

CHAPTER 5

Technical Investigation

This chapter will elaborate on the technical development and resolution of the design intervention for the D: NMCH. General technical aspects will be discussed as well as materials, wayfinding and lighting. Specific design elements will be resolved in this chapter.

Occupation classification: Design population:

C2-Museum 1 person per 20m²

6300m² - population = 315

(SANS 2011)



5.1. Materials

The technical approach to material choices is influenced by various factors.

The existing and new material and colour pallette can be seen in figure 4.3.2 moodboard images in Chapter 4. The existing materials are dark and is perceived to be heavy, while the new materials should contrast the existing. Even though the new materials contrast the existing materials used within the D: NMCH, the new materials should be appropriate to be used in a museum environment.

Characteristics that influenced material choice are: aesthetics, durability, temperature, sustainability, acoustics, light on surface and hygienics.

The colour palette of materials is chosen due to its relevance to the aesthetic concept of creating visual elements that link to the Ditsong logo, thus reminding of flames and embers. (As discussed in Chapter 4). The basis paint colour for walls is Plascon Cashmere, Midlands Marsh, a cool colour to complement the red, orange and yellow colours visible in the Ditsong logo.

Matte and brushed materials are used in the design intervention. The lighting above the reception desk (page 73) is bright to create a landmark in the foyer. The matte Interpon powder coated steel (Charcoal) desk will not reflect light to cause disabling glare for visitors approaching the reception desk. Matte surfaces will not show fingermarks as distinctly as gloss surfaces. The smooth surface finishes of the chosen materials are durable and easy to clean.

Lighting on materials are influenced by their surface finishes. Most of the materials used in the design have smooth finishes. The design concept of shaping elements with facets introduce depth to the material usage, The play of light and shadow create visual interest in the large foyer space.

Even though steel (a material cold to the touch) is used throughout the design intervention, other materials (warm to the touch) are incorporated to create comfortable environments. This includes the usage of American Walnut Formica on a Bisonboard substrate on the bench below the faceted steel clad wall.

The safety and health of visitors are also taken into account in the material decision making process. This aspect was considered with the floor finish, Marmoleum. Marmoleum is anti-slip, hypoallergenic and anti-bacterial. These characteristics results in Marmoleum being an appropriate floor finish in the D: NMCH.

Lafarge Acoustic Ceiling Boards and partitions are used to absorb and reduce sound, but not completely remove sound from the space. The faceted wall (page 77) along one curved wall mainly reflects sound at different angles, which aids in achieving comfortable room acoustics.

The steel sheets used in various design elements are stabilised by bending it and supporting it from the back.

The sustainability of a material is an important consideration in material choice. Sustainability relates to above mentioned characteristics as well as to the life cycle of the material.

Some characteristics of the chosen materials follow:

Marmoleum

- Anti-static properties that repel dust and dirt (hypoallergenic)
- Anti-bacterial
- Resilient underfoot
- Durable
- Acoustic impact noise reduction index of ≥10 dB.
- Biodegradable (Forbo 2014)

Rubber flooring

- Slip resistant
- Good impact sound reduction
- Resilient underfoot
- Durable
- Good resistance to water and fire (Truco 2015)

Interpon powder coating

- No VOCs
- Low wastage
- Durable
- Consistent colour (Interpon 2015)

Plascon paint colour

- Hides imperfections
- Anti-bacterial
- Stain resistant
 - Low VOC emissions (Plascon 2015)

Formica

- Durable
- Anti-bacterial
- Low VOC emissions
- · Impact resistant (PG Bison 2015)



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Location	Specification		Location	Specification
flooring	Marmoleum Acoustic 33139 lava		walls	Plascon Cashmere, Transcendent G4-C2-2
flooring	Marmoleum Unexpected Nature 3562 cosmic red		walls	Plascon Cashmere, African Light O4-B1-3
flooring	Marmoleum Unexpected Nature 3561 vibrating copper		walls	Plascon Cashmere, Bovine DC-16-47
flooring	Marmoleum Unexpected Nature 3564 glistening ochre Marmoleum Touch 3564 glistening ochre		walls	Plascon Cashmere, Bali Deep DC-16-46
staircase treads	Truco rhomboid rubber flooring 3mm black. Roll size: 20m x 1,2m. Usage: 2m x 300mm.		walls	Plascon Cashmere, Light Grey Aluminium
staircase risers (structure)	Magnus Steel mild steel perforated plate, staggered round holes			DC-15-44
ceiling	Lafarge Acoustic Ceiling Board, joints finished with Fibretape and Lafarge Jointing Compound, 12,5 x 1200 x2400mm		reception desk	Formica on 22mm Bisonboard substrate, American Walnut
wall cladding	Magnus Steel, steel alloy perforated plate, staggered round holes	Î	reception desk	Formica on 22mm Bisonboard substrate, New Burgundy
reception desk information stand free-standing signs	Interpon, Powder coating, Charcoal, ANP 3055	r e	reception desk	Formica on 22mm Bisonboard substrate, Orange
reception desk information stand free-standing signs	Interpon, Powder coating, New Orange, CEP 1130		staircase balustrade infill	GKD Metal Fabrics stainless steel diagonal woven mesh

Table 5.1. Material pallette.



"TO BE ORIENTED IS POSITIVE, BECAUSE IT BRINGS CERTAINTY, REASSURES, GIVES US TIME TO THINK" (Kling and Kruger 2017:11)

5.2. Wayfinding

The approach to wayfinding taken in this design is to use the principles to wayfinding set out in Chapter 3 as starting point. These principles are further explained according to the design in Chapter 4.

Wayfinding should create an identity for a space, increasing accessibility and functionality of the space. Successful wayfinding will make visitors feel confident to use the space, relaxed and ideally leave them with positive memories of their visit.

5.2.1. Lighting

Detail 1, page 64

Lighting is used as guiding element within the D: NMCH design intervention. The light quality is very bright in the entrance walkway and gradually decrease as the visitor moves further into the museum. There are bright elements throughout the space to act as landmarks. This includes the reception desk as landmark in the foyer and the atrium as a central landmark.

5.2.2. STAIRCASE

Detail 2, page 73

The staircase shape is conventional to create a familiar circulation identity to visitors. The staircase is mirrored around the elevator, which creates one central vertical circulation starting point.

The staircase uses sightlines to show what is ahead. For example a visitor descending the staircase will have a view of the temporary exhibition in the atrium. This will act as a "visual magnet" (Foltz 2015) to navigate towards. Banners that are suspended from the automated lighting system above the staircase add visual interest as visitors use the staircase.

The faceted steel mesh handrail aesthetically relates to the faceted steel elements in the foyer. This creates a visual connection to the identity created in the foyer.

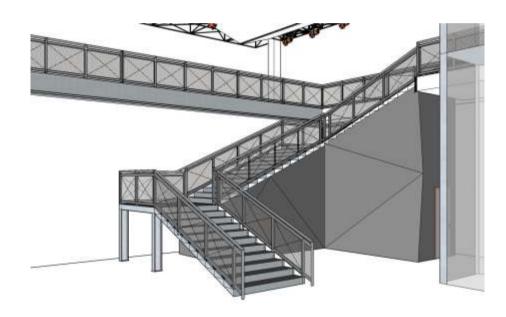


Figure 5.2.2.1. Staircase.



5.2.3. Reception desk

Detail 3, page 77

The reception desk is the main landmark in the foyer. It is visible from all angles when approaching the foyer. Lighting aids in emphasising the desk. The cosmic red Marmoleum floor finish guides the visitor towards the reception desk. Textured glistening ochre Marmoleum Touch inserts create a tactile notification of the coming desk.

The desk and bulkhead are the largest of the faceted design elements. This results in them being the main landmark the visitor encounters in the space.

The design allows a variety of visitors to comfortably use the reception desk. The front side of the desk has two heights, a counter and lower horizontal surface. This results in the desk being accessible to all. The back of the reception desk is wider to inhibit visitors standing on this side waiting for help from museum staff. This side includes diagonal brochure holders to supply museum maps and extra information.

Figure 5.2.3.1. Reception desk.

5.2.4. Wall cladding and seating

Detail 4, page 81

The wall cladding and seating is located to the right as a visitor enters the foyer. The faceted design identity is continued through the wall cladding.

Effect lighting from above and below the wall cladding create visual interest in the foyer and creates an identifiable seating area. The floor finish (vibrating copper Marmoleum) in this area differs from the rest of the foyer. This creates another region within the larger foyer space.

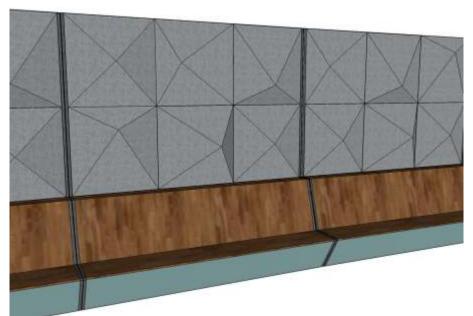


Figure 5.2.4.1. Wall cladding and seating.

5.2.5. Self service station and free standing signs

Detail 5, page 85

The self service stations include interactive information stations and self service ticket purchase stations.

The floor finish beneath the self service stations throughout the museum are vibrating copper Marmoleum. The faceted design and floor finish emphasises the stations as smaller landmarks throughout the museum.

Backlit signage is incorporated between grouped stations. Photoluminescent films are used as lettering on the free standing signs. These signs are to be used throughout the museum complex, and should be visible outside.

The free standing signs take the faceted design concept to the exterior. These signs are large enough to be seen from a distance, and is installed at critical decision points along the visitor's route through the museum complex.



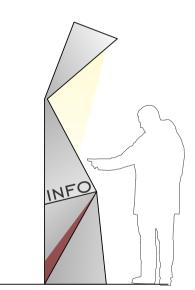


Figure 5.2.5.1. Self service station.



"IT IS LIGHT THAT MAKES SPACES INTELLIGIBLE FOR US IN THE FIRST PLACE"

(Hausladen and Tichelman 2010:46)

5.3. Lighting

Detail 1

Lighting plays an important role in museum design. The lighting design within the D: NMCH is an important aspect to improve the visitor's experience of the museum. The existing lighting conditions are very dark and monotonous (Figure 5.3.1.). The final lighting design is used as part of wayfinding and to create a positive experience for visitors. There is a large lighting level difference between the walkway and exhibition areas, this results in disabling glare (Figure 2.5.1.18.).



Figure 5.3.1. Existing lighting conditions of the D: NMCH.

In the final design, daylighting that visitors experience gradually decrease as they move from the exterior to the exhibition areas. This gradual decrease is supplemented with artificial lighting.

General lighting of the foyer plays an important part in the establishment of the visitor's first impression of the museum. Luminaire placement can be seen on the ceiling and lighting plan, figure 5.3.2. The luminaires are placed in this manner to improve the progression of light from the walkway into the main museum floor.

Artificial lighting should adhere to the minimum requirements set out in SANS 10400 – Part O and SANS 10114-1. The recommended lighting levels are, a museum (C2) – 200 lux, foyer – 100 lux (soft general illumination), and circulation – 150 lux.

The lighting approach within the intervention relates to contrasting and improving the existing lighting levels within the museum to improve the

visitor's experience as well as relating to the concept of the Ditsong logo representing fire. The foyer's overall illumination is 100 lux. The reception desk is lit from above (300 lux) to create a focus point to draw visitors to this area.

General illumination throughout the museum is 200 lux. The same luminaires (Recessed Kit Hal Pro sq) are used in the general areas and foyer but with different lamps. (See calculations on page 65-67 for specifications.) Colour rendering of all artificial lighting within the museum is warm white to reinforce the warm colours seen within a fire. LED lighting used has changing light colours.

Exhibition lighting and focussed lighting along walls will include spotlights (Modario Spot LED). The spotlights directs the visitor's focus to specific elements. These elements include objects on display and signage.

LED lighting (Dragonchain colourmix DC24B-RGBW) is installed within light troughs above and below the wall cladding to wash the wall with changing coloured light. This will enhance the texture created by the pyramid cladding and provide a backdrop to the seating area in the foyer. LED lighting (Lightify Flex – RGBW) is also used in the light trough that covers the newly exposed concrete slab edge within the atrium. This implementation of the light trough transmits a sliver of light which subtly highlights the atrium edge.

The Lightify LED lighting is also employed as backlight to the translucent signage screens between the interactive information stands (Detail 5, page 81).

The atrium, which acts as a landmark within the museum is lit using an automated lighting system (page 63). The automated lighting system is based on the lighting and prop systems used in theatre design. The lighting used within the atrium is warm white general lighting and exhibition specific lighting. The exhibition specific lighting relates to the temporary exhibition installed in the atrium at ground level. The lighting effect creates a theatre like atmosphere. The luminaires used are Kreios SL LED luminaires which has a frame for various filters and gobos. General lighting within the museum is achieved by installing metal halide lamps. These lamps are an appropriate choice for a large volume that requires even lighting at ground level.

This system (Detail 1, page 63) incorporates four main components:

- 1. Rigging system
- 2. Power distribution system
- 3. Data distribution and control system
- 4. Luminaires and fixtures

The structure of the automated lighting system is constructed from aluminium trusses. A primary truss structure is fixed to four existing structural columns. These columns will be strengthened according to the engineer's recommendations. The luminaires and banners are suspended from a secondary truss system.

The rigging system is based on a counterweight system. The counterweight system is installed in the existing services shaft.

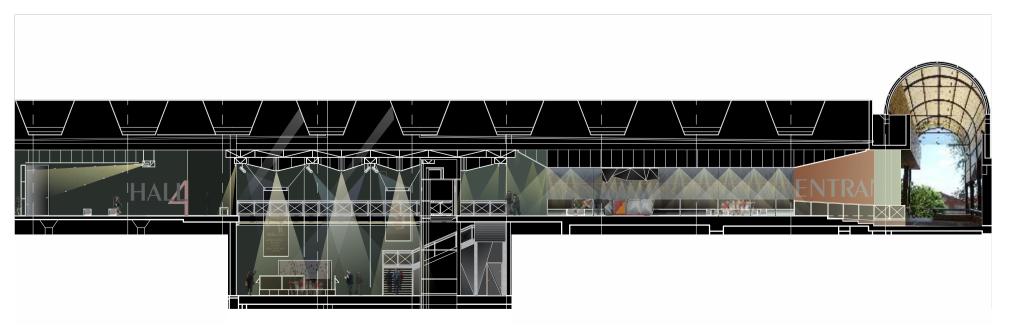


Figure 5.3.2. Lighting section.



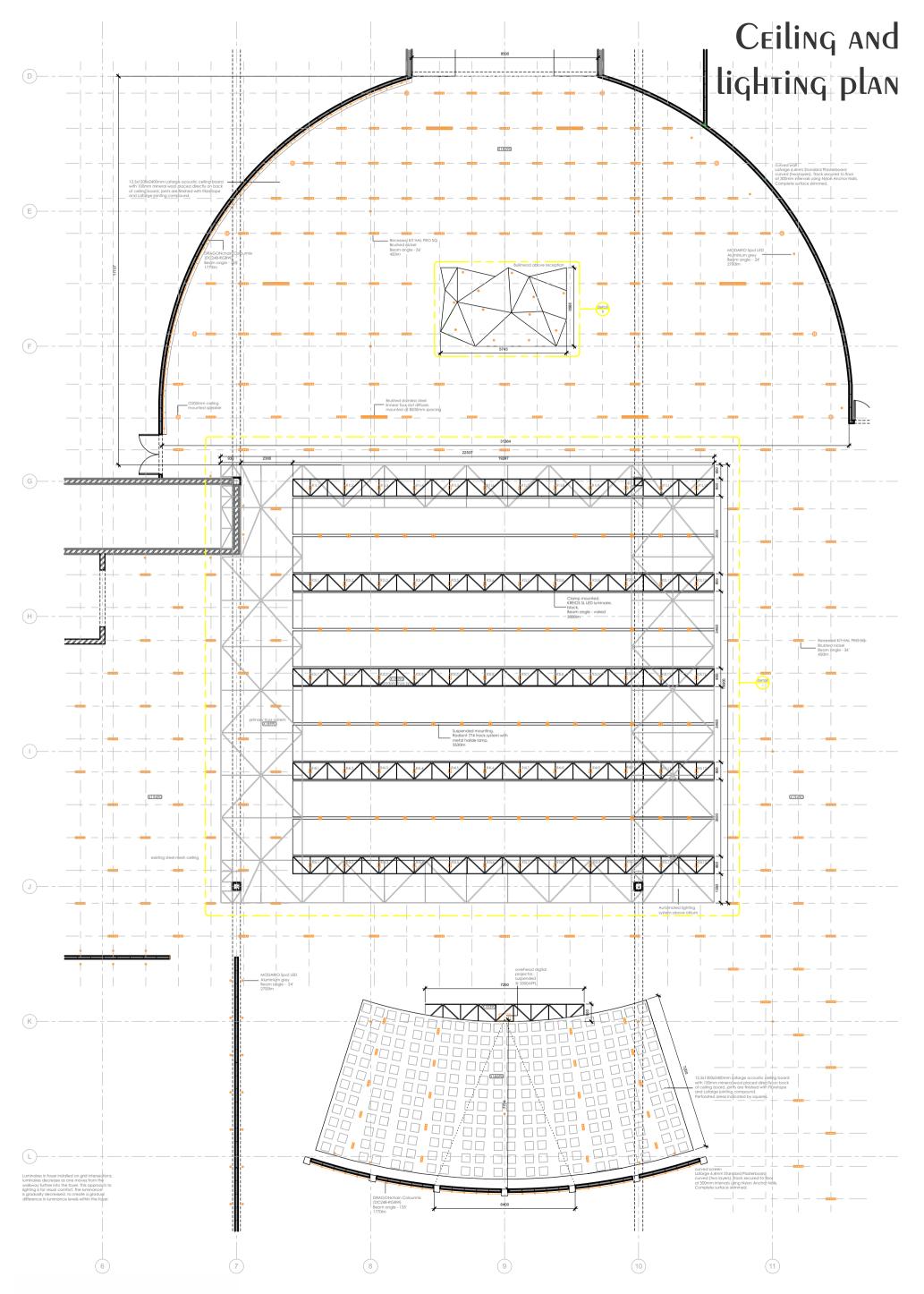
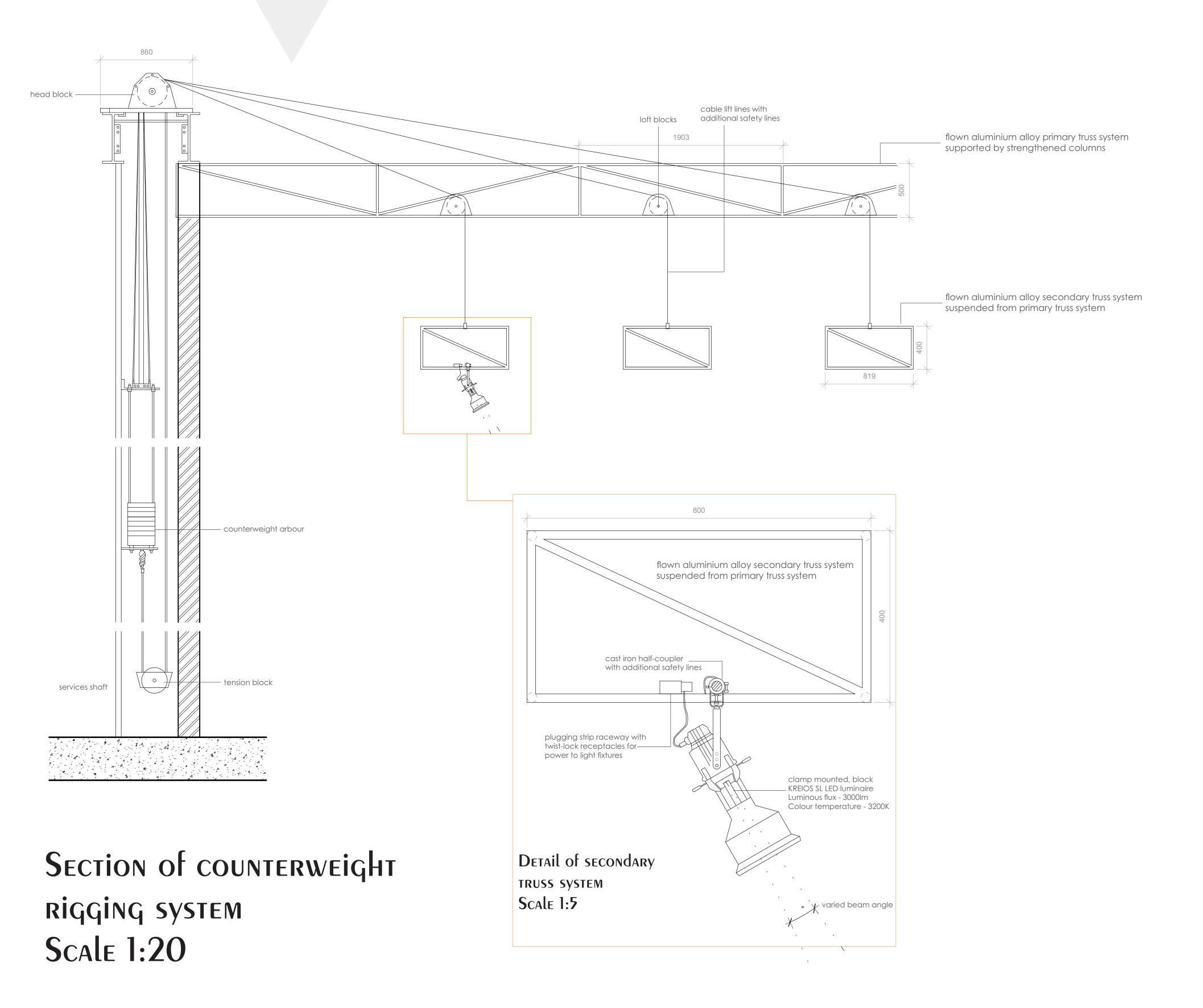
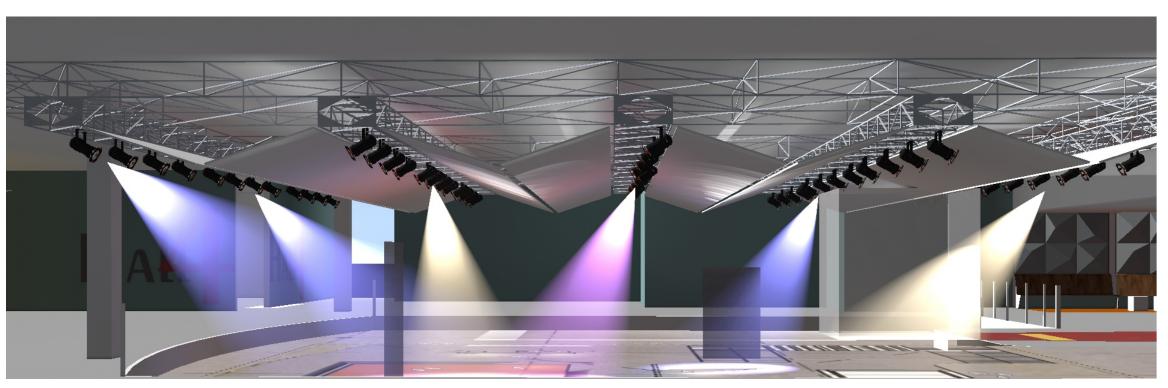


Figure 5.3.3. Ceiling and Lighting plan.

Detail 1

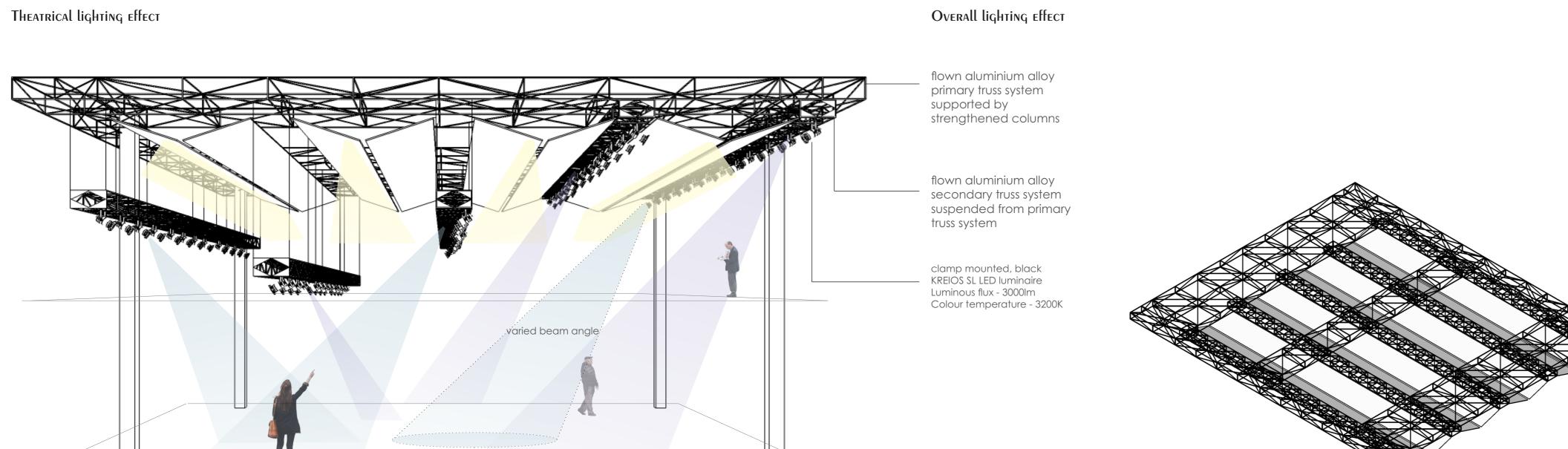


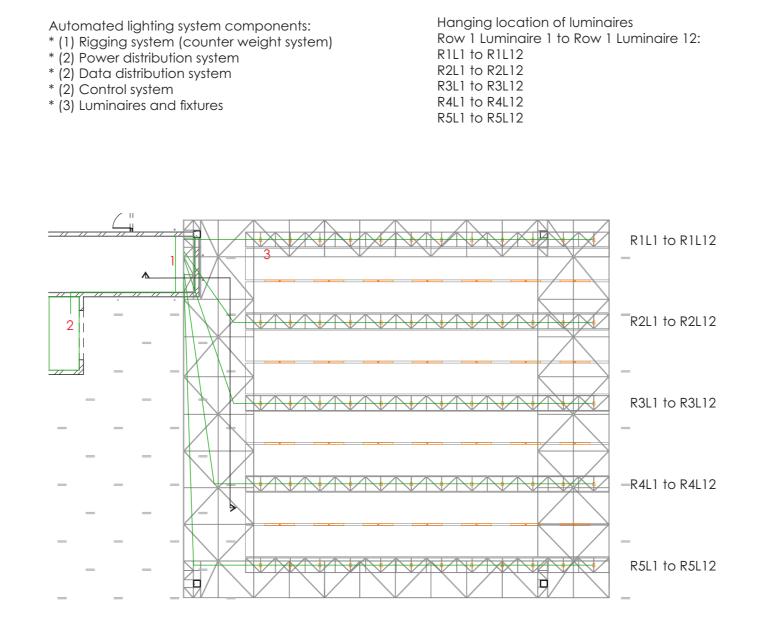




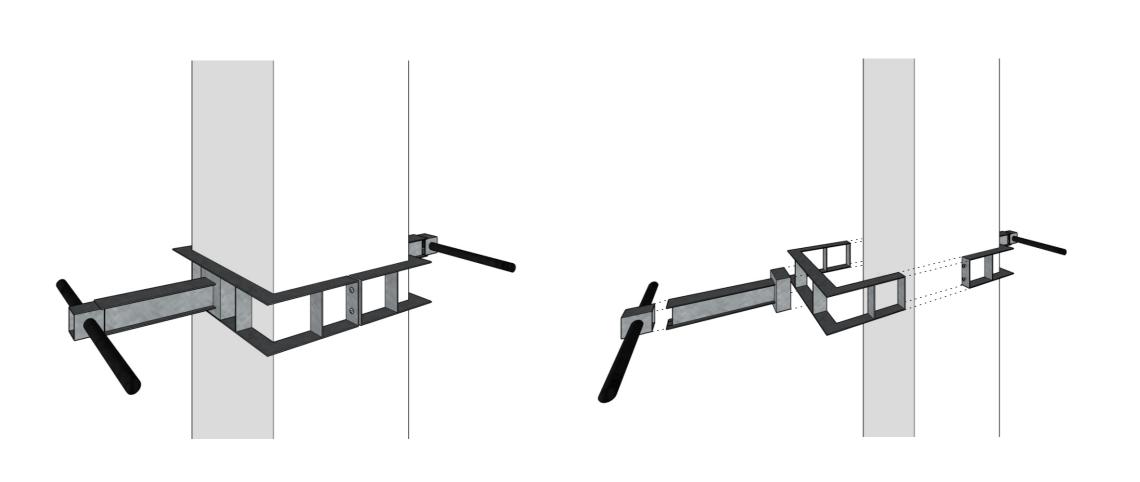


Lighting system from above

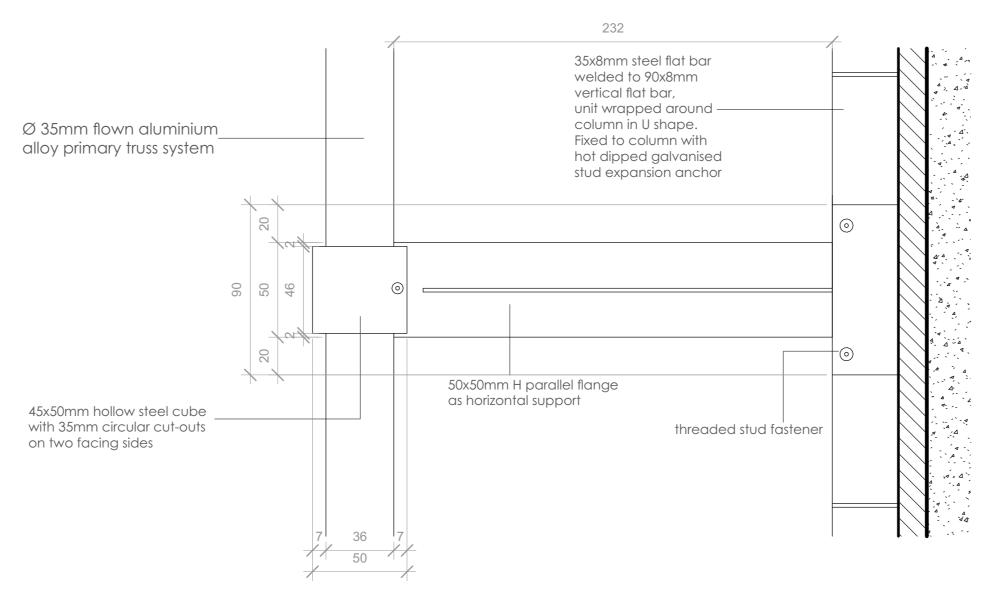




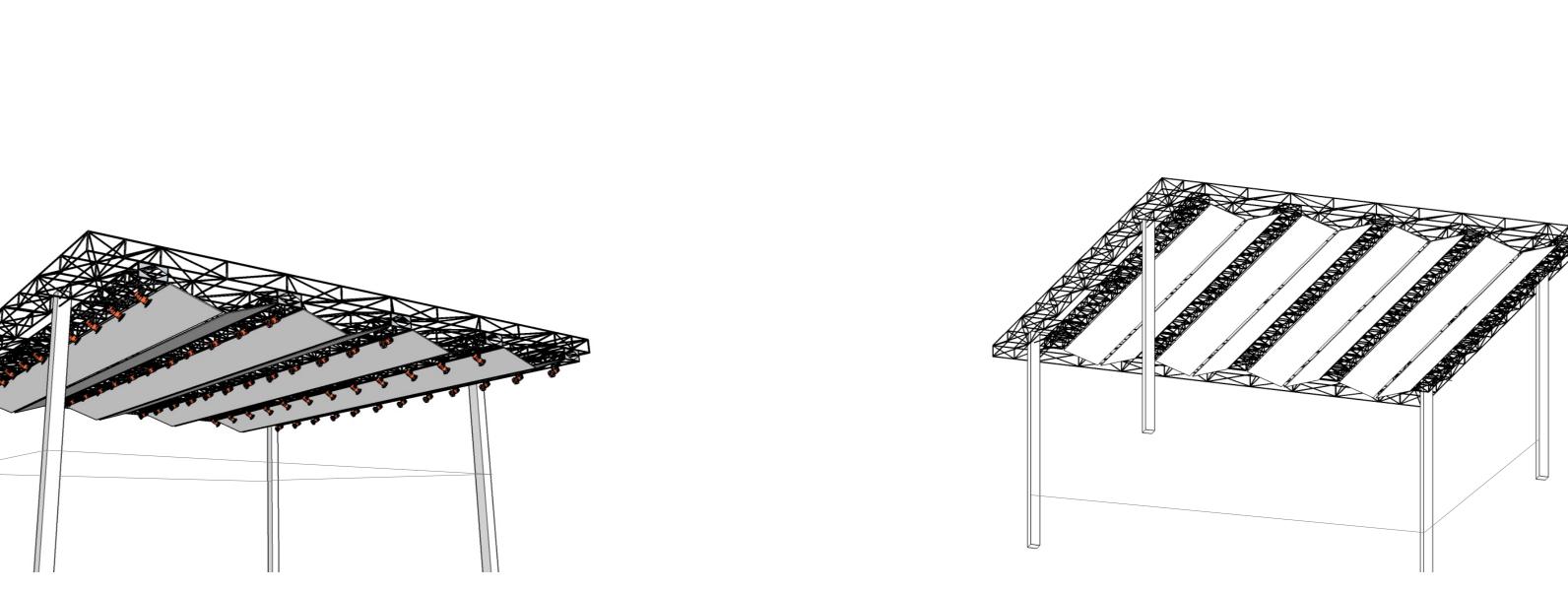
Automated lighting system diagram Scale 1:200



Column support

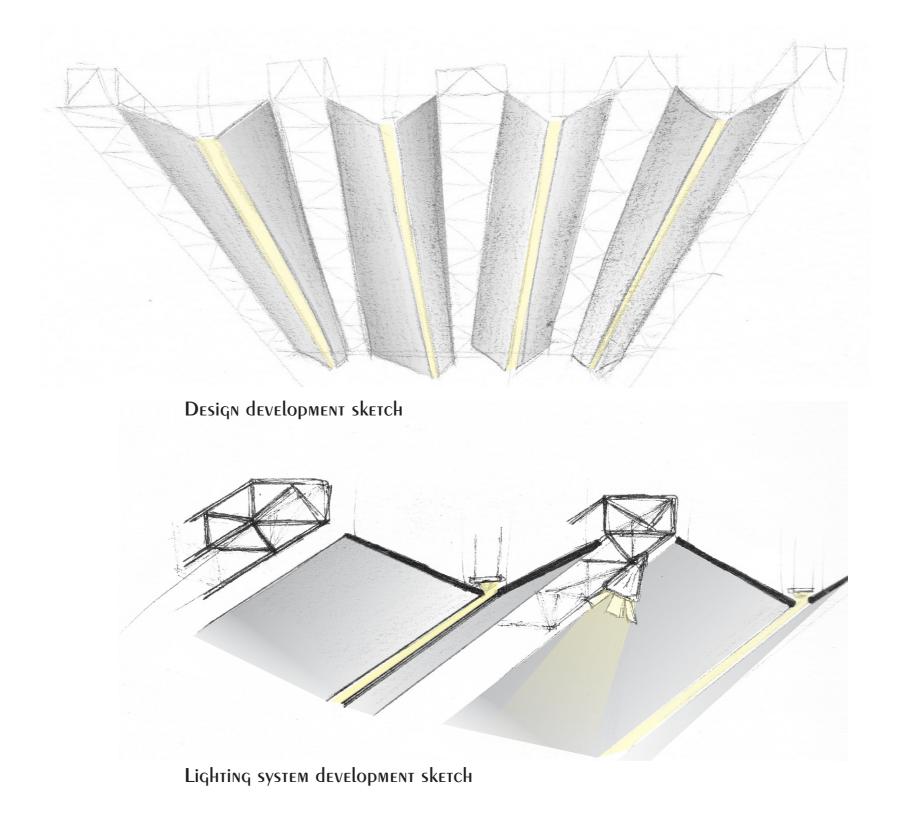


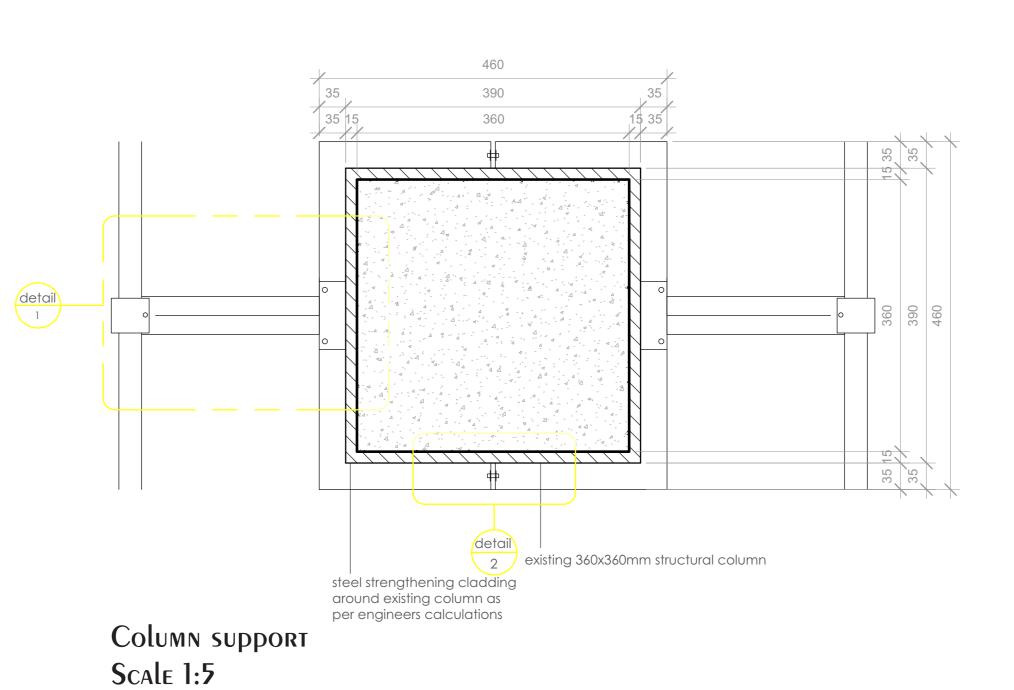
Column support Detail 1 Scale 1:2

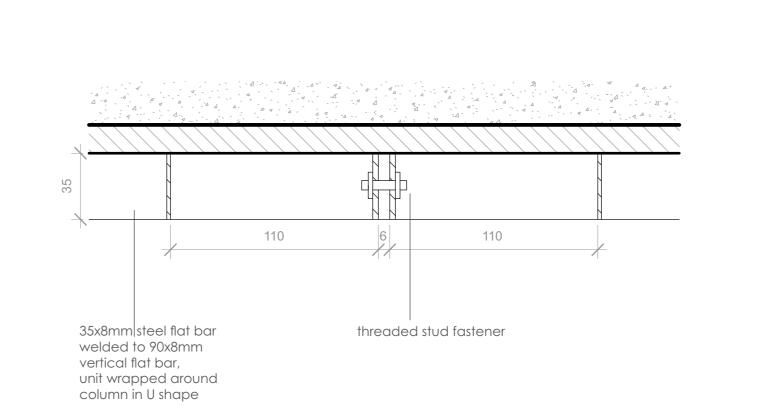


Lighting system indicating Kreios luminaires in orange

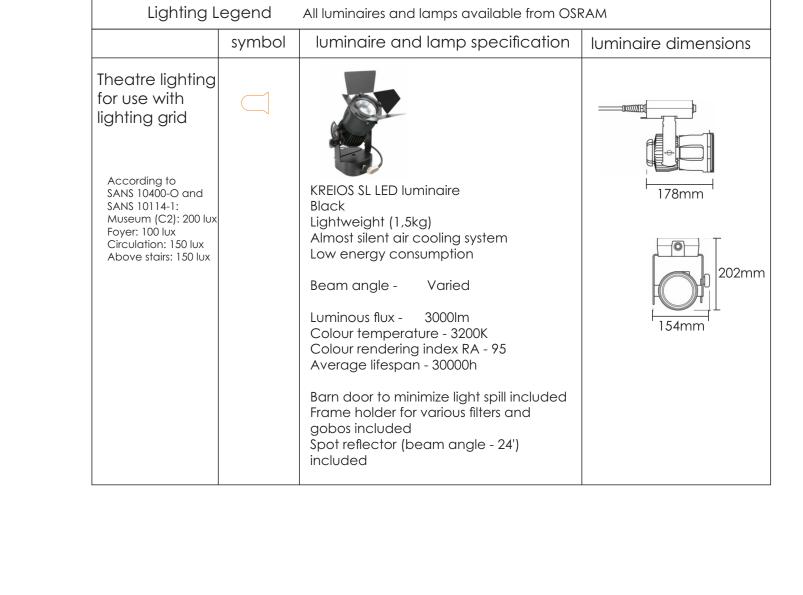
C University of Pretoria







Column support Detail 2 **S**cale 1:2



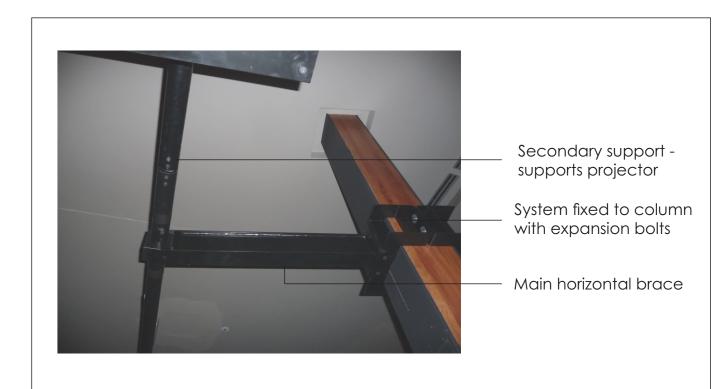
Incorporating facets in

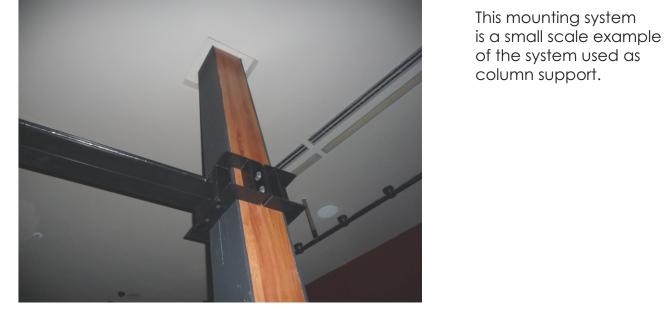
Theatrical lighting and prop elements to be used above atrium.

Kreios LED luminaires (Gobos and focus spots) will be suspended

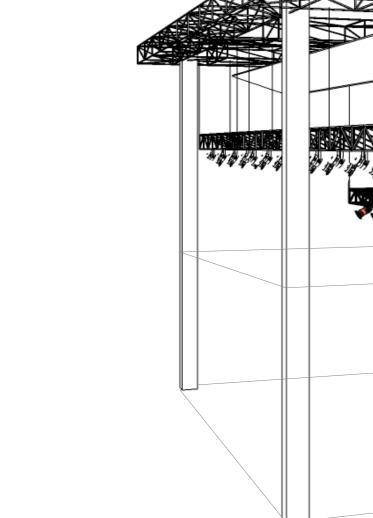
from steel frame, to be adjusted and used in temporary exhibitions. Permanent metal halide lighting will be used for general illumination.

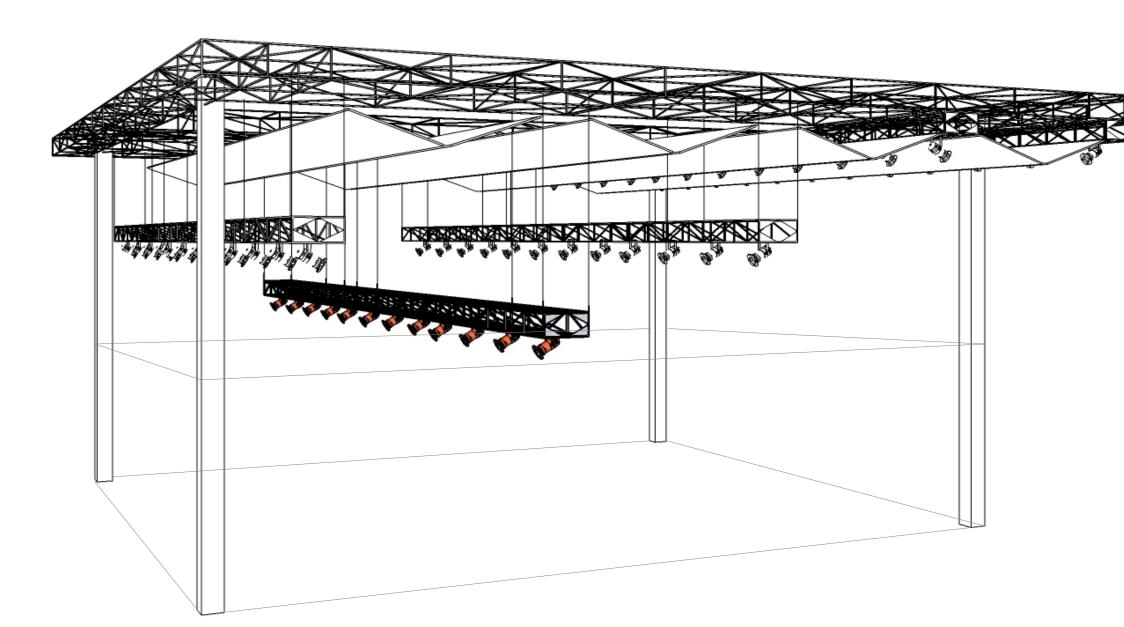
ANOTHER MANNER





Technical precedent - Freedom park museum, projector mounting system







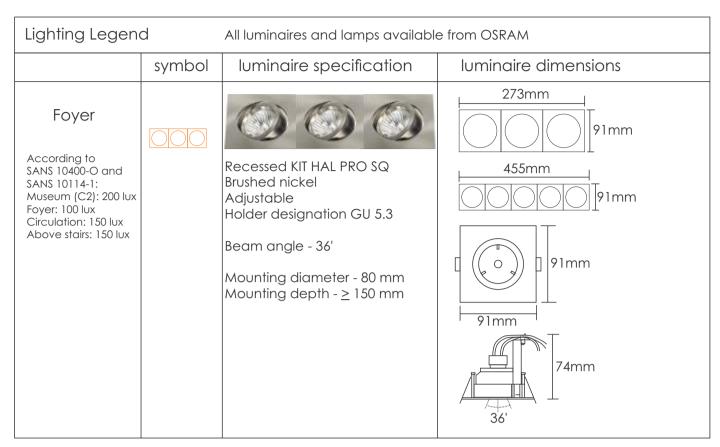


Table 5.3.1. Foyer luminaire specification

Lighting Legend		All luminaires and lamps available from OSRAM	
	symbol	lamp specification	illuminance calculations
Foyer According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		Osram PARATHOM PRO Ar111 50 with retrofit pin base 8,5 W Luminous intensity - 8500 cd Luminous flux - 450 lm Colour temperature - 2700 K Colour rendering index RA - 90 Light colour - Warm white Beam angle - 9' Common application in museums and galleries. Long life Low energy consumption No UV and near-IR radiation in light beam	MF = LLMF x LSF x LMF x RSMF = 0,7 x 0,7 x 0,86 x 0,96 = 0,4 Average illuminance = Fx UF x MF area of working plane 100 = Fx 0,48 x 0,4 432 F = 225000 F = n.luminaires x n.lamps x lumen of lamp 225000 = n.lu x n.la x 450 n = 500 Five lamps per luminaire = 100 luminaires

Table 5.3.2. Foyer lamp specification and calculations

Lighting Legen	d	All luminaires and lamps available from OSRAM		
	symbol	luminaire and lamp specification	luminaire dimensions	
Wall wash lighting According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		DRAGONchain Colourmix (DC24B-RGBW) Red, green and blue LED, plus a cold- white (6500K) LED. Uniform backlighting - wide angle optics Flexible chain UV and IR-free light (preserves exhibits) Beam angle - 135' Colour temperature - 2700 - 6500K Luminous flux - 1770lm Lifespan - 40000h	3000mm 555mm 500mm	

Table 5.3.3. Wall lighting lamp specification



Lighting Legen	d	All luminaires and lamps availab	ole from OSRAM
	symbol	luminaire specification	
According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		Radiant 774 track line system Suspended mounting Body material - Die-cast aluminium, Brushed Nickel finish Used with PAR 30 lamps	preferred position -38- 142

Table 5.3.4. Atrium luminaire specification

Lighting Legend		All luminaires and lamps available from OSRAM		
	symbol	lamp specification	illuminance calculations	
Atrium			MF = LLMF x LSF x LMF x RSMF = 0,63 x 0,77 x 0,74 x 0,95 = 0,34	
According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		HCI - PAR30 metal halide lamp 70 W Luminous flux - 3530 lm Colour temperature - 4200 K Colour rendering index RA - ≥90 Light colour - Neutral white Beam angle - 30° Service life - 12000 h High efficiency Base up installation Good colour stability UV values low	Average illuminance = $\frac{F \times UF \times MF}{\text{area of working plane}}$ $200 = \frac{F \times 1.1 \times 0.34}{335}$ $F = 179144$ $F = \text{n.luminaires} \times \text{n.lamps} \times \text{lumen of lamp}$ $179144 = \text{n.lu} \times \text{n.la} \times 3530$ $n = 50$	

Table 5.3.5. Atrium lamp specification and calculations



Lighting Legend All luminaires and lamps available from OSRAM				
	symbol	luminaire and lamp specification	luminaire dimensions	
Spotlight According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		MODARIO Spot LED Aluminium grey (RAL 9006) Adjustable Beam angle - 24' Light distribution - Rotational symmetric Rotation - 360', pivoting 60' Luminous flux - 2700lm Colour temperature - 3000K Colour rendering index RA - 80 Light colour - Warm White Average lifespan - 50000h Long lifespan Glare-free light	598mm 280mm 102mm	

Table 5.3.6. Spotlight luminaire and amp specification.

Lighting Legend All luminaires and lamps available from OSRAM			
	symbol	luminaire and lamp specification	luminaire dimensions
Theatre lighting for use with lighting grid According to SANS 10400-O and SANS 10114-1: Museum (C2): 200 lux Foyer: 100 lux Circulation: 150 lux Above stairs: 150 lux		KREIOS SL LED luminaire Black Lightweight (1,5kg) Almost silent air cooling system Low energy consumption Beam angle - Varied Luminous flux - 3000lm Colour temperature - 3200K Colour rendering index RA - 95 Average lifespan - 30000h Barn door to minimize light spill included Frame holder for various filters and gobos included Spot reflector (beam angle - 24') included	178mm 202mm

Table 5.3.7. Atrium luminaire and lamp specification.

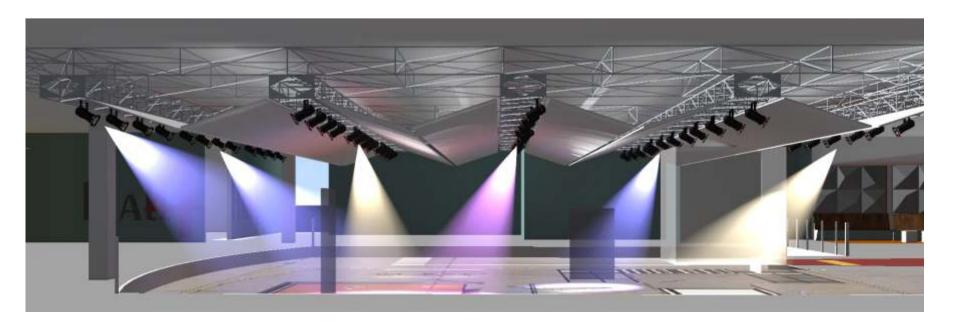


Figure 5.3.4. Atrium theatrical lighting effect.



5.4. Design elements

The following design elements were chosen for development and resolution due to their expression of the theories investigated and design concept.

The design elements all contribute to the overall visitor experience of the D: NMCH. These elements come together as the physical manifestation of the programmatic and technical requirements and conceptual approach.

5.4.1. STAIRCASE

The double staircase and elevator is located on the northern edge of the atrium. These vertical circulation elements physically connect the first and ground floor of the museum.

The staircase provides sightlines towards the temporary exhibition on the ground floor. The temporary exhibition is incentive to navigate to the ground floor via the staircase or elevator.

The balustrade design incorporates the faceted design identity created in the foyer through the use of faceted stainless steel infill panels.



Figure 5.4.1.1. View towards staircase.

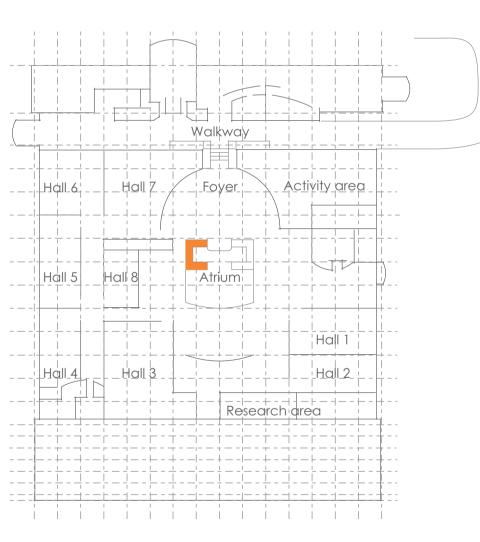
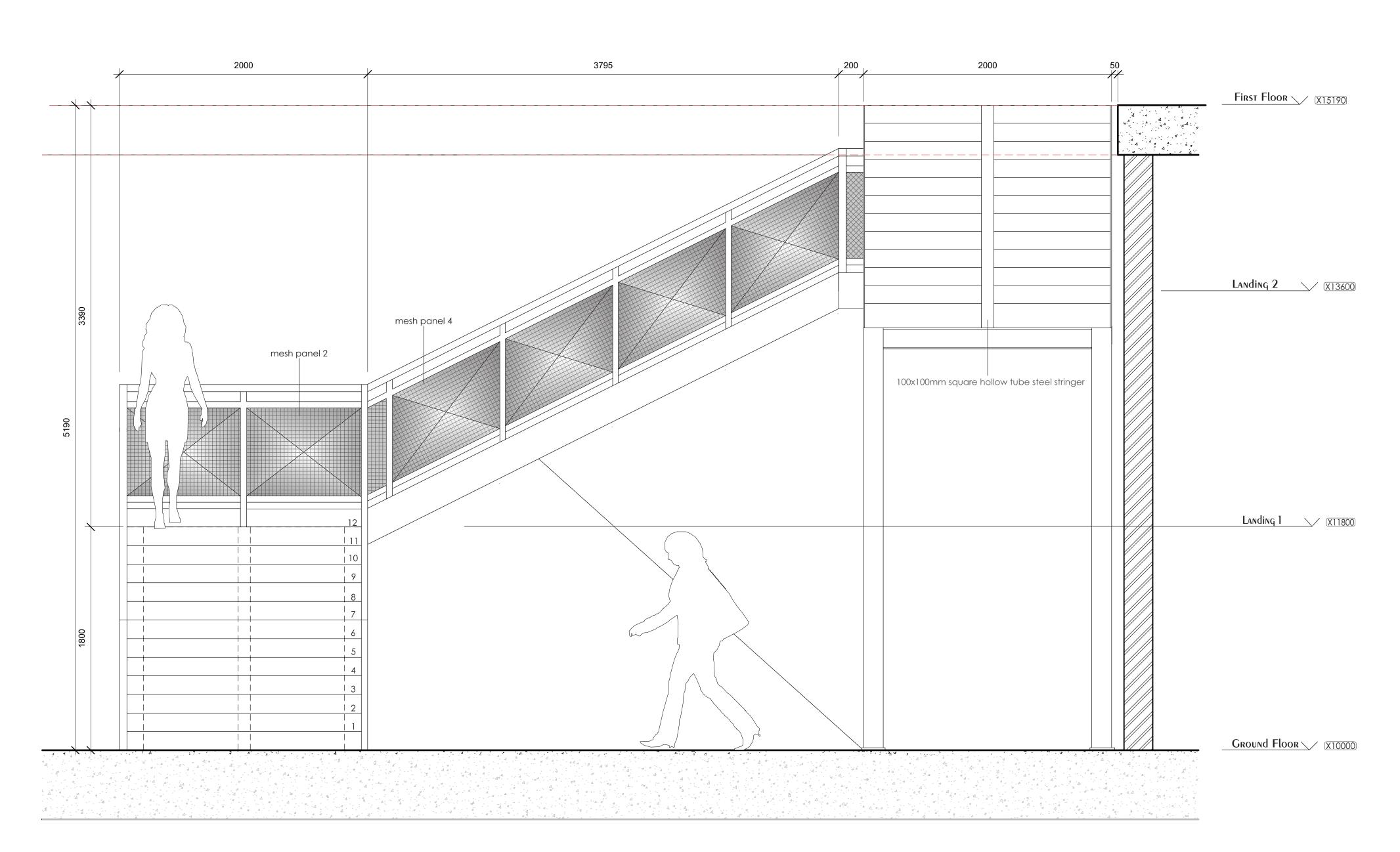


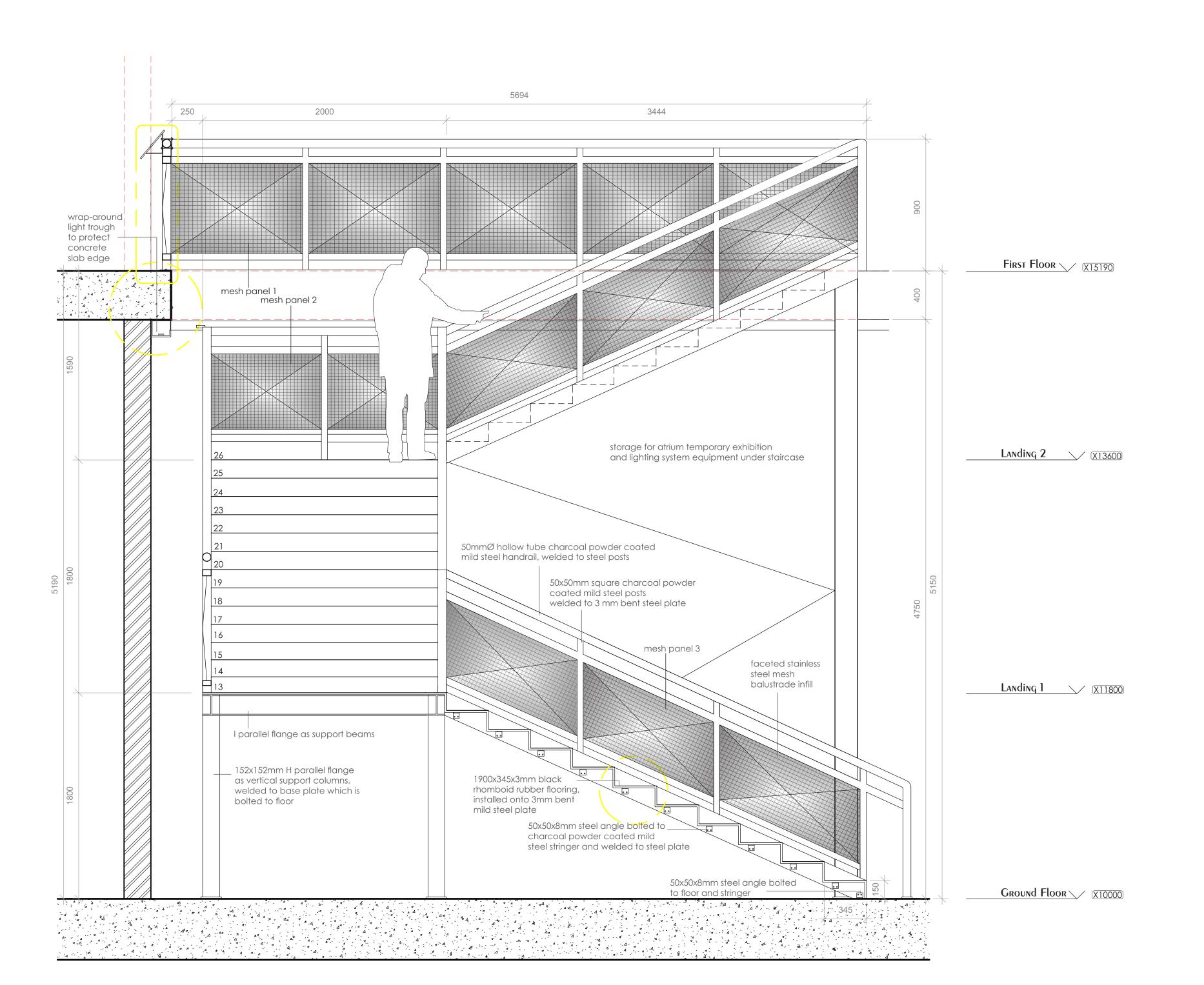
Figure 5.4.1.2. Location of staircase.







Elevation of staircase Scale 1:20



removable rail mounted information panel

50mmØ hollow tube charcoal powder coated mild steel handrall, welded to steel posts rail clamps

stainless steel diagonal mesh shaped into facets welded to steel posts

steel posts

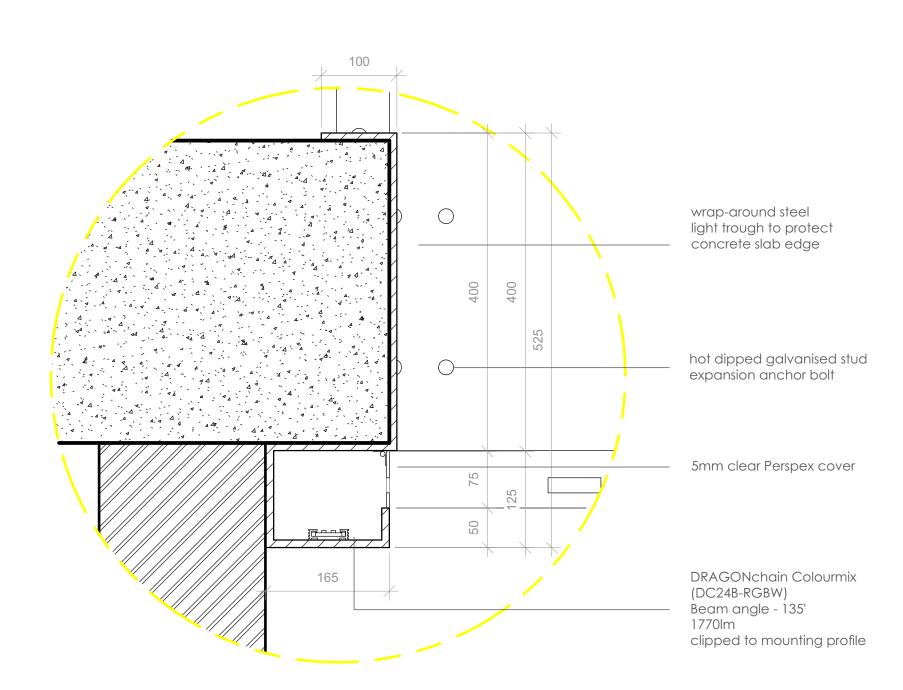
stainless steel diagonal mesh shaped into facets welded to steel posts

50x50mm square charcoal powder coated mild steel posts welded to 3 mm bent steel plate

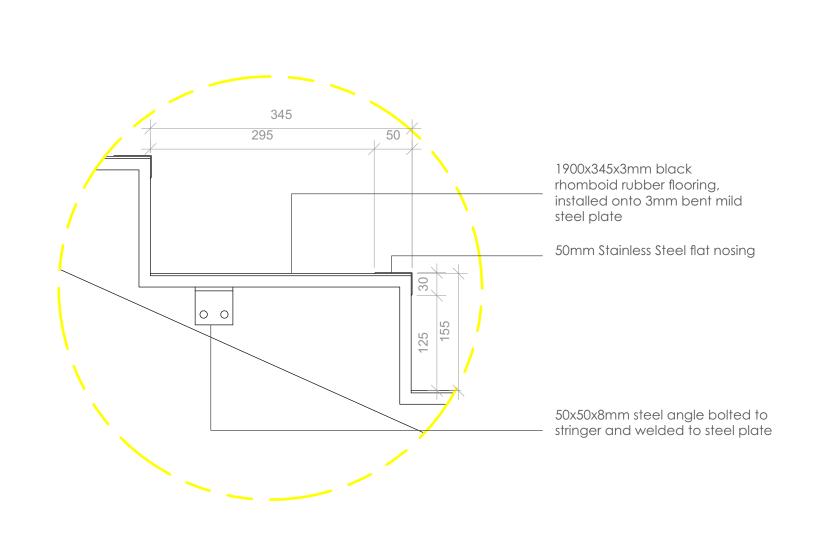
wrap around steel plate

wrap around steel light trough to protect concrete slab edge

Balustrade Detail 1 Scale 1:5

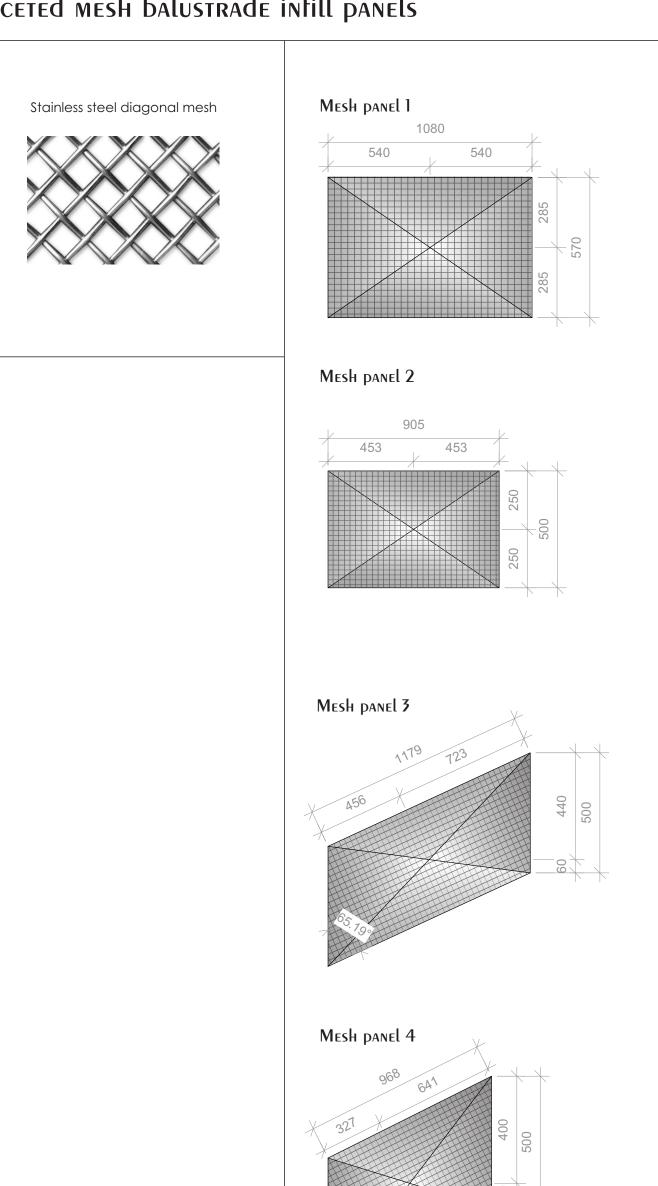


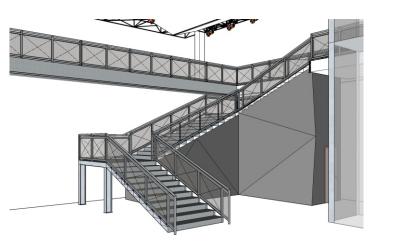
Lighting trough Detail 2
Scale 1:5

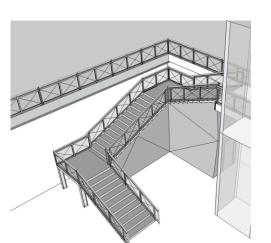


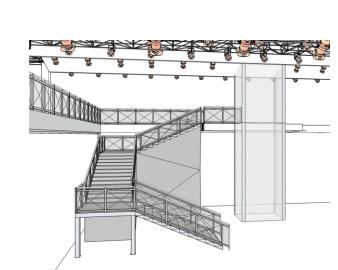
Stair construction Detail 3
Scale 1:5

Faceted mesh balustrade infill panels

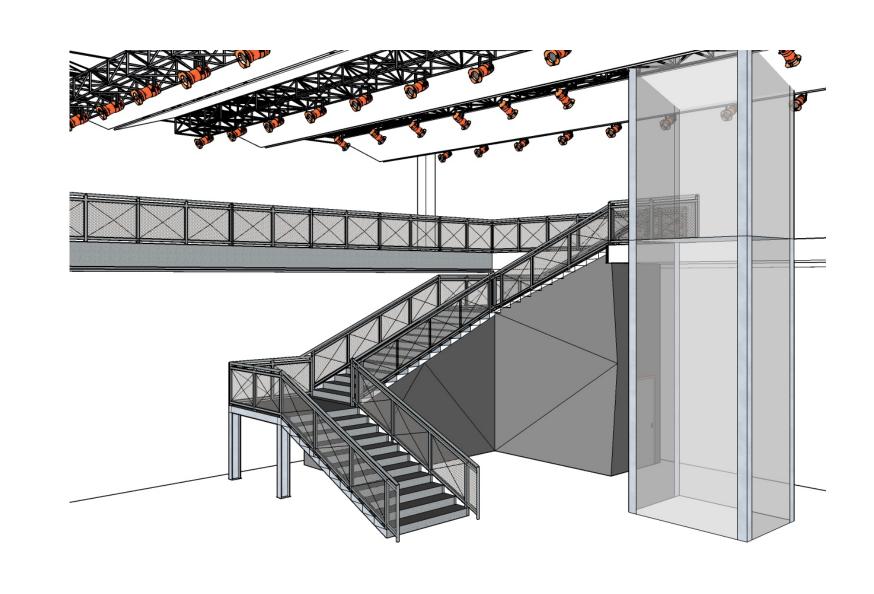








Views towards staircase



View towards staircase



5.4.2. Reception desk

The reception desk is the first design element that the visitor visually encounters in the foyer. The reception desk acts as landmark and orientation point in the foyer.

The faceted design is implemented on a larger scale in the reception desk design. Direct lighting from above and indirect lighting from below emphasises the reception desk as landmark.

The reception desk is inclusively designed to allow for a variety of visitors to be able to use the desk. The reception desk provides a place of contact with museum staff. Brochures are available at the back of the reception desk.



Figure 5.4.2.1. View towards reception desk.

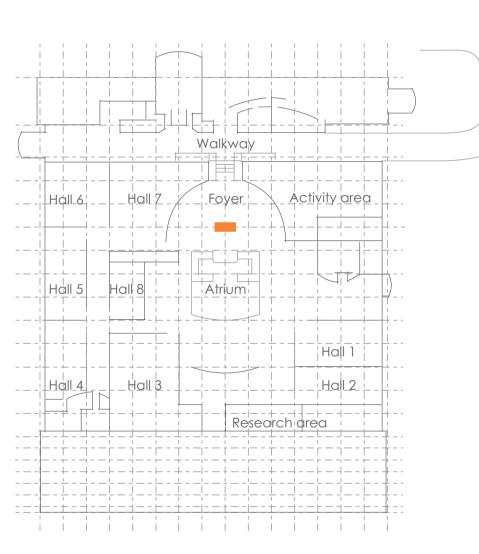
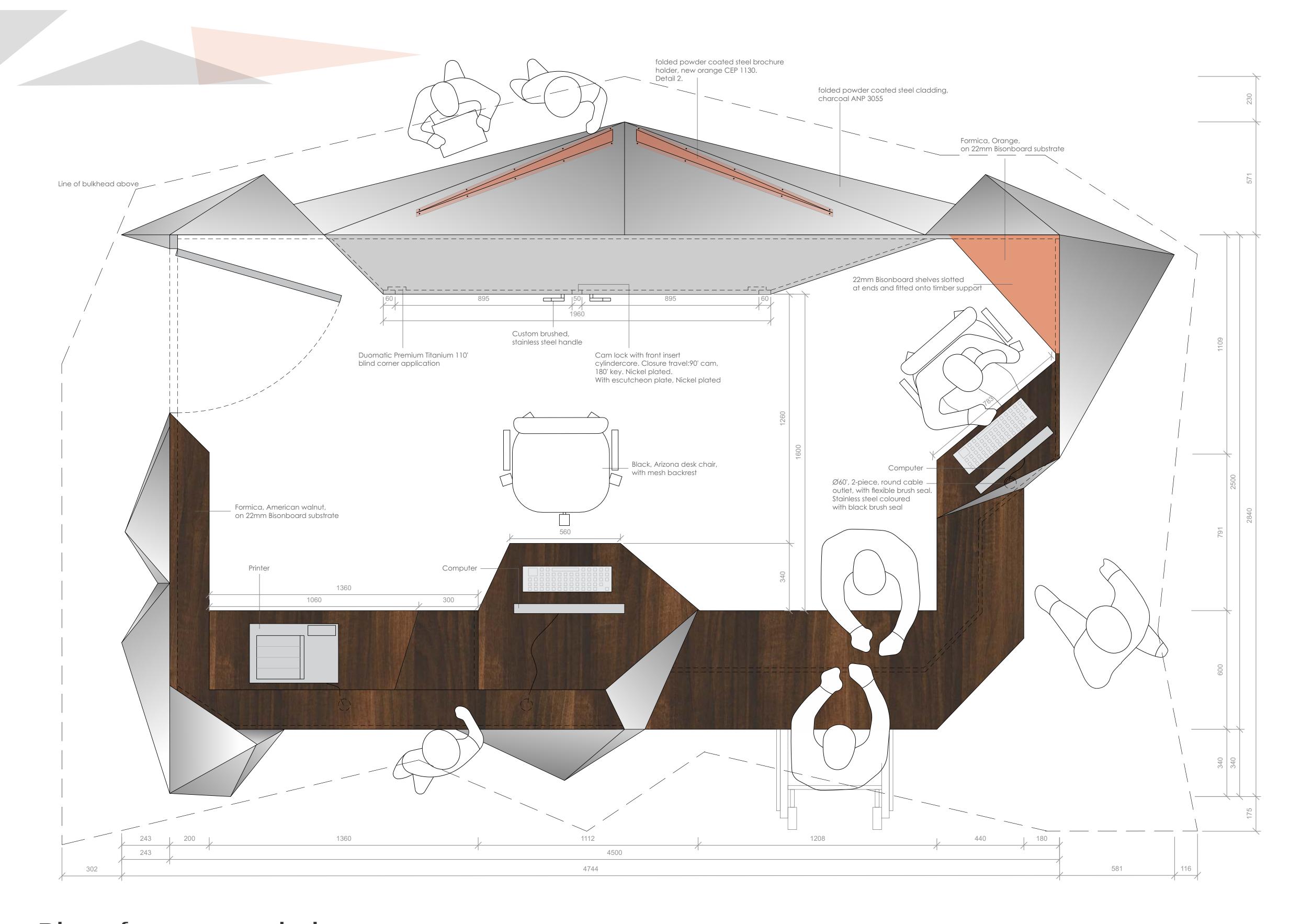


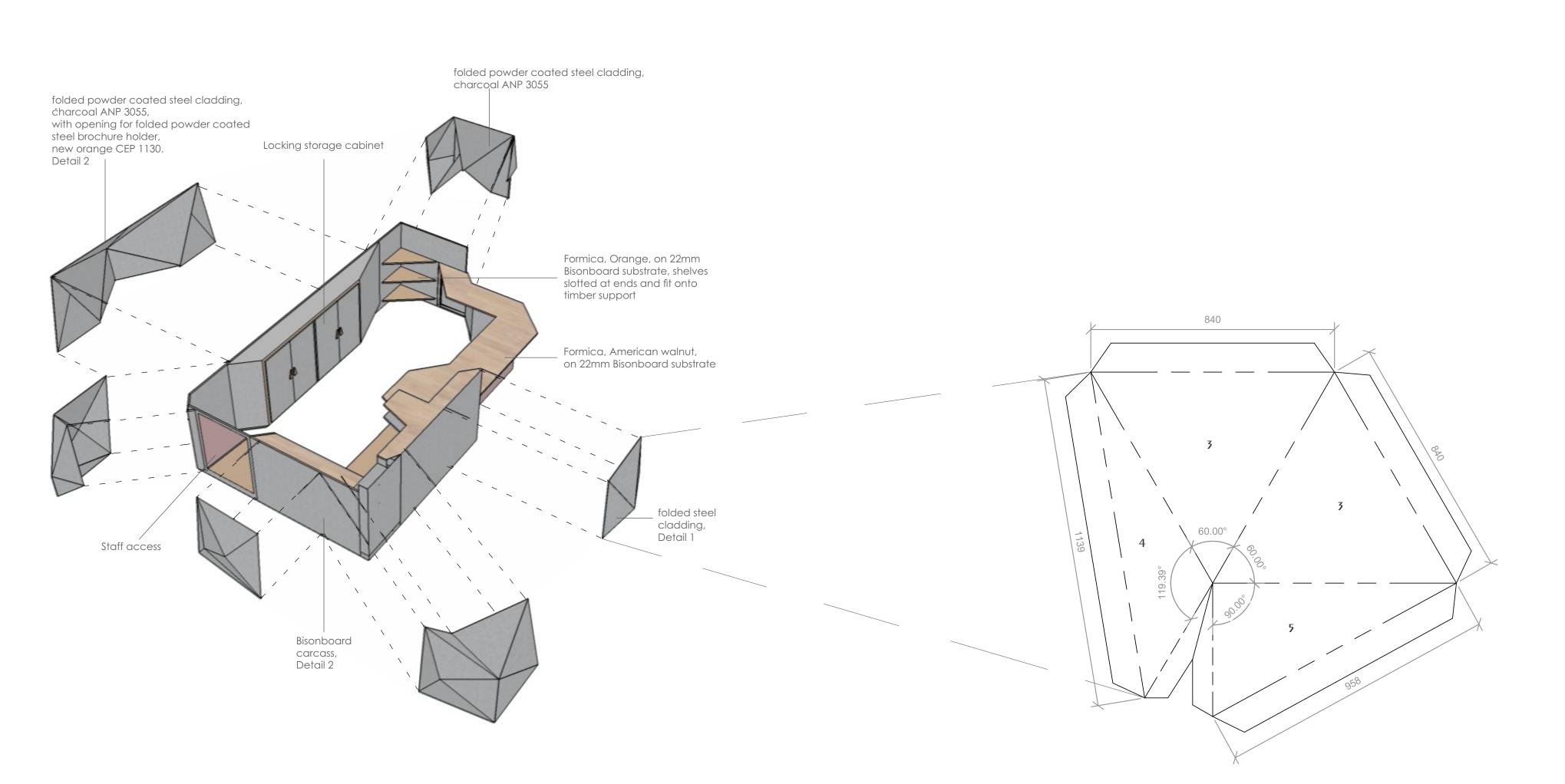
Figure 5.4.2.2. Location of reception desk.





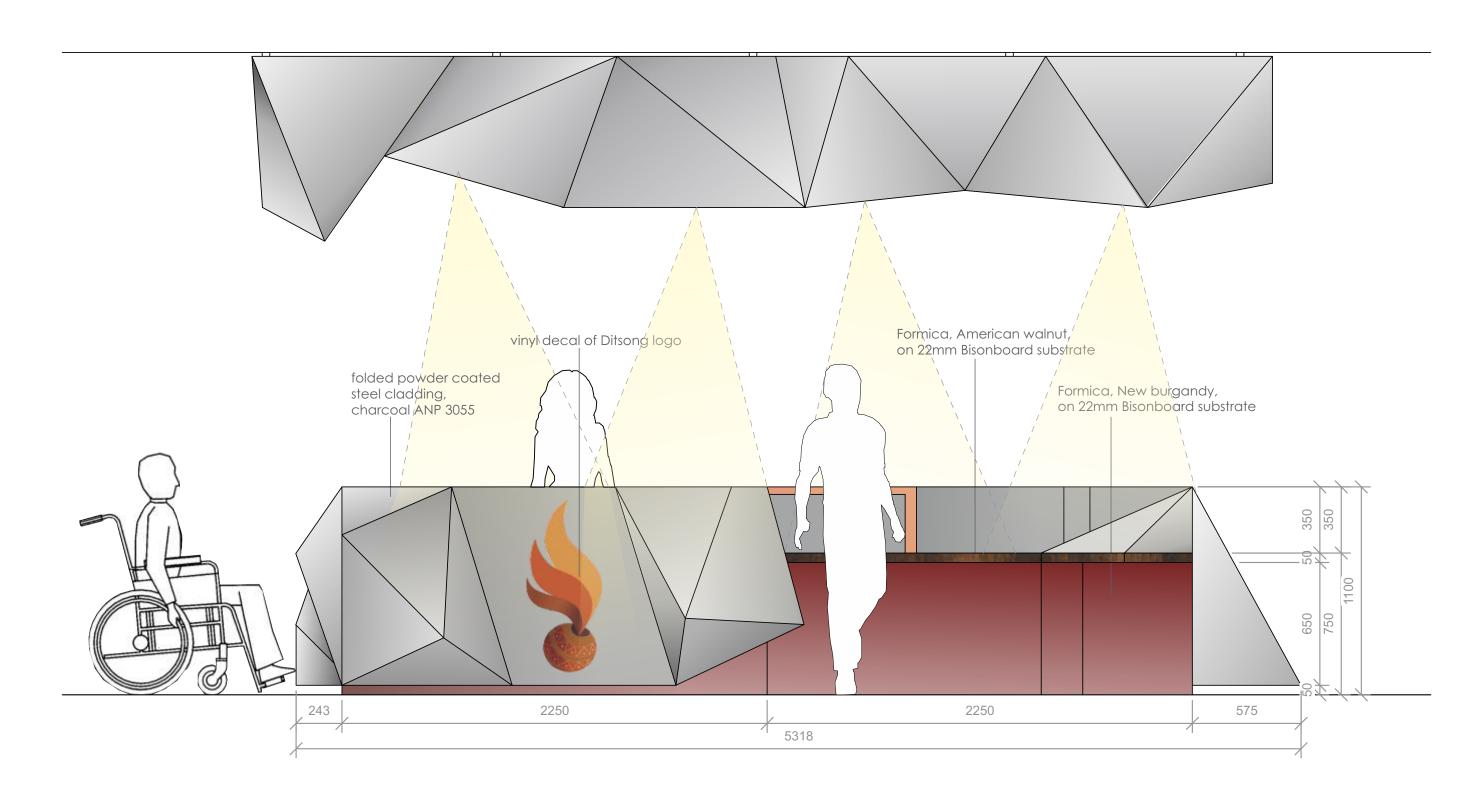
Plan of reception desk **S**cale 1:10

Exploded axonometric of reception desk

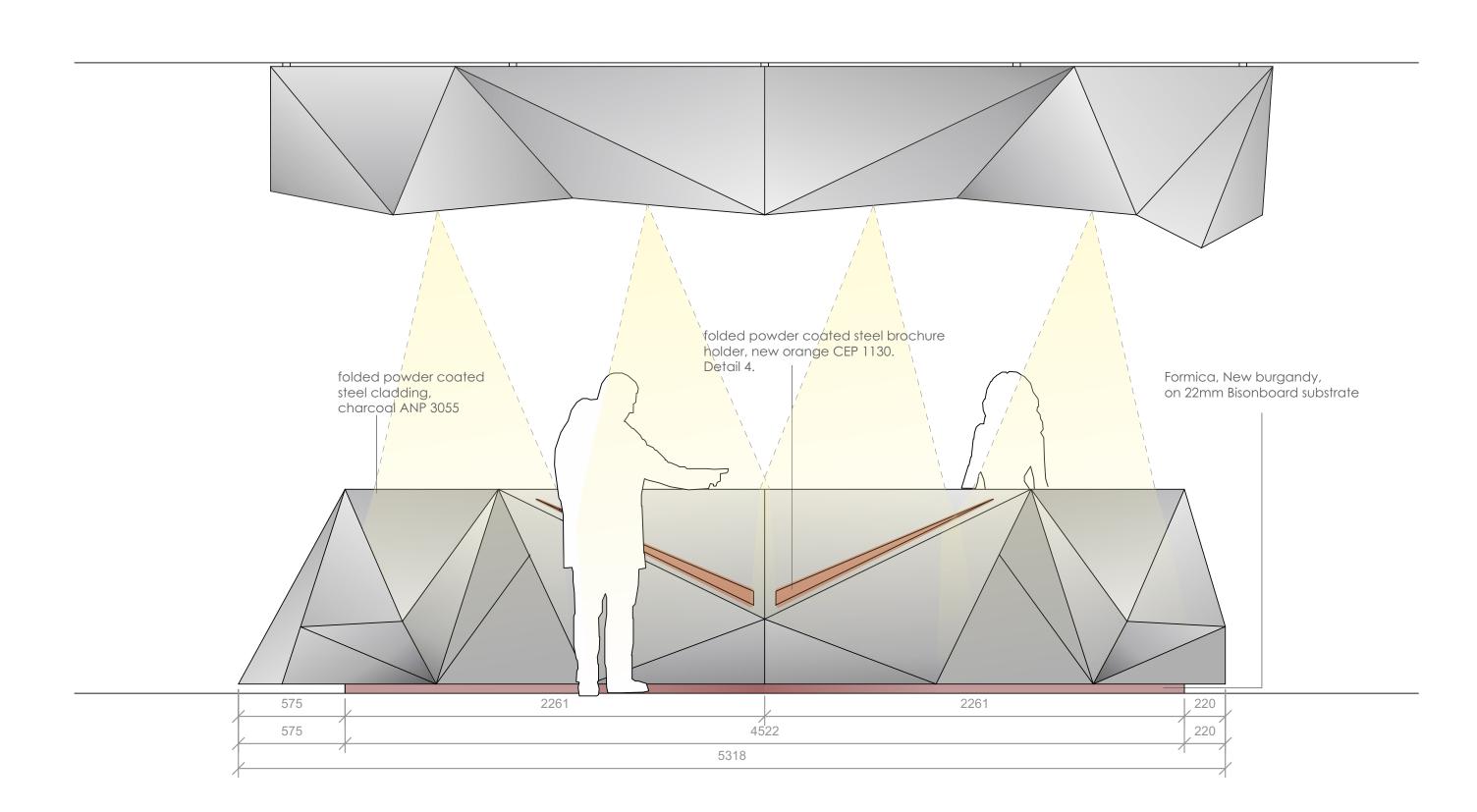


Flat cladding unit



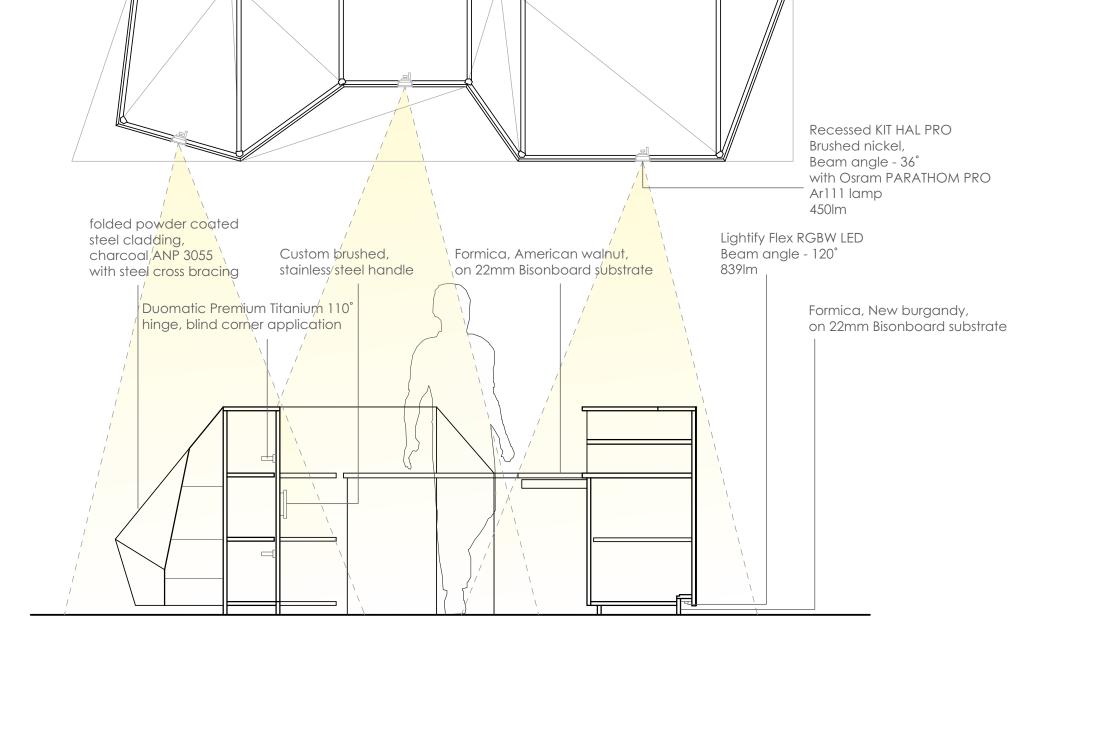


Front elevation of reception desk and bulkhead Scale1:20

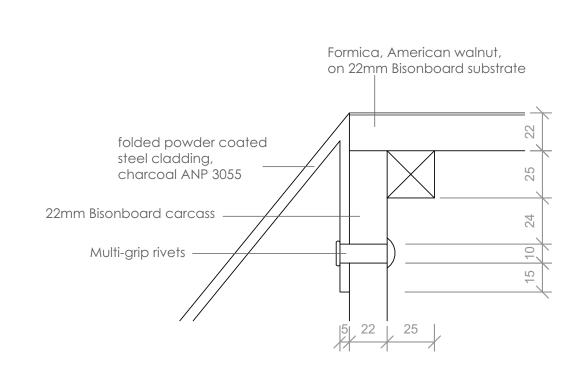


Back elevation of reception desk and bulkhead Scale1:20

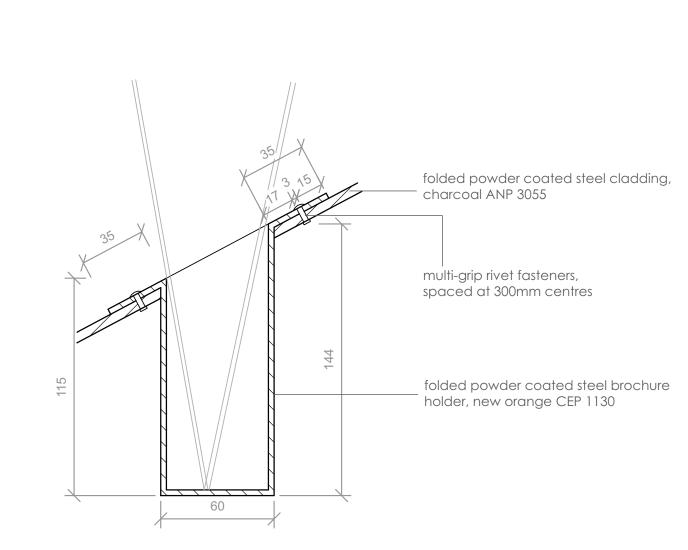
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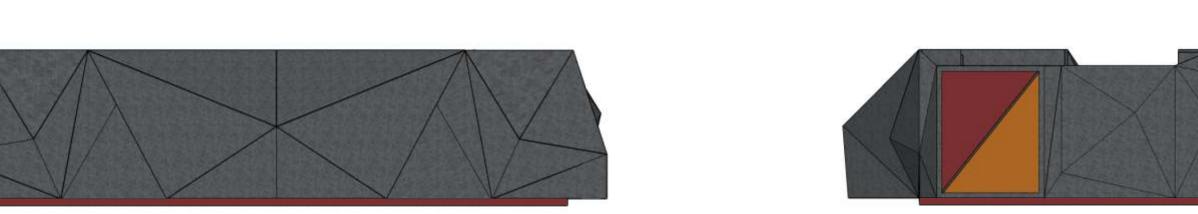
Scale1:20



Cladding fixed to carcass, Detail 1 **S**cale 1:2



Brochure Holder, Detail 2 Scale 1:2



| Interpon powder | No VOCs

sections, fixed Durable

coating, matte

Solvent free
Overspray can be reclaimed,

Folded steel recyscled or reprocessed

Bisonboard fingermarks as quick as gloss

(Interpon 2015)

with rivets to Matte - do not show

Reception desk materials

22mm Bisonboard substrate

High pressure laminate on a

Bisonboard

substrate

carcass

Resistance to wear

Low maintenance

excellent structural strength

superior screw-holding

Bisonboard

capability smooth surface

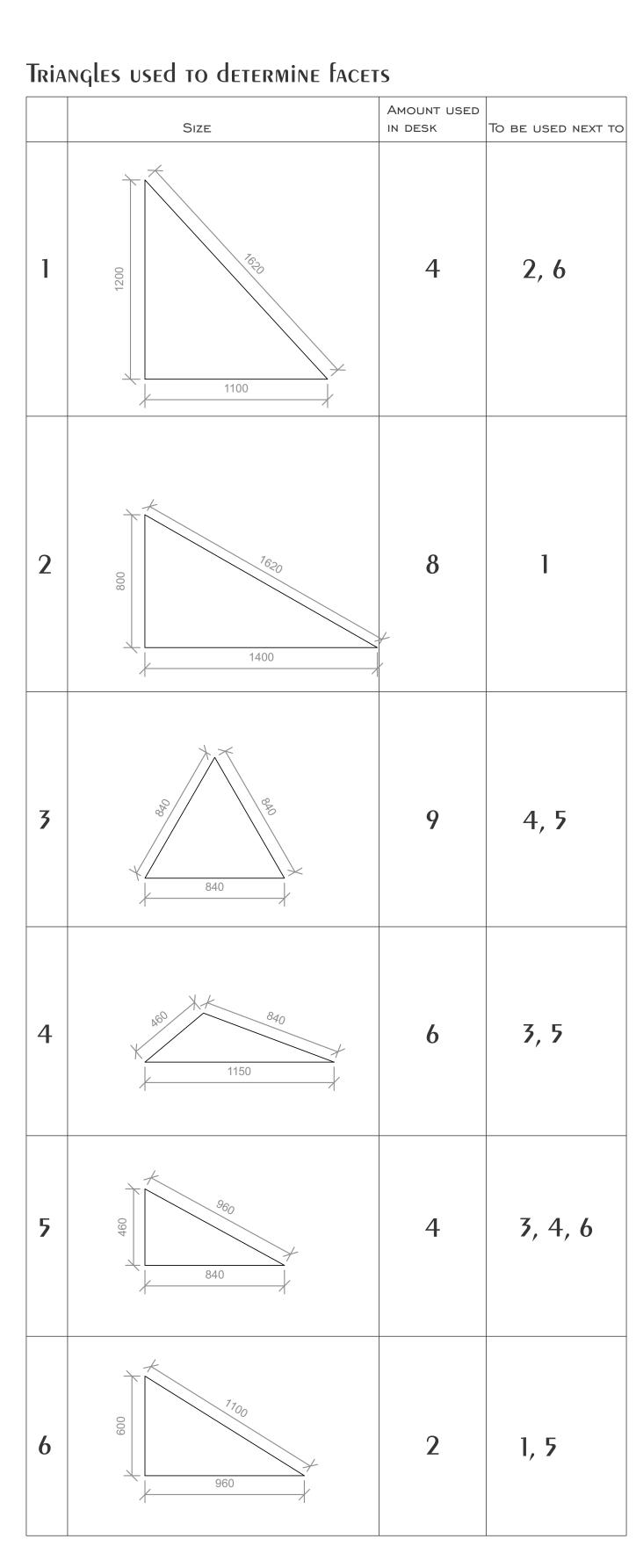
New Burgundy

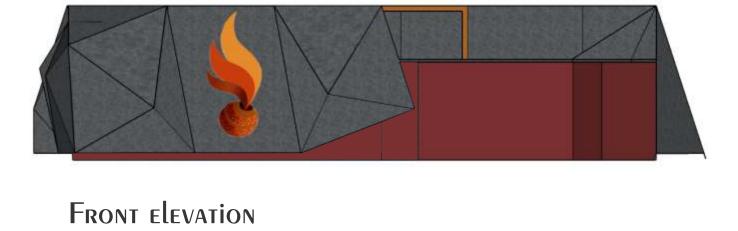
American Walnut

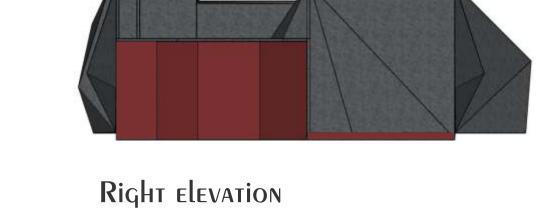
Charcoal, ANP 3055

New Orange, CEP 1130

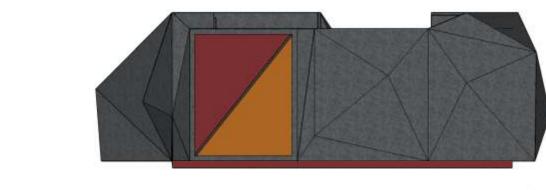
Interpon 700,











Back elevation



5.4.3. Wall cladding and seating

The wall cladding and seating is located to the right as visitors enter the foyer. The bench seating is supplemented with free standing ottomans. The seating provides a rest area to visitors to inhibit fatigue.

The faceted wall cladding provides a focus wall within the foyer. The facets are emphasised with LED colour changing lighting. The concealed lighting units are located above and below the faceted cladding.

The faceted wall cladding reflects sound at different angles which prevents echoes within the foyer. Some facet units are perforated to allow a small amount of sound to be absorbed by an absorbent backing material.



Figure 5.4.3.1. View towards wall cladding and seating.

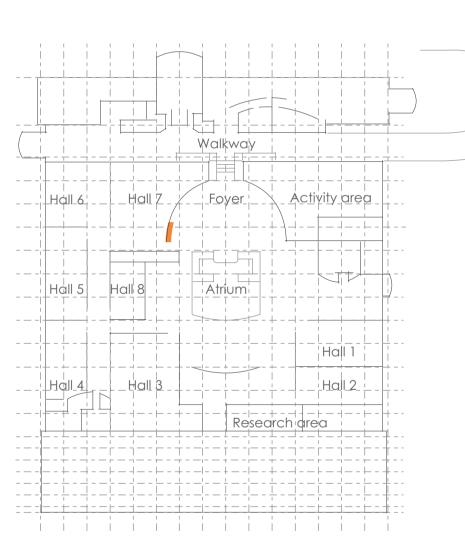
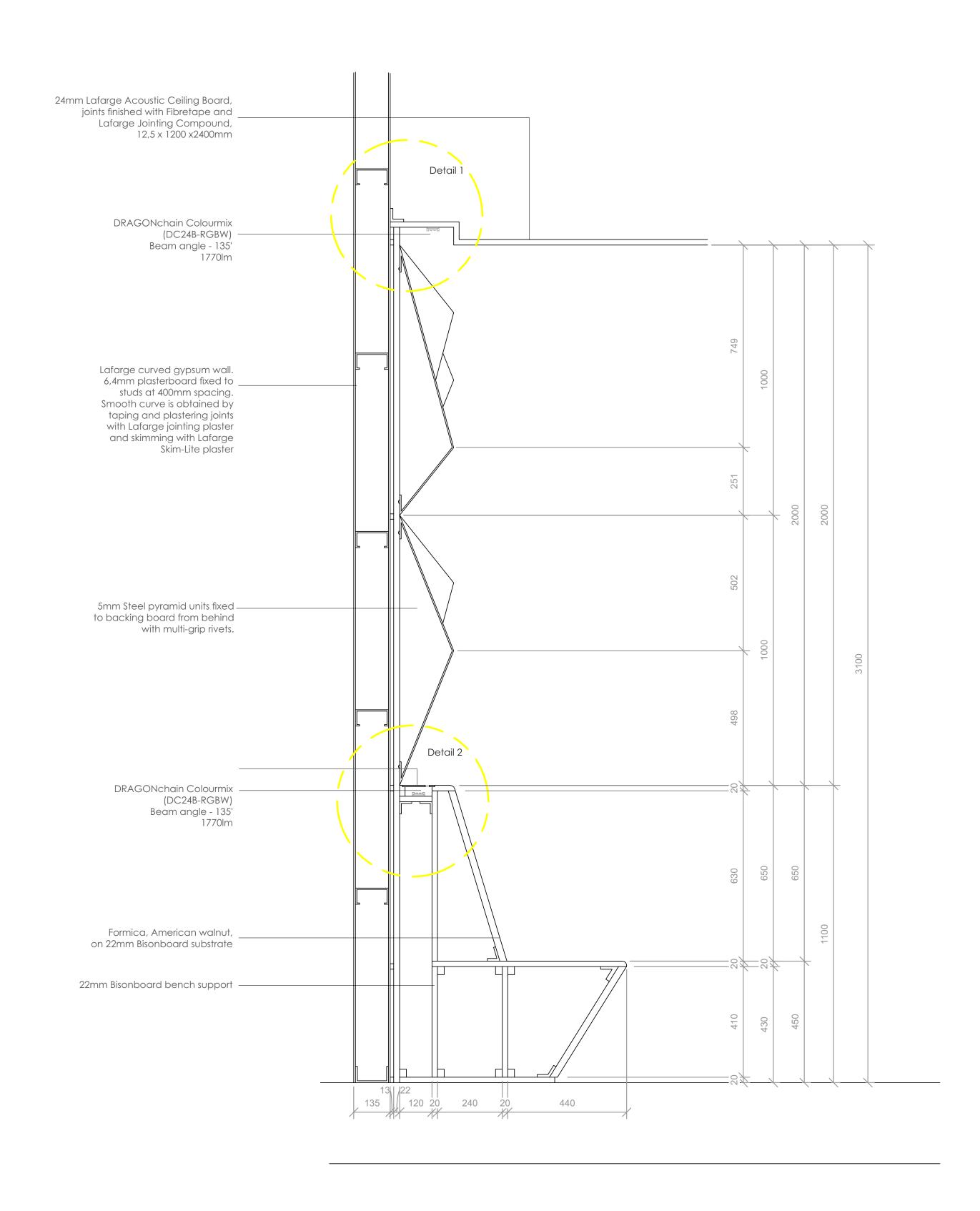


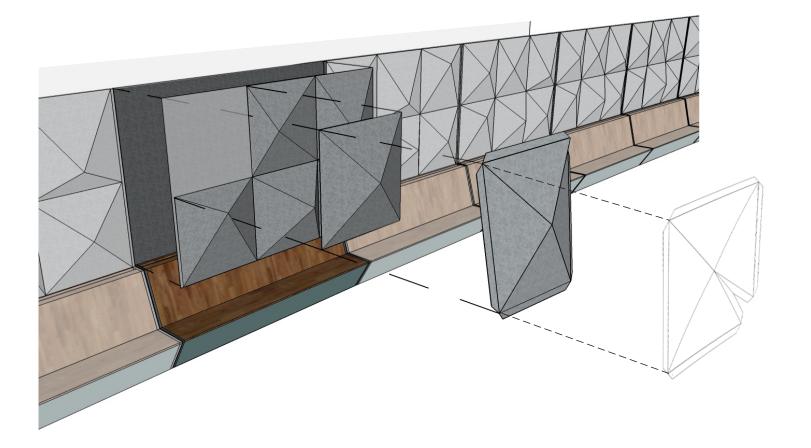
Figure 5.4.3.2. Location of wall cladding and seating.



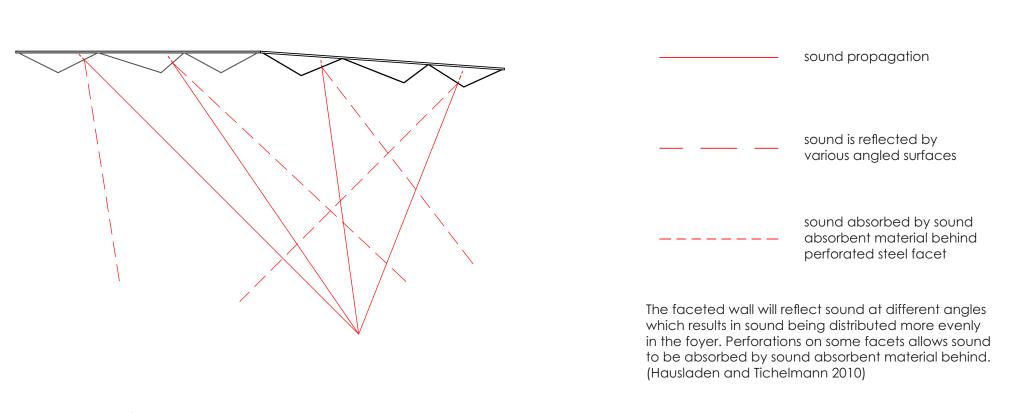




Section Scale 1:10

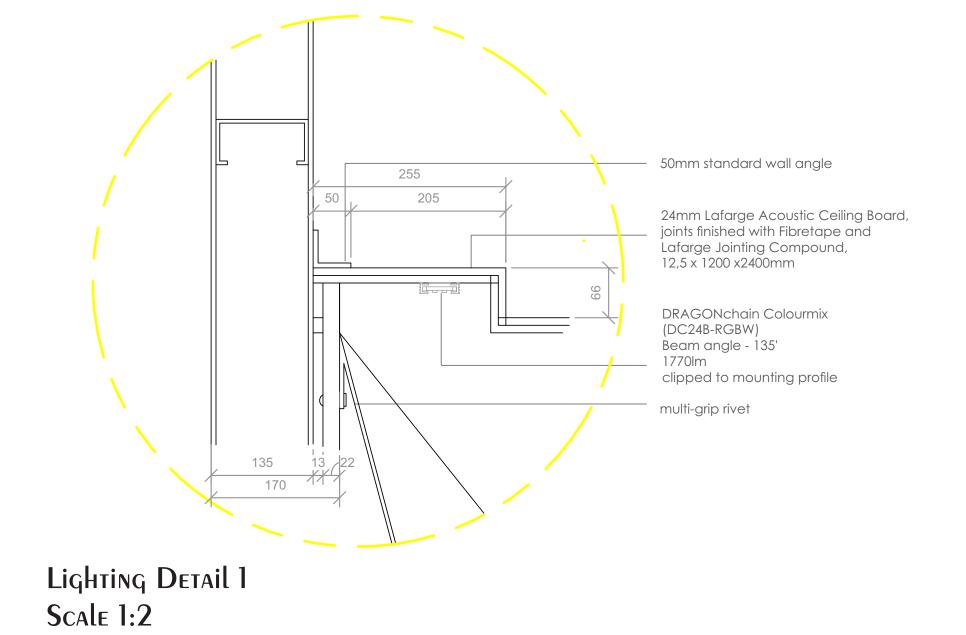


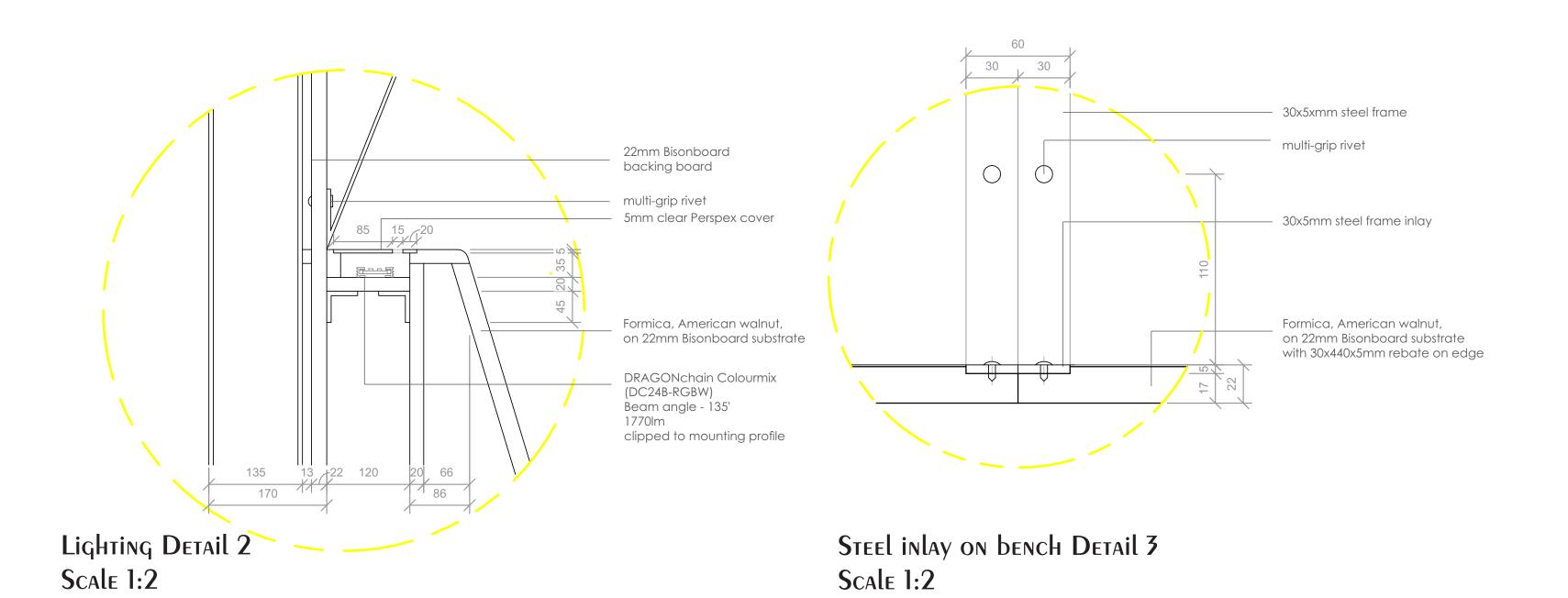
Exploded axonometric of wall cladding

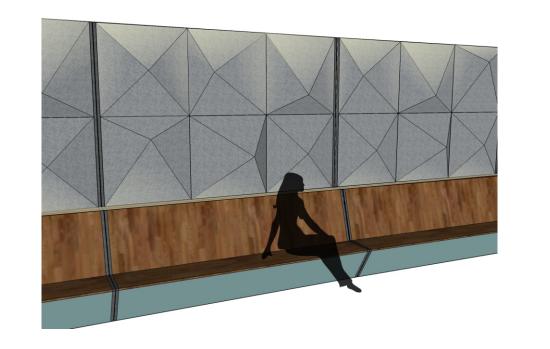


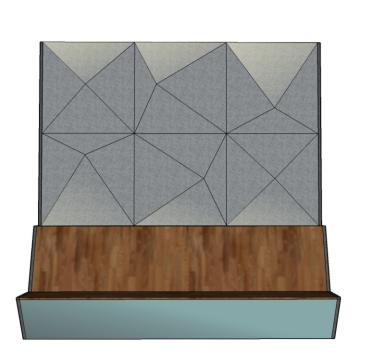
3120 3000 83 1000 1000 1000

Elevation Scale1:20





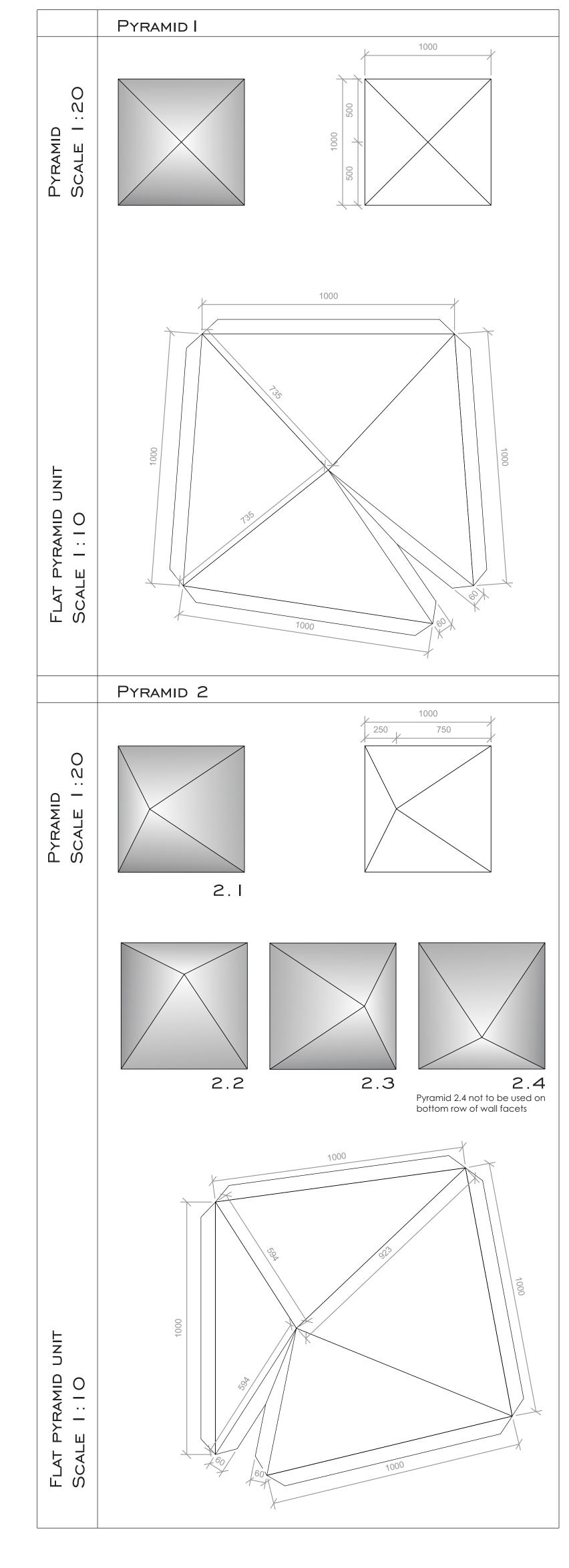




Views of wall cladding and seating

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Pyramid units used to create facet wall





5.4.4. Self service station and free standing sign

The self service stations and free standing signs provide navigational aids for visitors.

The self service stations include free standing units to be used for electronic ticket purchasing and three-station units to be used for interactive maps.

The free standing signs are located throughout the museum complex at navigational decision points. The text on the signs is covered by a photoluminescent vinyl film which will emphasise the sign in darker lighting conditions.

Lighting and floor finishes will emphasise these units as secondary landmarks within the museum. The self service station and free standing signs have a minimum height of 2200mm which allows them to be visible from afar.

The self service stations and free standing signs incorporate the faceted design identity of the intervention.



Figure 5.4.4.1. View towards self service stations.

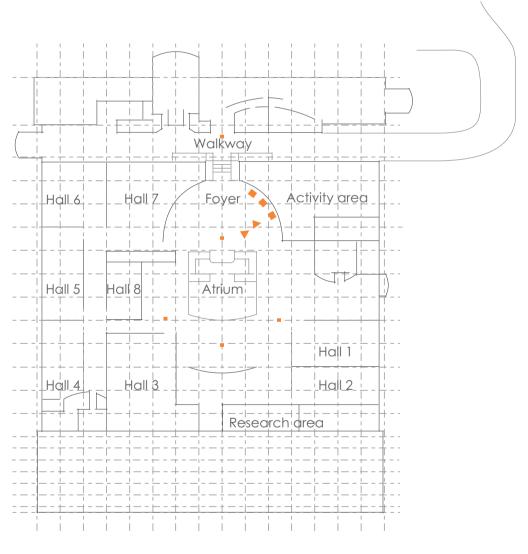
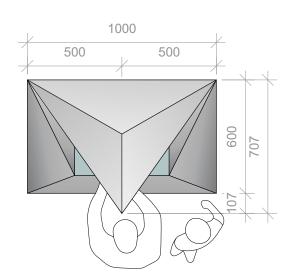


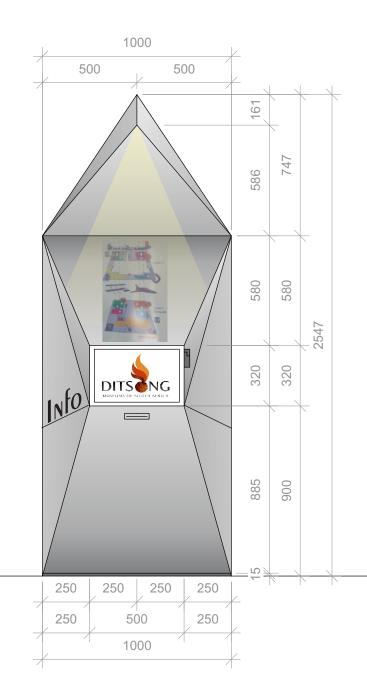
Figure 5.4.4.2. Location of self service stations and free standing signs.

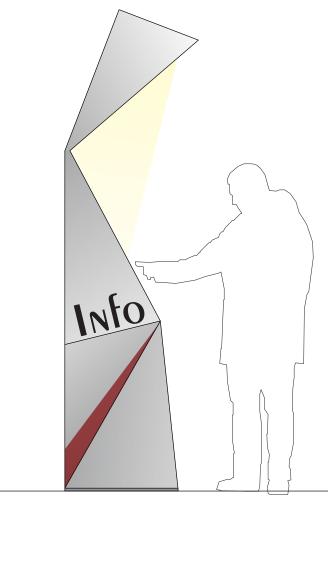


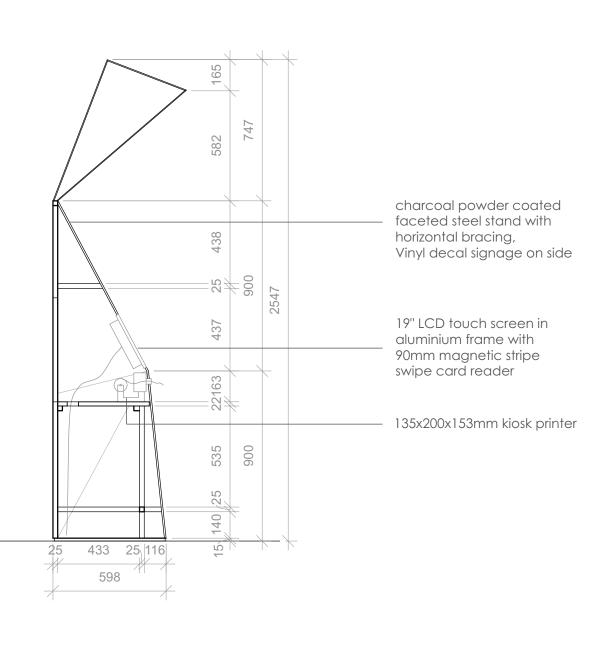




Plan Scale 1:20



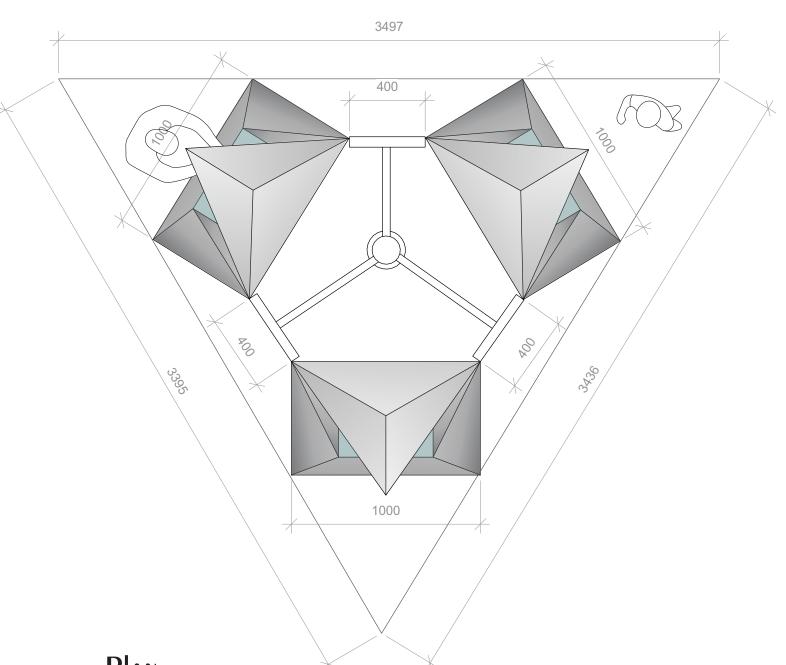




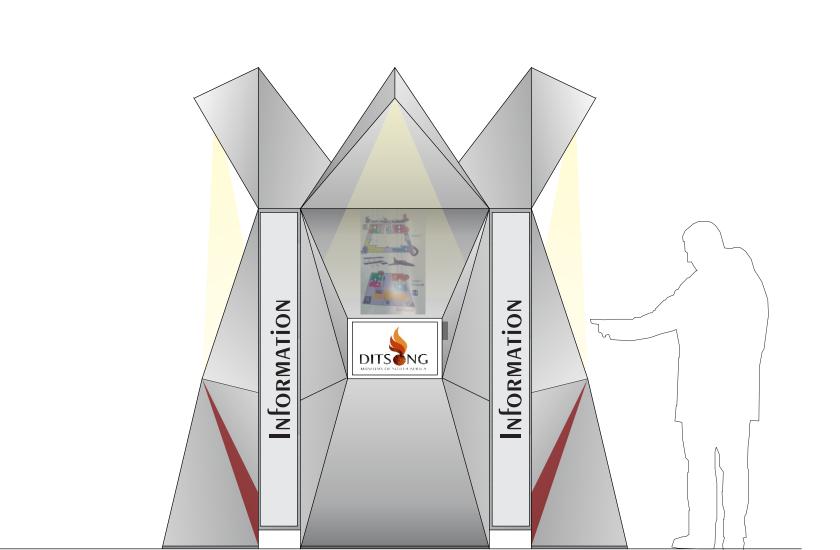
Front elevation Scale 1:20

Side elevation
Scale 1:20

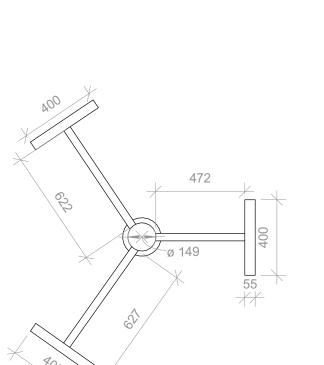
Section
Scale 1:20



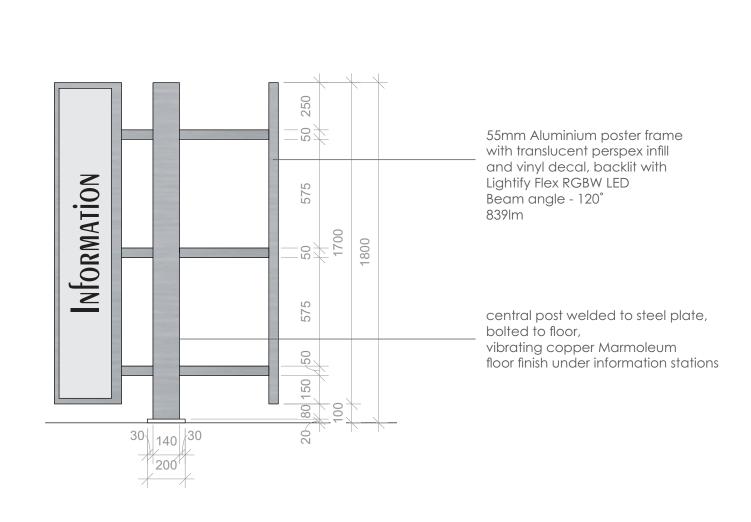
Plan Scale 1:20



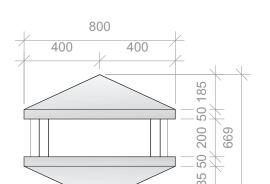
Elevation
Scale 1:20



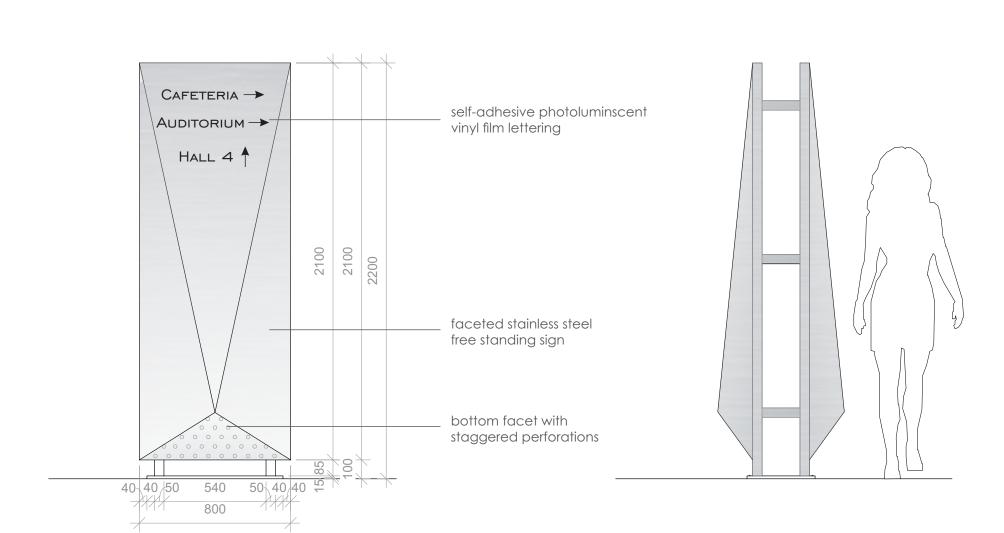
Plan Scale 1:20

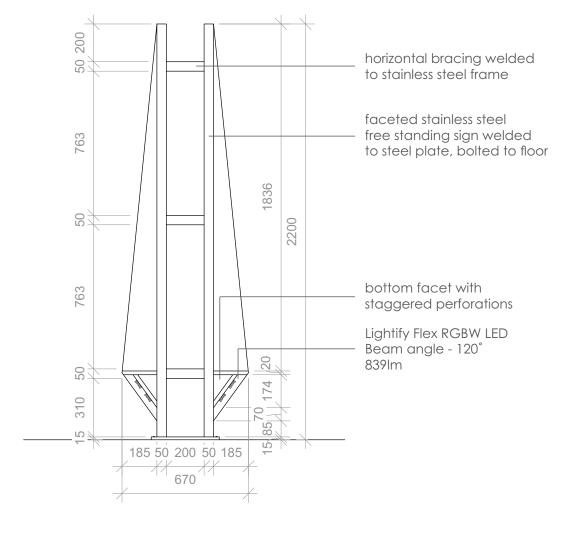


Elevation
Scale 1:20



Plan Scale 1:20





Front elevation Scale 1:20

Side elevation
Scale 1:20

Section
Scale 1:20







View of free standing sign