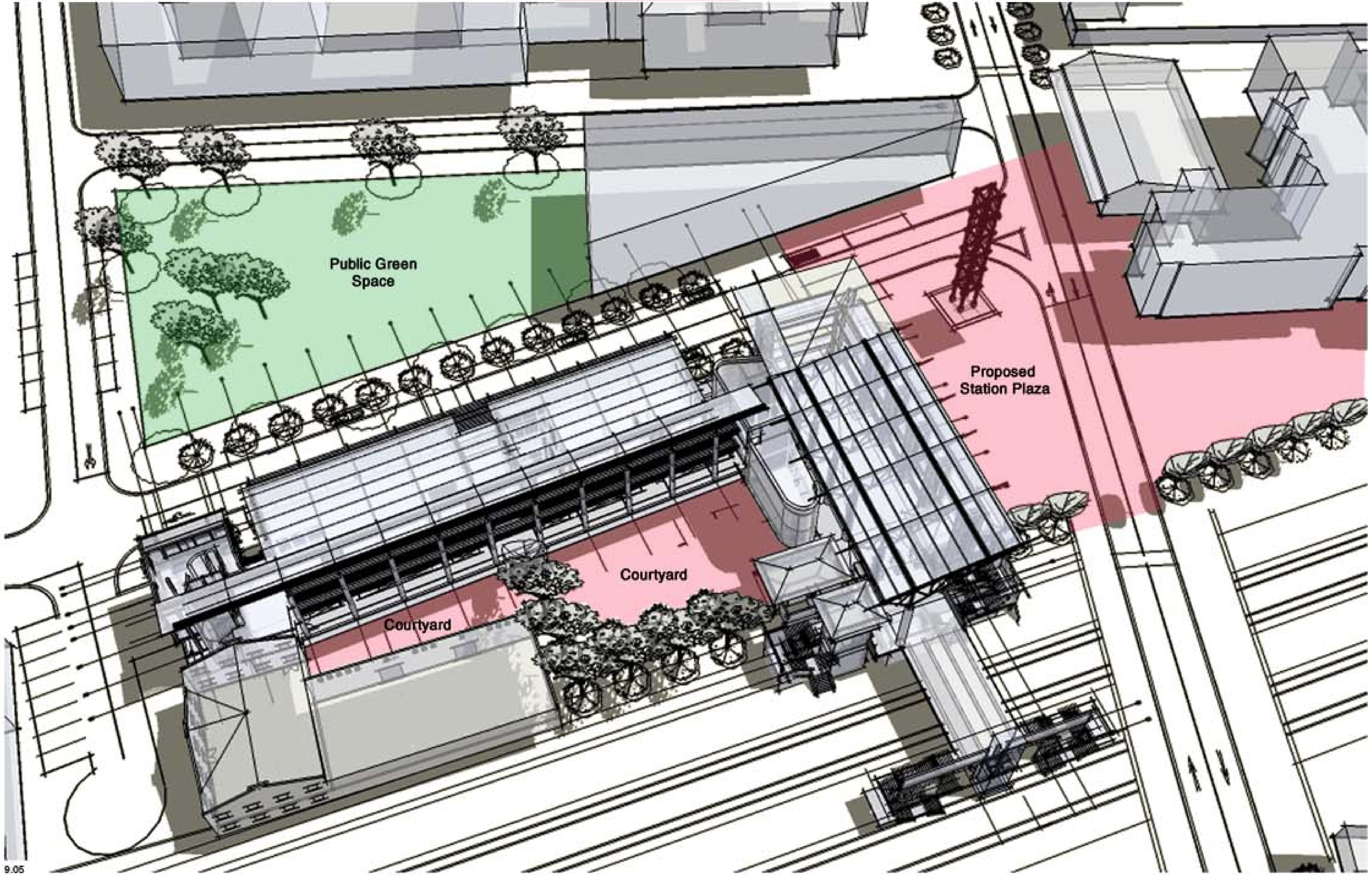
Site access & parking



9.04

9.04 Site access and parking

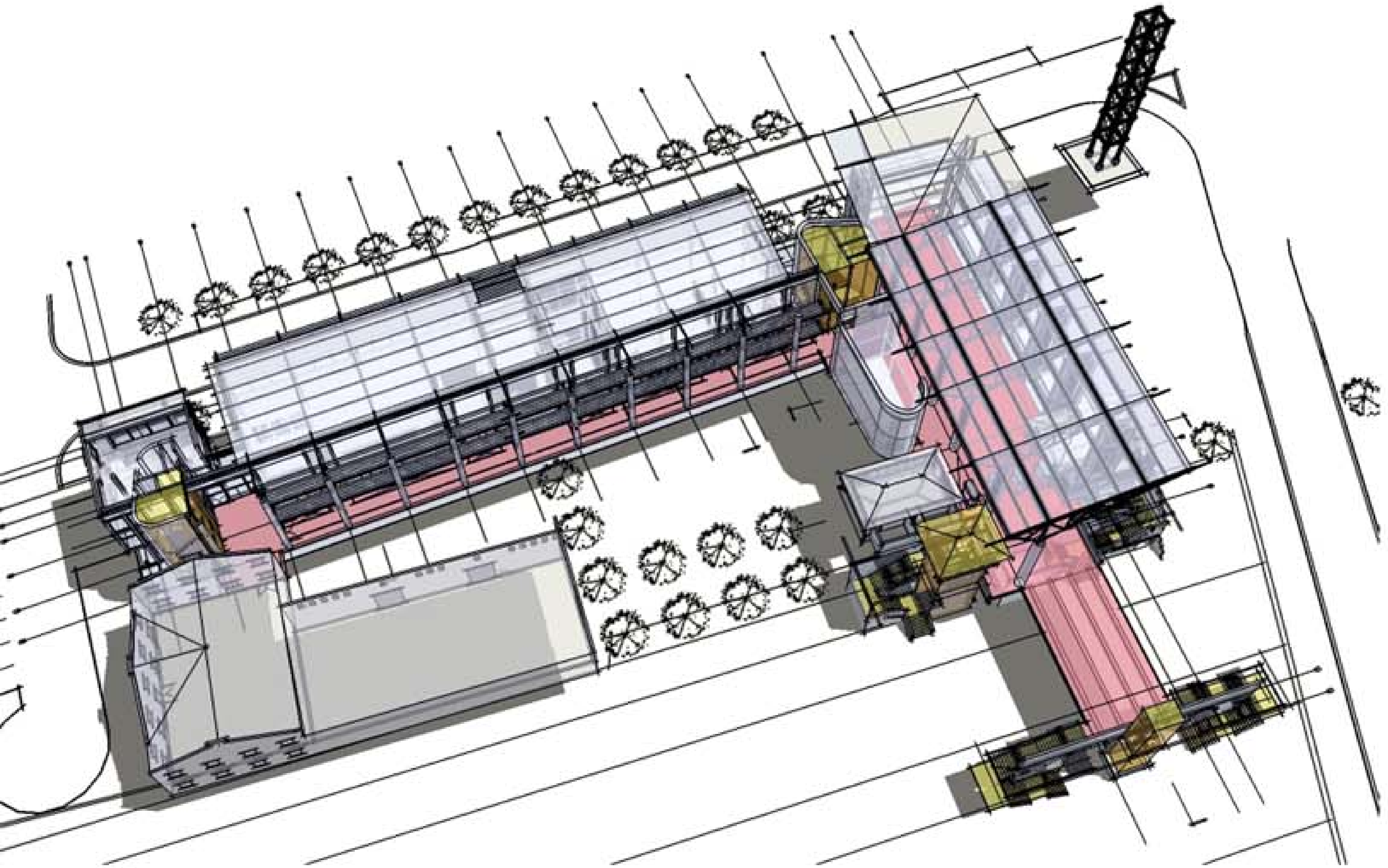
Public space



9.05 Proposed public space at Rissik Station

Circulation

- horisontal circulation
- vertical circulation



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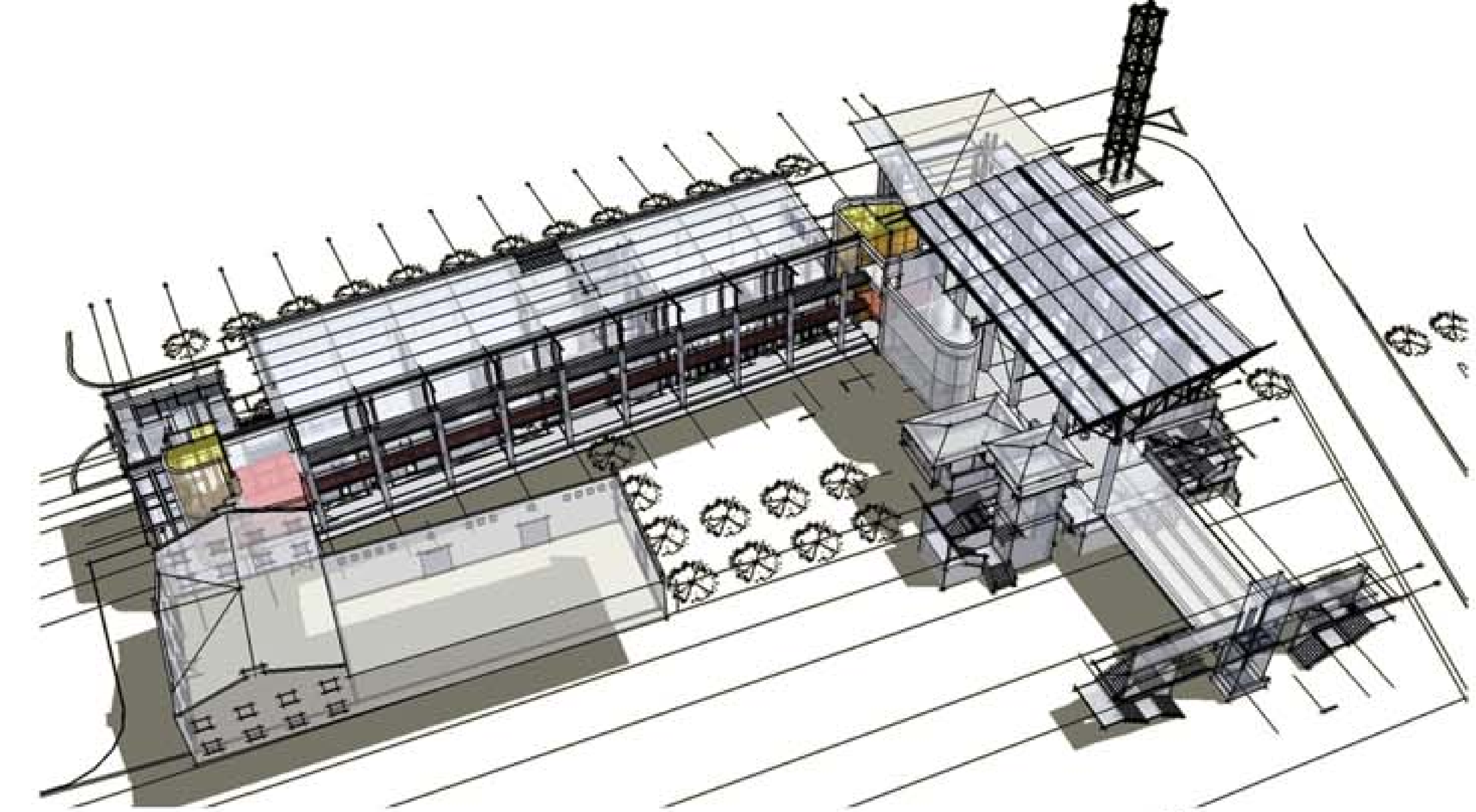

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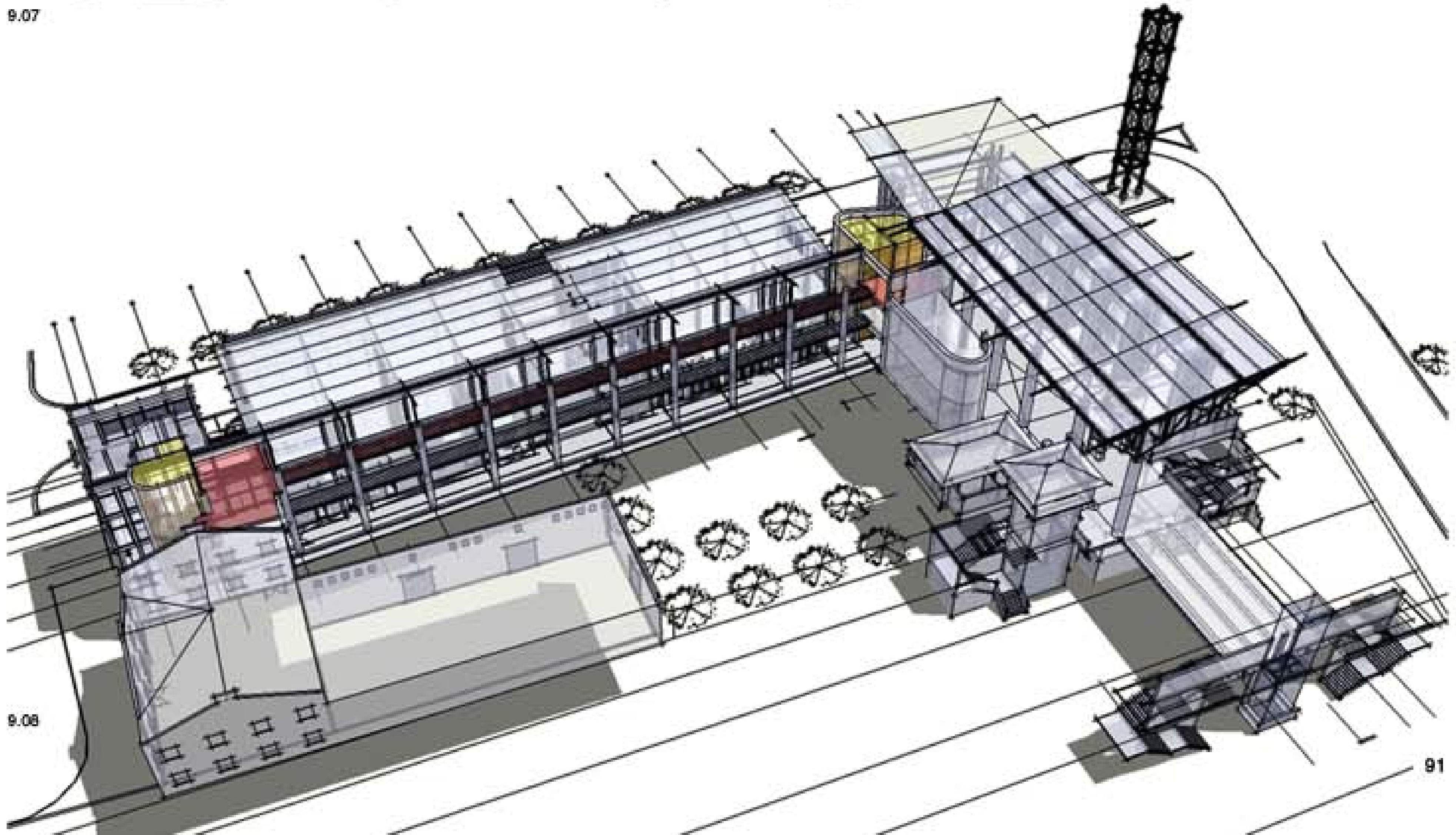
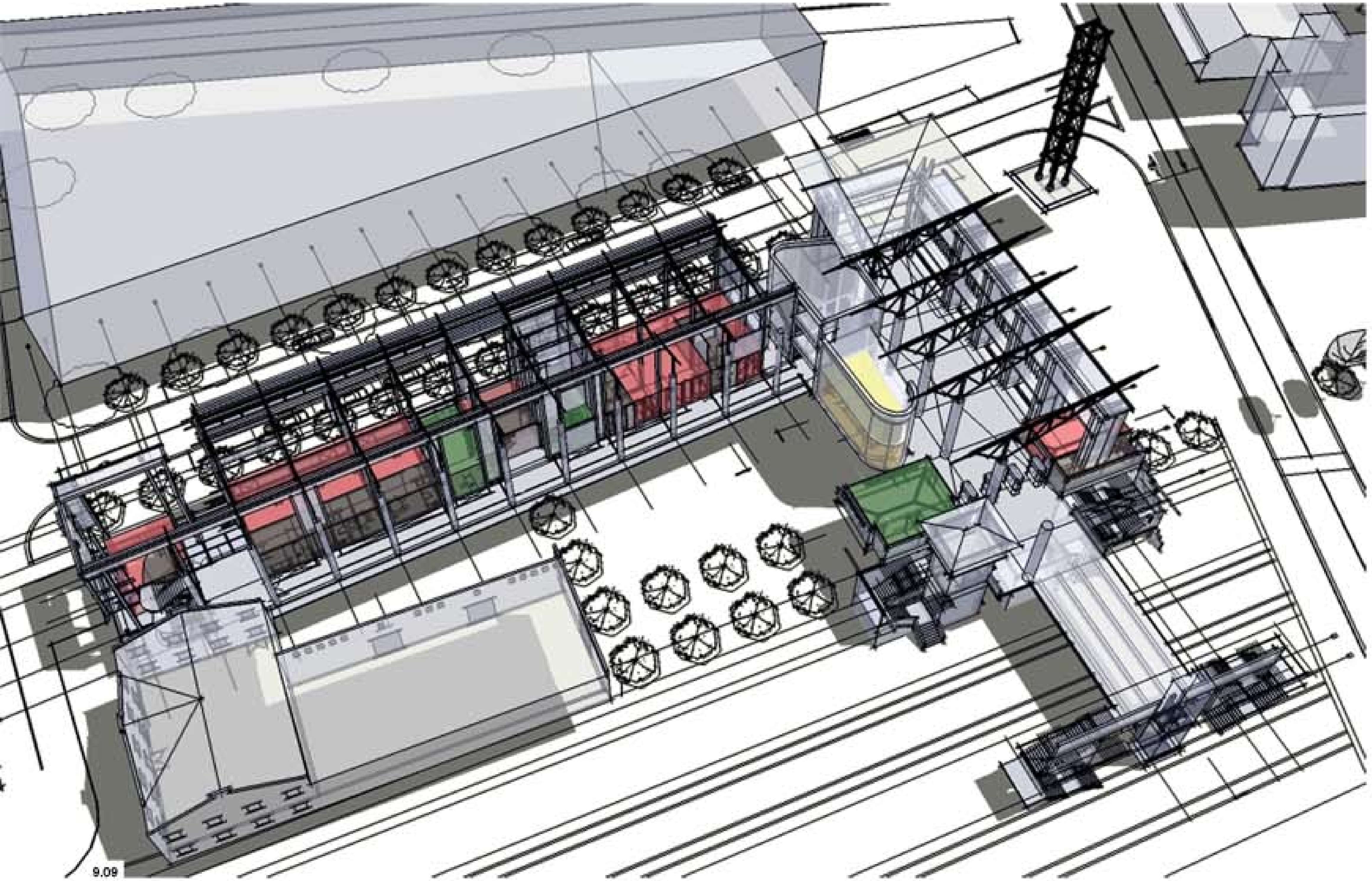


9.08

9.06 Ground floor circulation
9.07 First floor circulation
9.08 Second floor circulation

Building programme



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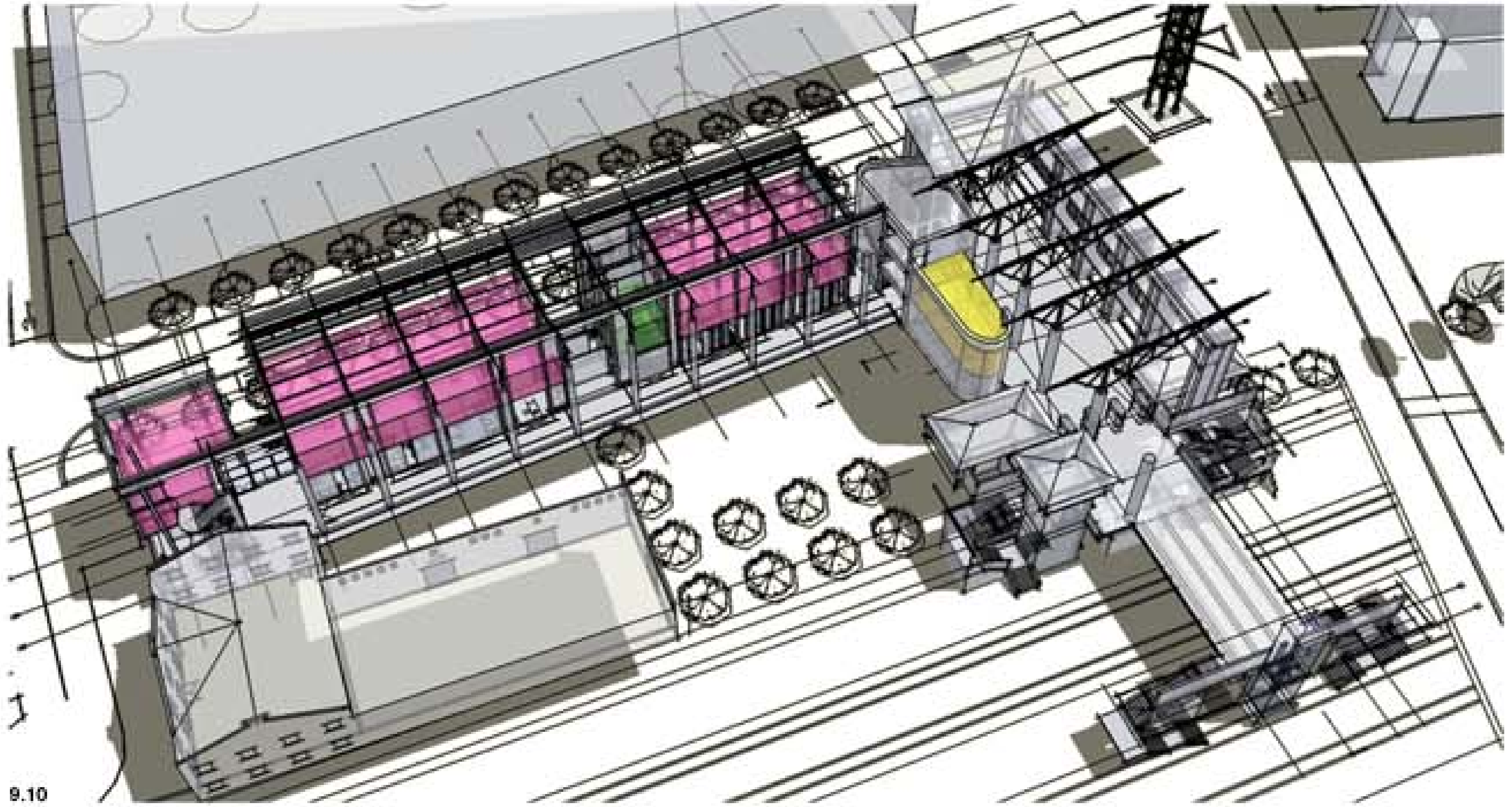

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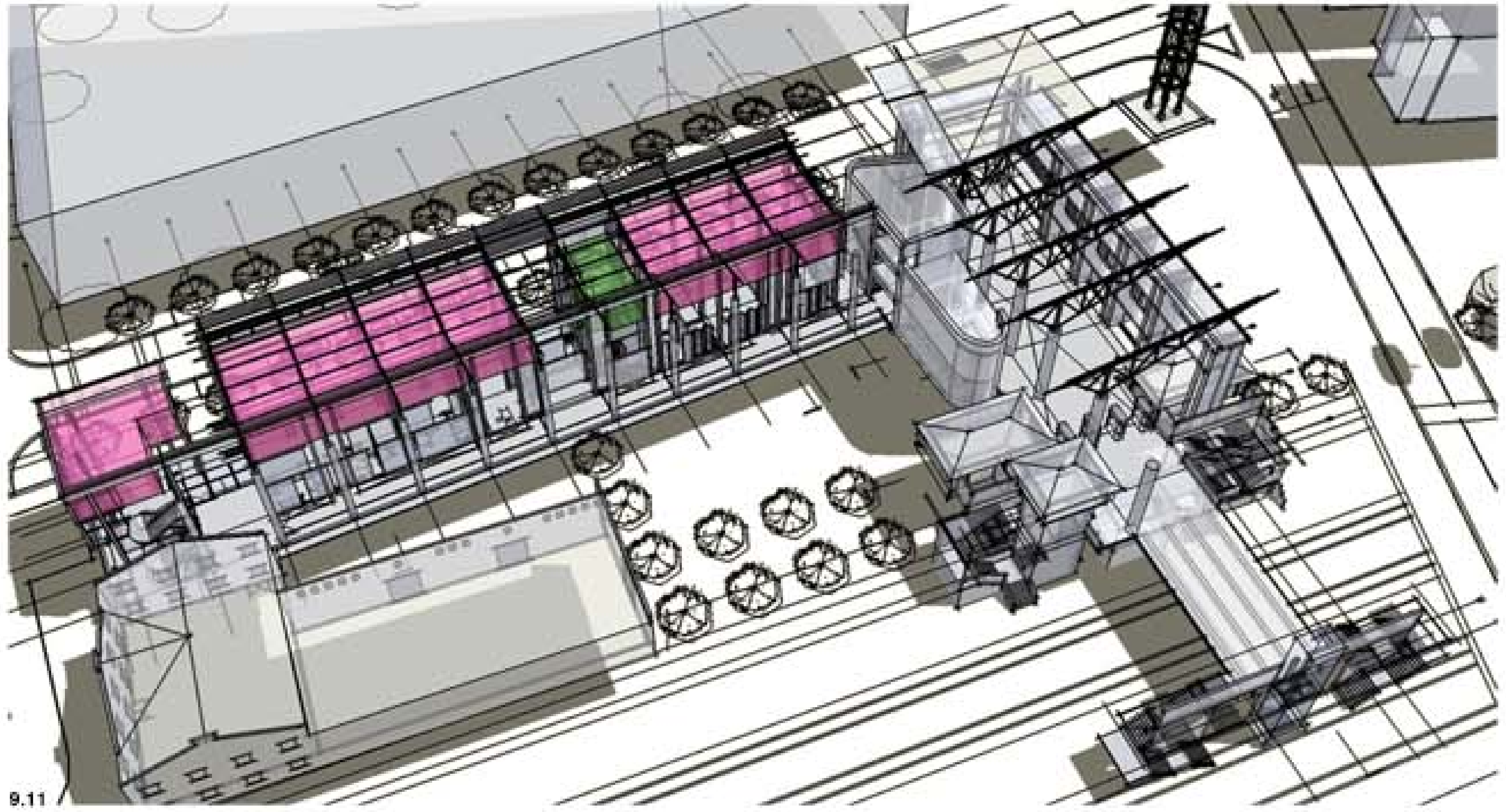


9.11

- Retail
- Back-of-house (Retail)
- Station administration
- Office
- Ablutions

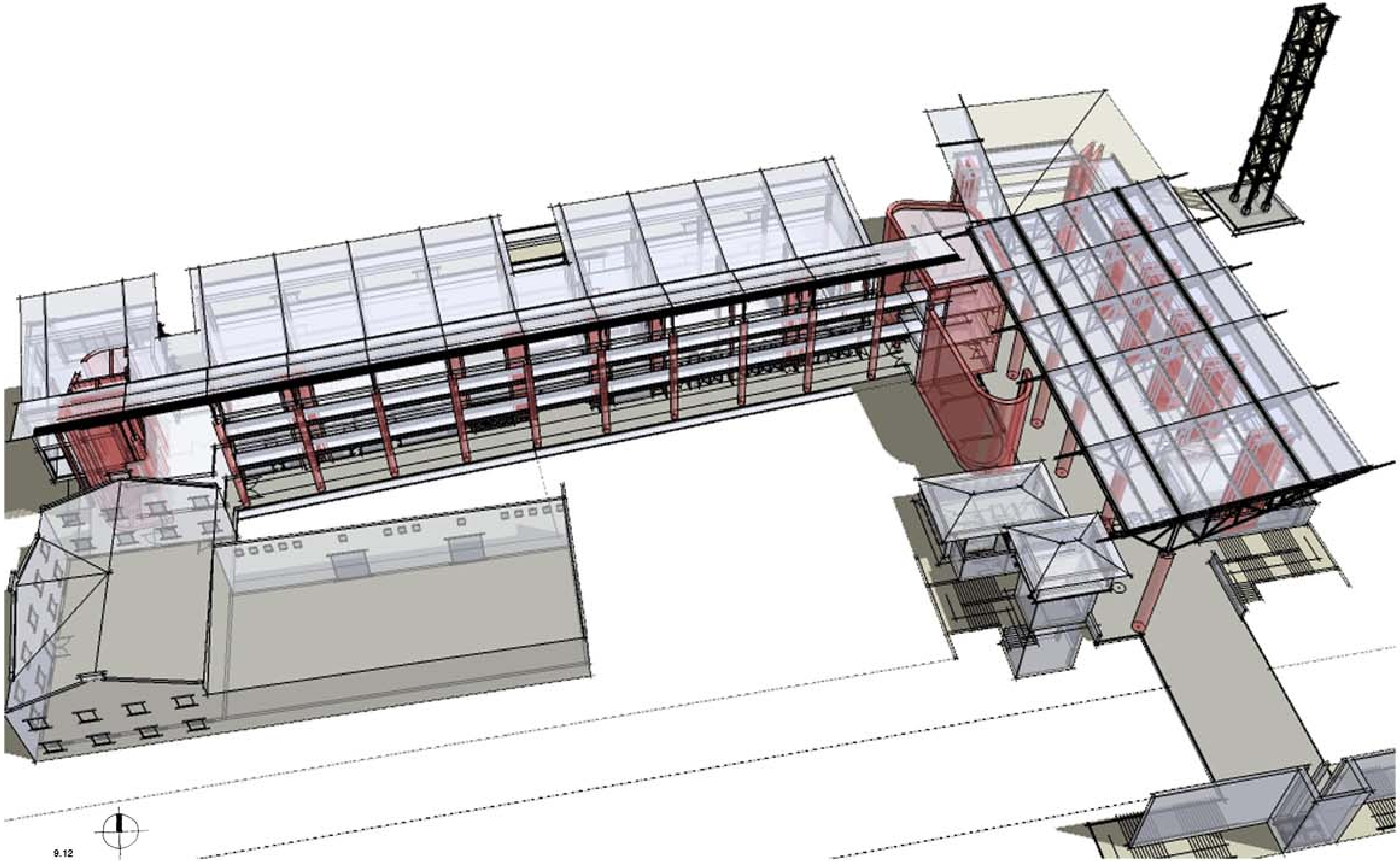
9.09 Ground floor programme
9.10 First floor programme
9.11 Second floor programme

Structural system

The primary reinforced concrete structure of the proposed building is based on a 6m x 6m grid. It consists of columns and beams, with lateral stability provided for by the service shafts and concrete floor slabs. This skeletal structure is informed by Le Corbusier's "Domino Structure", and allows for flexibility within the building. As such, it accommodates future changes to the building programme.

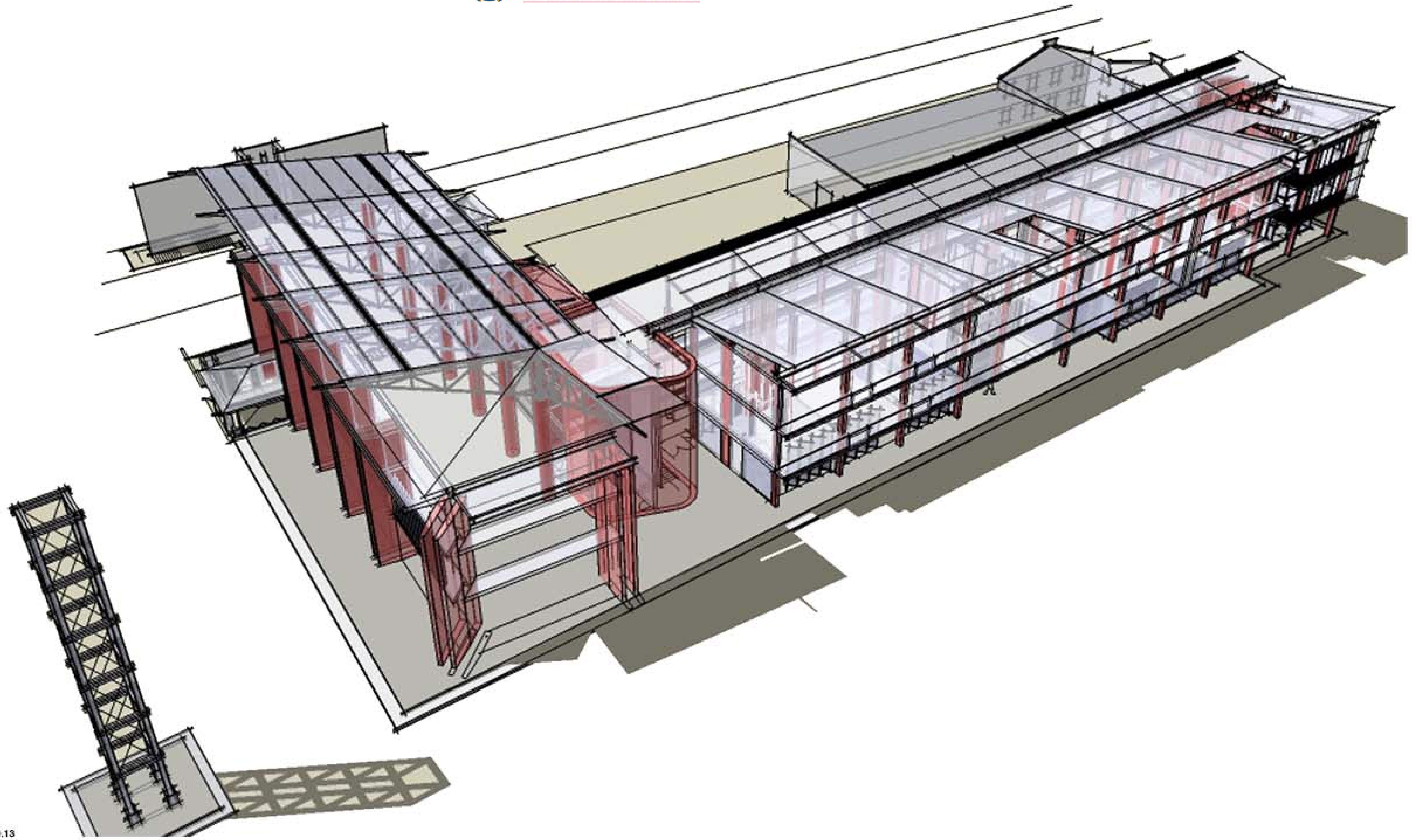
Due to the adaptable nature of the proposed building and its variable functions, the building is designed to achieve flexibility. This is achieved by the bulk of interior walls consisting of dry-walling that can be easily moved to achieve any required spaces. This results in a reduction of the overall weight of the building and enables easy adaptation. In addition, dry-walling achieves the required acoustic levels and is reusable.

Similarly, services are provided for by means of vertical shafts. Floor to ceiling heights are 3.6m at ground floor level and 3.3m on the upper levels and allows for the accommodation of suspended ceilings should it be required for the effectiv distribution of services, or for reasons relating to accoustics.



9.12

9.12 3D model of the proposed building with the structural system highlighted in red

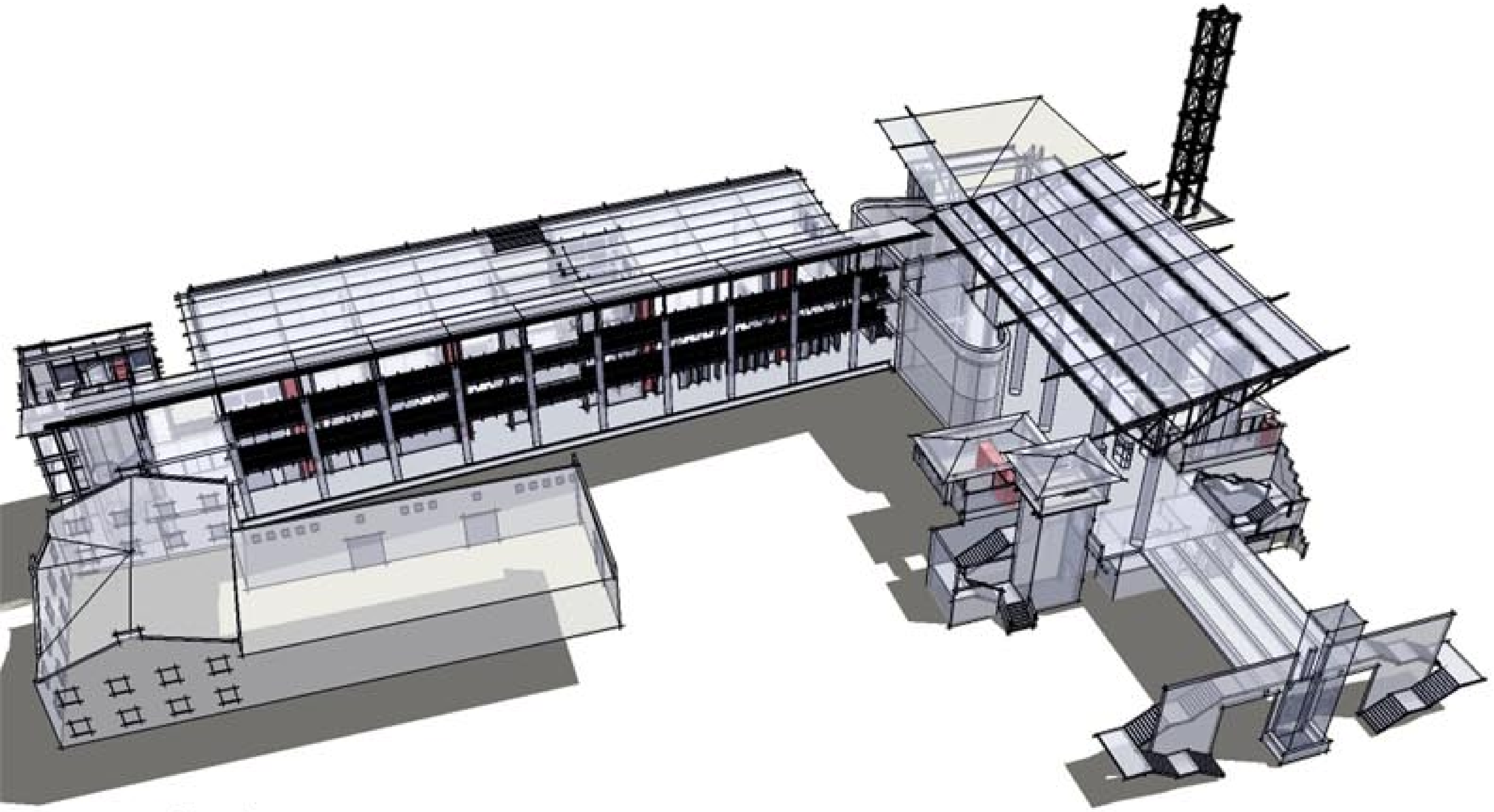


9.13 Structure viewed from the north

9.13

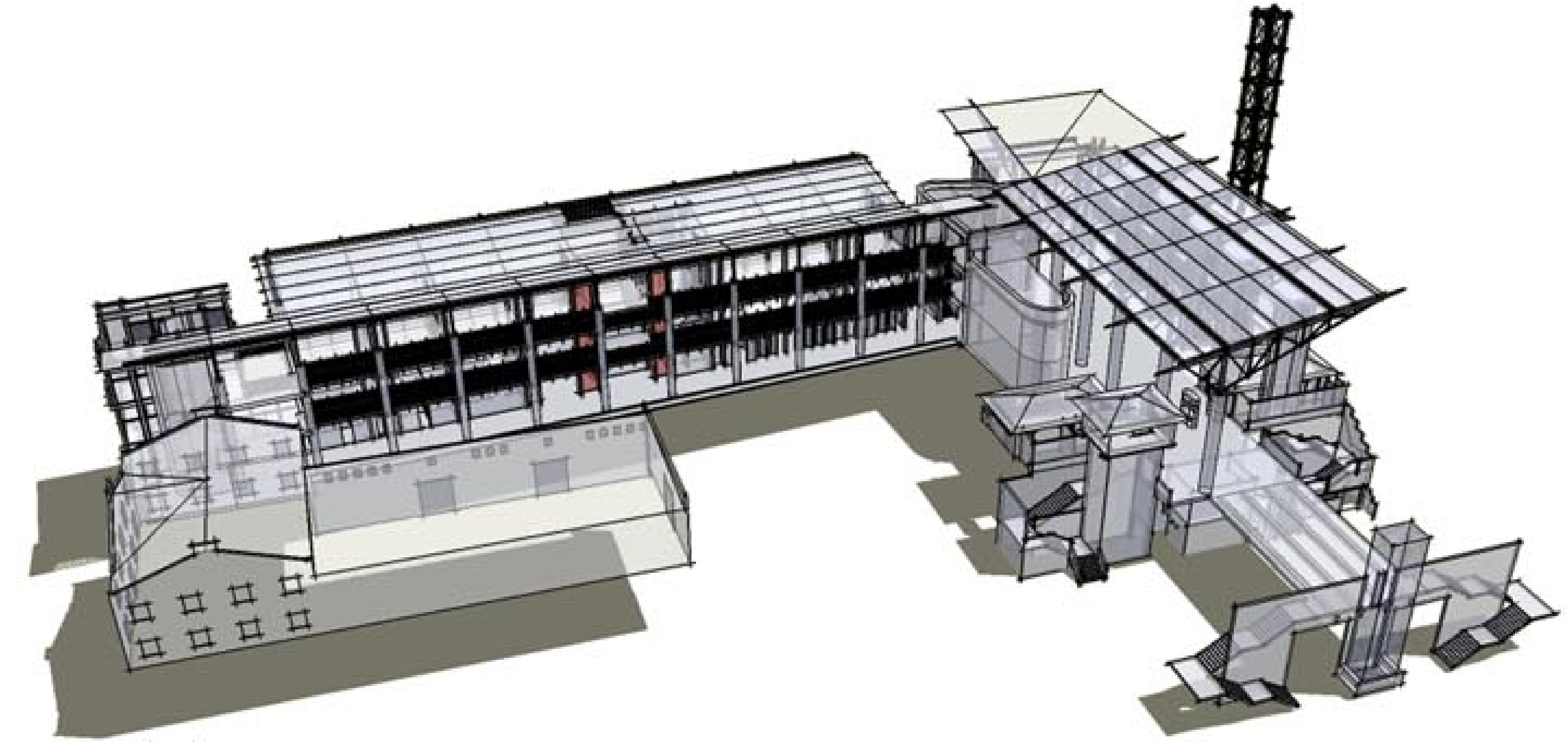
Vertical service ducts

Various services are housed in separate vertical ducts located on the southern façade. These include wet services, fire protection services, and electrical services.

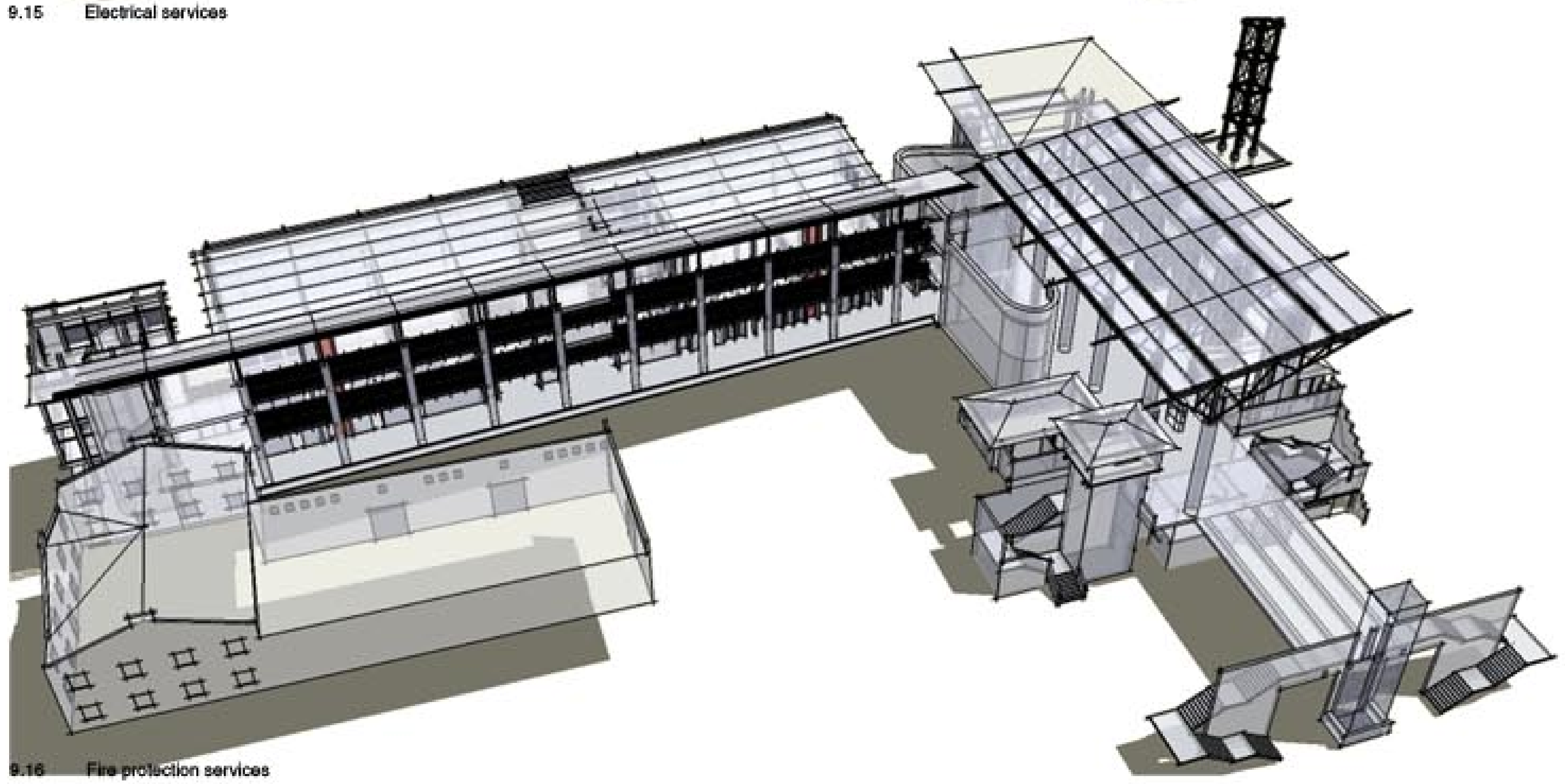


9.14 Wet services

9.14 Wet services
9.15 Electrical services
9.16 Fire protection



9.15 Electrical services



9.16 Fire protection services

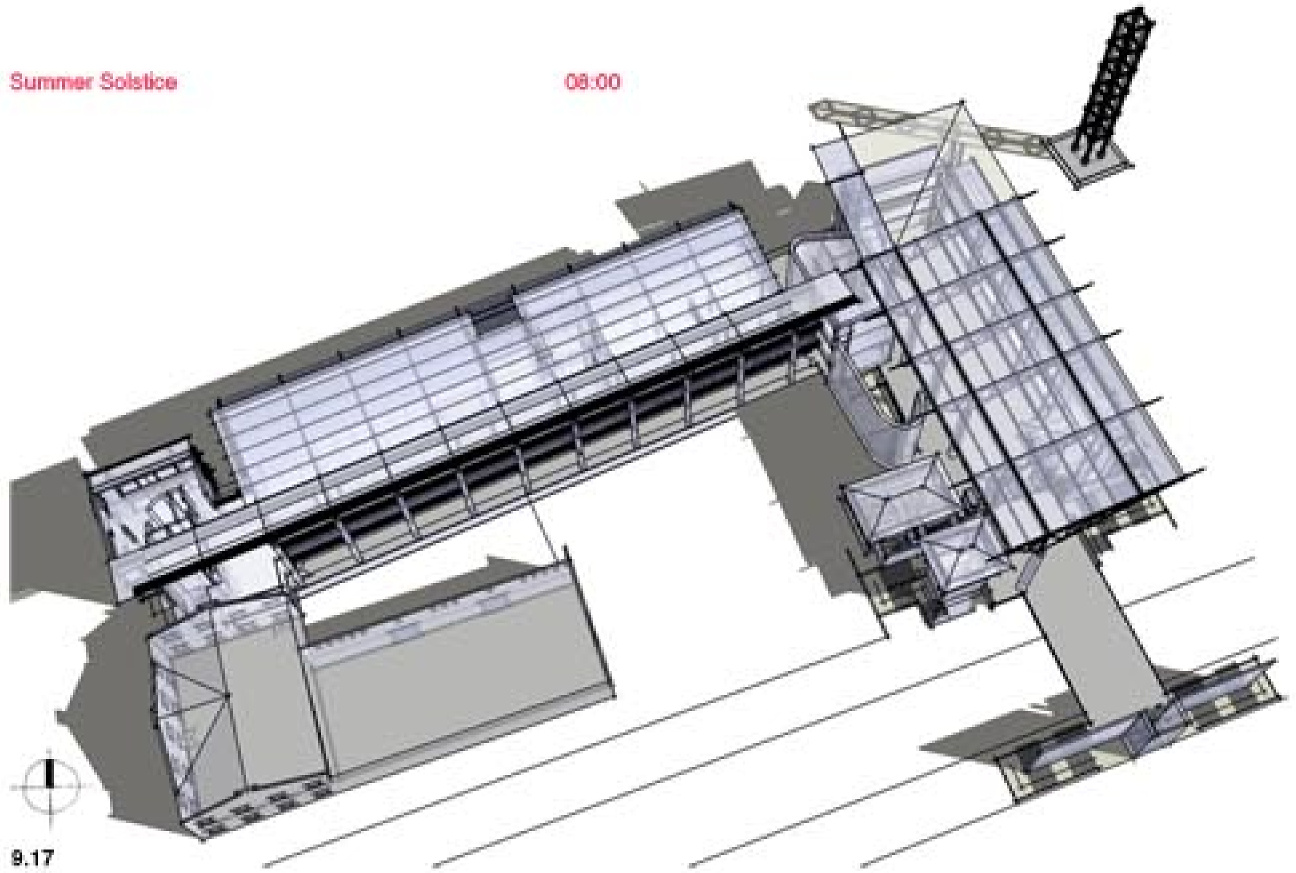
Sun study

A SketchUp massing model of the proposed building was composed to examine the day lighting scenario. Natural lighting scenarios were examined for both the summer and winter solstices at 08:00, 12:00 and 16:00. From this investigation it becames clear that the summer scenario differs greatly from the winter. In summer, the internal courtyards are exposed to sunlight for the bulk of the day, with minimal shade in the morning and afternoon. This is not the case during the winter solstice when the internal courtyards are primarily shaded for the entire day.

This sun study determines that large indigenous trees can be used to strategically provide shade during the summer months.

Summer Solstice

08:00



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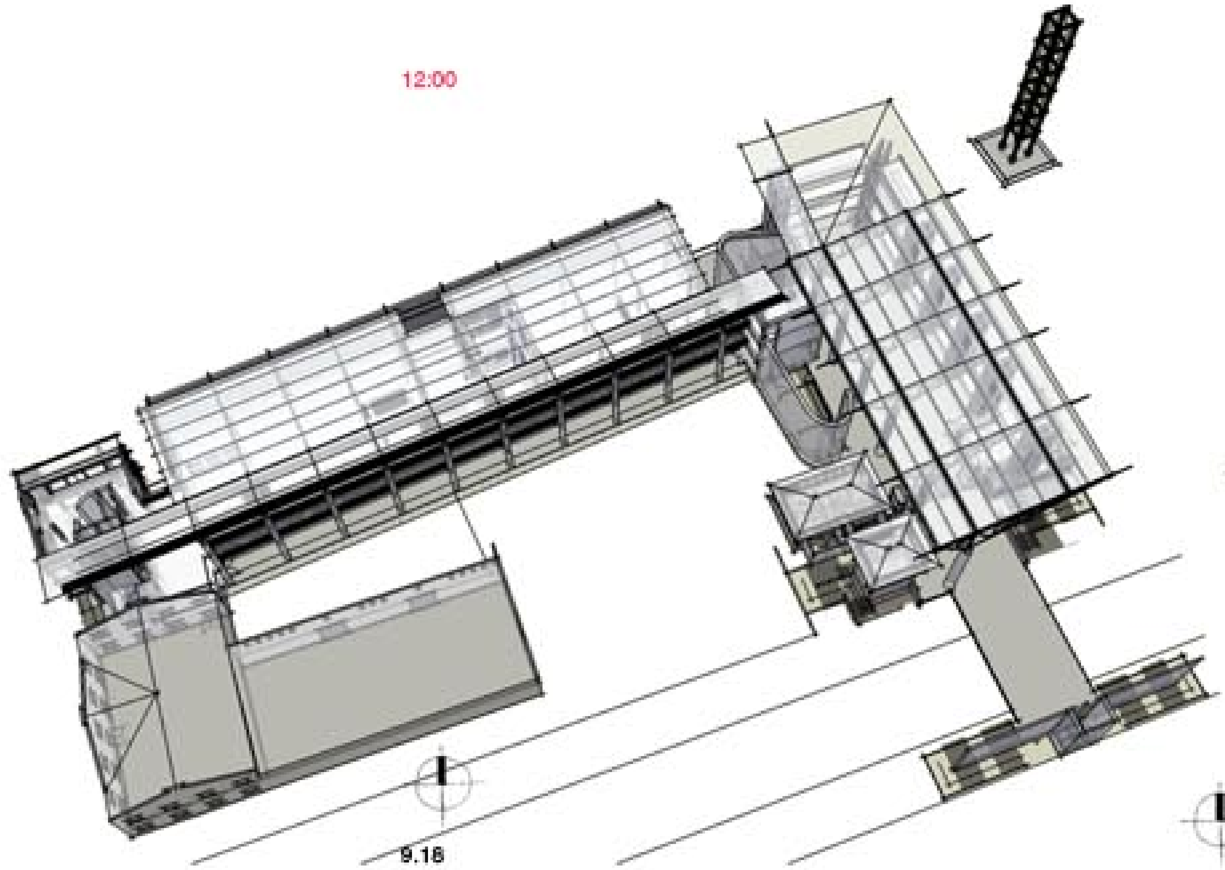
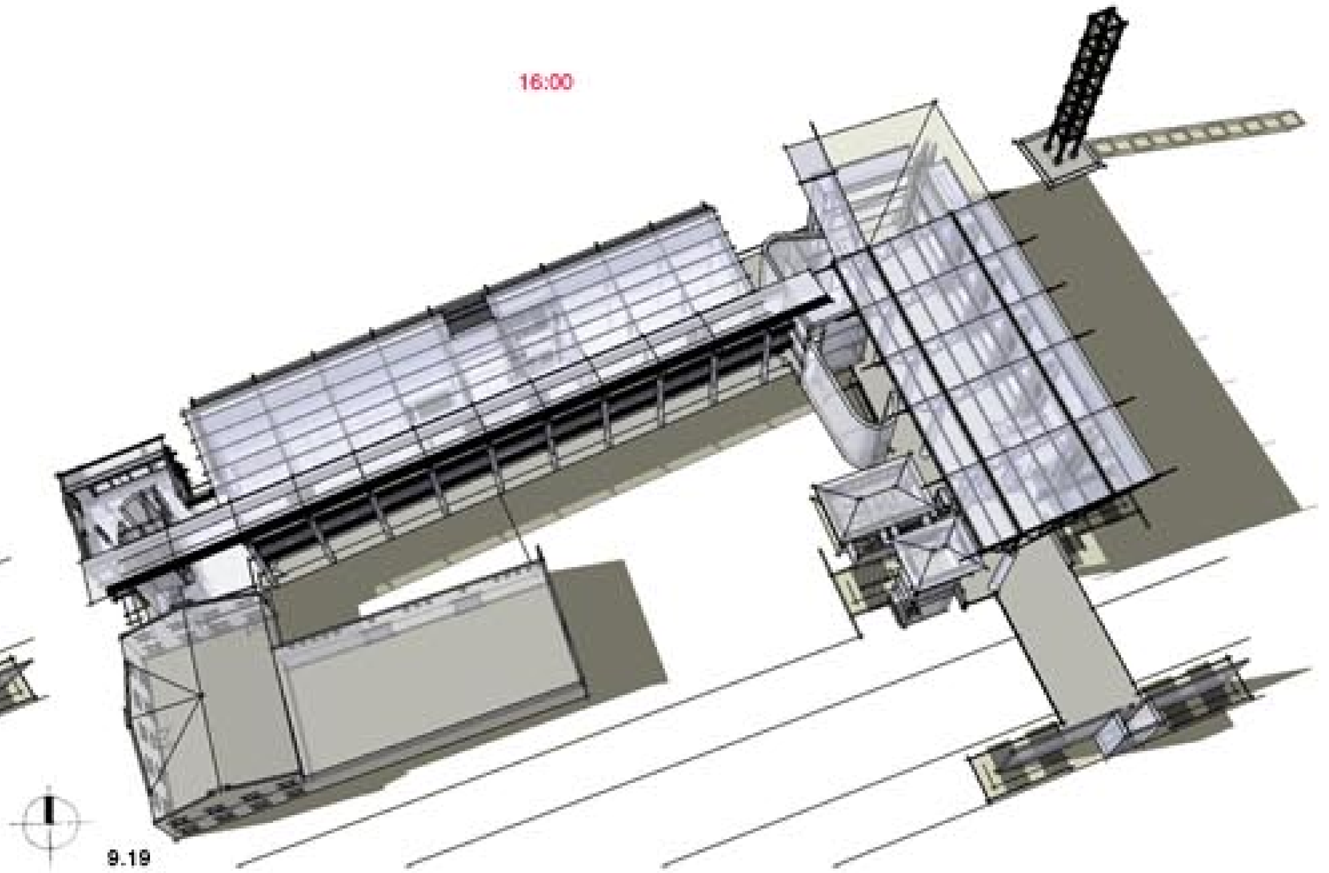
12:00



9.18

16:00



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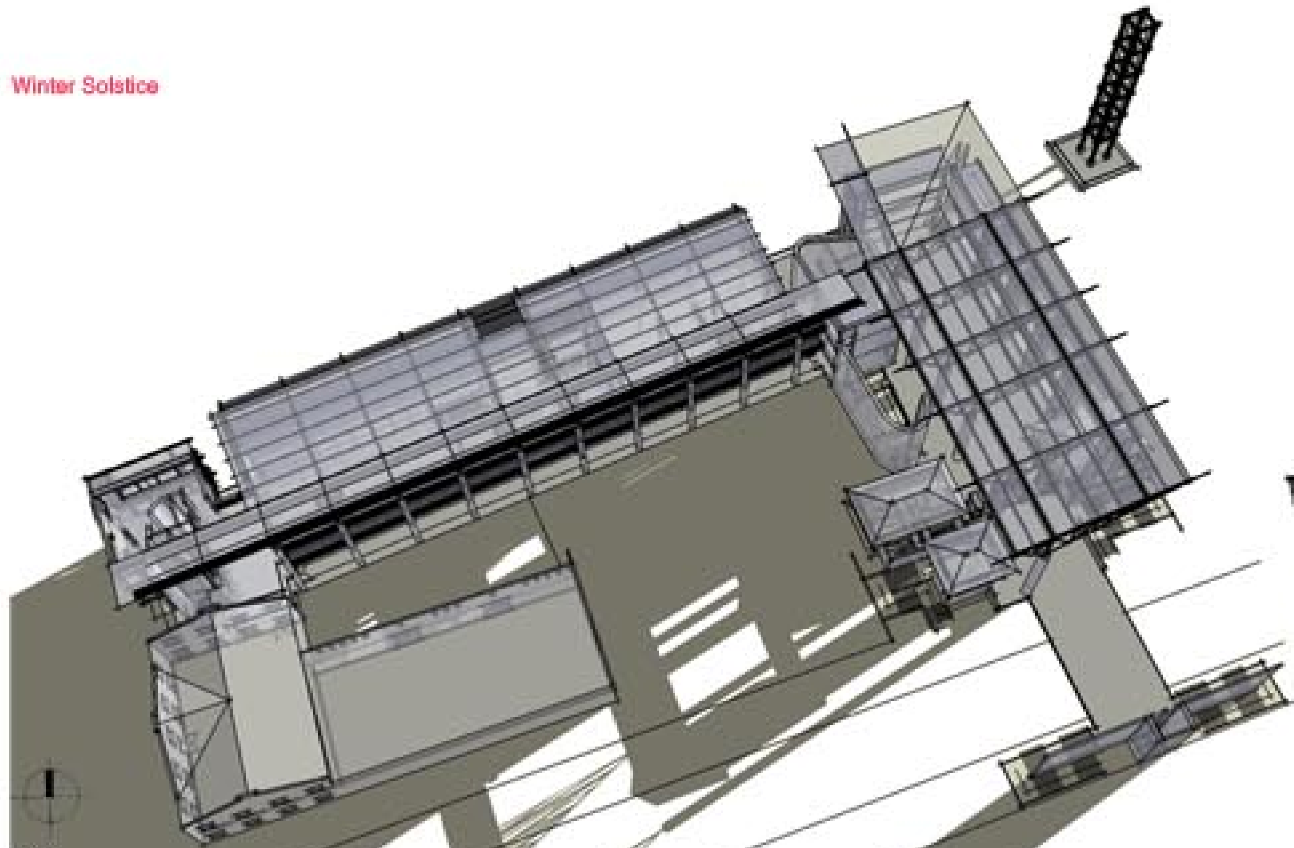
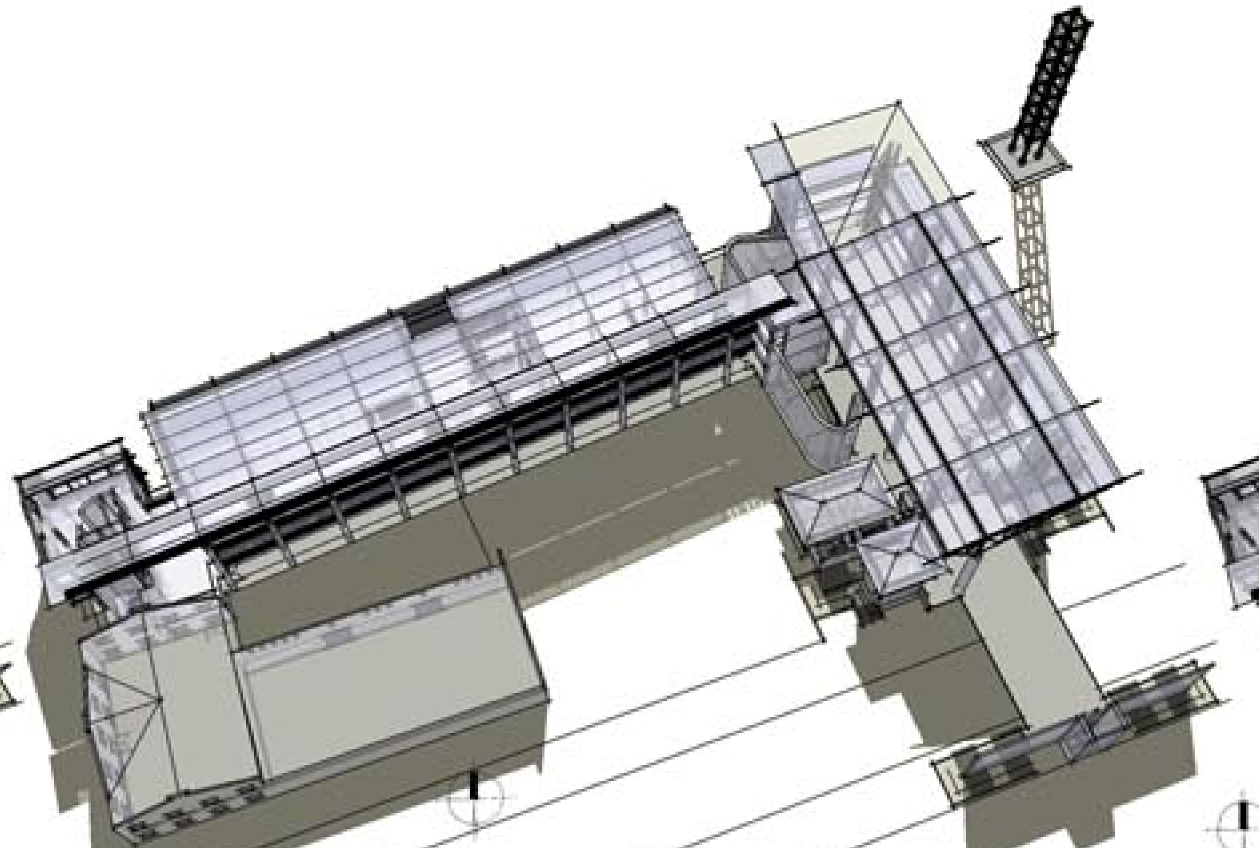
Winter Solstice



9.20



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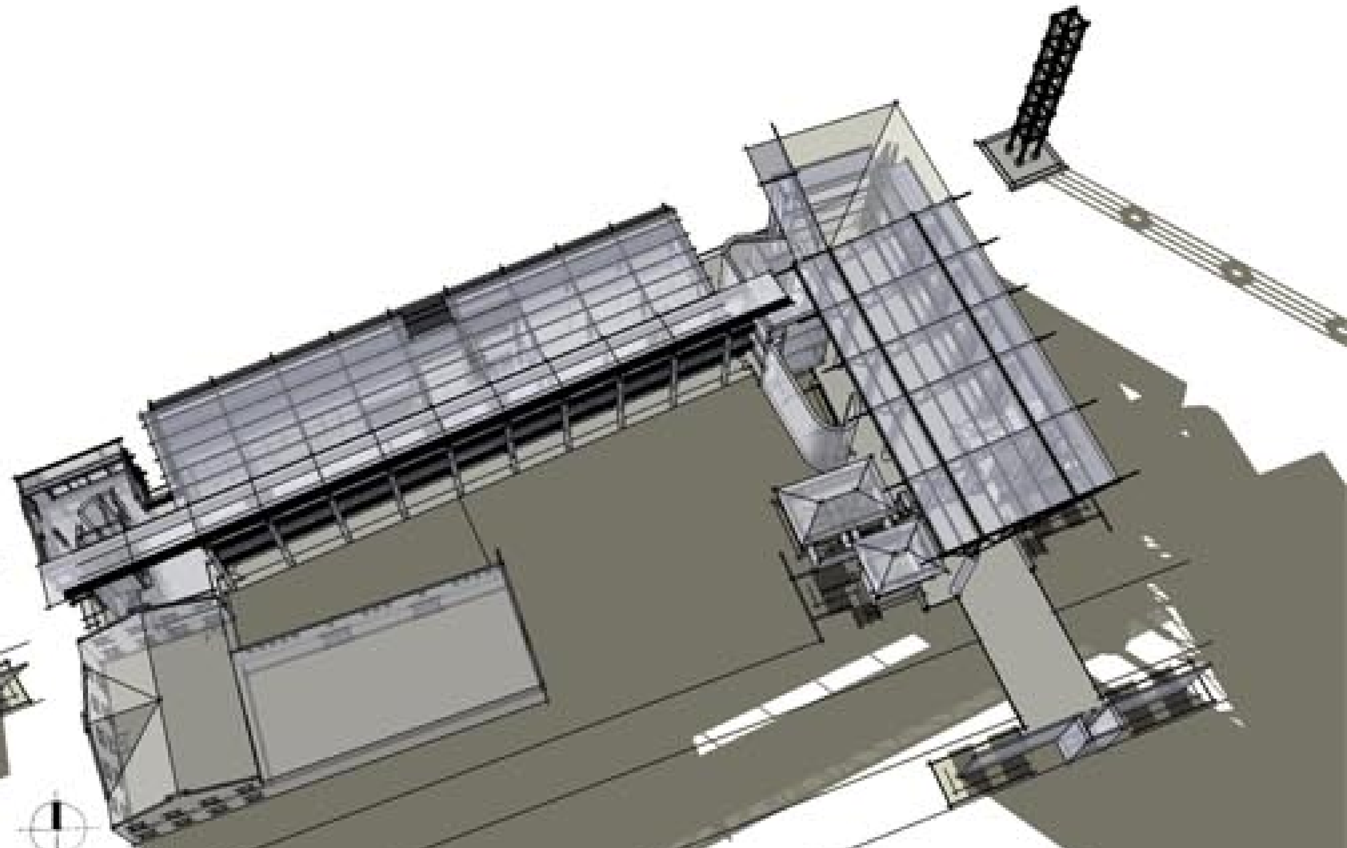


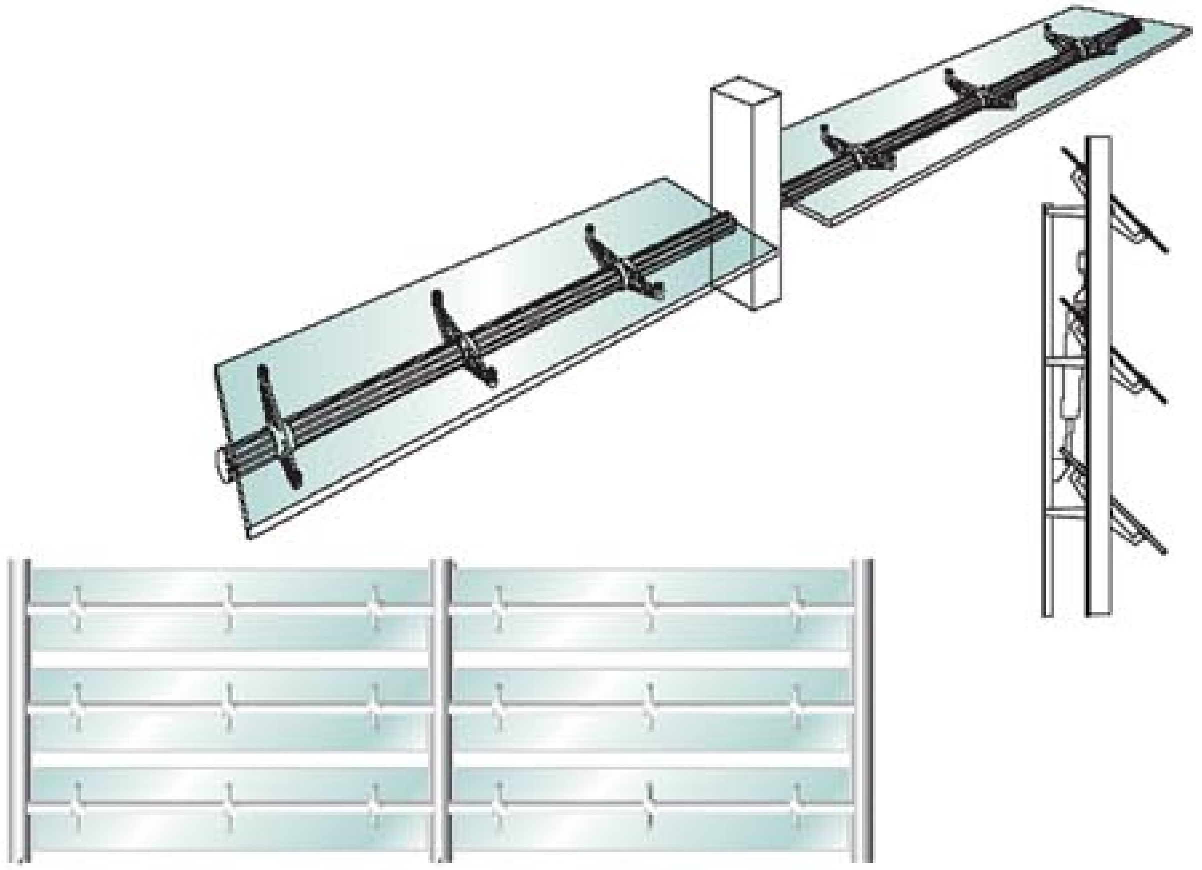
9.22

9.17 08:00 Summer Solstice
9.18 12:00 Summer Solstice
9.19 16:00 Summer Solstice
9.20 08:00 Winter Solstice
9.21 12:00 Winter Solstice
9.22 16:00 Winter Solstice

Solar control

Vertical solar shading on the eastern and western façades of the station concourse is achieved with the use of Colt Shadowglass Glass Solar Shading System. This system provides a "solution to low energy building demands by maximising natural daylight whilst controlling solar heat gain and glare. Shadoglass also affords a view outside, ensuring that occupants remain connected to the external environment" (Colt International 2008:1). Solar control is achieved through the use of a THA-Thermo-Hydraulic control system, which is self-powered by the sun using the heat generated to expand or contract fluid within a tube. This system requires no external power, as absorber tubes that are enclosed by mirrors detect the position of the sun and force a hydraulic cylinder to open or close the louvers. "When absorber tube 1 gets hotter than tube 2, gasses in the centre tube expand which hydraulically control the cylinder rod, the louver will rotate until both tubes are in equal alignment with the sun" (Colt International 2008:15).

9.23



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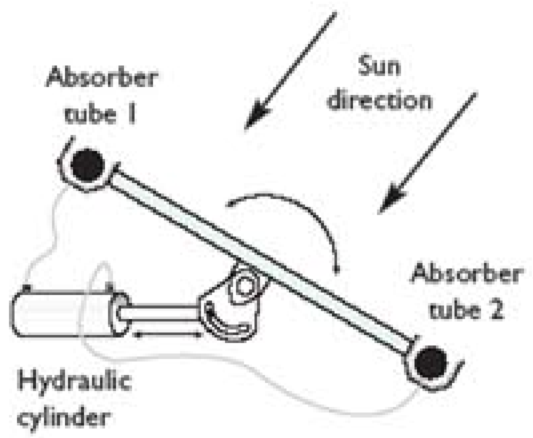

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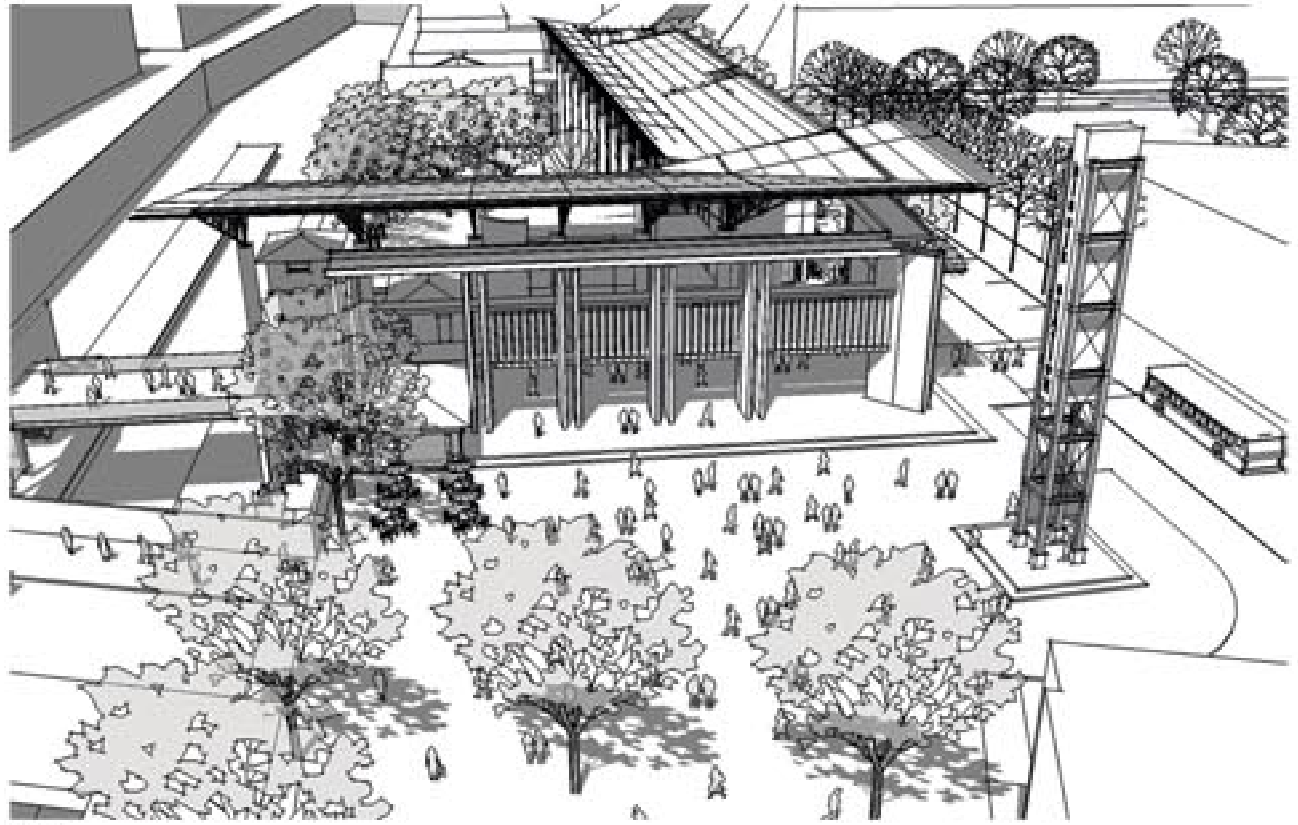

9.27

9.23 Office interior with Colt Shadow Glass louvres (*Source*: Colt International 2008)
9.24 Colt louvre system (*Source*: Colt International 2008)
9.25 Louvres on building exterior (*Source*: Colt International 2008)
9.26 Solar control mechanics (*Source*: Colt International 2008)
9.27 Louvre system on easter facade

Cooling system

Passive Chilled Beams

Chilled Beams are a cooling system that offers an alternative to conventional mechanical ventilation systems. It was first introduced in 1962 and has been extensively use in both the UK and Australia over the past 15 years (Frenger Systems 2008).

Passive Chilled Beams use potable water as a heat transfer medium. The water is circulated through copper cooling pipes bonded in aluminium heat transfer fins, which enables the cooling of a large area through both natural convection and radiation (Frenger Systems 2008). As warm air rise, it is drawn to the chilled beam and cooled before returning downwards. This results in the system being quiet and draft free. The system can be fully integrated with a normal suspended ceiling, but will require perforated ceiling tiles immediately surrounding it to work effectively.

Multiservice Chilled Beam Systems (MSCB) offer the opportunity for even further incorporation of services such as cooling, uplighting and downlighting, condensation sensors and integrated control valves, fire alarms and sprinkler systems, as well as pipework, ducting and power or compartmental trunking. Passive Chilled Beams provide up to 400 W/m (up to 150 W/m2) of cooling (Frenger Systems 2008).

The system requires low maintenance as it has no moving parts. The use of copper and aluminium means that the system is both durable and recyclable. In addition, the system has a life cycle guarantee of up to 25 years (Frenger Systems 2008).

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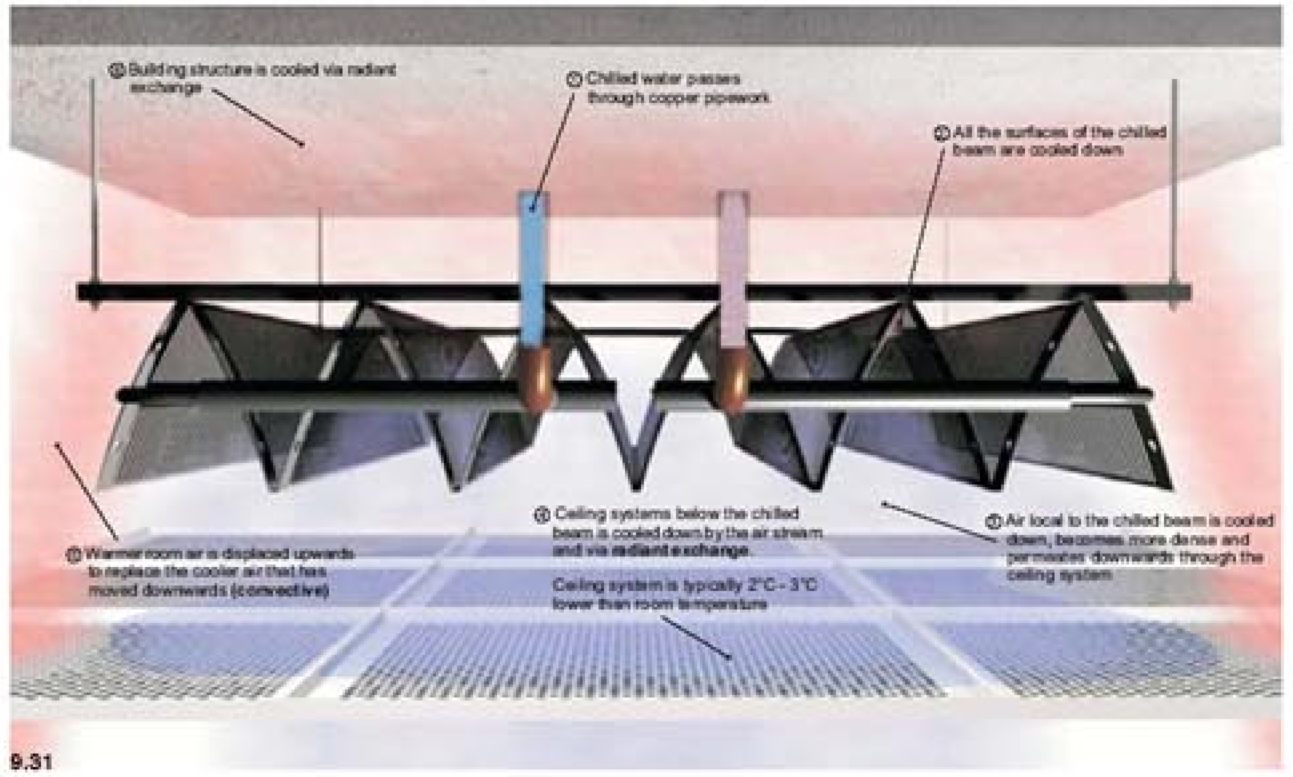

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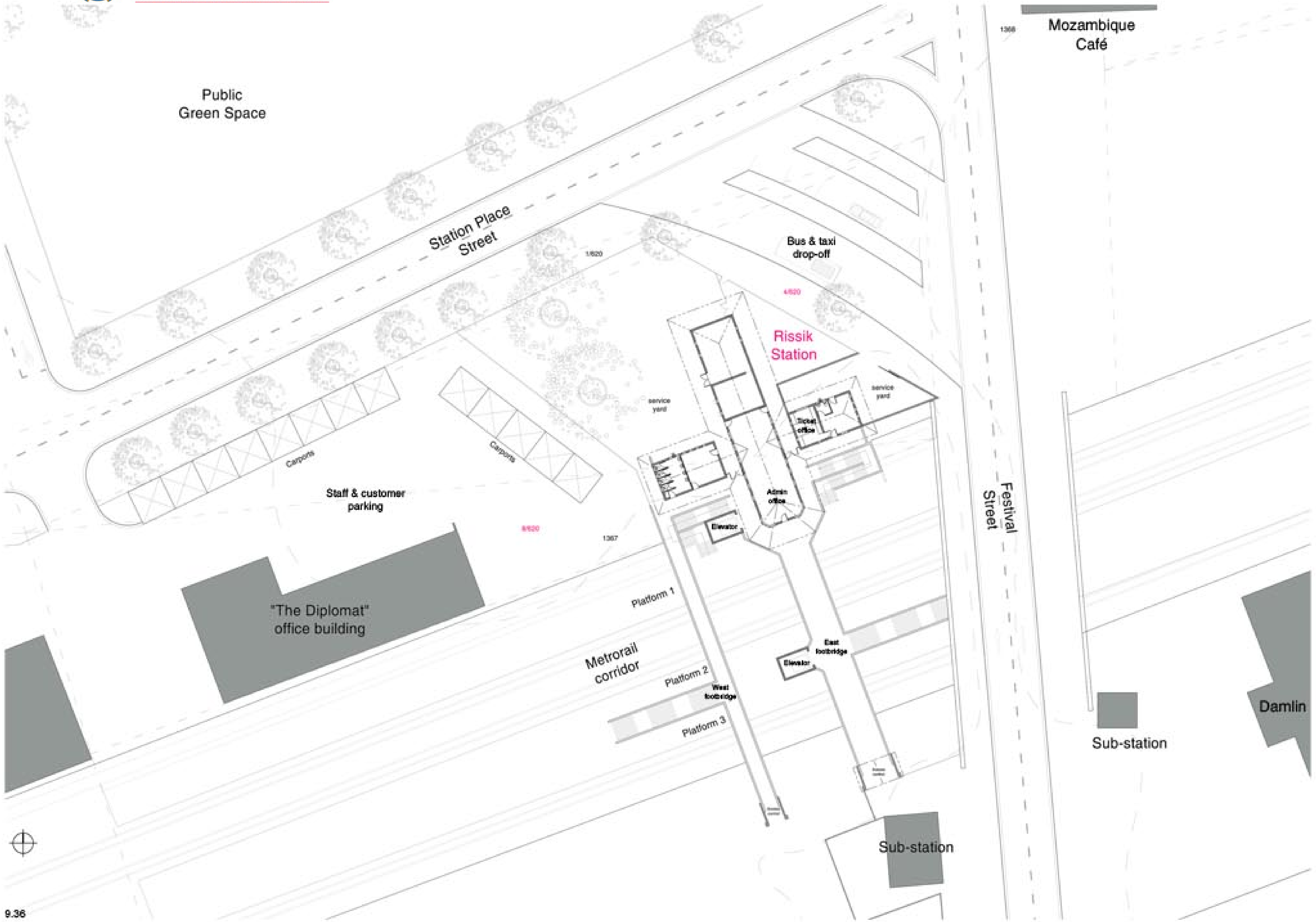
9.28 Frenger's Carat chilled beam (Frenger Systems 2006)
9.29 Hanging Carat with adjustable suspension wire (Frenger Systems 2006)
9.30 Multiservice Chilled Beam Systems (MSCB) (Frenger Systems 2006)
9.31 Cooling principle (Frenger Systems 2006)
9.32 Water point connection and flow control mechanism (Frenger Systems 2006)
9.33 Chilled beam orientation (Frenger Systems 2006)
9.34 MSCB in office setting (Frenger Systems 2006)
9.35 Installation (Frenger Systems 2006)

Drawings
Existing site plan



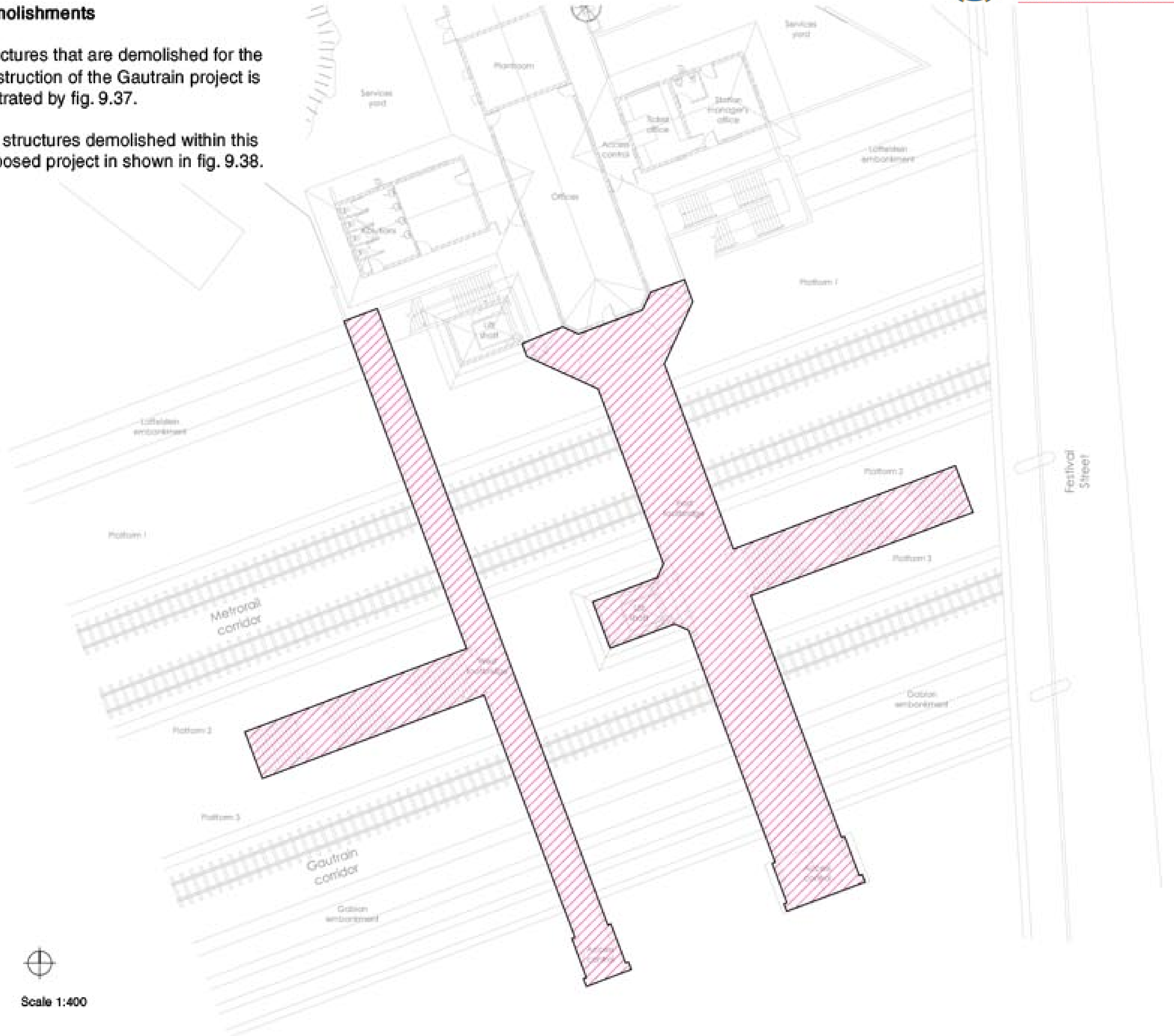
9.36 Existing site plan

9.36

Demolishments

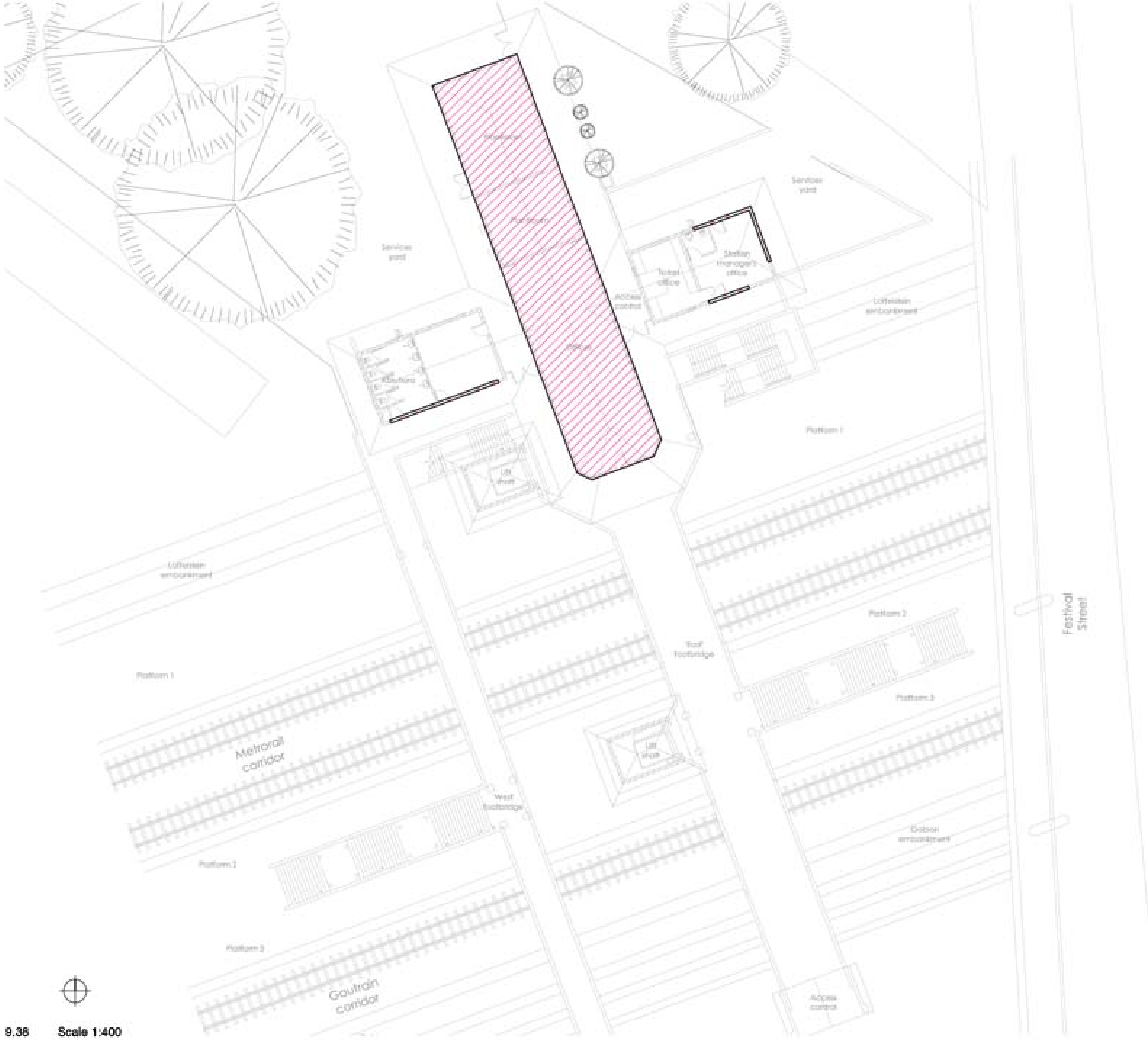
Structures that are demolished for the construction of the Gautrain project is illustrated by fig. 9.37.

The structures demolished within this proposed project in shown in fig. 9.38.



9.37 Scale 1:400

9.37 Structures demolished by the Gautrain project
9.38 Demolishment by this proposed project



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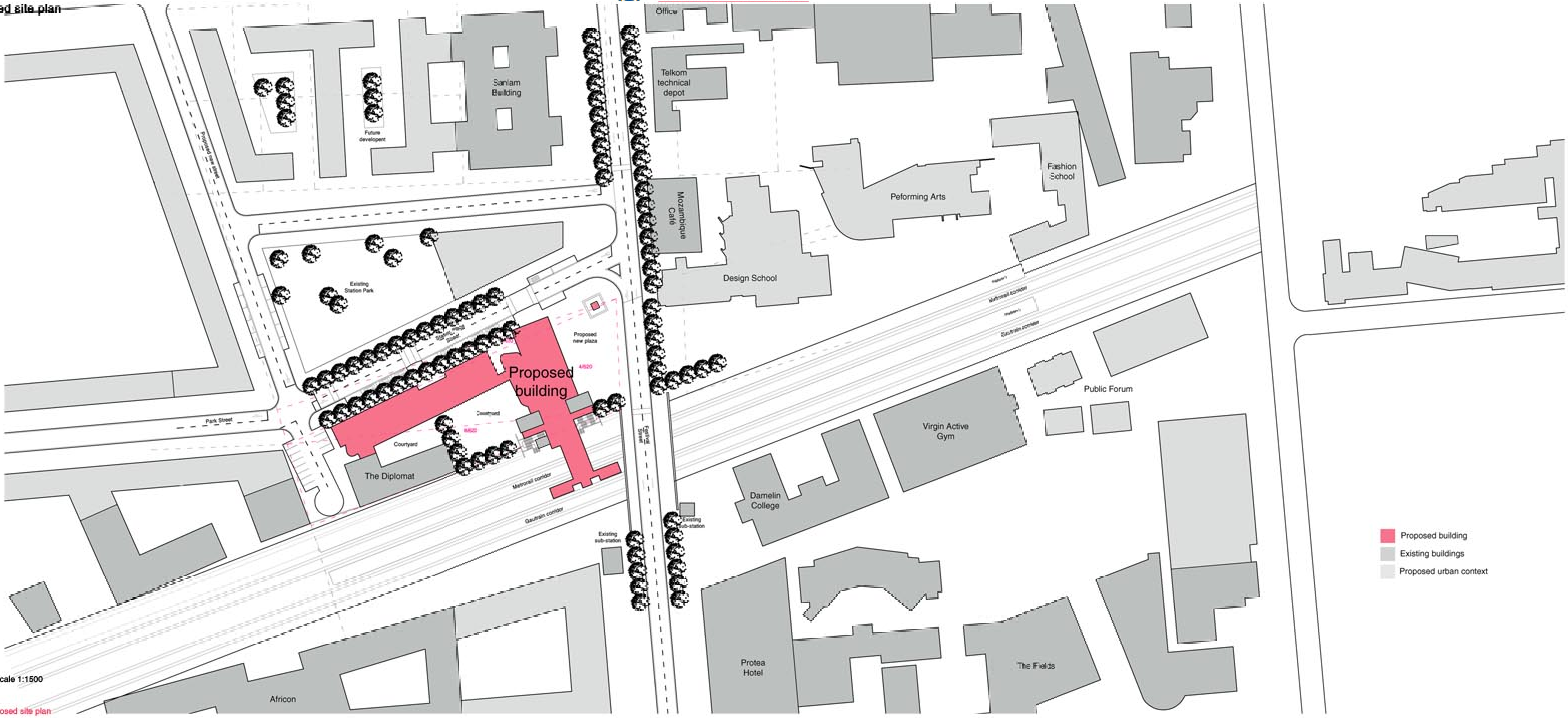
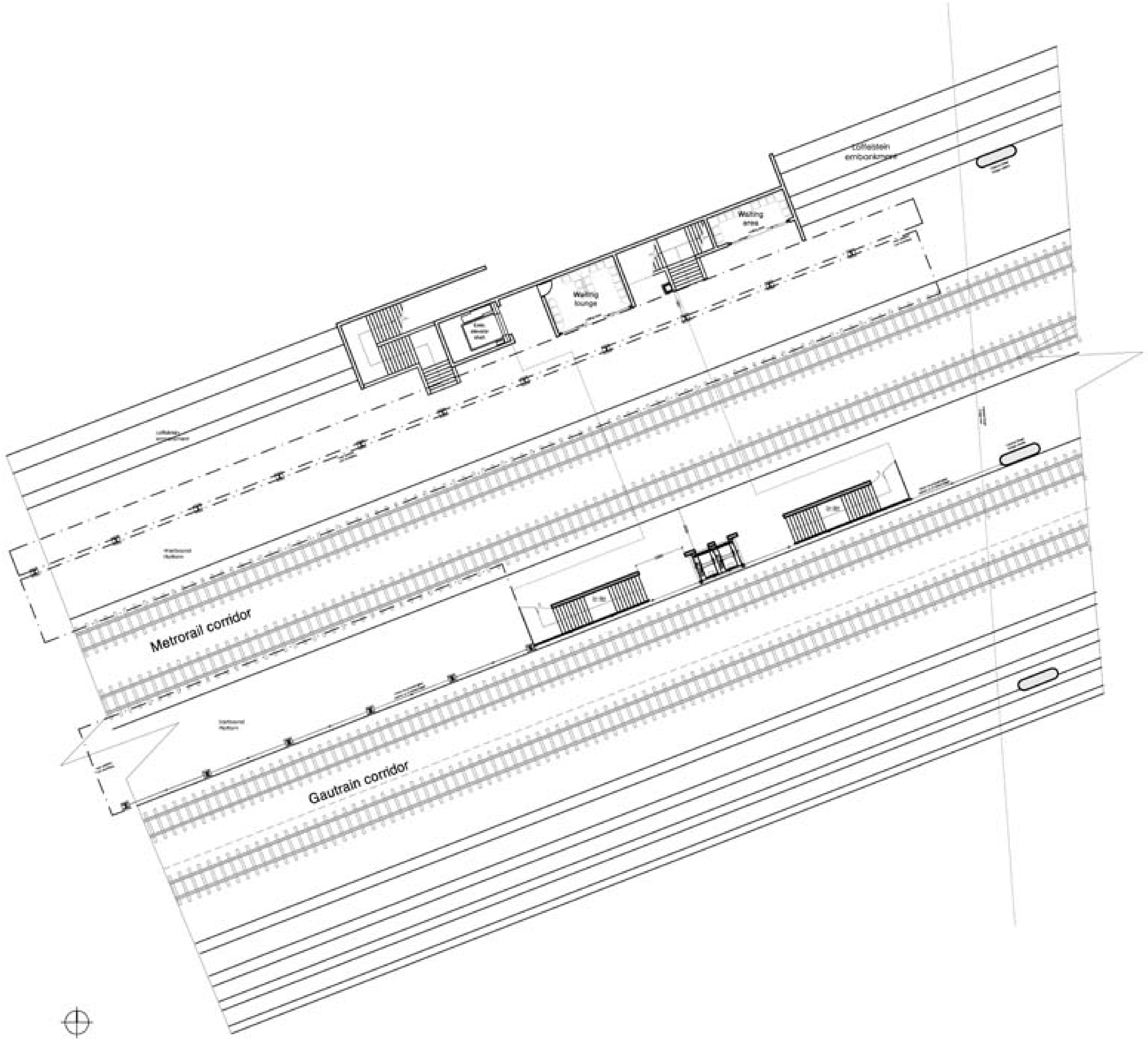
Proposed site plan



9.39 Scale 1:1500

9.39 Proposed site plan

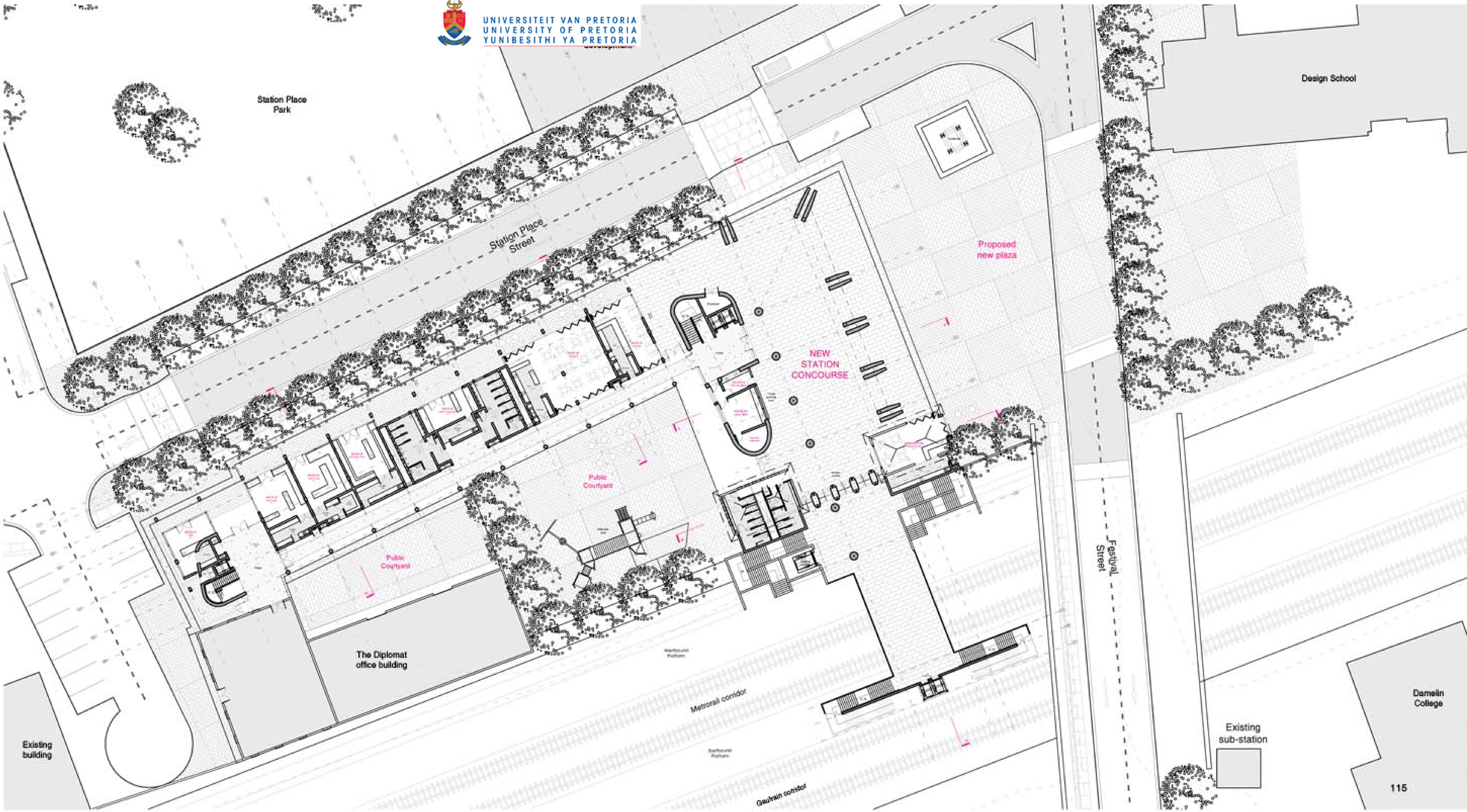
Platform level plan



9.40 Scale 1:400

9.40 Platform level plan

Ground floor plan



9.41 Scale 1:500

9.41 Ground floor plan

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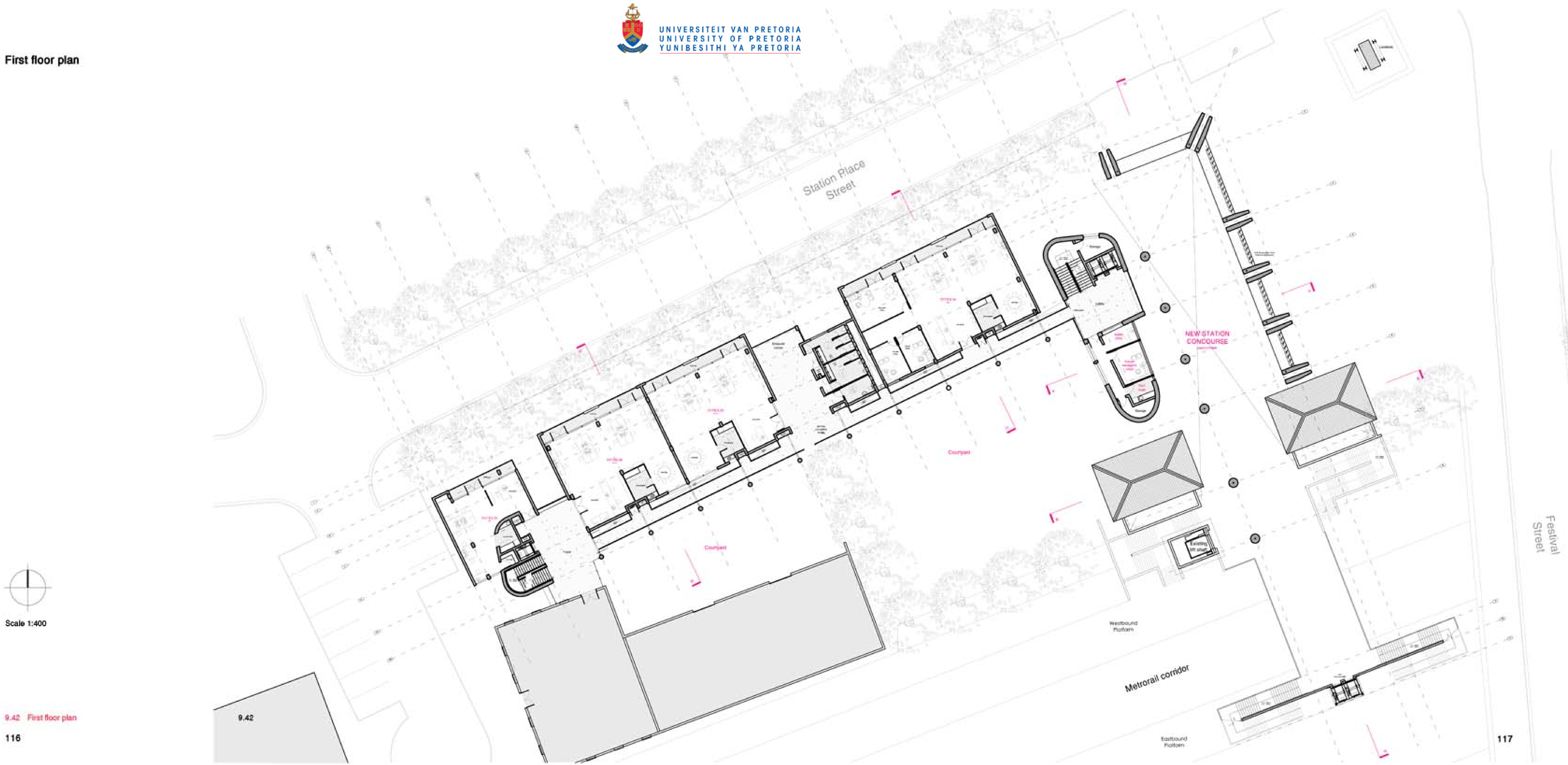
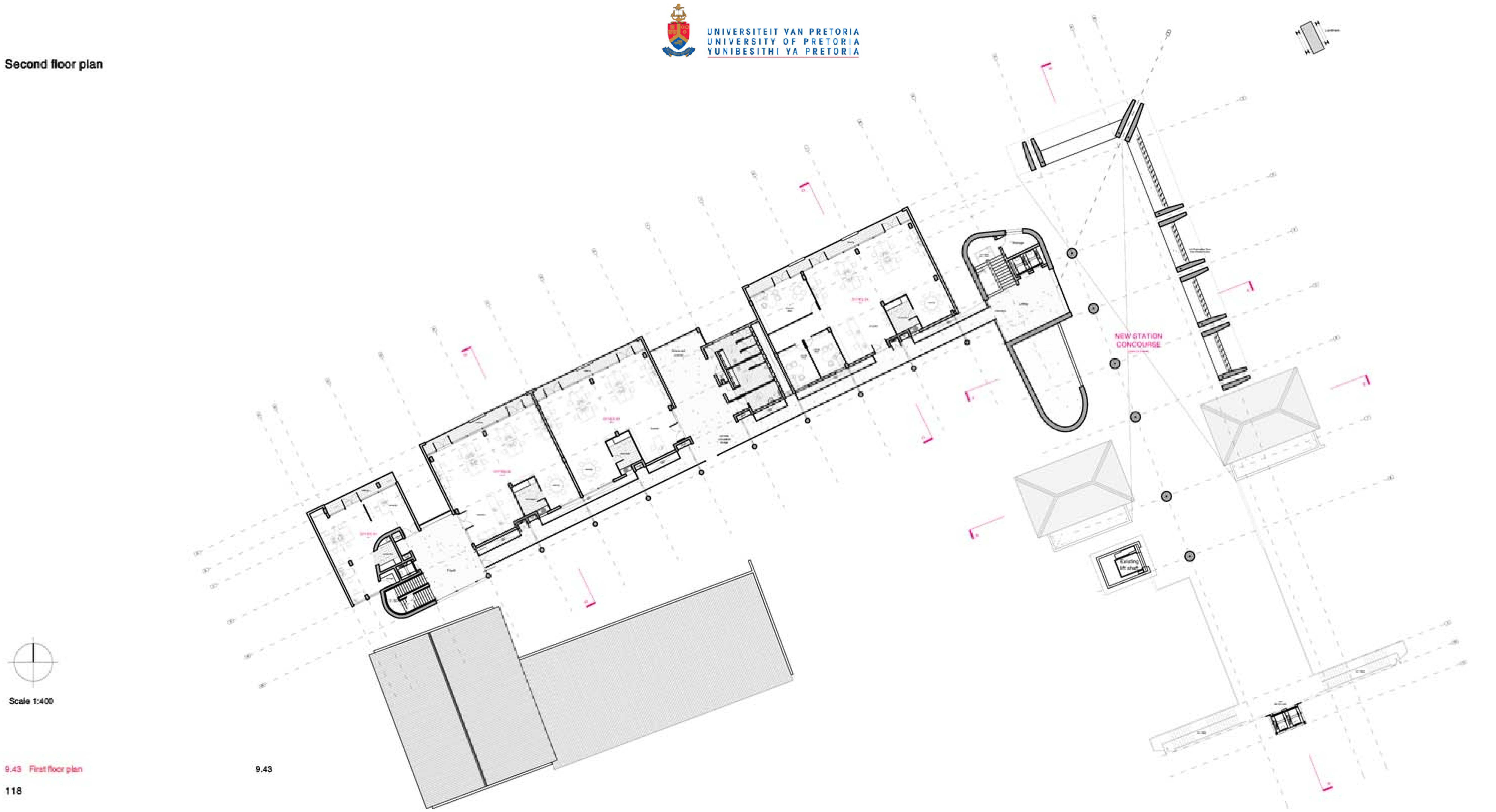
First floor plan



9.42 First floor plan

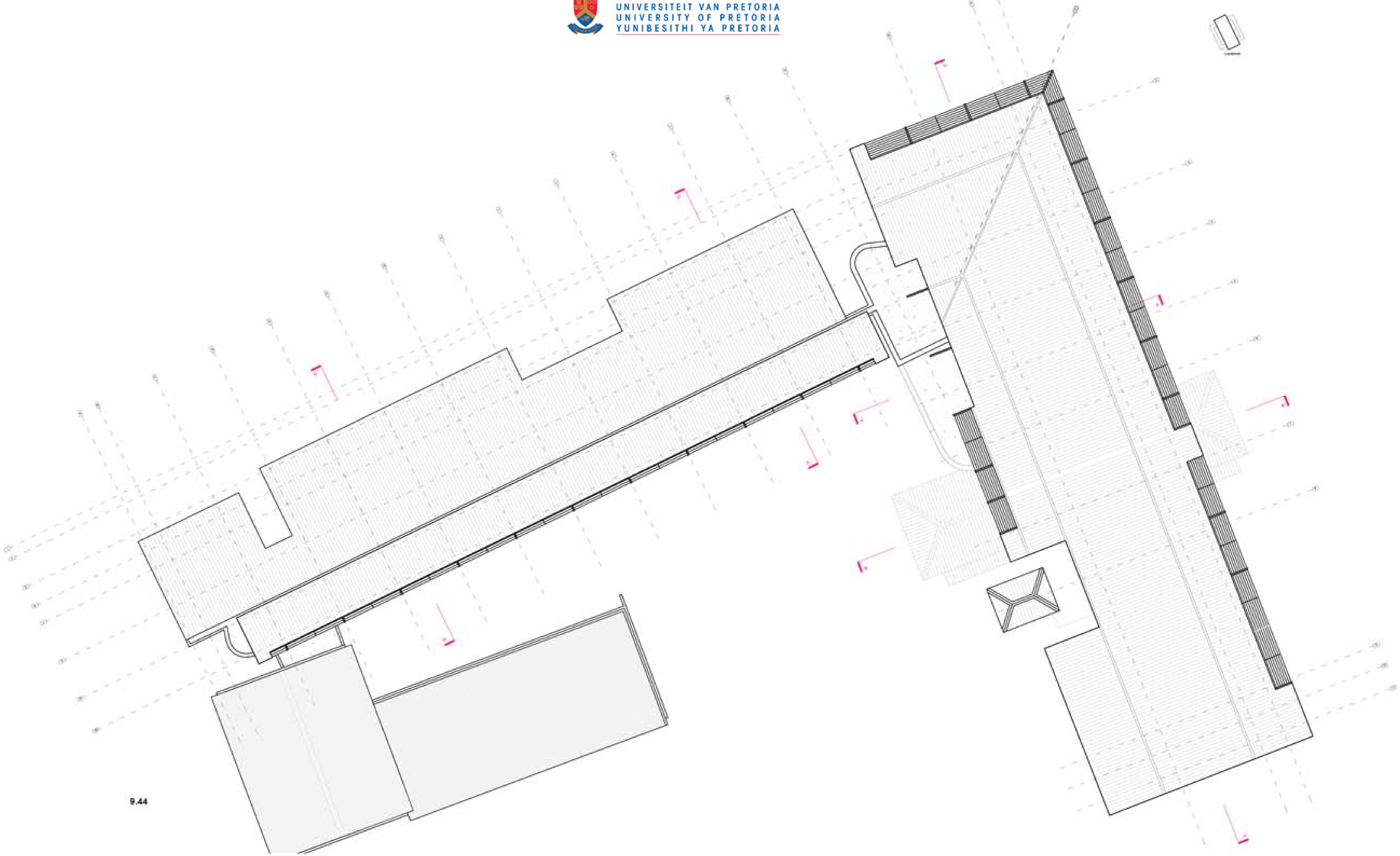
Second floor plan



9.43 First floor plan

9.43

Roof plan



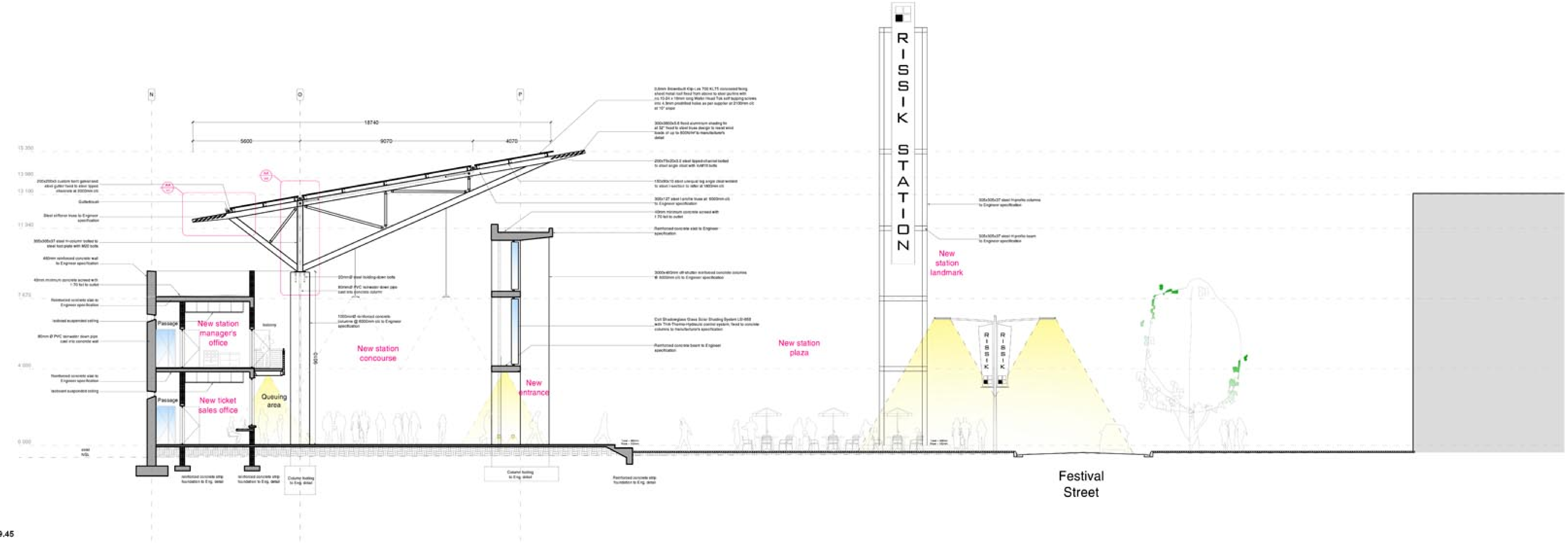
Scale 1:400

9.44 Roof plan

9.44

Section AA

Scale 1:200

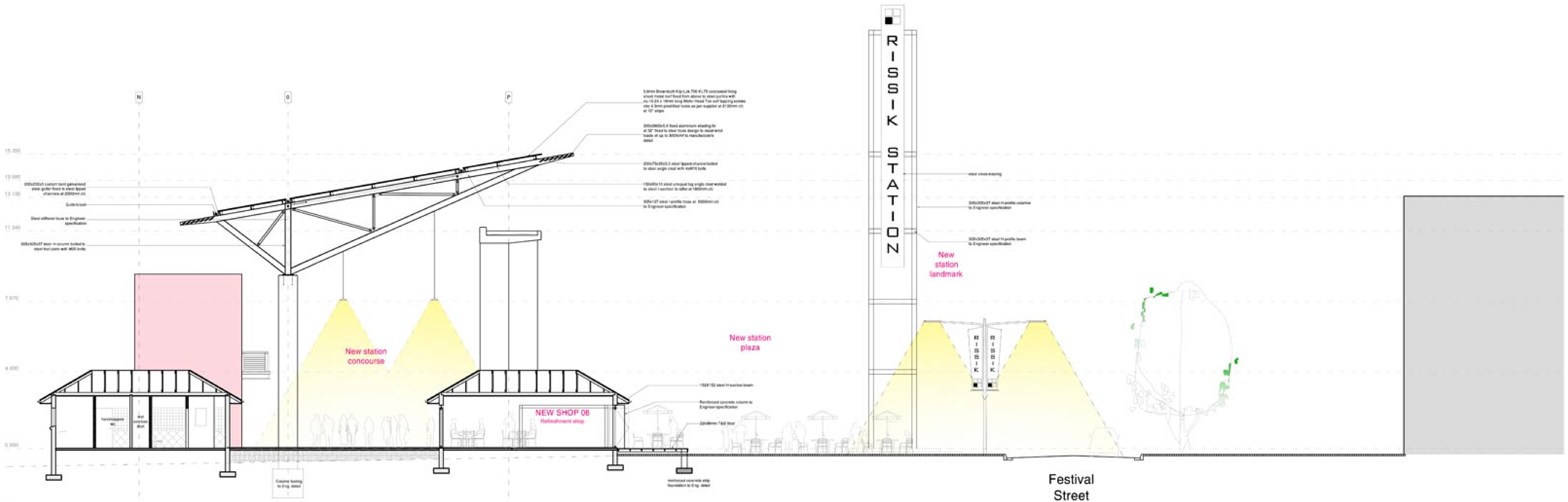


9.45

9.45 Section AA

Section BB

Scale 1:200

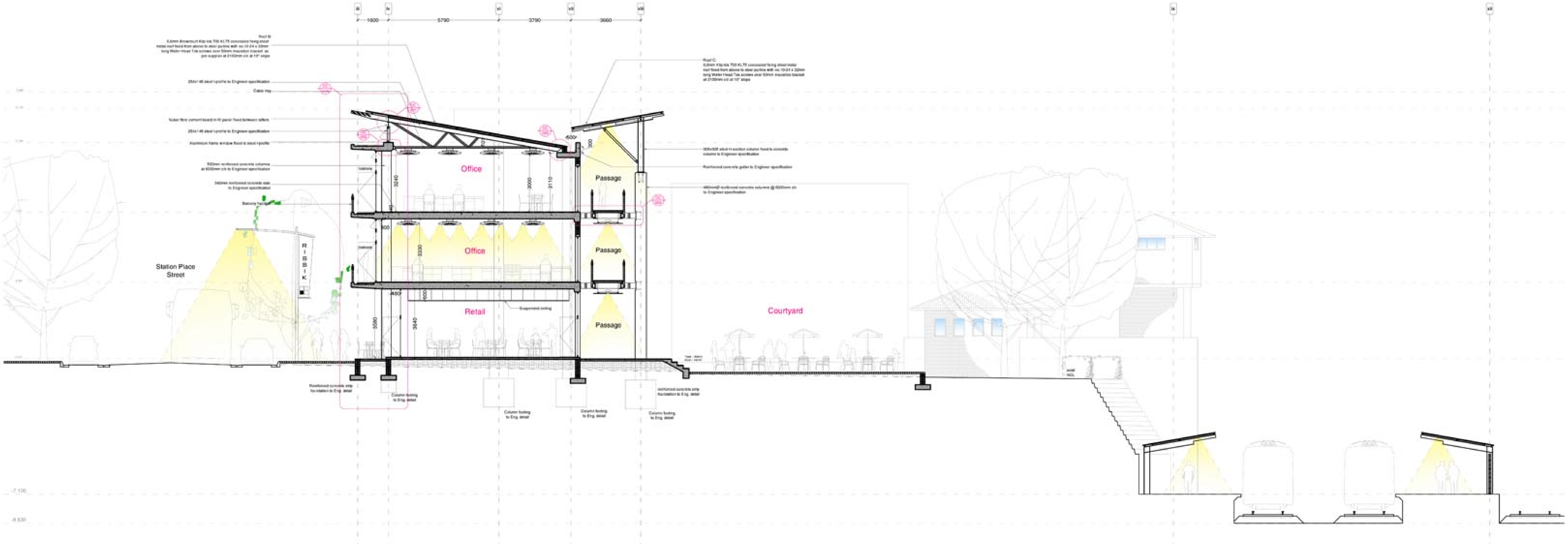


9.46

9.46 Section BB

Section CC

Scale 1:200



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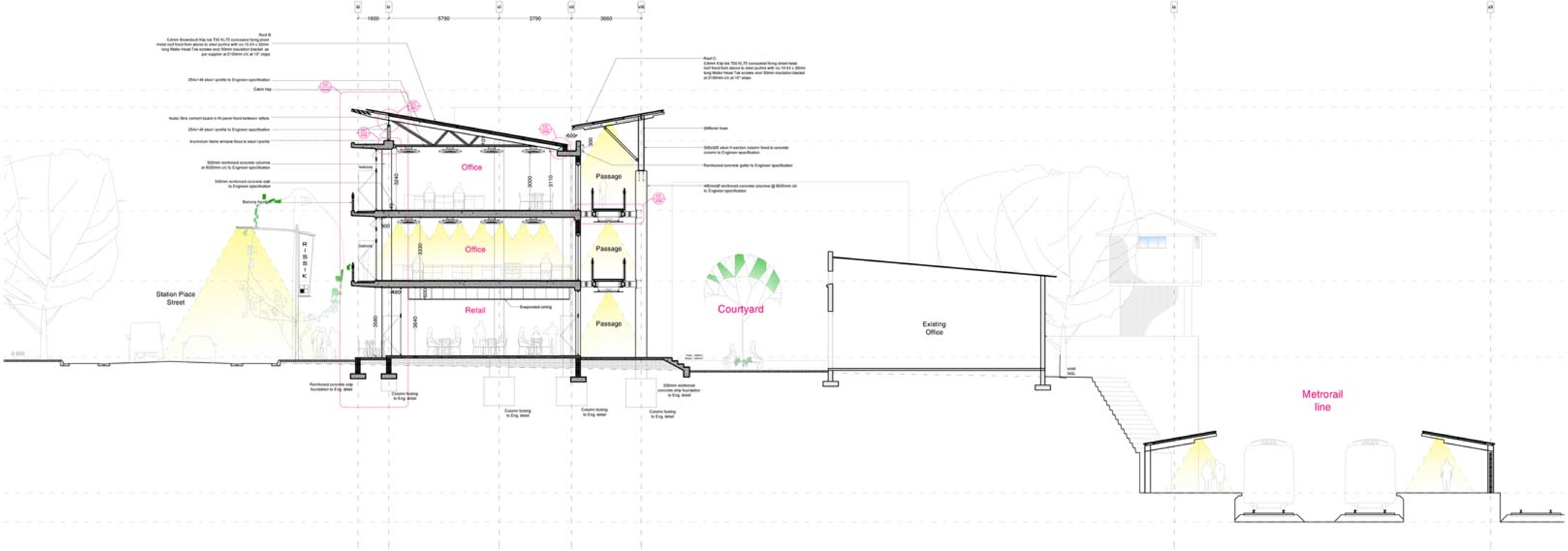
9.47 Section CC

Section DD

Scale 1:200



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9.48 Section DD

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Section EE

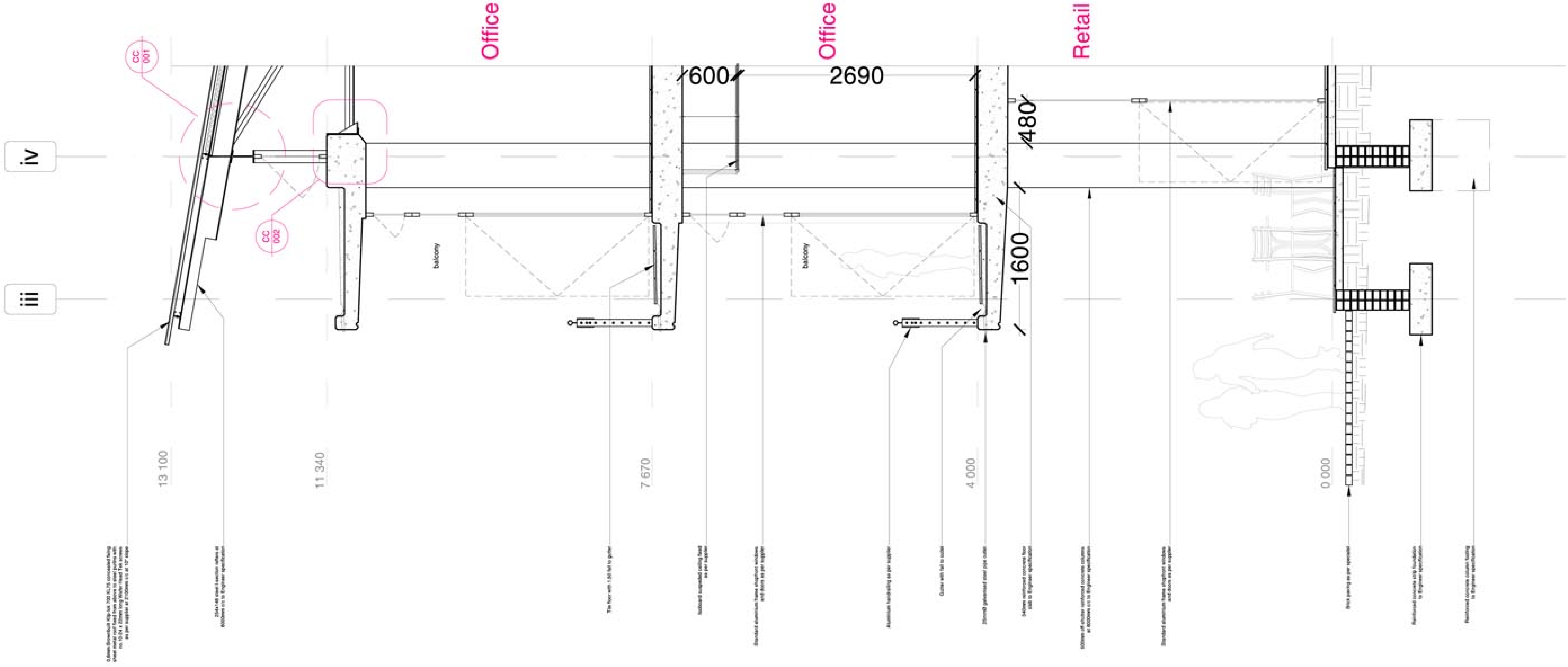
Scale 1:300

9.49

9.49 Section EE

Northern facade detail

Scale 1:50



9.50

9.50 Northern facade detail

Details

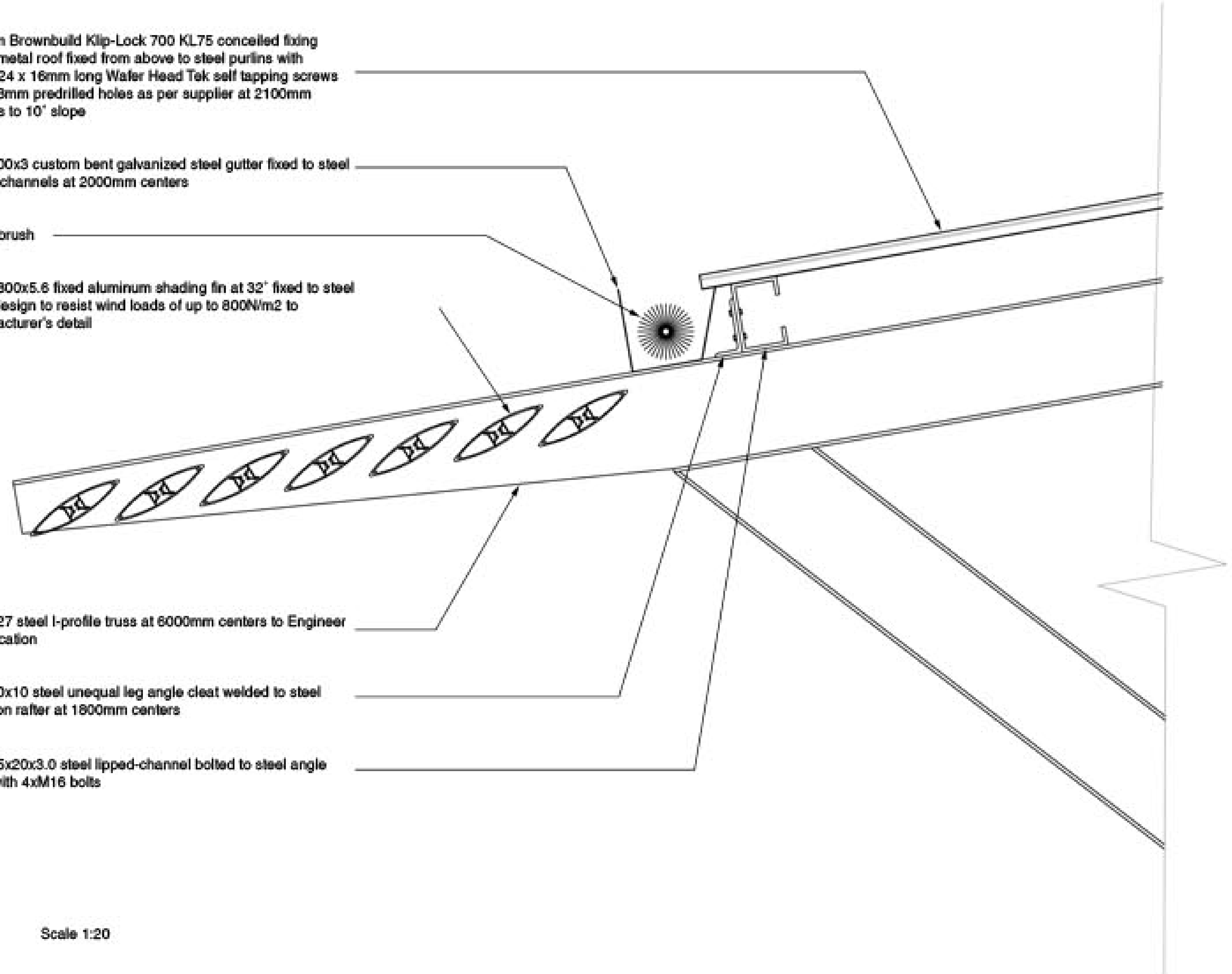
Station concourse roof

0.6 mm Brownbuild Klip-Lock 700 KL75 concealed fixing sheet metal roof fixed from above to steel purlins with no.10-24 x 16mm long Wafer Head Tek self tapping screws into 4.3mm predrilled holes as per supplier at 2100mm centers to 10˚ slope

200x200x3 custom bent galvanized steel gutter fixed to steel lipped channels at 2000mm centers

Gutterbrush

300x3800x5.6 fixed aluminum shading fin at 32˚ fixed to steel truss design to resist wind loads of up to 800N/m2 to manufacturer's detail



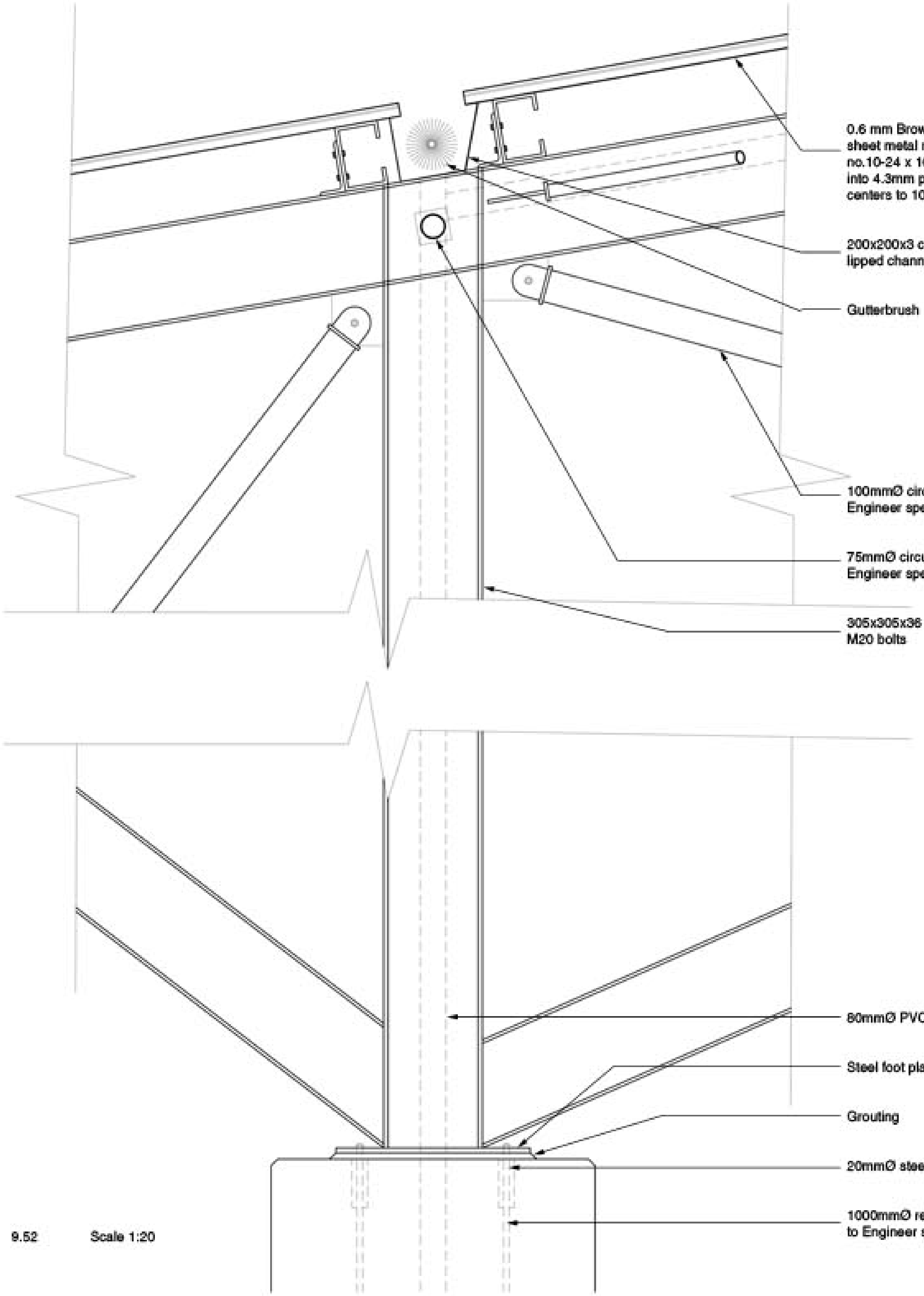
305x127 steel I-profile truss at 6000mm centers to Engineer specification

150x90x10 steel unequal leg angle cleat welded to steel I-section rafter at 1800mm centers

200x75x20x3.0 steel lipped-channel bolted to steel angle cleat with 4xM16 bolts

9.51 Scale 1:20

9.51 Station roof edge detail
9.52 Station roof gutter & column connection



0.6 mm Brownbuild Klip-Lock 700 KL75 concealed fixing sheet metal roof fixed from above to steel purlins with no.10-24 x 16mm long Wafer Head Tek self tapping screws into 4.3mm predrilled holes as per supplier at 2100mm centers to 10˚ slope

200x200x3 custom bent galvanized steel gutter fixed to steel lipped channels at 2000mm centers

Gutterbrush

100mmØ circular hollow section welded to steel flat bar to Engineer specification

75mmØ circular hollow section welded to steel flat bar to Engineer specification

305x305x36 steel H-column bolted to steel foot plate with M20 bolts

80mmØ PVC rainwater down pipe cast into concrete column

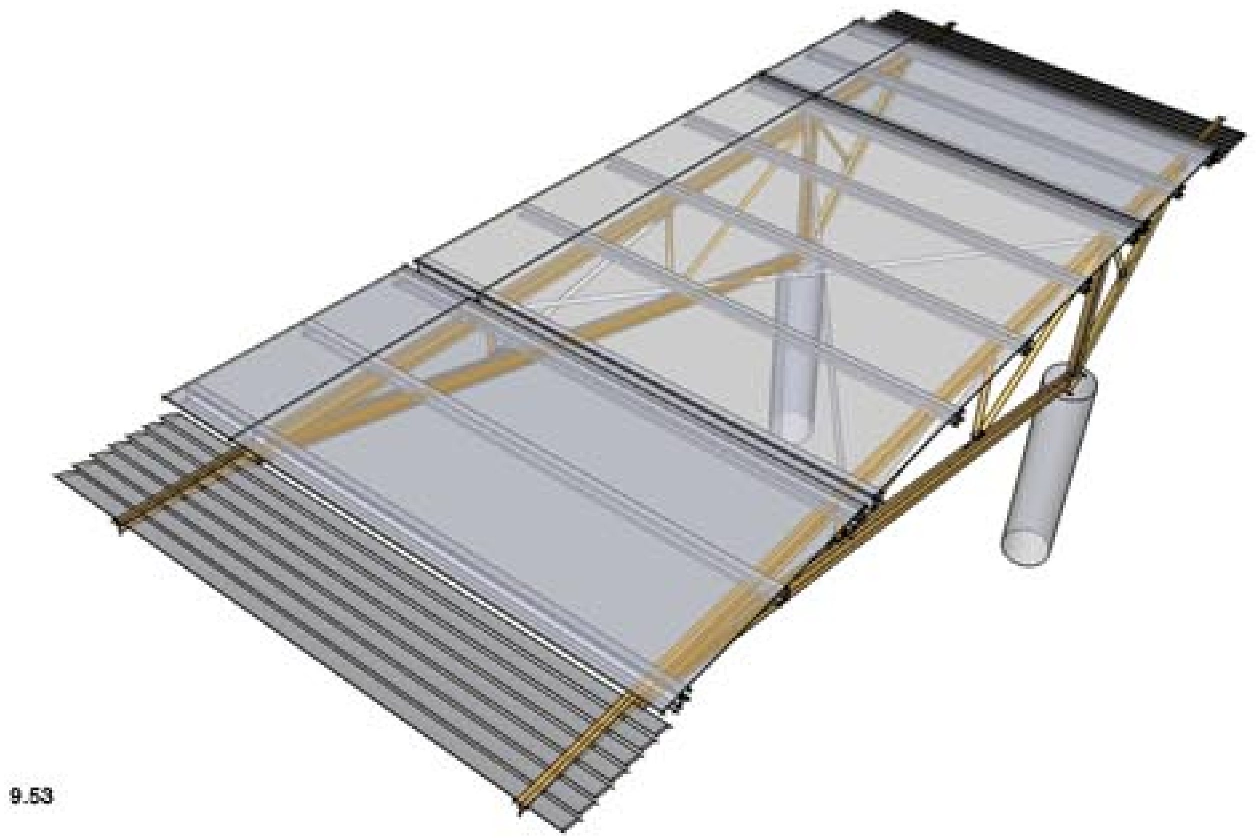
Steel foot plate

Grouting

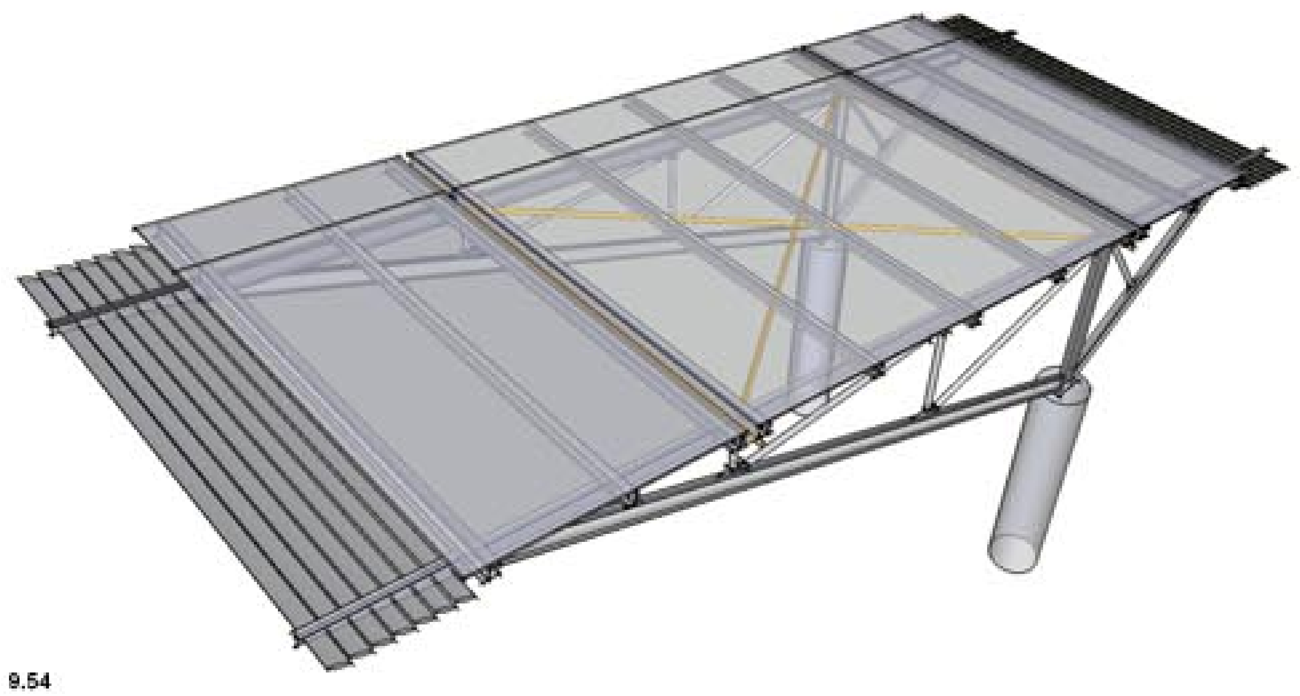
20mmØ steel holding-down bolts cast into concrete column

1000mmØ reinforced concrete columns at 6000mm centers to Engineer specification

9.52 Scale 1:20



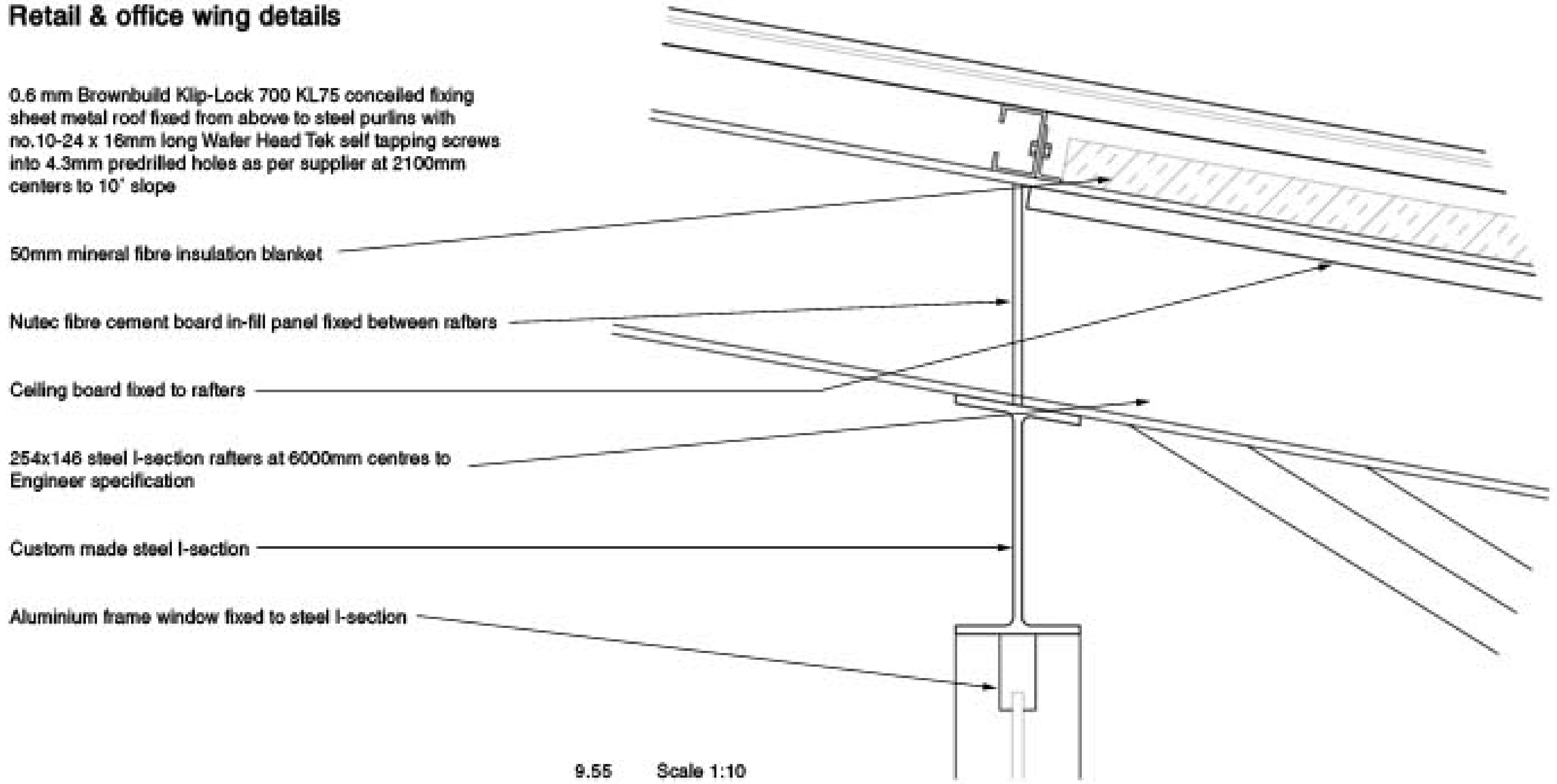
9.53



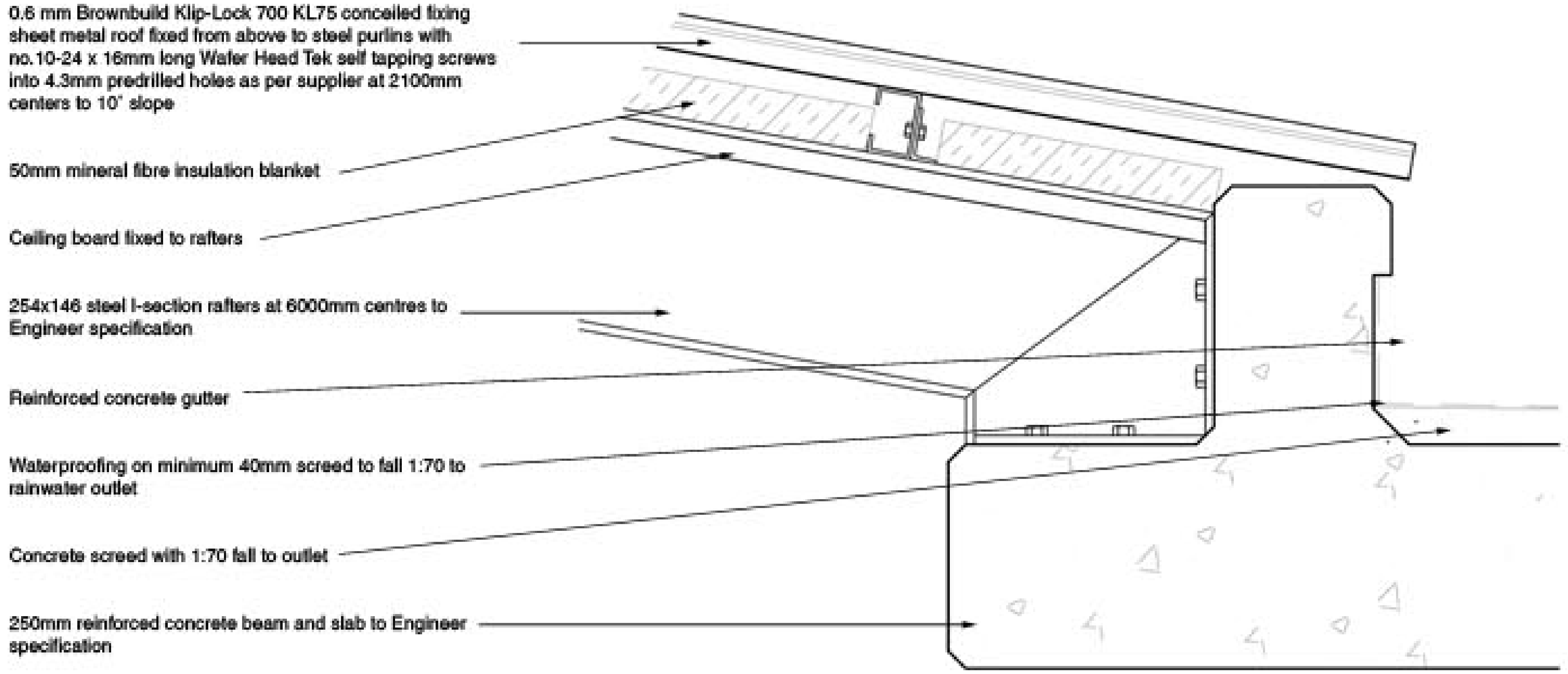
9.54

9.53 Station roof main truss
9.54 Station roof stiffeners
9.55 Roof detail on north façade
9.56 Roof fixing on south façade

Retail & office wing details

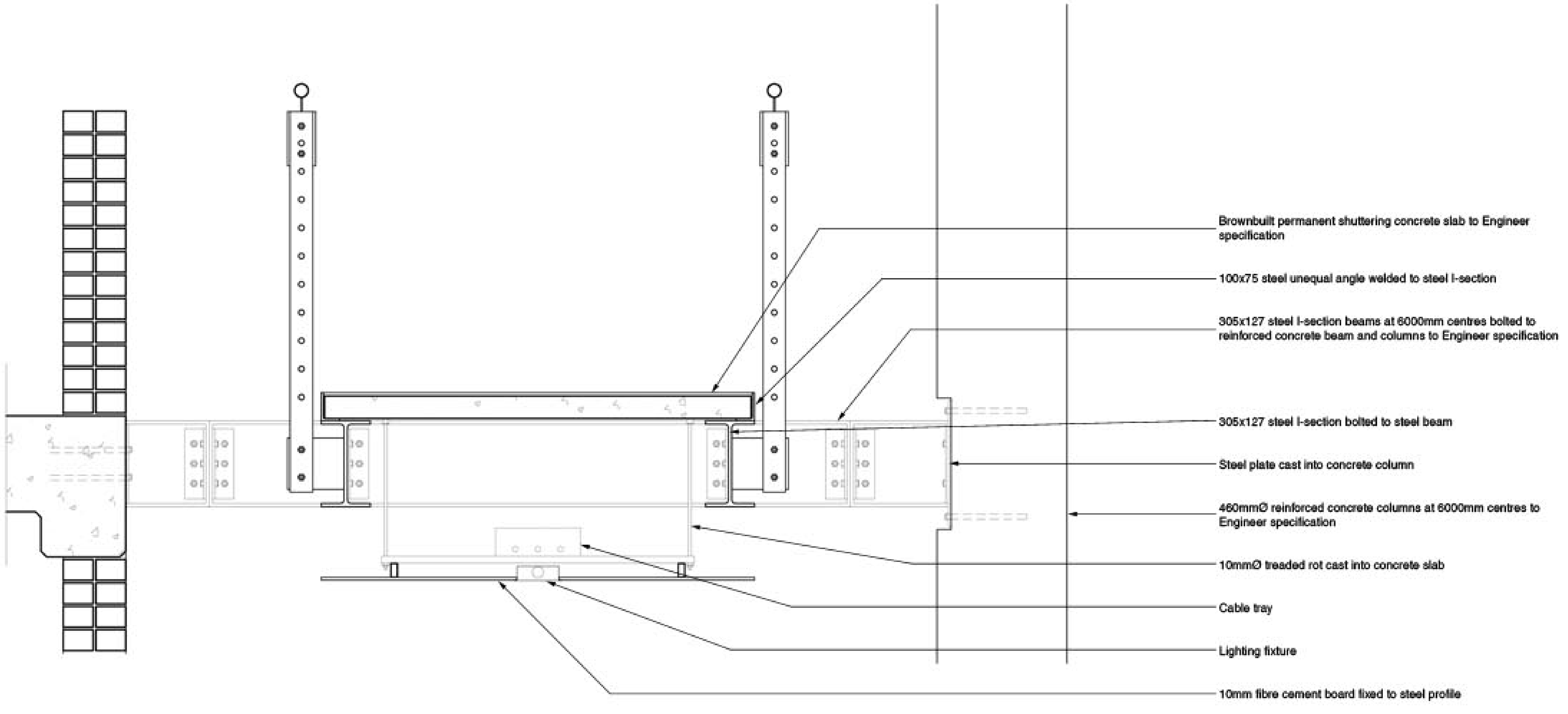


9.55 Scale 1:10

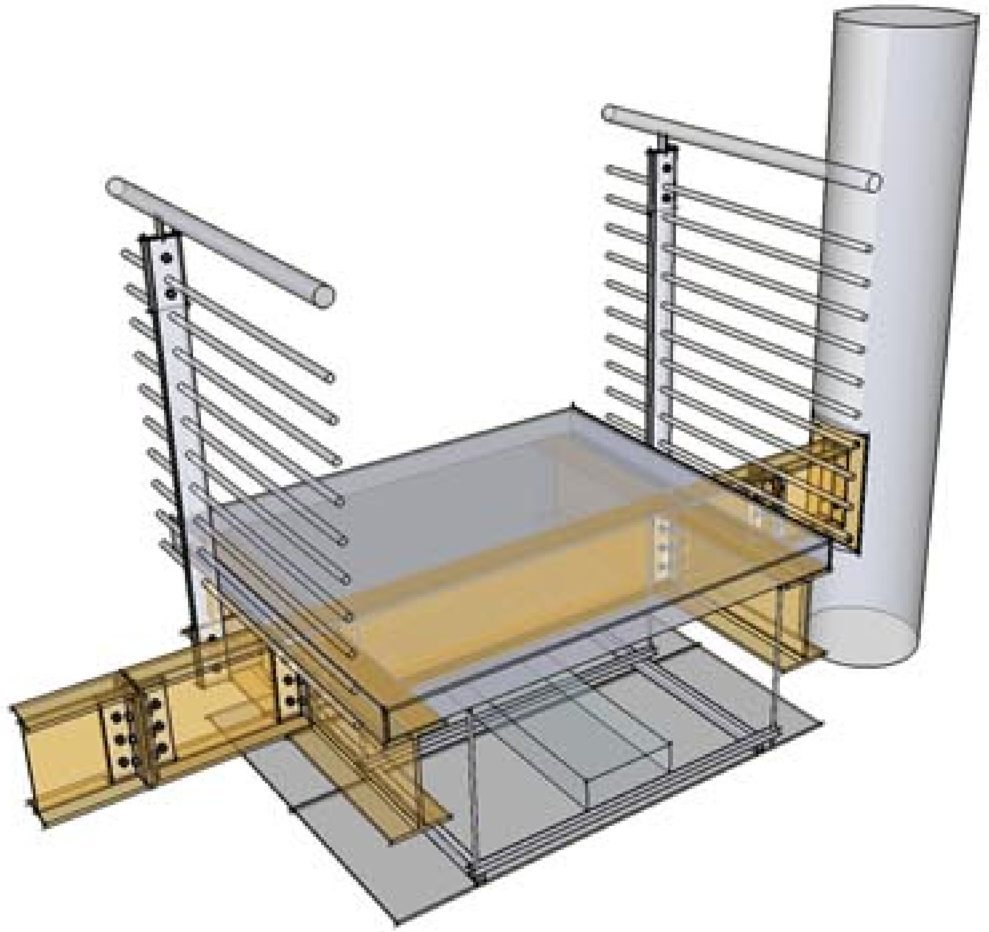


9.56 Scale 1:10

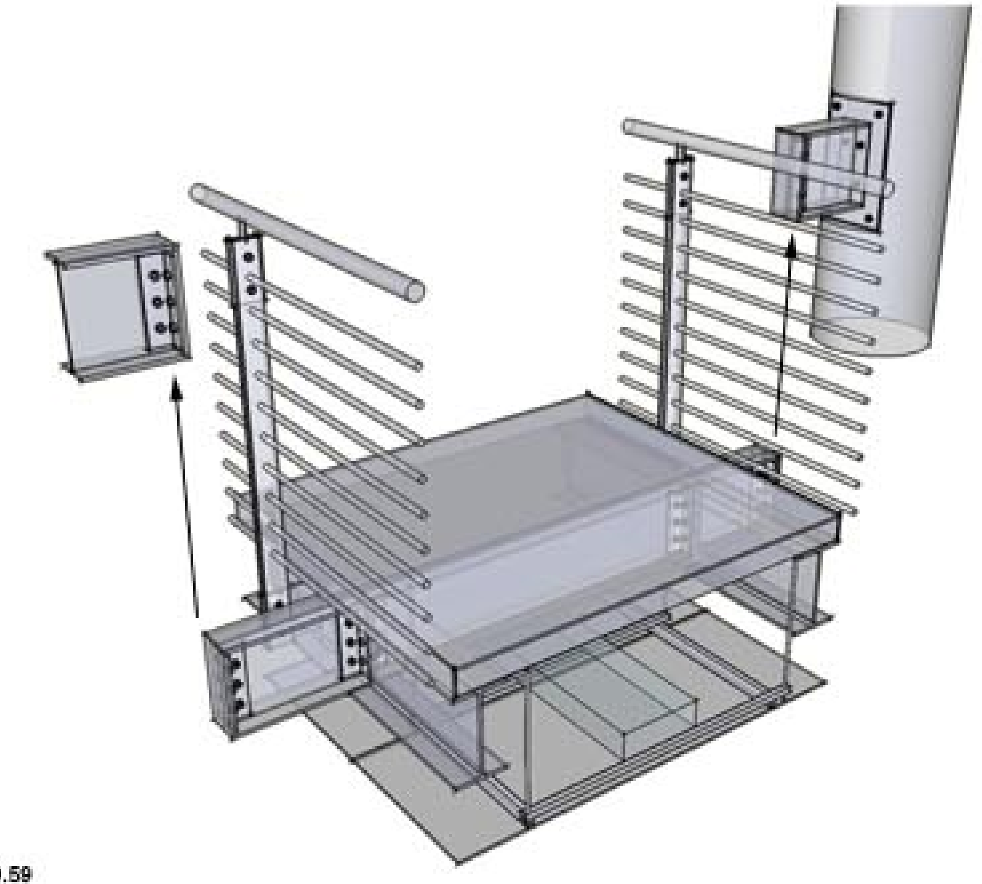
Circulation bridge detail



9.57 Scale 1:20



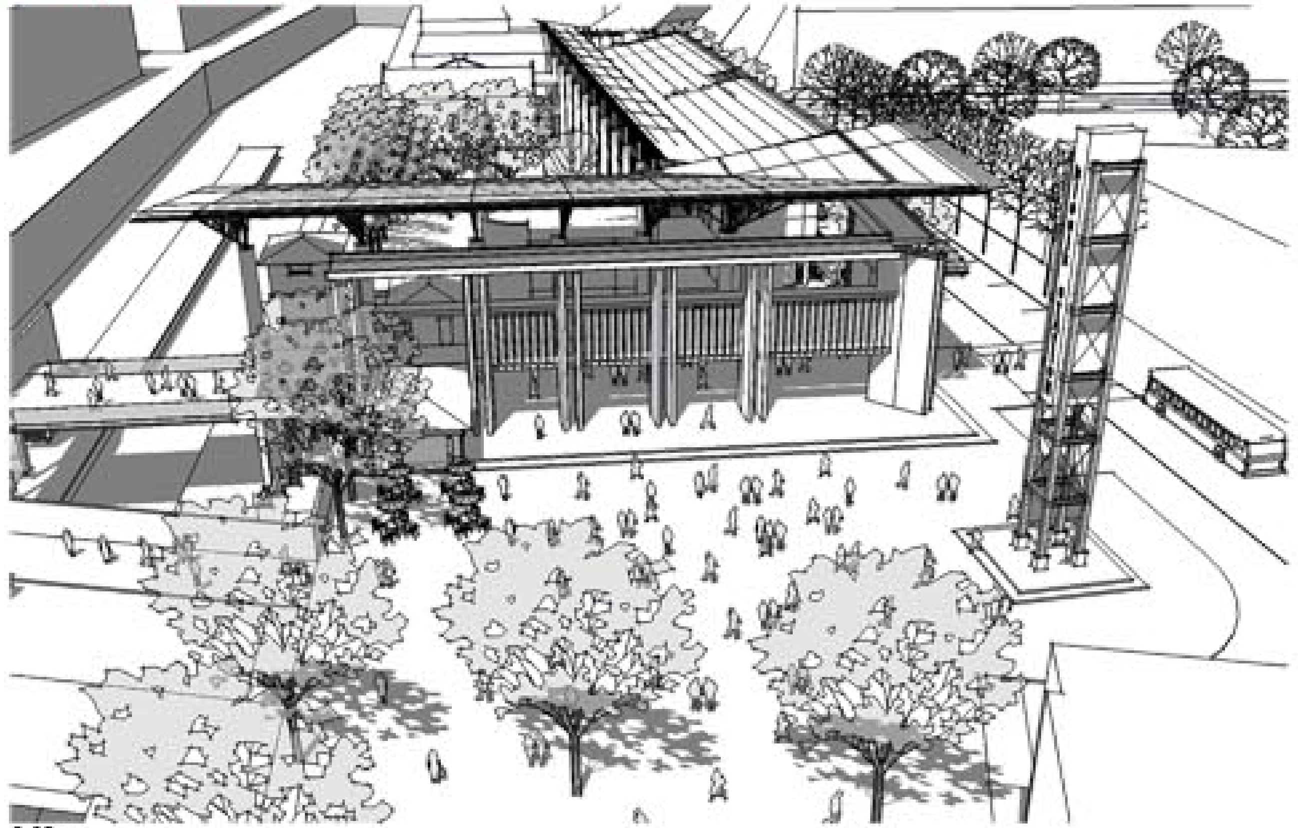
9.58



9.59

9.57 Circulation bridge detail
9.58 3D exploration
9.59 Assembly

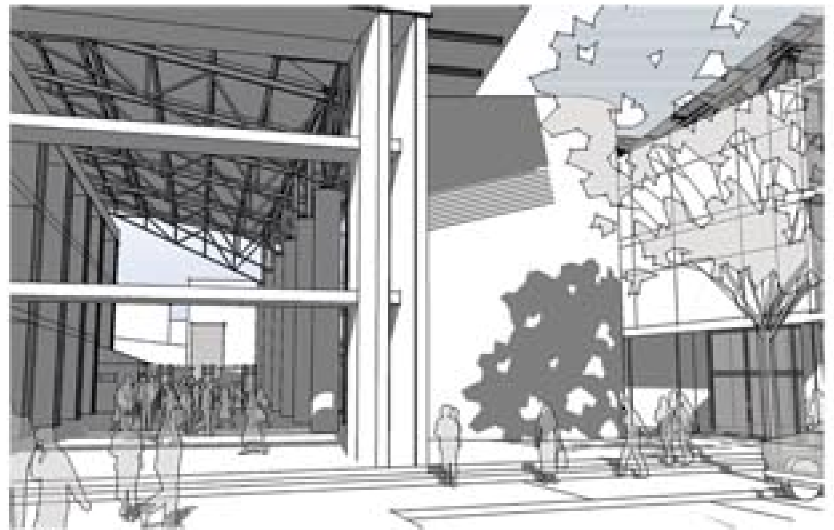
Perspectives


9.60

9.60 View from the proposed plaza
9.61 View of plaza & station
9.62 Station concourse
9.63 Looking east from Park Street
9.64 View along Station Place Street
9.65 Internal courtyard


9.63


9.61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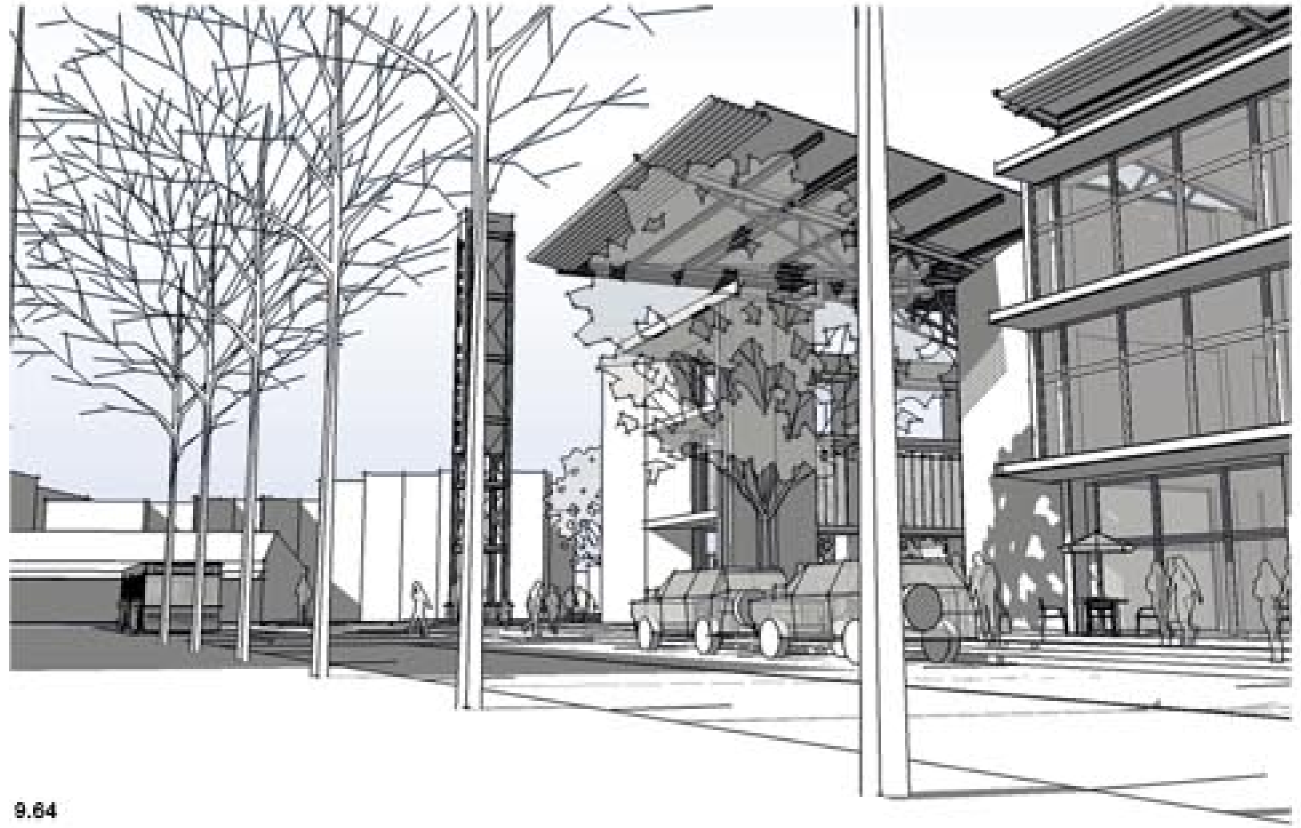
9.64


9.65

Concluding comments

The proposed building is the consequence of a process that, from the beginning, had no clear image of the outcome. It is a process that was driven by rational, cumulative decisions taken within the bigger picture of development frameworks and historical references. This process was concerned with creating a place rather than an object or a preconceived outcome. Its aim was to re-generate a culture of "publicness", of collective public ownership and responsibility for public space. Past and future is interwoven by retaining selective parts of the existing Rissik Station building, and incorporating these into the proposed complex.