ADDENDUM

CALCULATIONS

Although figures are based on assumptions the following are examples of how calculations may be based around an estimated community of 2000 people.

VOLUME OF WATER RESERVOIR

Water volume needed per day for a community of ≈ 2000

There is approximately 32 shacks per 10 000 m² (100m x 100m) in the informal settlement of Phumolong.
Assume a family of 5 per household on average.
Therefore 33 x 5 = 165 people/10 000 m²

Community standpipes are usually located at 200 m radii intervals
Therefore area served within 200m radius:
$\pi(r)^2 = \pi(200)^2 = 125\ 000$ m²

Population:
125 000/10 000 = 12.5 x 165 people = 2062.5 people/200 m radii

Borehole yield:
Borehole yield ≈ 1.5 ℓ/s (based on surrounding borehole yields)
24hrs ≈ 129 600 ℓ/day
12hrs ≈ 64 800 ℓ/12hrs

Water per capita per day:
Metric handbook: 20 – 40 ℓ/c/day
Dept. of Water & Environmental Affairs: 25 ℓ/c/day (desired increase to 50 ℓ/c/day)
Therefore average ≈ 37.5 ℓ/c/day

Thus: 64 800 ℓ/37.5 ℓ/c/day ≈ enough water for a community of 1728 in a 12 hour period or a community of 3456 in a 24 hour period

Thus: a community of 2062.5 requires 77 343 ℓ/day
Therefore storage tank size (1000 ℓ = 1 m³) ≈ 77 m³

ANAEROBIC METHANE PRODUCTION

A septic tank behaves as an anaerobic digester and is used in isolated areas. It is important to note that the biodigester proposed for this project is used as a temporary holding tank. The sludge from this holding tank would be removed by commercial trucks transporting the waste to a nearby treatment plant (approximately 5 km from site at the sewage disposal works) for disposal. However, during the storage period, methane gas is produced naturally and it could be extracted and stored as a fuel.

Methane gas (CH4), is a natural carbohydrate gas.

Advantages of anaerobic fermentation:
Reduced odour, disease control, pollution control, self-sufficiency, fertiliser production and biogas production.

"Anaerobic fermentation or digestion discovered by J. Louis Mouras in 1860 led to the development of the septic tank by means of which odours and water pollution are controlled. Pathogens are killed and the bulk of the waste is reduced at least 50 per cent" (Holm, 1983: 73).

Minimum ignition temperature of methane: 650ºC
Minimum ignition temperature of petrol: 480-550 ºC

In the publication *Energy Conservation in Hot Climates*, 1 m³ of waste material produces 0.75 m³ of gas per day (Holm, 1983: 74).

Quantities of biogas in typical wastes (Holm, 1983: table 7.2)

Material	Unit gas production m³/day 0.028	Volume of gas/ mass waste m³/kg	% methane
Sewage (human)	0.22	0.31 – 0.74	68
Cattle	0.014	0.094 – 0.31	65
Chickens		0.31 – 0.62	60

Domestic daily biogas consumption (Holm, 1983: table 7.4)

Use	Quantity of biogas m³/day
Cooking and baking (1 person)	0.255
Cooking and baking (5-6 persons)	1.5 – 2
Hot water (kitchen, bath and shower)	5.0
Bath once	0.6
Shower once	0.35
Refrigerator	2.5 – 3.0
Lighting (5 hours)	3.0

Volume of biogas produced in m³ per day for a community of 2062.5:
2062.5 x 0.028 = 57.75 m³/day
Such volume of gas may be sold and used as gas to cook for 255 people or 96.25 lighting hours (19.25 x 5 hours lighting)

SOLAR WATER GEYSER

Type: Solar geyser, Thermosiphon close-coupled system
Output: A 250 ℓ storage tank with 1 collector (2 m²) allows for 5 showers/3hours.
Manufacturer: SolarTech (South Africa)

Calculations are based on figures made available from SolarTech, a South African solar water geyser supplier.

The K250i indirect SolarTech water heating system is a close-coupled system (tank higher than the collectors) using a natural thermosiphon method of water circulation. 1 collector of 2 m² is capable of heating 250 ℓ of water every 4 hours (approximately) (SolarTech, 2009). The average water consumption per shower is 30 - 50ℓ (Solarheat, 2005). With the use of low-flow shower heads, shower water may be reduced by 50 – 75% (Smeddle, [sa]: 86), thus reducing the shower water to approximately 15 - 25 ℓ.

Hot water form a geyser is usually mixed with cold water to bring the shower water to an ambient temperature of between 30 - 40 ºC. Thus not all 250ℓ of hot water in the geyser is used directly for shower water. Temperature within a solar tank may typically be 80ºC. Assuming ambient shower temperature is 37ºC, the ratio of hot to cold water is 1:3 [(80 + 25 + 25 + 25) / 4)] (25ºC average temperature of cold water from tap).
Assuming average water consumption per shower is 20ℓ (15 - 25ℓ), 5 of which is made up of hot water. Thus a 250ℓ solar collector tank (at 80ºC) can supply hot water for 50 showers.

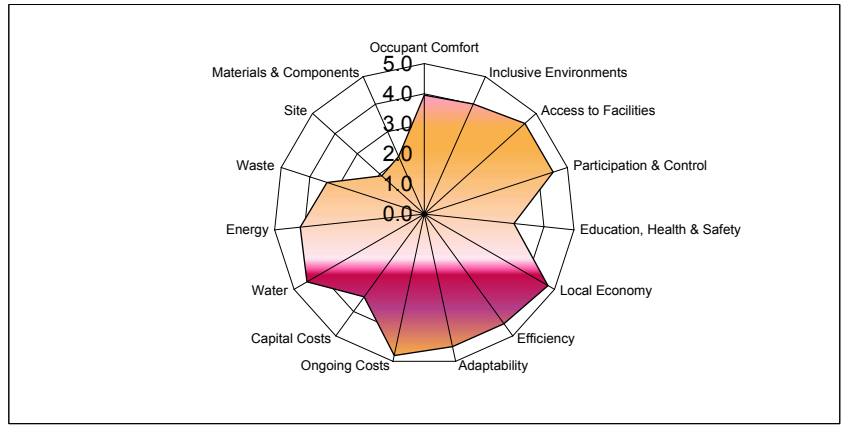
Assuming that at maximum operation the public ablution facility can support 1000 people/day, the amount of water needed for showering will approximately be = 1000 people x 20ℓ = 20 000ℓ
Hot water needed (1:3) = 5000ℓ of the 20 000ℓ for hot water.

1000 showers/50 showers per 250ℓ tank = 20 units
Thus 20 solar water geysers and collectors are needed for 5000ℓ of hot water simultaneously. However, shower use is throughout the day and will decrease the amount of solar water heating systems needed at once.

This calculation is based mainly on assumptions. Final figures should be discussed with specialists. However, the design intervention has provided ample installation area for additional units to be installed.

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT	
Project title:	Servant Core	Date:	Oct-09
Location:	Mamelodi, Tshwane	Undertaken by:	D Gottsmann
Building type:	Multi-functional public amenities building	Company / organisation:	
Internal area (m2):	750	Department of Rural Development & Land Reform	
Number of us users:	n.a		



Social	4.0	Economic	4.4	Environmental	3.2
Overall	3.9	Classification	VERY GOOD		

SUSTAINABLE BUILDING ASSESSMENT TOOL

Used as an impact assessment tool during the design process, the SBAT system aids in providing possible approaches towards reducing the buildings impact on the environment.

However, the system is open to misuse and may not reflect the true environmental impact of the completed building. Certain approaches towards architecture have also not been considered.

Werner Sobek stated:
“Environmental efficiency is not a goal in itself but simply a by-product of good building” (Dwell, 2009: 94)

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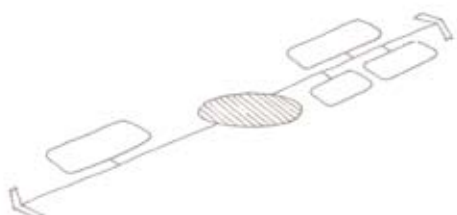

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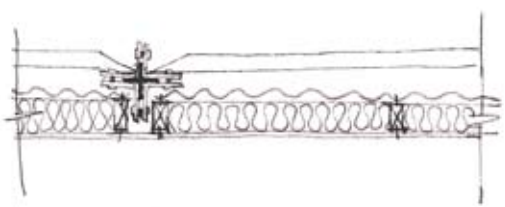

Fig. 133 Details

Fig. 134 Next page: Silhouette of structure within its context

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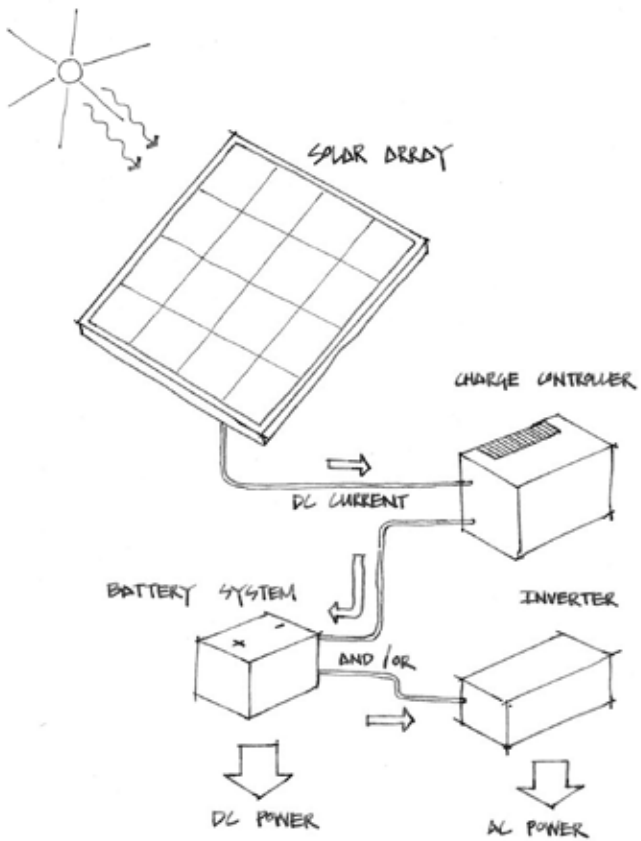
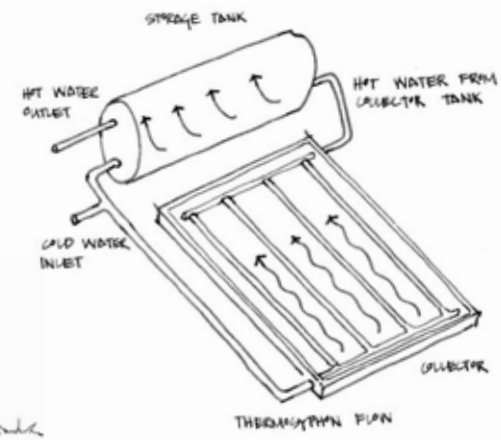




SOLAR PANELS

Type: Solar panels
Source: Solar rays
Output: Ranges from 10 to 240 W power output are common. A typical 240W photovoltaic (PV) module of approximately 1.4 m^2 in area produces power voltages of 12/24V
Cost: ± R3000 – R10 000
Inverter-battery charger ± R9000
12V Willard solar battery ± R800
Advantages: automatically run and requires little maintenance.
Supplier: Gwstore

WINDMILL

Type: Windmill
Source: Wind
Output: 5kW at 12m/s and 258W at 4 m/s
Cost: R25 000 – R150 000 (2009)
Comments: The 4.6m rotor requires a start-up wind speed of 2 m/s
Manufacturer: Turbex

WIND TURBINE GENERATOR

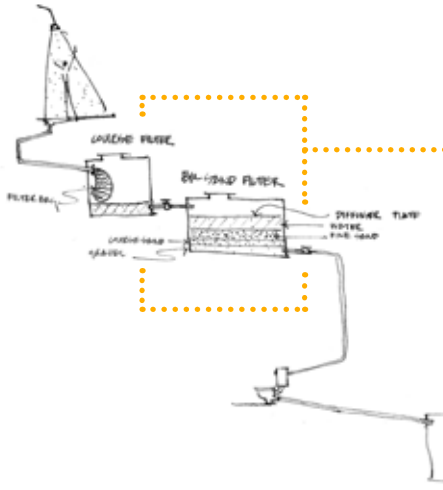
Type: Wind turbine generator
Source: Wind
Output: 900 W power output at 17 m/s
Cost: R50 000 – R250 000
Advantages: start up wind speed at 3.5m/s
Manufacturer: Lakota Aeromax 900W Wind Turbine

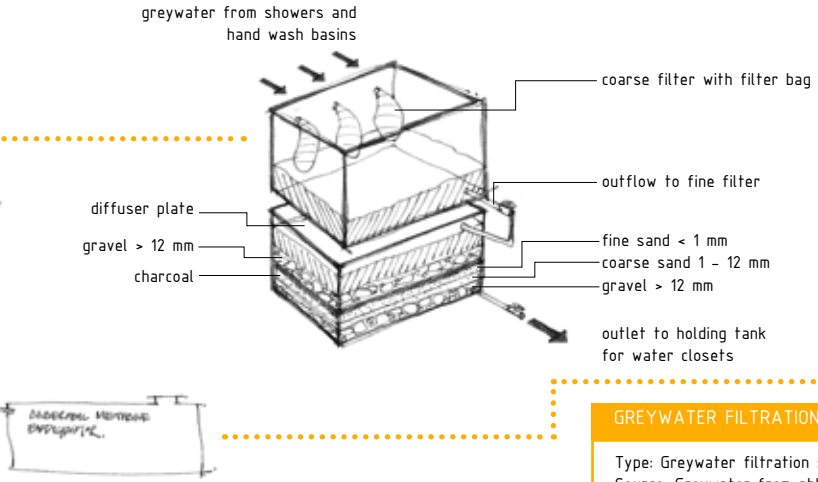
HAND PUMP

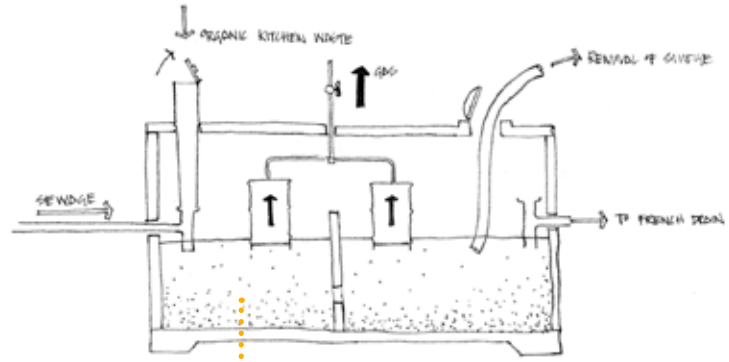
Type: Hand pump, reciprocating (plunger)
Source: manual labour
Output: 5-10 m^3/day
Cost: R5000 – R15 000
Comments: the cost of using numerous pumps in close proximity due to higher water demands, (requiring more boreholes to be sunk) may render this operation too expensive

SOLAR GEYSER

Type: Solar geyser, Thermosiphon close-coupled system
Source: Solar rays
Output: A 250 l indirect solar water heating system with 1 collector (2 m^2) provides for 5 showers/3hours.
Cost: ± R3500 – R7000
Advantages: No pumps are required to circulate water
Manufacturer: SolarTech





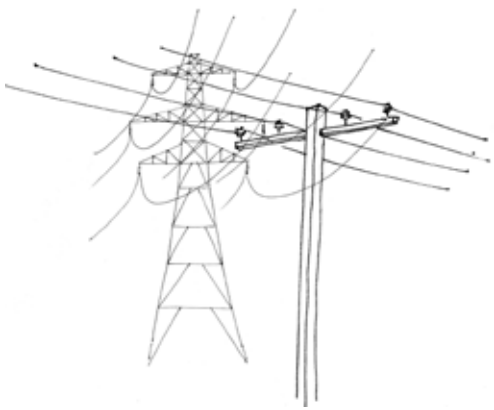


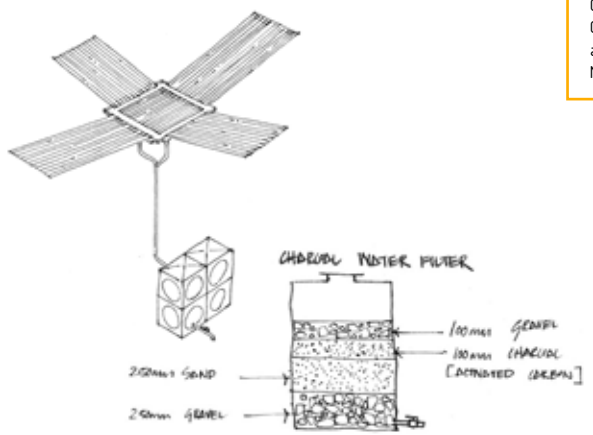
GREYWATER FILTRATION

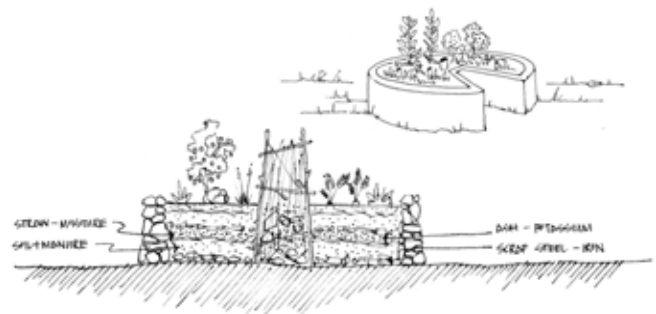
Type: Greywater filtration system
Source: Greywater from ablution facilities
Output: Filtered water used in water cistern
Cost: R1000 – R10 000 (depending on tank size)
Comments: Filtered water not harmful to anaerobic methane biodigestor
Manufacturer: Construction by local community

ANAEROBIC METHANE BIODIGESTER

Type: Anaerobic methane biodigester
Source: Human excreta and organic waste
Output: 1 m^3 of waste material produces 0.75 m^3 of gas per day
Gas production per person per day = 0.03 m^3 (Holm, 1983: 76)
Cost: Variable
Comments: Gas may be used for cooking or to heat water
Manufacturer: Construction by local community







NATIONAL GRID

Type: National grid
Source: Municipal grid
Output: 400–800 kWh/month (domestic low)
Cost: 62.57c /kWh (2009)
Comments: The national power grid is an option to be considered once the necessary infrastructure has been installed in the relevant area
Supplier: Eskom

RAINWATER HARVESTING

Type: Rainwater harvesting
Source: Rainwater
Output: Roof area x average rainfall = 44.4 m^2 x 0.674 m (weathersa, 2009) = 30 m^3 potential rainwater catchment per structure
Cost: R5000 – R10 000 (depending on tank size)
Comments: Rainwater could be further filtered and used in ablution facilities or unfiltered for irrigation
Manufacturer: Abeco tanks

REDUCED TOILET FLUSHING

Type: Reduced toilet flush systems
Source: Greywater
Output: Multi-flush systems use as much water as needed so long as the handle is held down. Dual-flush systems use 3 l (light setting) or 6 l (heavier setting)
Cost: R200 – R700
Comments: conventional toilets use between 11 – 15 l per flush
Manufacturer: Gypsy

LOW-FLOW SHOWERHEADS

Type: Low-flow showerheads and tap aerators
Source: Borehole water or municipal
Output: Reduces shower water by 50 – 75% (Smeddle, [sa]: 86)
Cost: R50 – R300
Comments: Aids in reducing water consumption
Manufacturer: Energywise

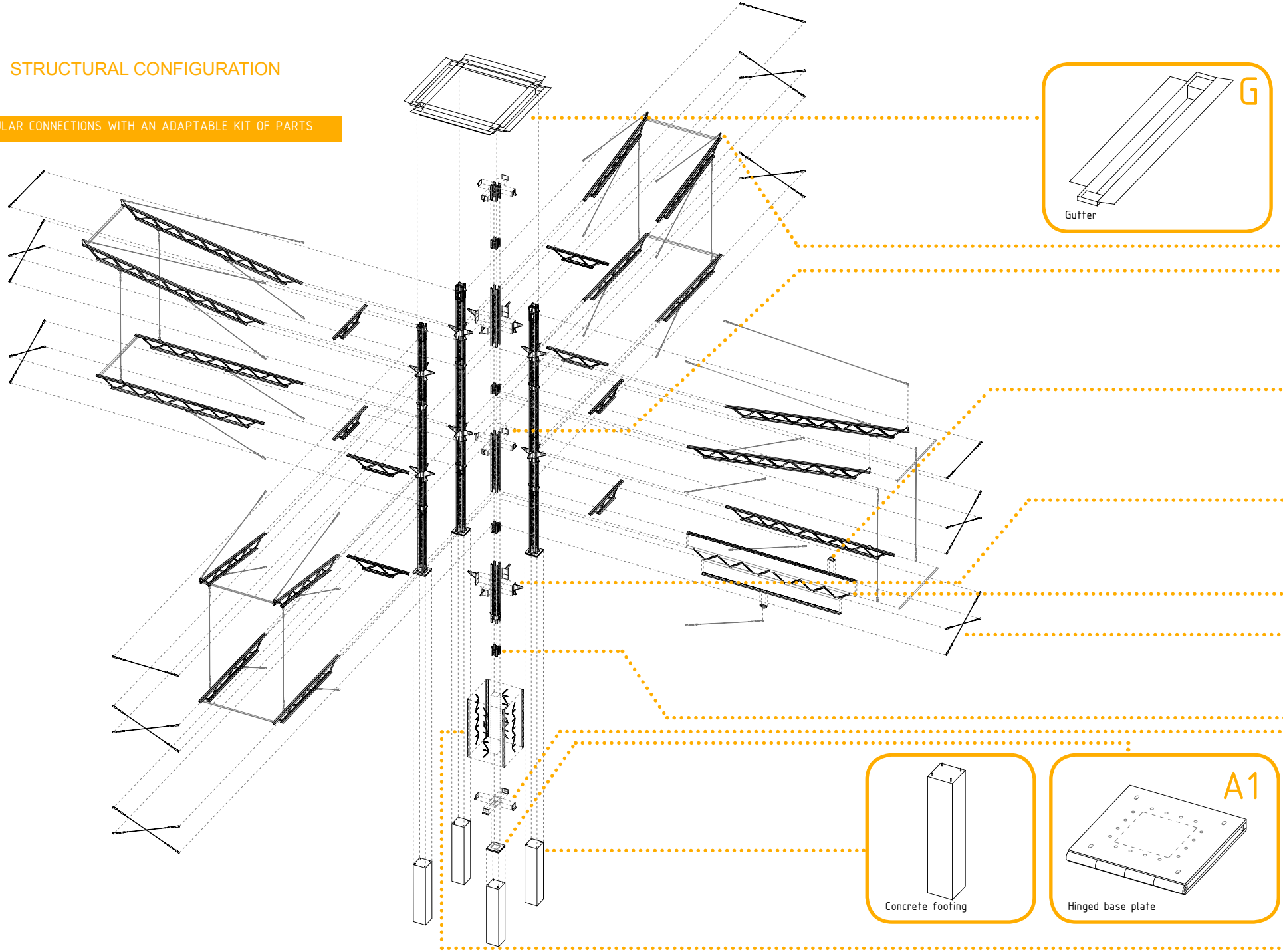
KEYHOLE GARDENS

Type: Keyhole gardens
Source: Excess filtered greywater
Output: Vegetables
Cost: Natural and recycled material used
Comments: Less susceptible to water loss through evaporation.
Manufacturer: Local community intervention

Fig. 135 Energy sources and water conservation strategies

STRUCTURAL CONFIGURATION

MODULAR CONNECTIONS WITH AN ADAPTABLE KIT OF PARTS



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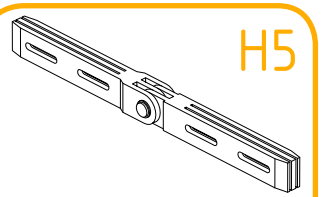
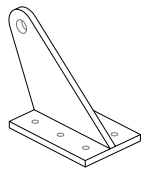


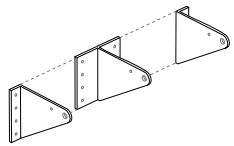
Horizontal hinged joint connector between beam and beam

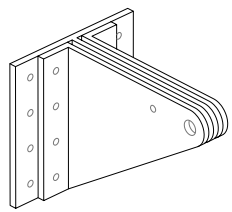
H4



Cable to beam

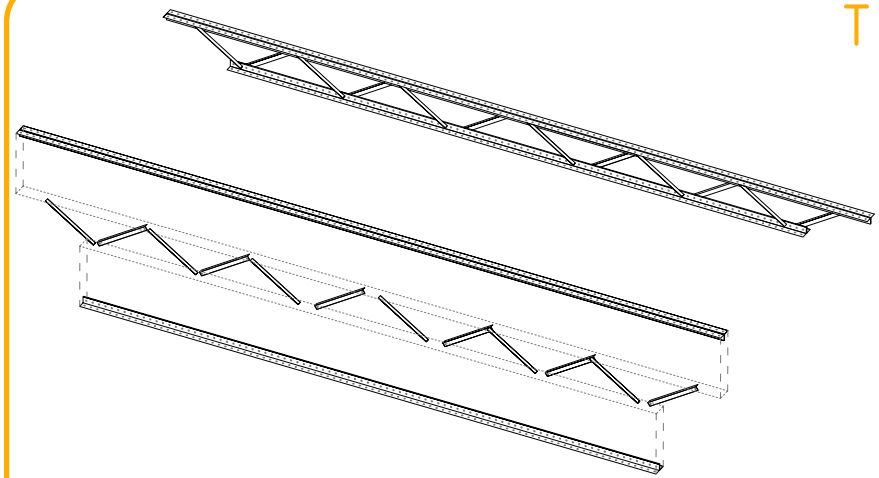
H1





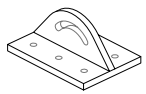
Truss to column

T



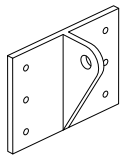
T – Truss composition of cold formed angle irons (50 x 50 x 3 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 420 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

H3



Cable to beam

H2



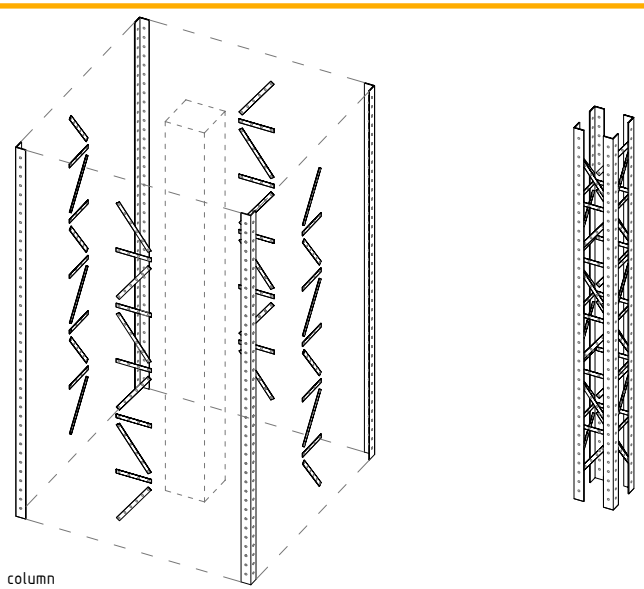
Cable to column

X

Turnbuckle with high tensile steel cable

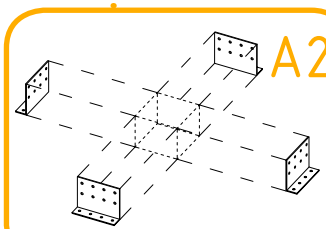
Kit of parts:
A – Footing connections
C – Lattice column
F – M8 nut and bolt
G – Gutter
H – Mild steel hinges
J – Vertical connection joint
T – Composite webbed truss
X – Cable bracing
All steel members to be hot dipped galvanised
Fasteners either M8 bolt and nut or 8 dia gutter bolt

C



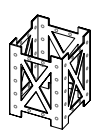
Lattice column

A2



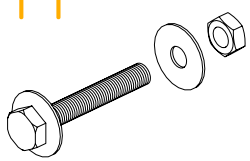
Column to base plate

J

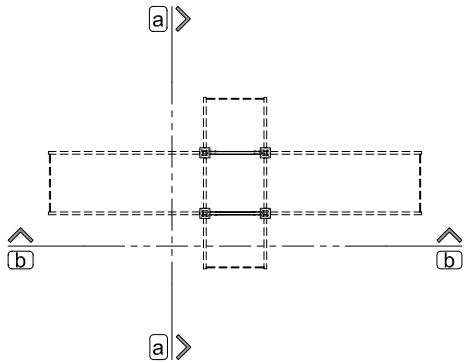


Column to column

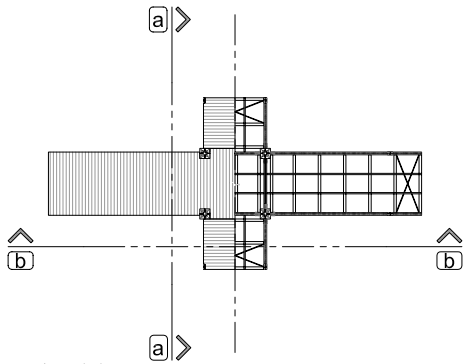
F1



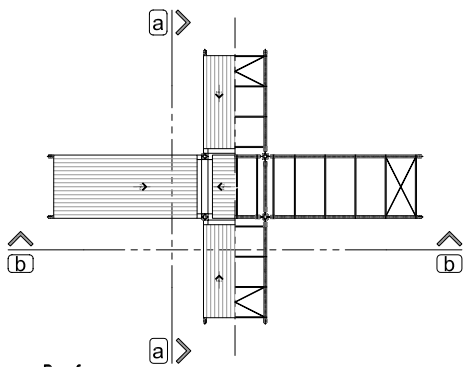
Fastener



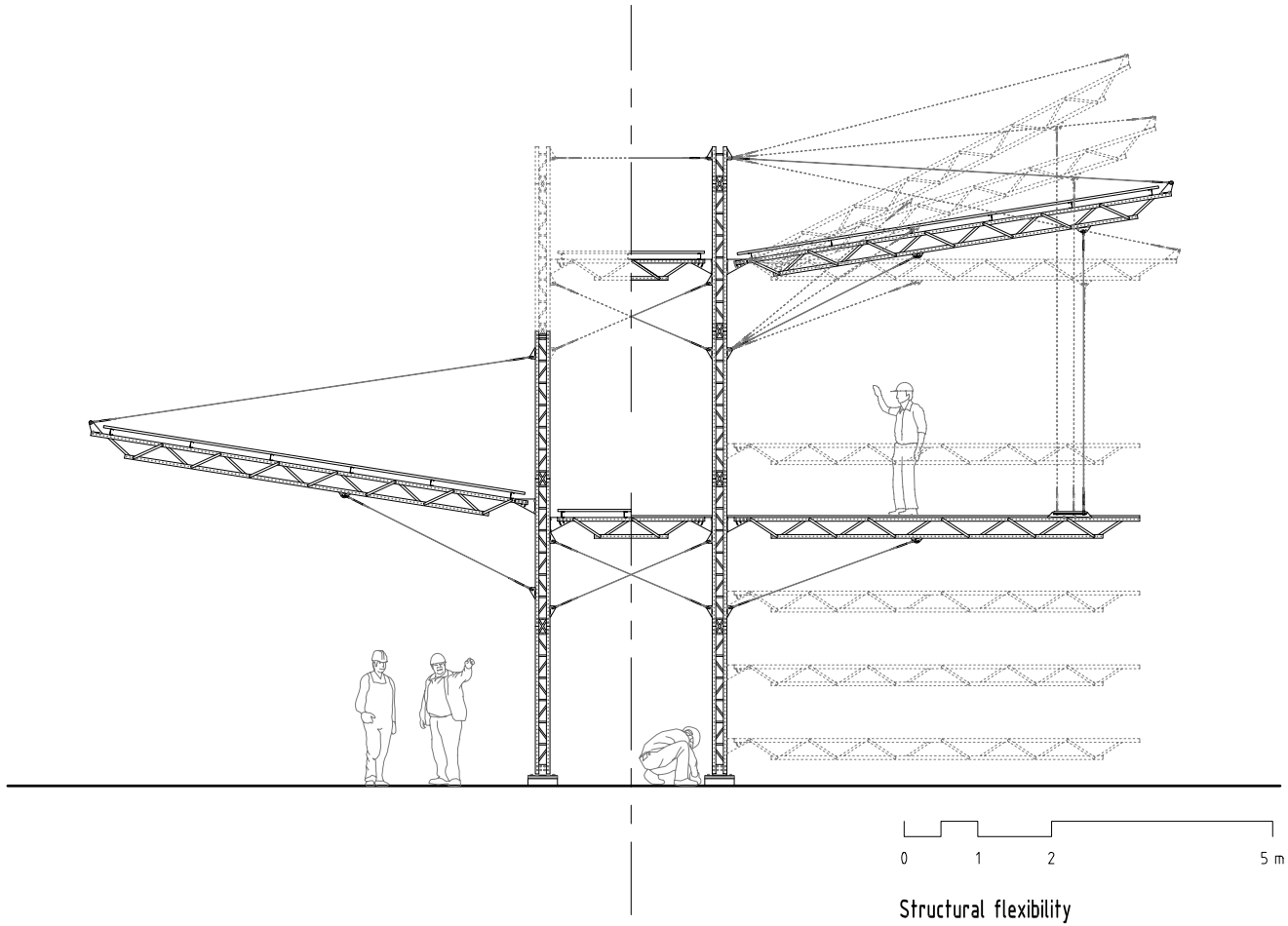
Ground



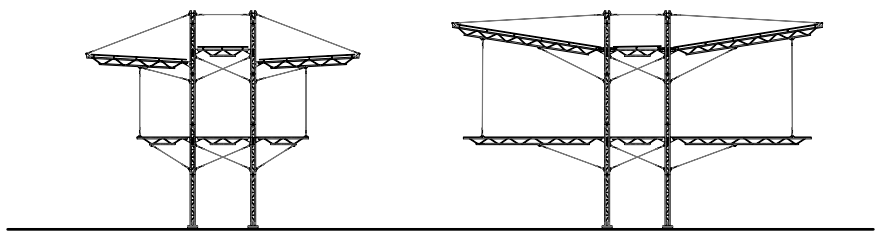
Level 1



Roof

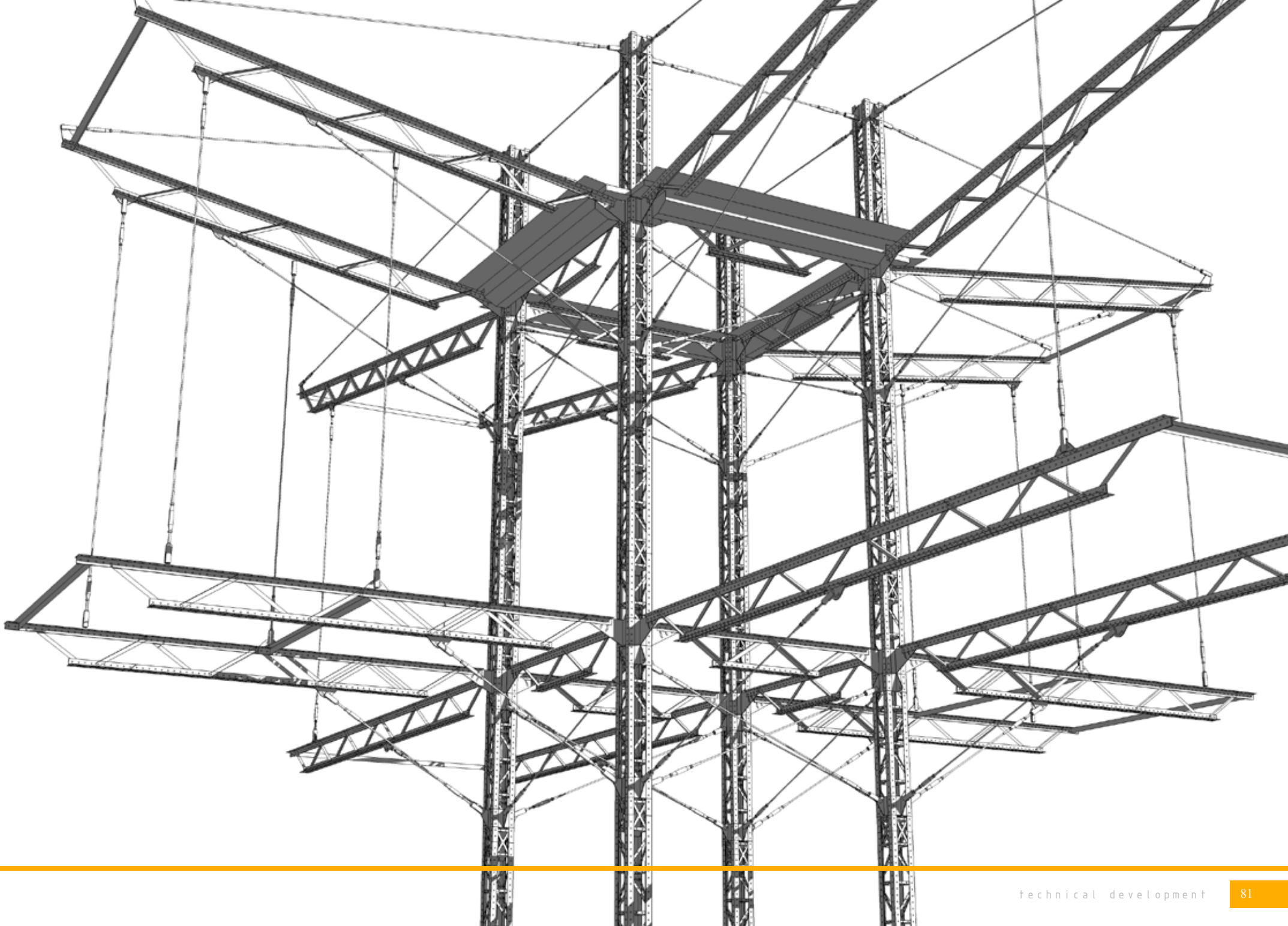


Structural flexibility

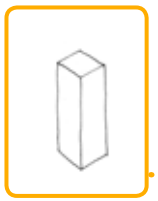


a-a b-b

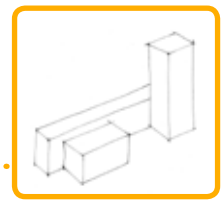
Tensile structure

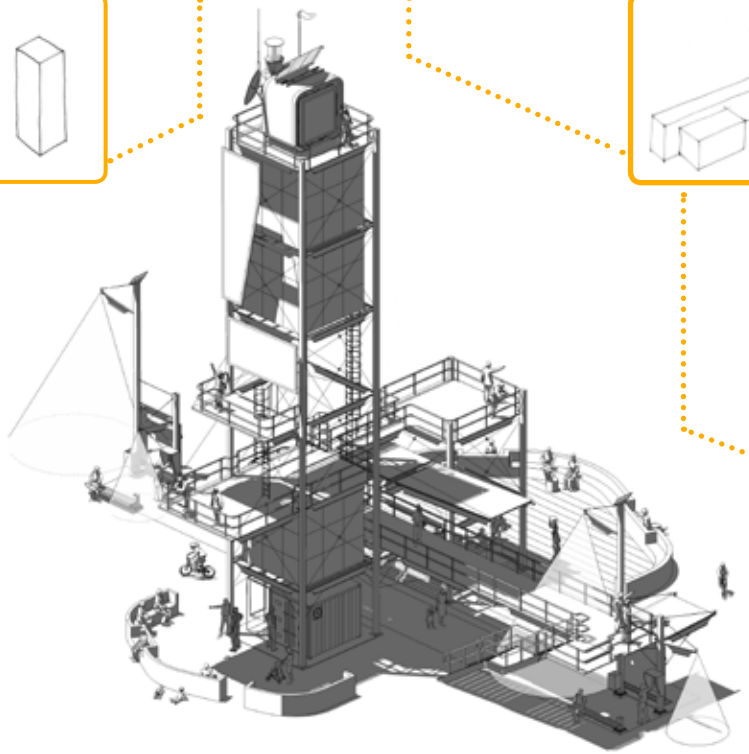


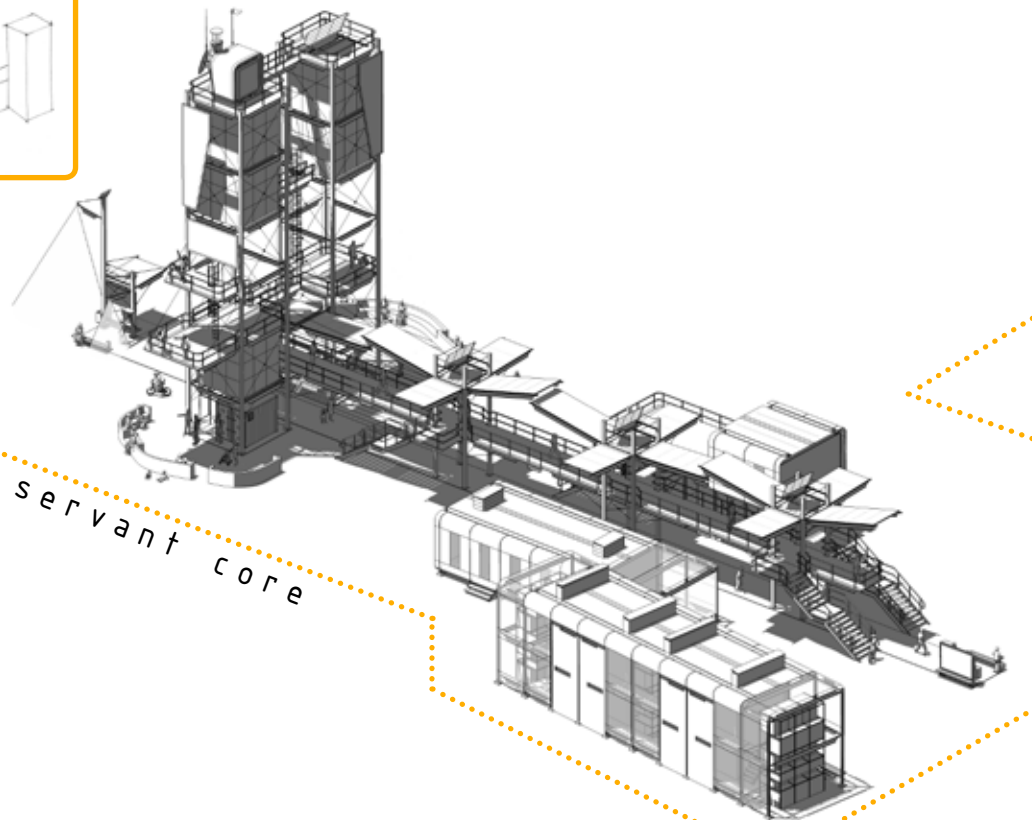
PHASE 1



PHASE 2







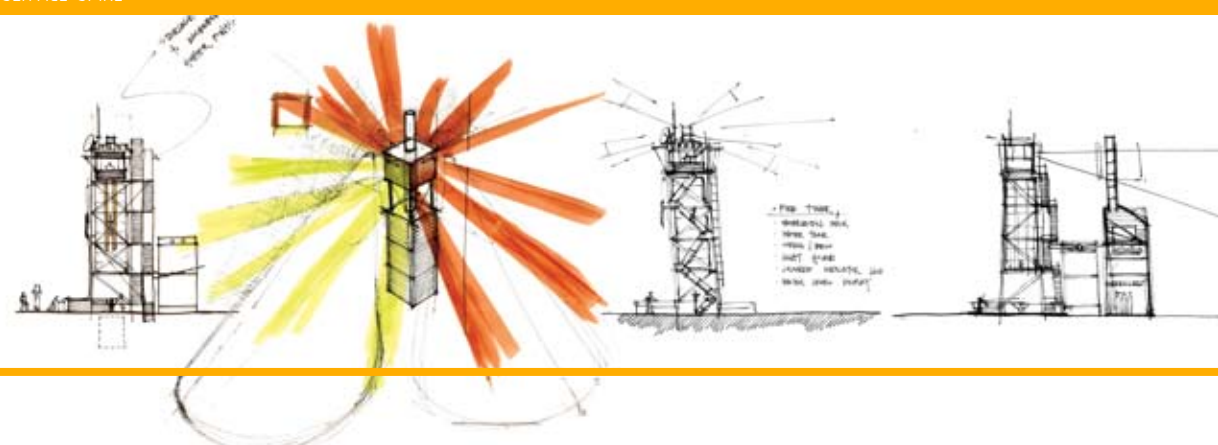
servant core

Servant Core

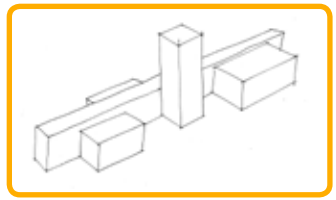
The servant core as a design intervention exists as a process. A phased upgrading is envisioned introducing additional services at later stages of the project. The first stage is to initiate the catalyst whilst the modular steel units extend through later phases defining the spine[s]. Additional public amenities programmes may be accommodated through the servant spine. Any part of the programme may be detached when rendered obsolete.

The original design intervention initiated a servant core in the form of a water reservoir tower. The tower should serve as a catalyst stimulating new activities (both built and social).

SERVANT CORE TO SERVICE SPINE



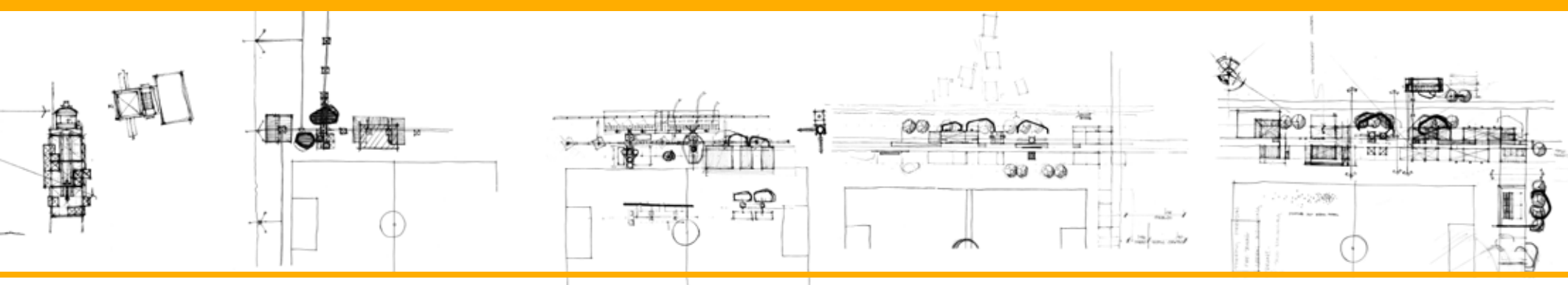
PHASE 3



Servant Spine

An adaptable structure should allow for reuse of the structure and its servant spine. A change in building programme or the introduction of a complete new programme should be facilitated to accommodate a future function and user.

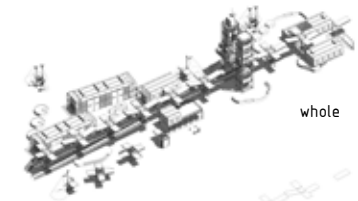
multi-functional service facilities



Locality map

Distance relation to educational facilities, taxi rank and main roads

6S'S



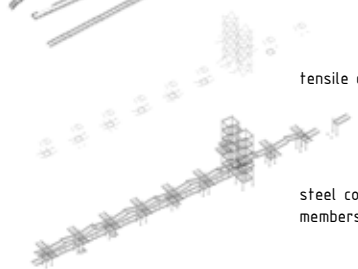
whole

skin

water tanks

circulation

services



tensile cables

steel compression members

structure

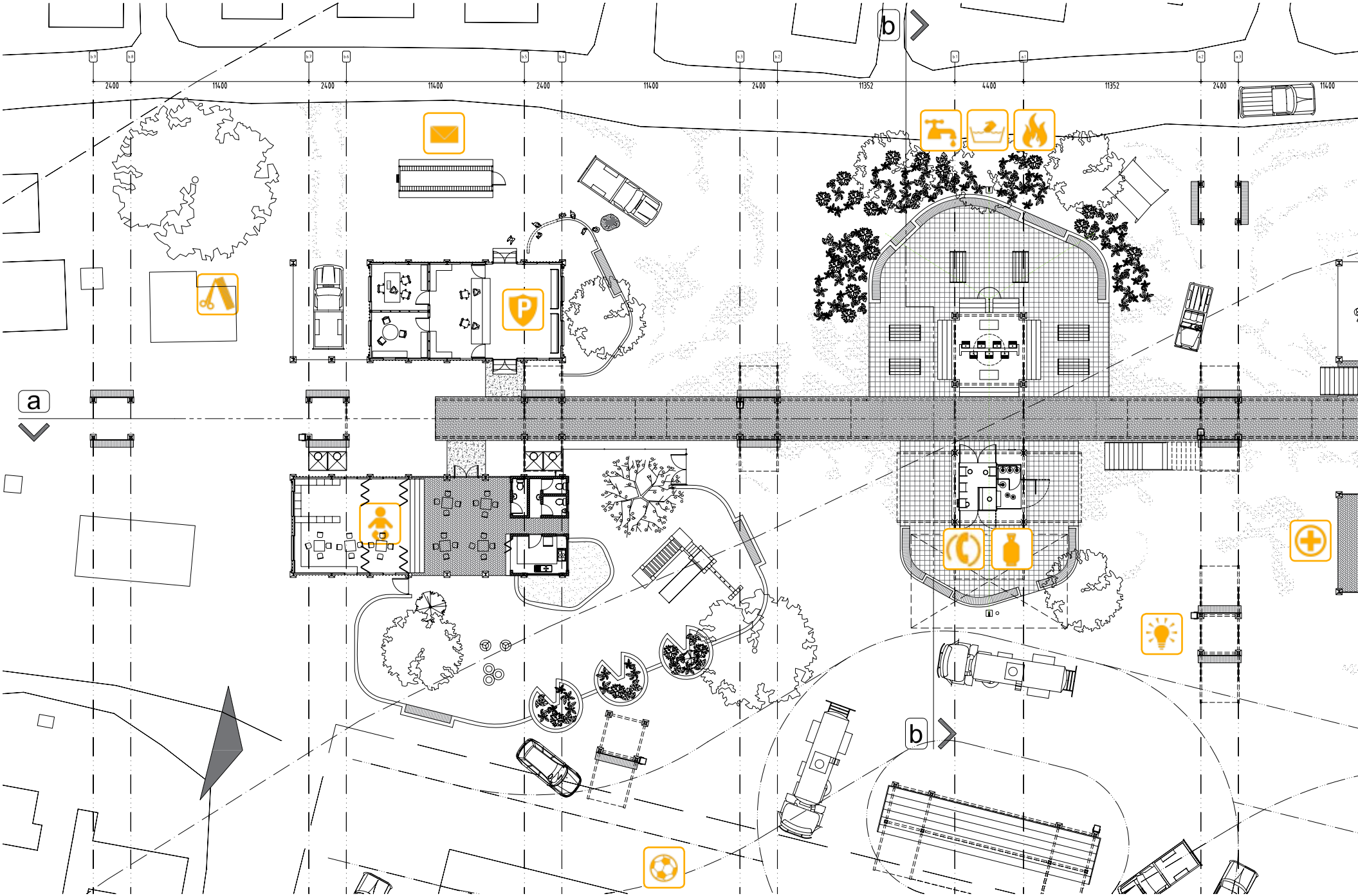
space plan

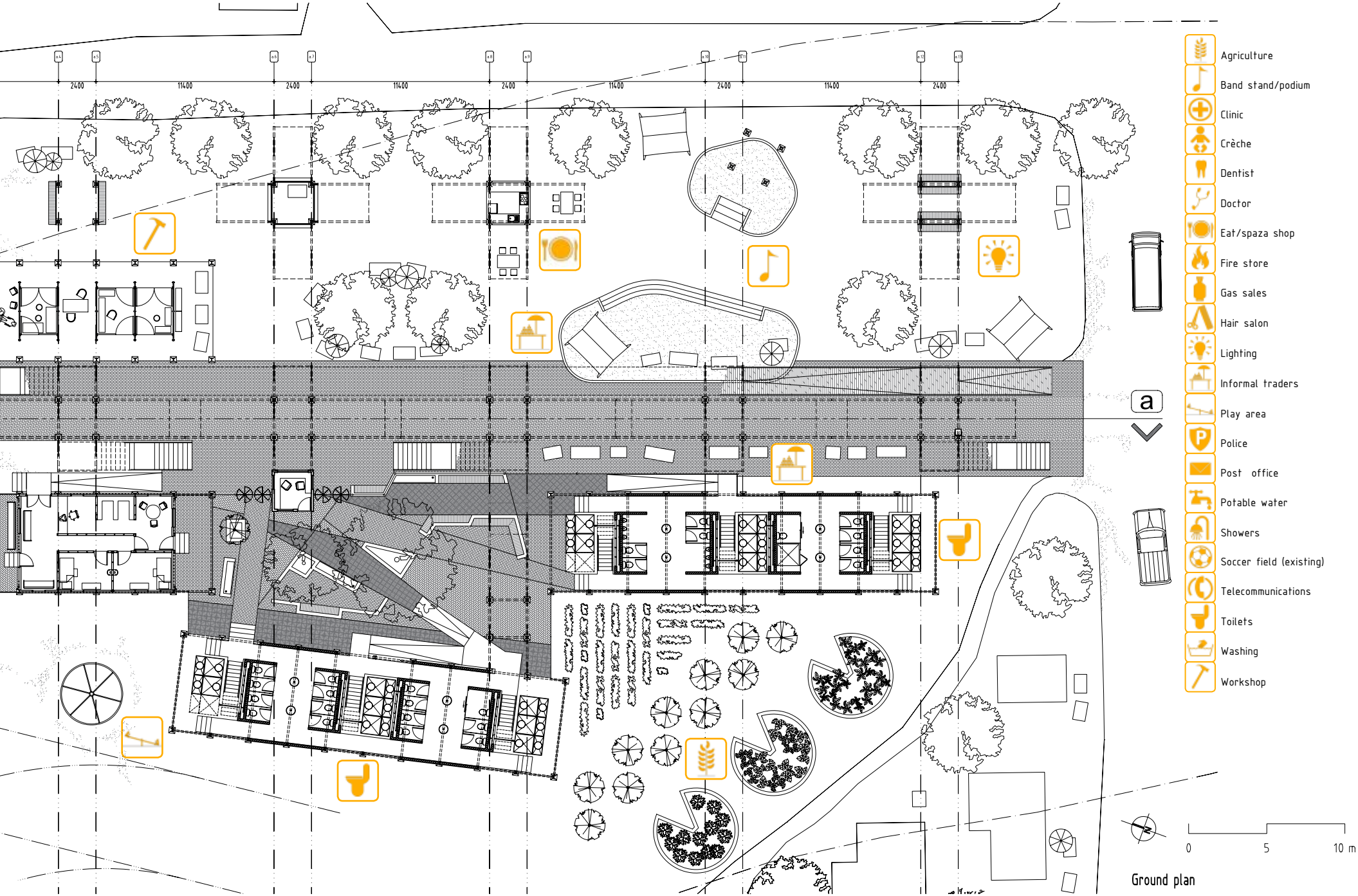
auxiliary programmes

site

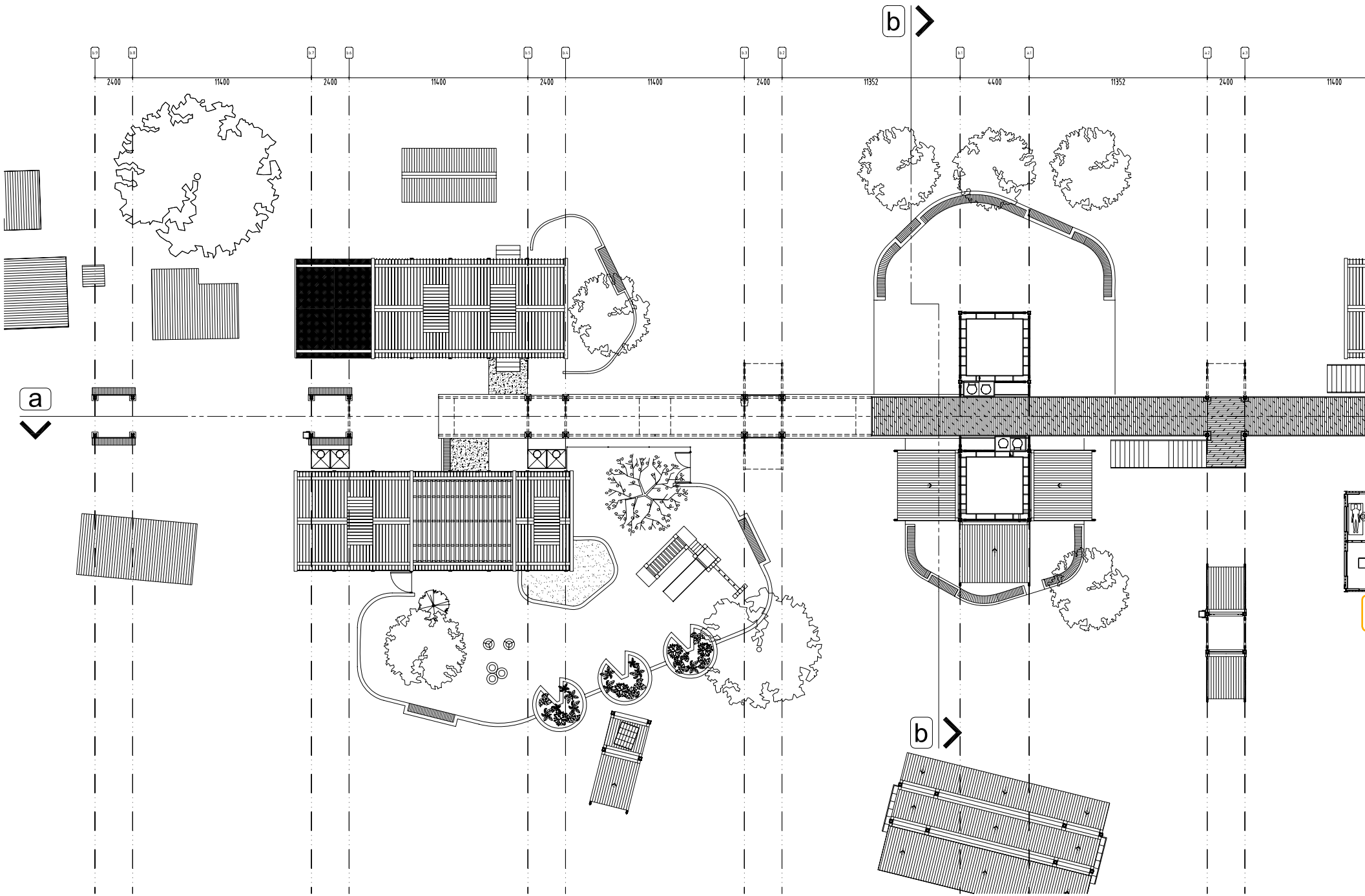
Site plan
Representation of possible scenario at advanced stage of the servant cores life

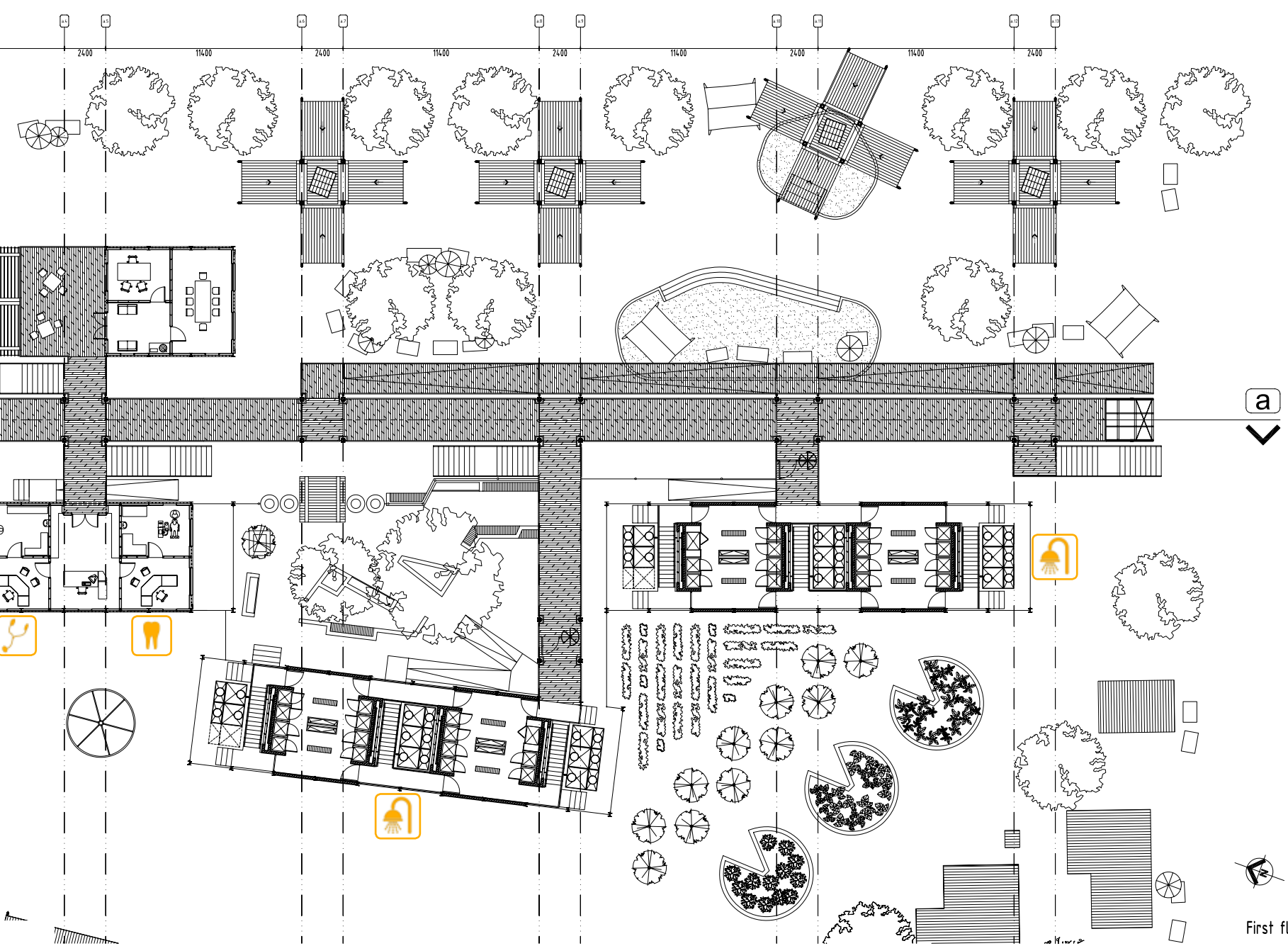
0 10 m 50 m 100 m


a
b
b
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400


2400
11400
2400
11400
2400
11400
2400
11400
2400
a
Agriculture
Band stand/podium
Clinic
Crèche
Dentist
Doctor
Eat/spaza shop
Fire store
Gas sales
Hair salon
Lighting
Informal traders
Play area
Police
Post office
Potable water
Showers
Soccer field (existing)
Telecommunications
Toilets
Washing
Workshop
0
5
10 m

Ground plan

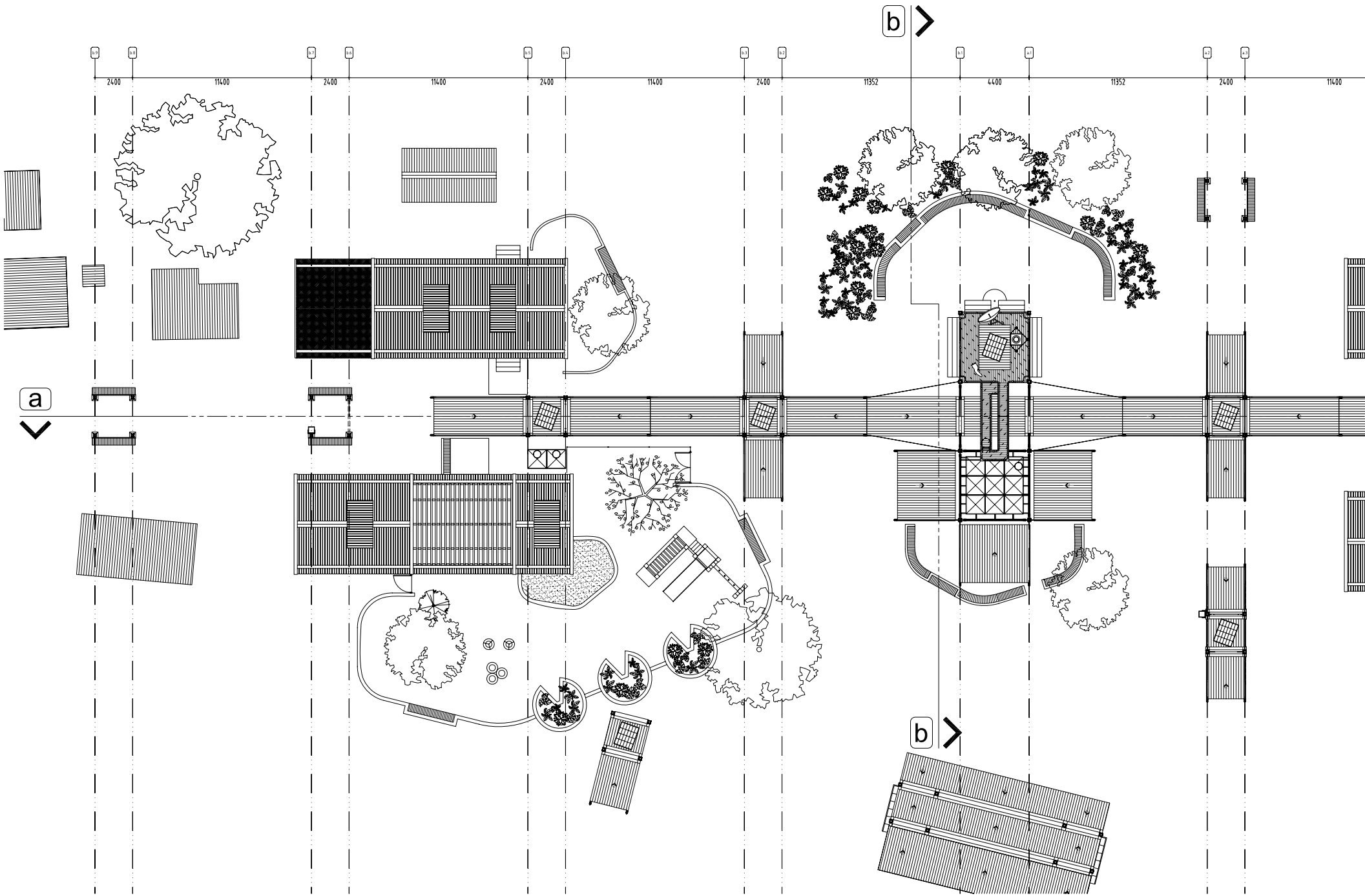

b
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400
a
b

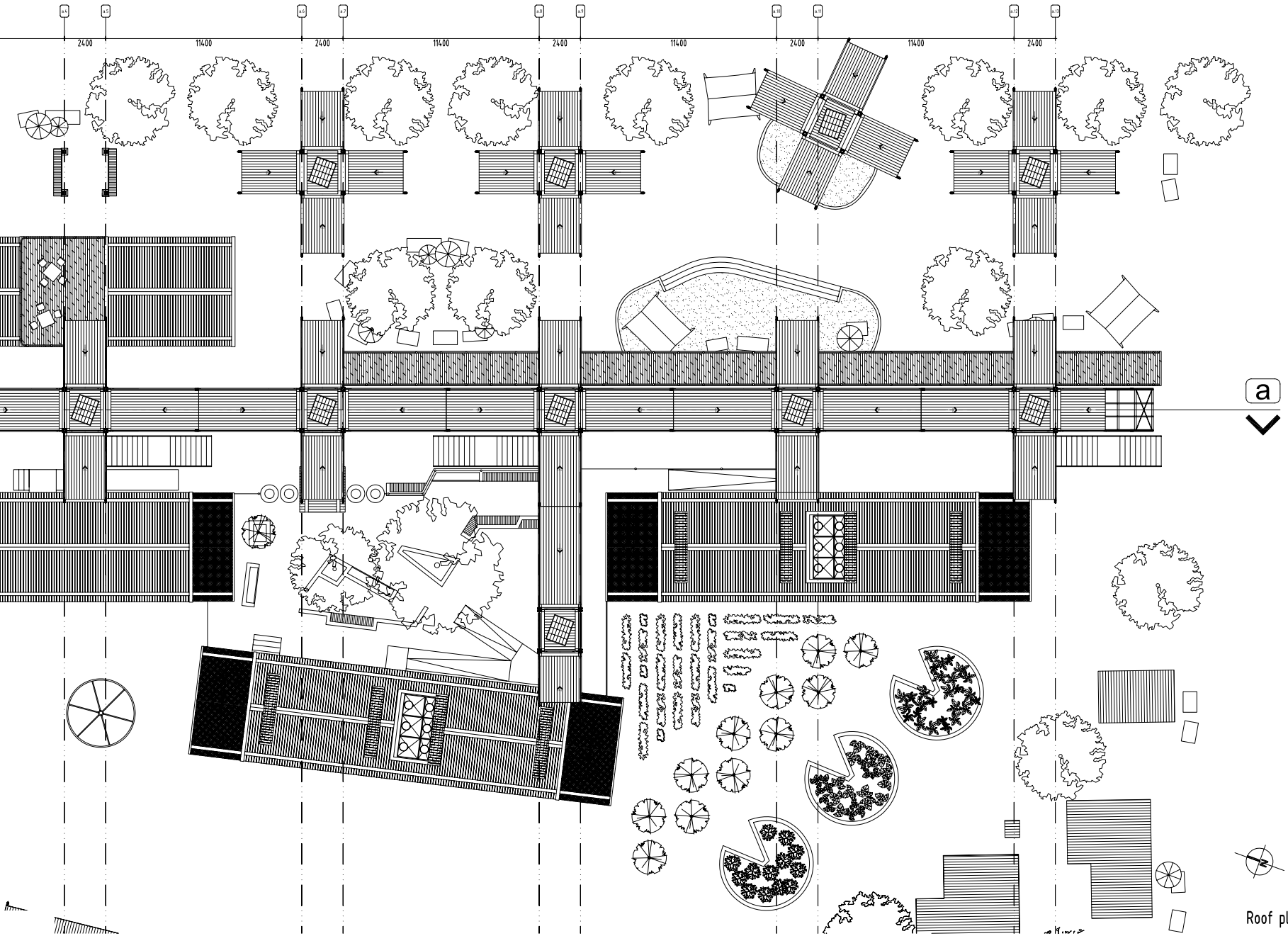


- Agriculture
- Band stand/podium
- Clinic
- Crèche
- Dentist
- Doctor
- Eat/spaza shop
- Fire store
- Gas sales
- Hair salon
- Lighting
- Informal traders
- Play area
- Police
- Post office
- Potable water
- Showers
- Soccer field (existing)
- Telecommunications
- Toilets
- Washing
- Workshop

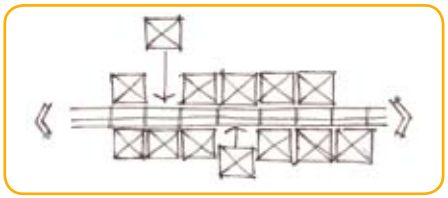
0 5 10 m

First floor plan

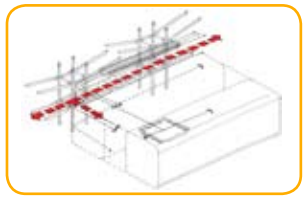

b
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400
a
b

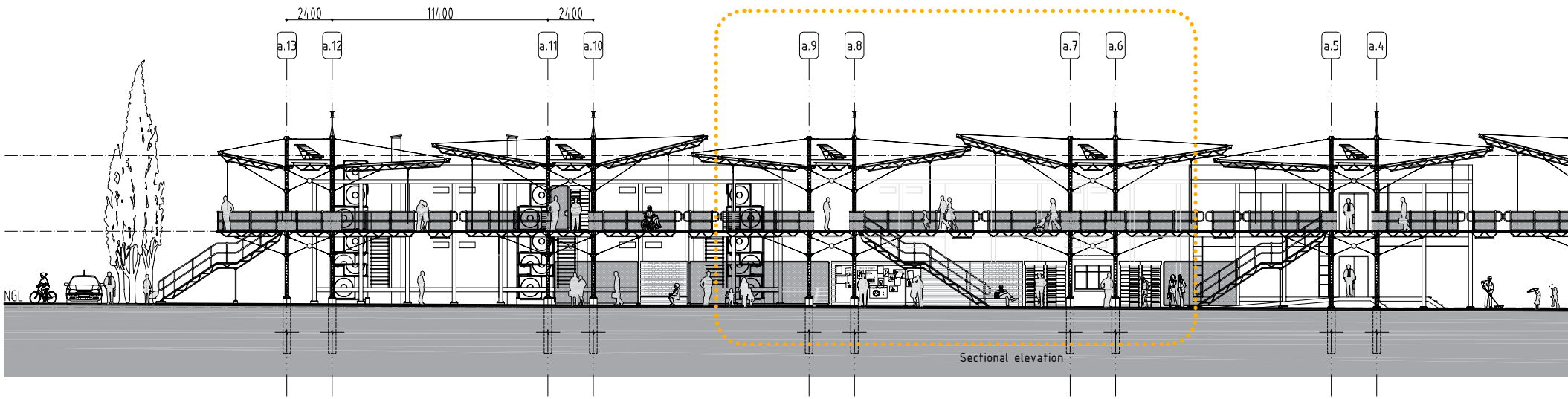


Roof plan



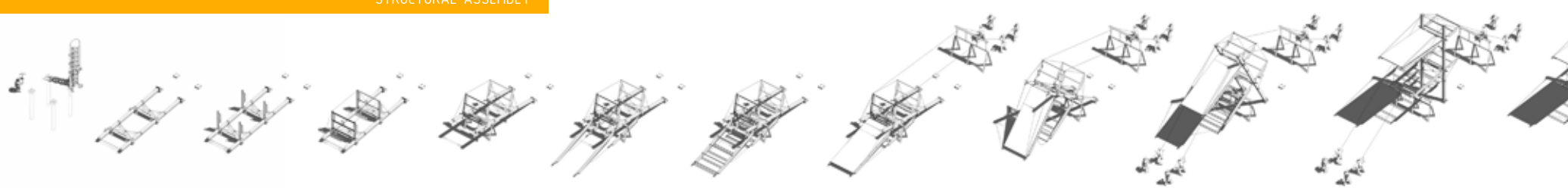
programme attachment

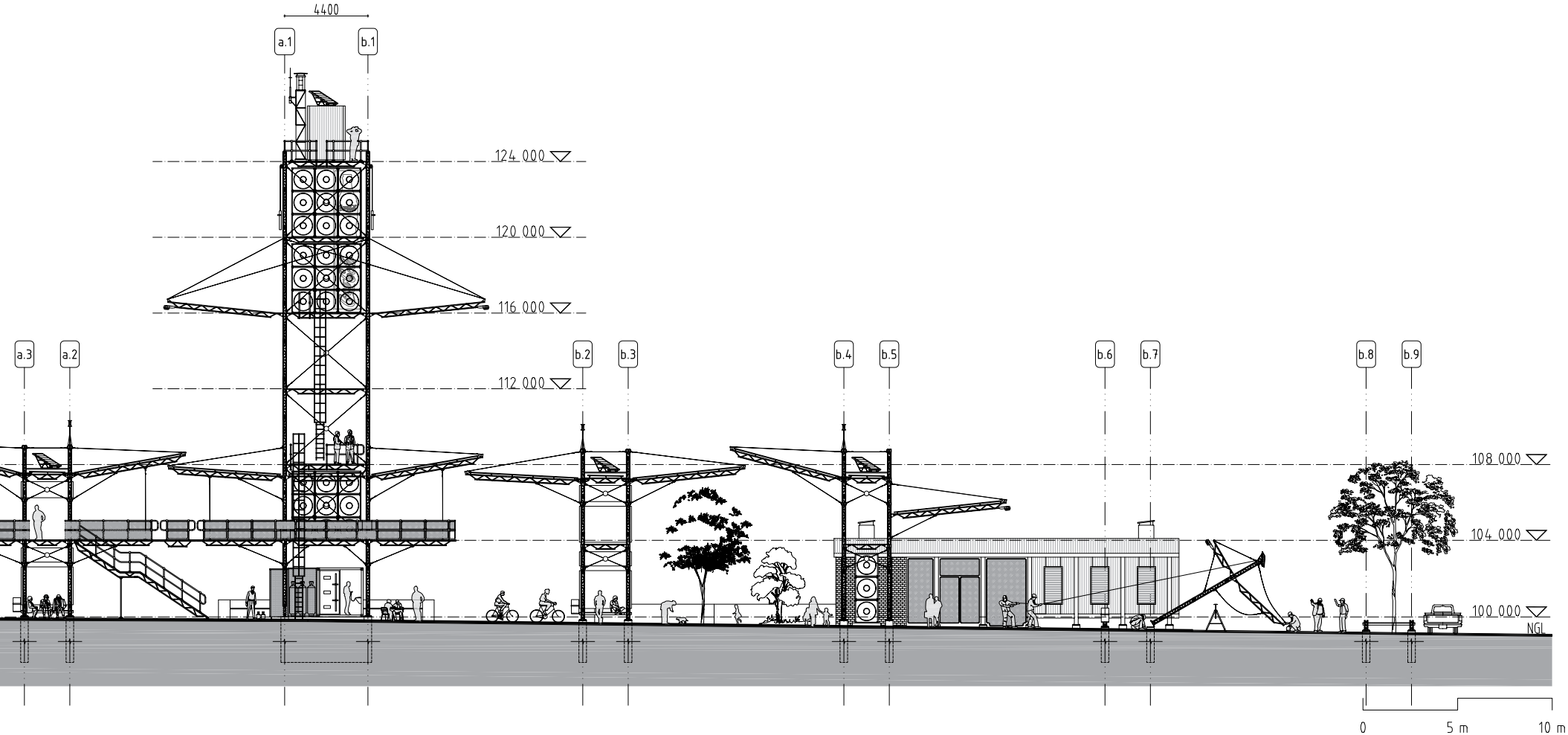




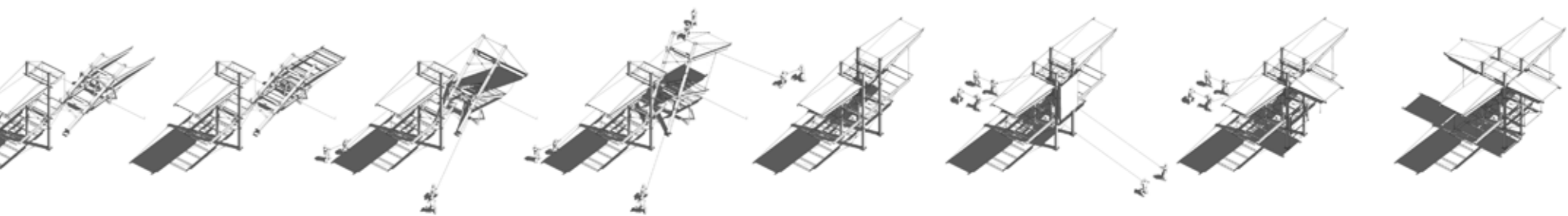
Sectional elevation

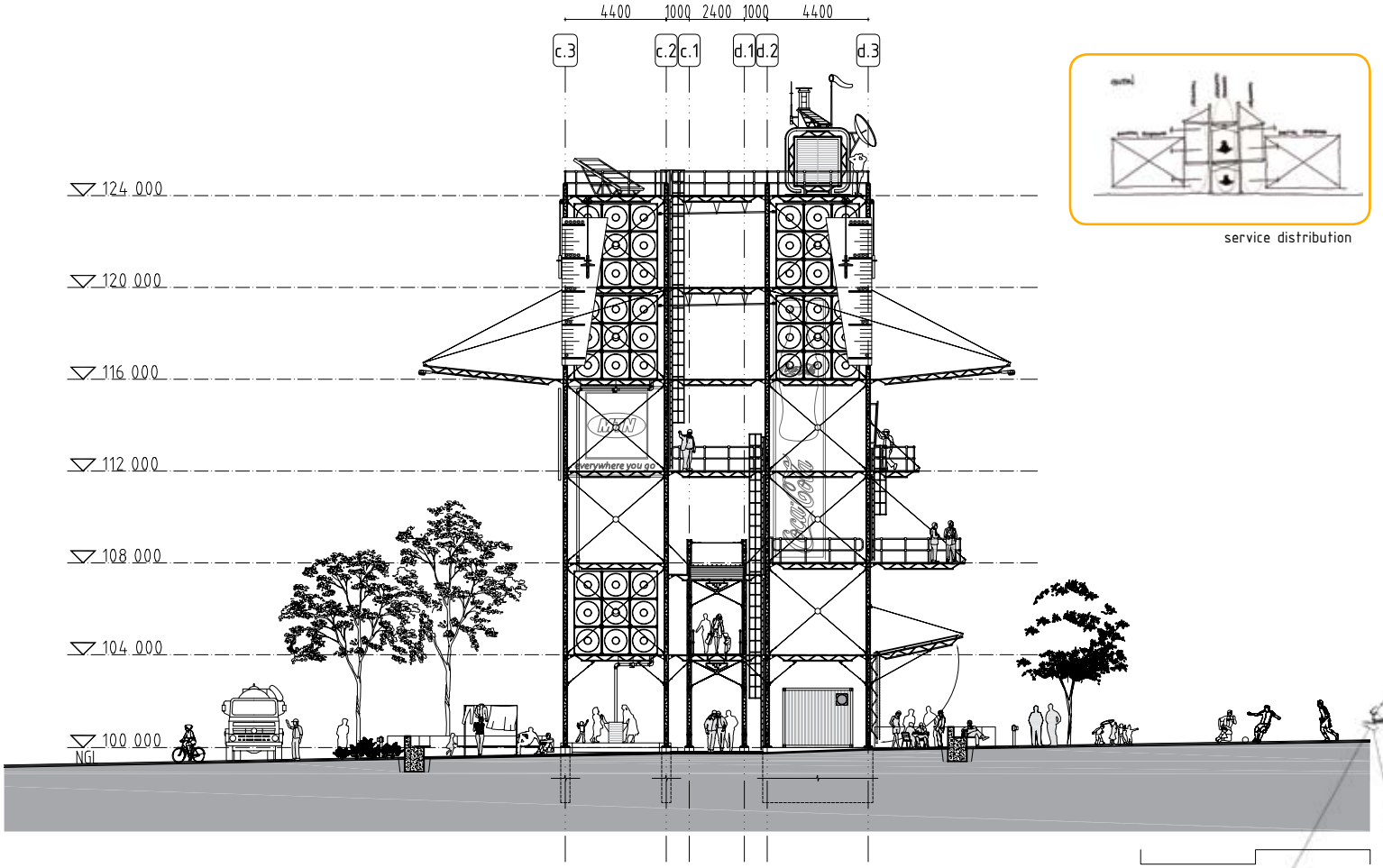
STRUCTURAL ASSEMBLY




4400
a.1
b.1
124 000
120 000
116 000
112 000
a.3
a.2
b.2
b.3
b.4
b.5
b.6
b.7
b.8
b.9
108 000
104 000
100 000
NGL
0
5 m
10 m

Section a-a

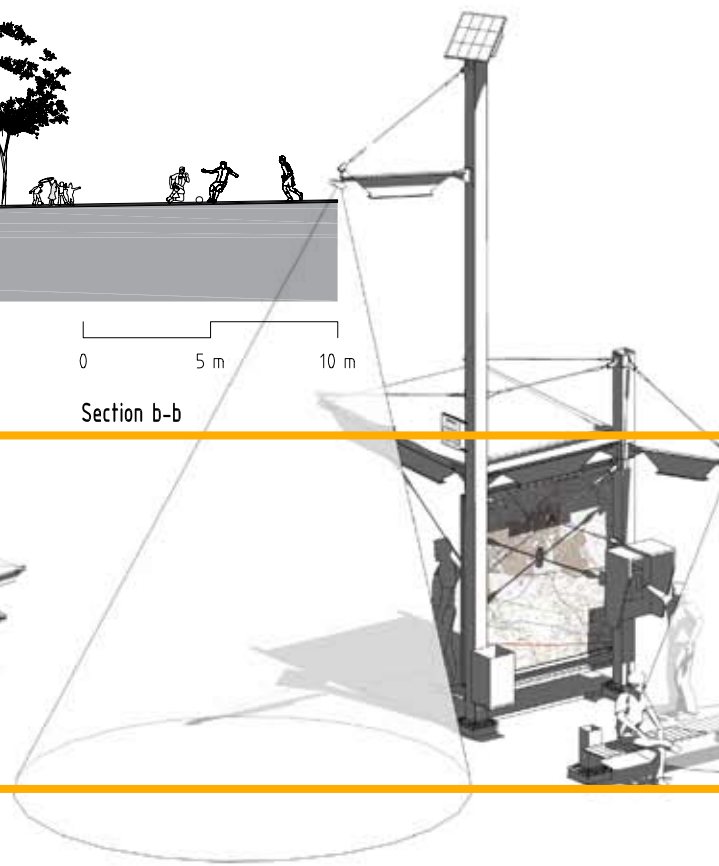




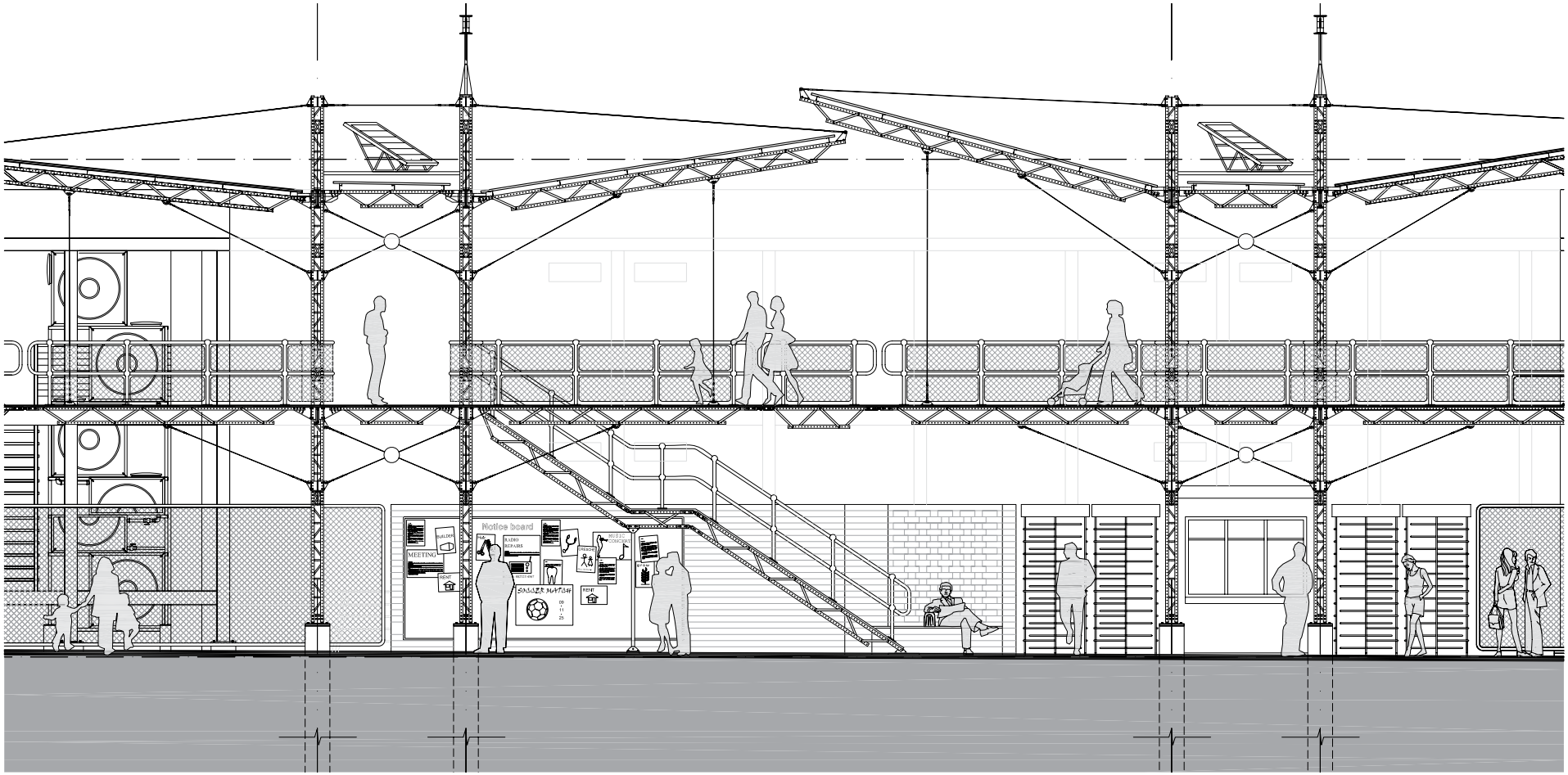
service distribution

0 5 m 10 m

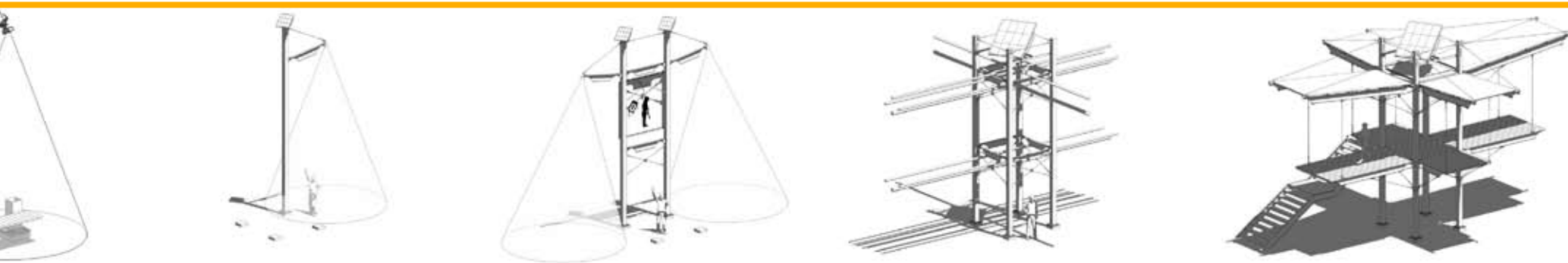
Section b-b



STRUCTURAL EVOLUTION



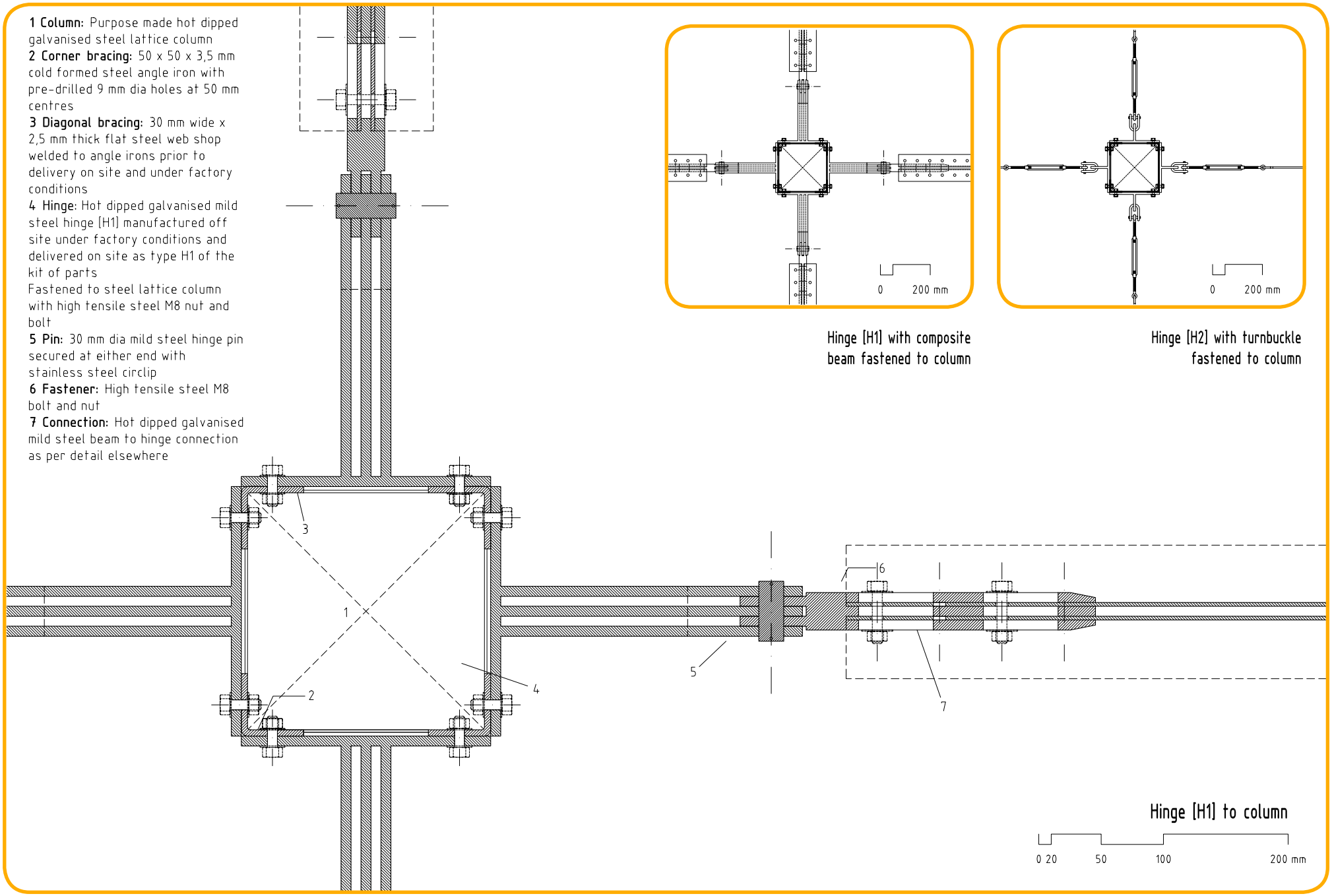
Sectional elevation



1 Column: Purpose made hot dipped galvanised steel lattice column
2 Corner bracing: 50 x 50 x 3,5 mm cold formed steel angle iron with pre-drilled 9 mm dia holes at 50 mm centres
3 Diagonal bracing: 30 mm wide x 2,5 mm thick flat steel web shop welded to angle irons prior to delivery on site and under factory conditions
4 Hinge: Hot dipped galvanised mild steel hinge [H1] manufactured off site under factory conditions and delivered on site as type H1 of the kit of parts
Fastened to steel lattice column with high tensile steel M8 nut and bolt
5 Pin: 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
6 Fastener: High tensile steel M8 bolt and nut
7 Connection: Hot dipped galvanised mild steel beam to hinge connection as per detail elsewhere

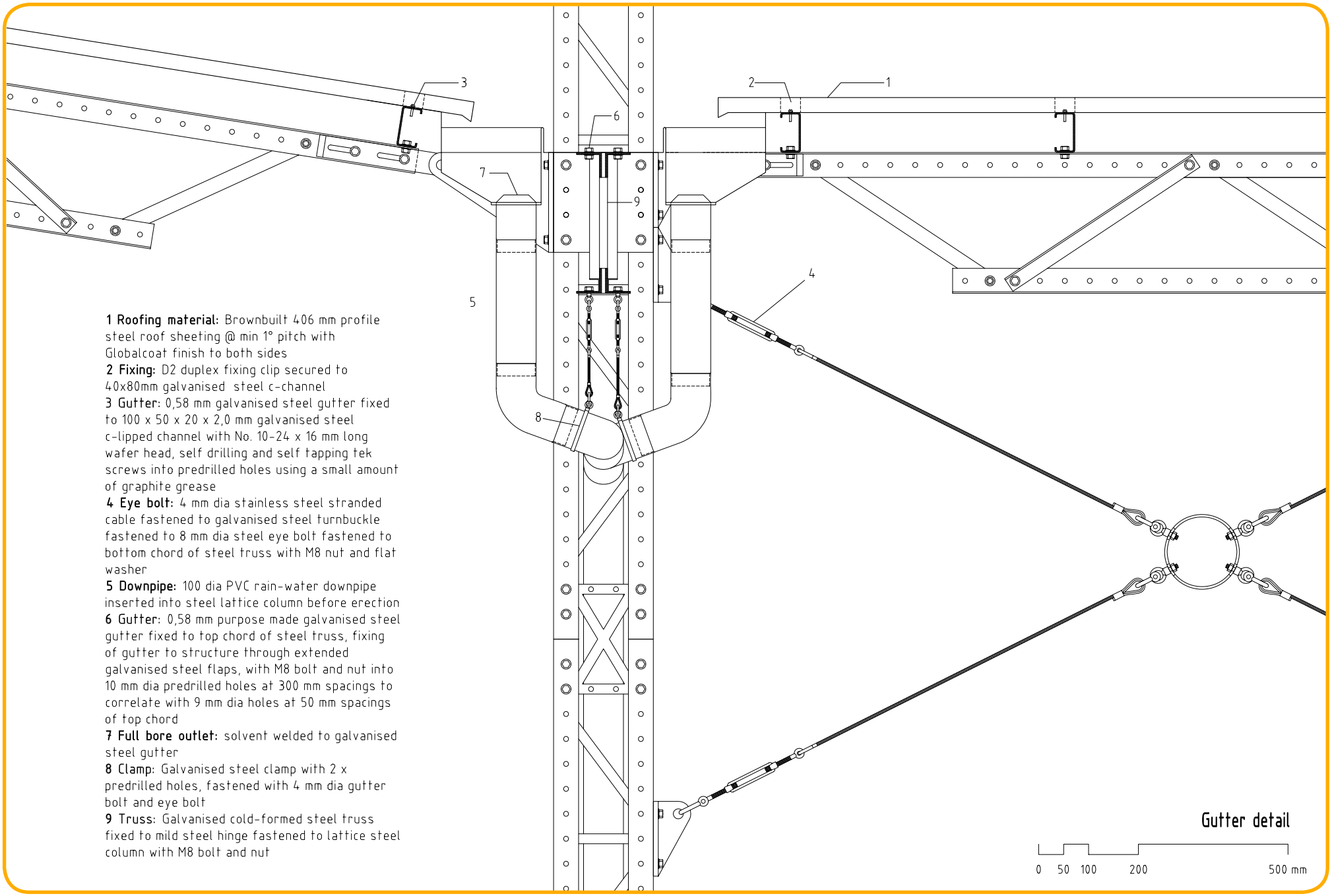
Hinge [H1] with composite beam fastened to column

Hinge [H2] with turnbuckle fastened to column

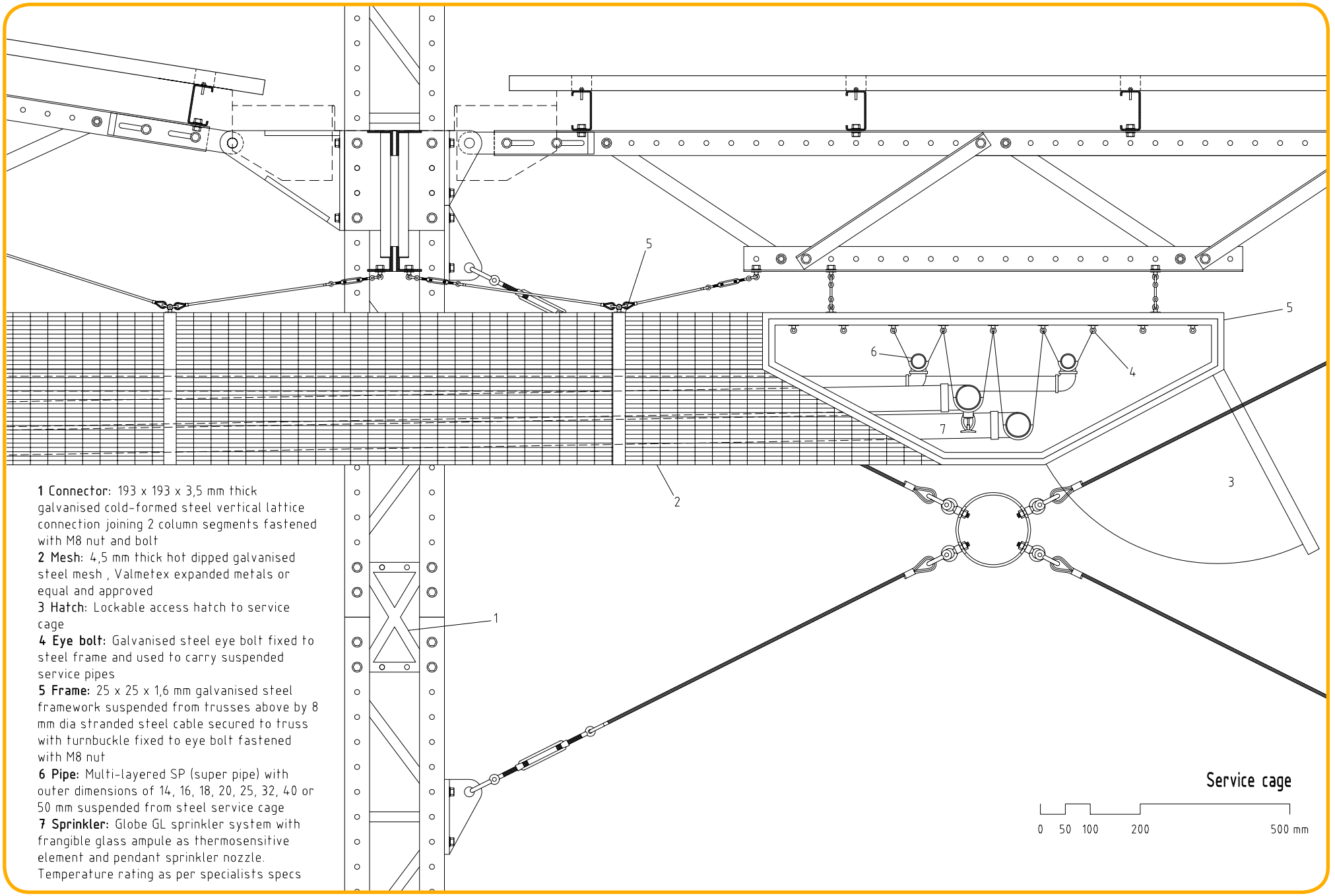


Hinge [H1] to column

0 20 50 100 200 mm



1 Roofing material: Brownbuilt 406 mm profile steel roof sheeting @ min 1° pitch with Globalcoat finish to both sides
2 Fixing: D2 duplex fixing clip secured to 40x80mm galvanised steel c-channel
3 Gutter: 0,58 mm galvanised steel gutter fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws into predrilled holes using a small amount of graphite grease
4 Eye bolt: 4 mm dia stainless steel stranded cable fastened to galvanised steel turnbuckle fastened to 8 mm dia steel eye bolt fastened to bottom chord of steel truss with M8 nut and flat washer
5 Downpipe: 100 dia PVC rain-water downpipe inserted into steel lattice column before erection
6 Gutter: 0,58 mm purpose made galvanised steel gutter fixed to top chord of steel truss, fixing of gutter to structure through extended galvanised steel flaps, with M8 bolt and nut into 10 mm dia predrilled holes at 300 mm spacings to correlate with 9 mm dia holes at 50 mm spacings of top chord
7 Full bore outlet: solvent welded to galvanised steel gutter
8 Clamp: Galvanised steel clamp with 2 x predrilled holes, fastened with 4 mm dia gutter bolt and eye bolt
9 Truss: Galvanised cold-formed steel truss fixed to mild steel hinge fastened to lattice steel column with M8 bolt and nut



1 Connector: 193 x 193 x 3,5 mm thick galvanised cold-formed steel vertical lattice connection joining 2 column segments fastened with M8 nut and bolt

2 Mesh: 4,5 mm thick hot dipped galvanised steel mesh , Valmetex expanded metals or equal and approved

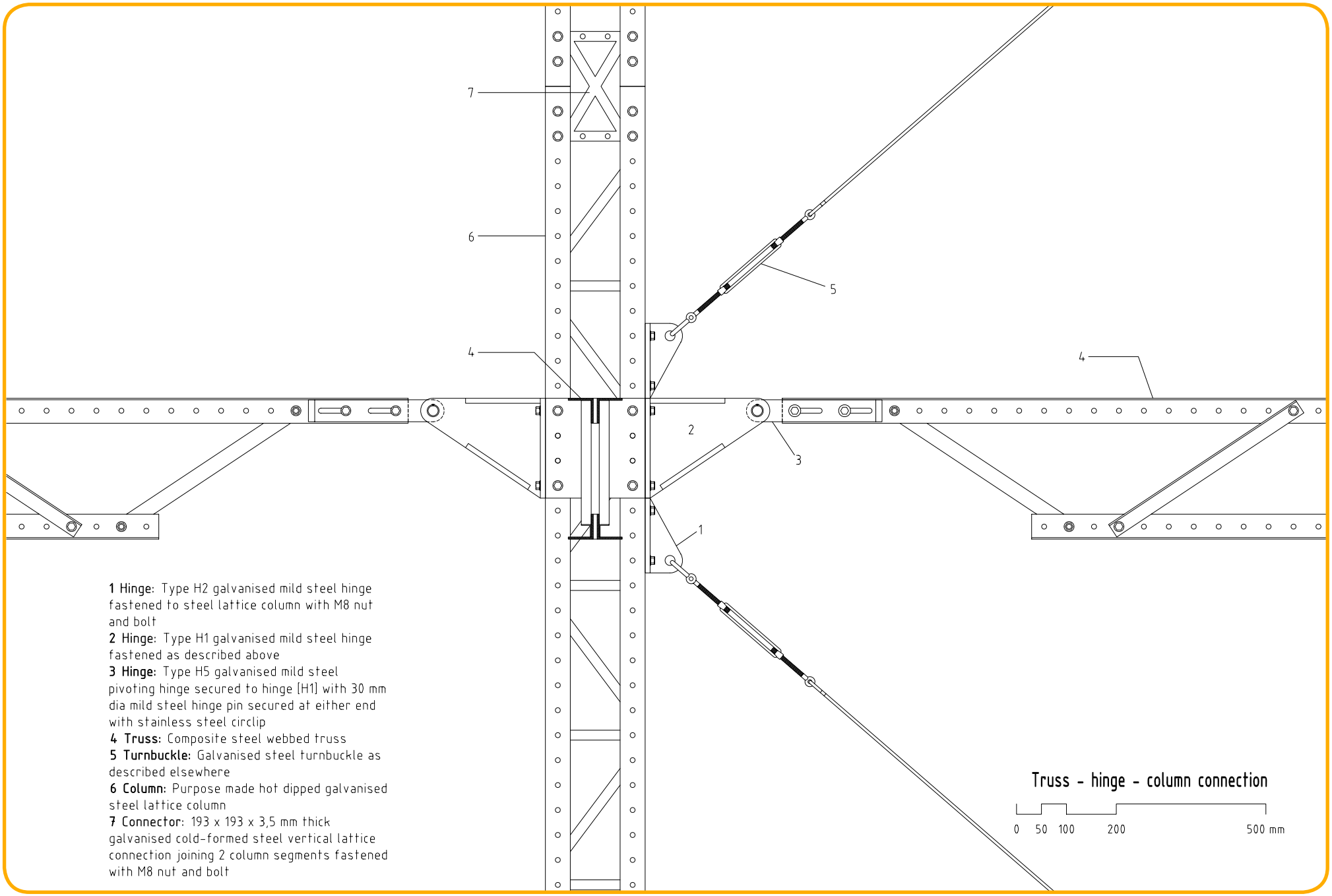
3 Hatch: Lockable access hatch to service cage

4 Eye bolt: Galvanised steel eye bolt fixed to steel frame and used to carry suspended service pipes

5 Frame: 25 x 25 x 1,6 mm galvanised steel framework suspended from trusses above by 8 mm dia stranded steel cable secured to truss with turnbuckle fixed to eye bolt fastened with M8 nut

6 Pipe: Multi-layered SP (super pipe) with outer dimensions of 14, 16, 18, 20, 25, 32, 40 or 50 mm suspended from steel service cage

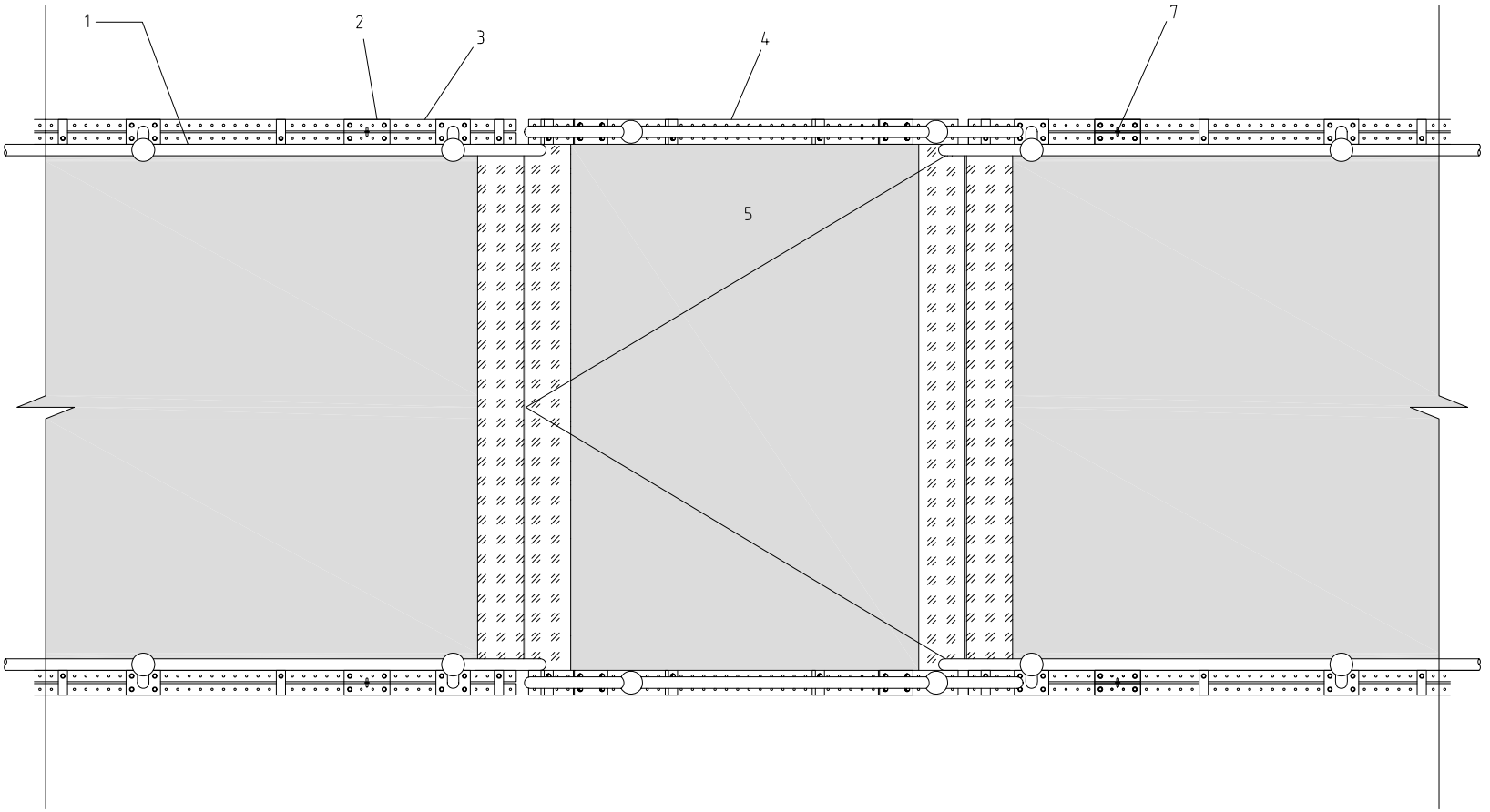
7 Sprinkler: Globe GL sprinkler system with frangible glass ampule as thermosensitive element and pendant sprinkler nozzle. Temperature rating as per specialists specs



1 Hinge: Type H2 galvanised mild steel hinge fastened to steel lattice column with M8 nut and bolt
2 Hinge: Type H1 galvanised mild steel hinge fastened as described above
3 Hinge: Type H5 galvanised mild steel pivoting hinge secured to hinge (H1) with 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
4 Truss: Composite steel webbed truss
5 Turnbuckle: Galvanised steel turnbuckle as described elsewhere
6 Column: Purpose made hot dipped galvanised steel lattice column
7 Connector: 193 x 193 x 3,5 mm thick galvanised cold-formed steel vertical lattice connection joining 2 column segments fastened with M8 nut and bolt

Truss - hinge - column connection

0 50 100 200 500 mm



1 Balustrade: Mild steel ball type We cro lok hand-rail system with stanchions placed max 1,8 m apart fastened to top chord of composite beam with galvanised M8 nut and bolt

2 Hinge: Type H3 galvanised mild steel hinge

3 Truss: Truss composition of cold formed angle irons (50 x 50 x 3 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9 mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 450 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

4 Truss: 2000 mm intermediately connected composite webbed truss

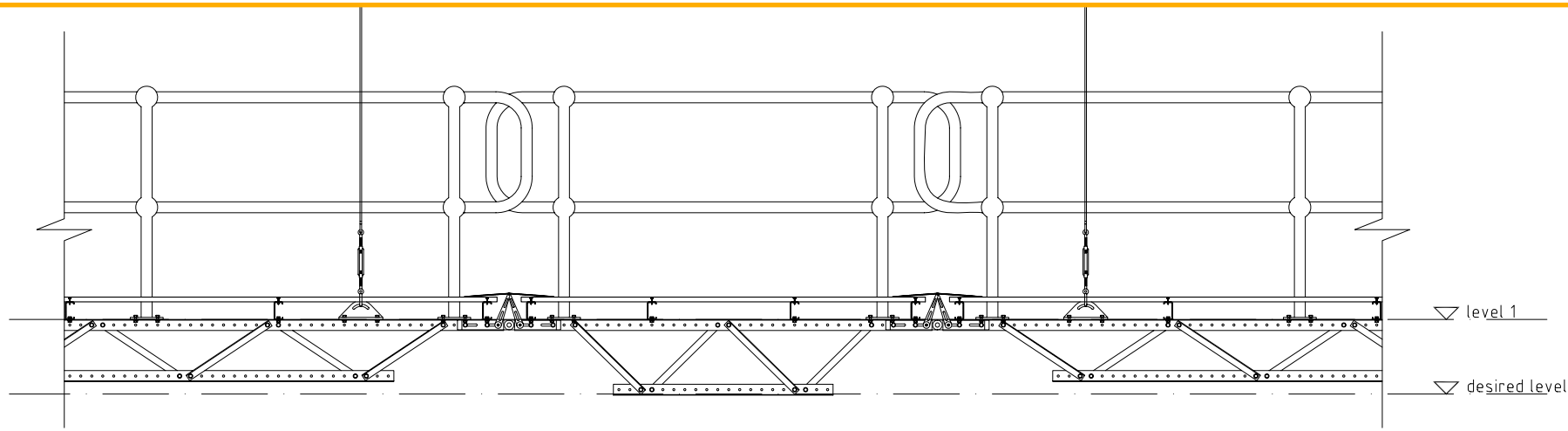
5 Flooring: 25 mm shutterply fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws

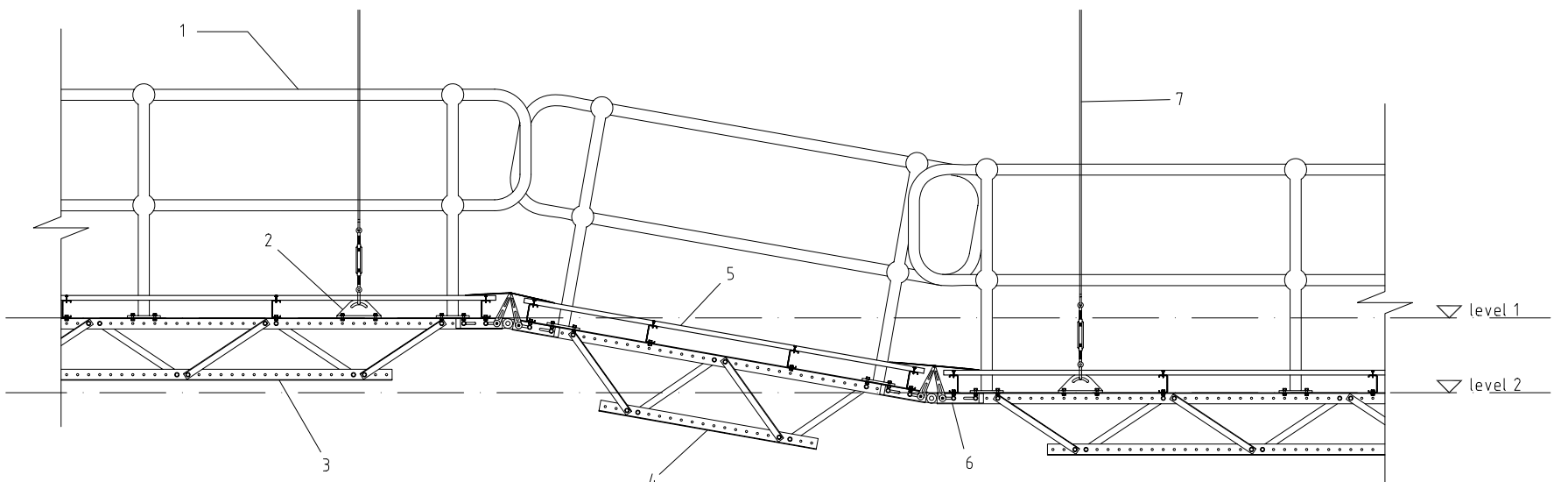
6 Connector: Galvanised mild steel hinged connector joining beam to beam and secured to beams with M8 nut and bolt

7 Cable: 4 mm dia stainless steel stranded cable

Intermediate change in levels plan

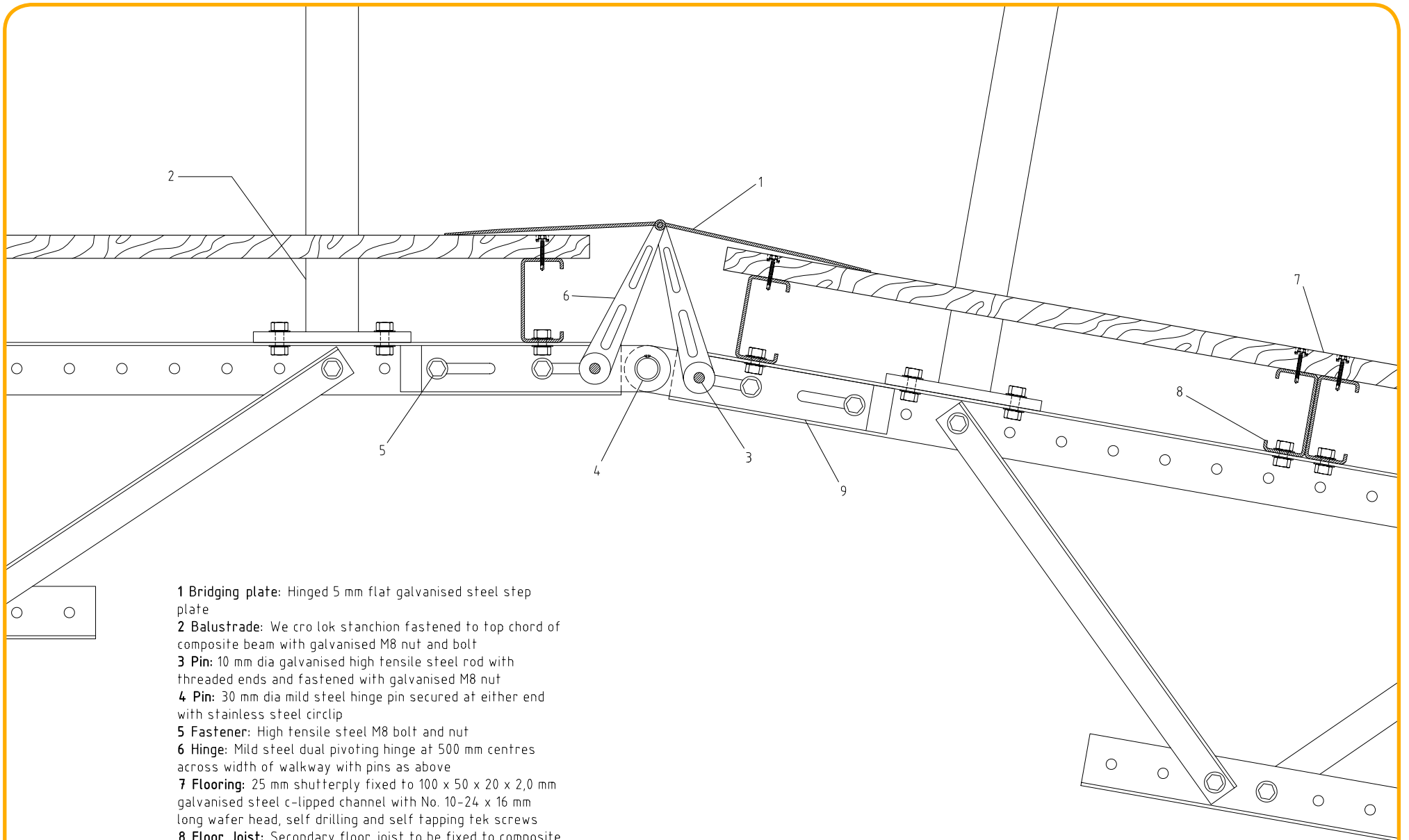
0 100 500 1000 mm





Intermediate change in levels
section

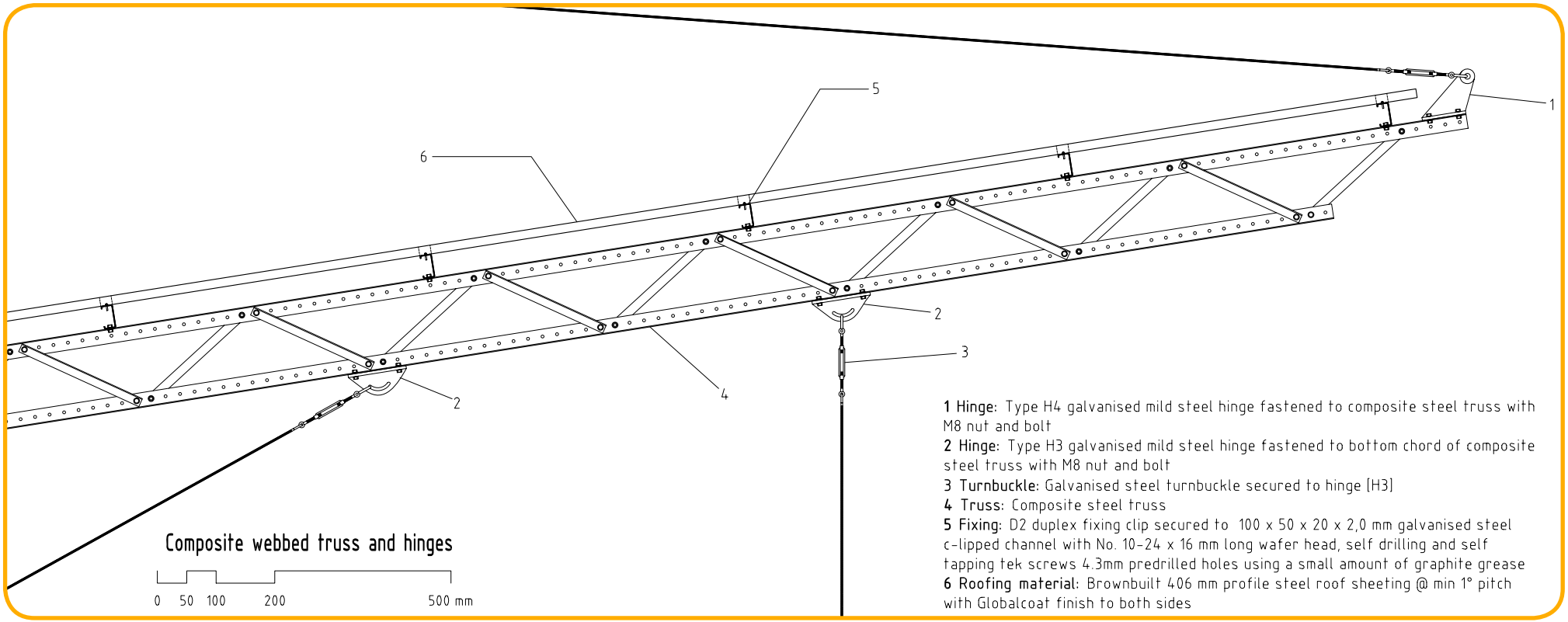
0 100 500 1000 mm



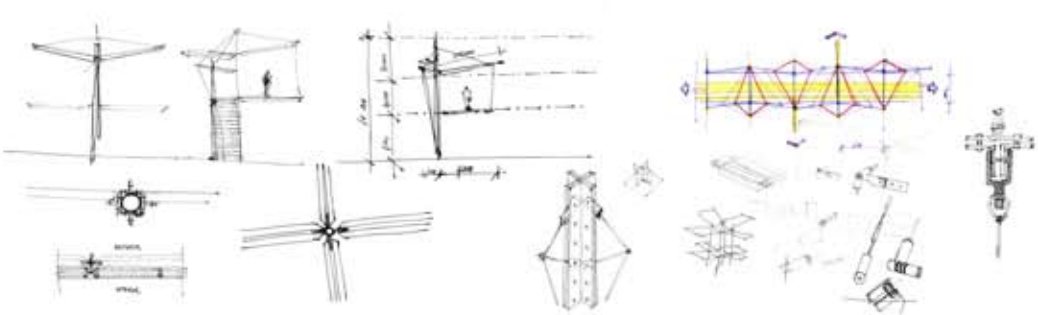
1 Bridging plate: Hinged 5 mm flat galvanised steel step plate
2 Balustrade: We cro lok stanchion fastened to top chord of composite beam with galvanised M8 nut and bolt
3 Pin: 10 mm dia galvanised high tensile steel rod with threaded ends and fastened with galvanised M8 nut
4 Pin: 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
5 Fastener: High tensile steel M8 bolt and nut
6 Hinge: Mild steel dual pivoting hinge at 500 mm centres across width of walkway with pins as above
7 Flooring: 25 mm shutterply fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws
8 Floor Joist: Secondary floor joist to be fixed to composite steel beam where 2 shutterply floor boards meet
9 Connector: Galvanised mild steel hinged connector joining beam to beam and secured to beams with M8 nut and bolt

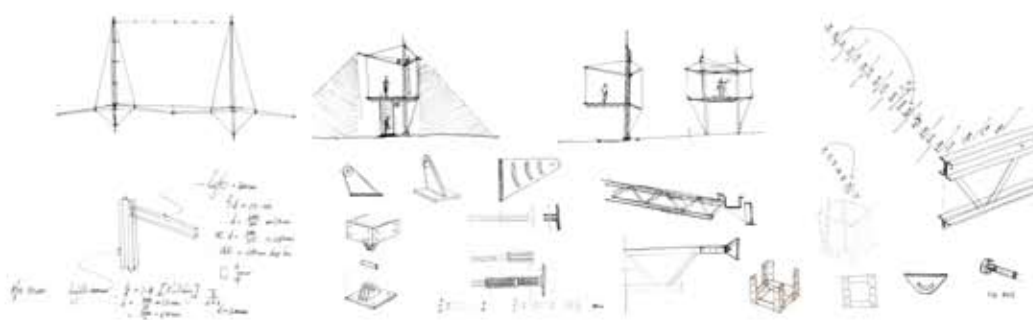
Beam to beam connection

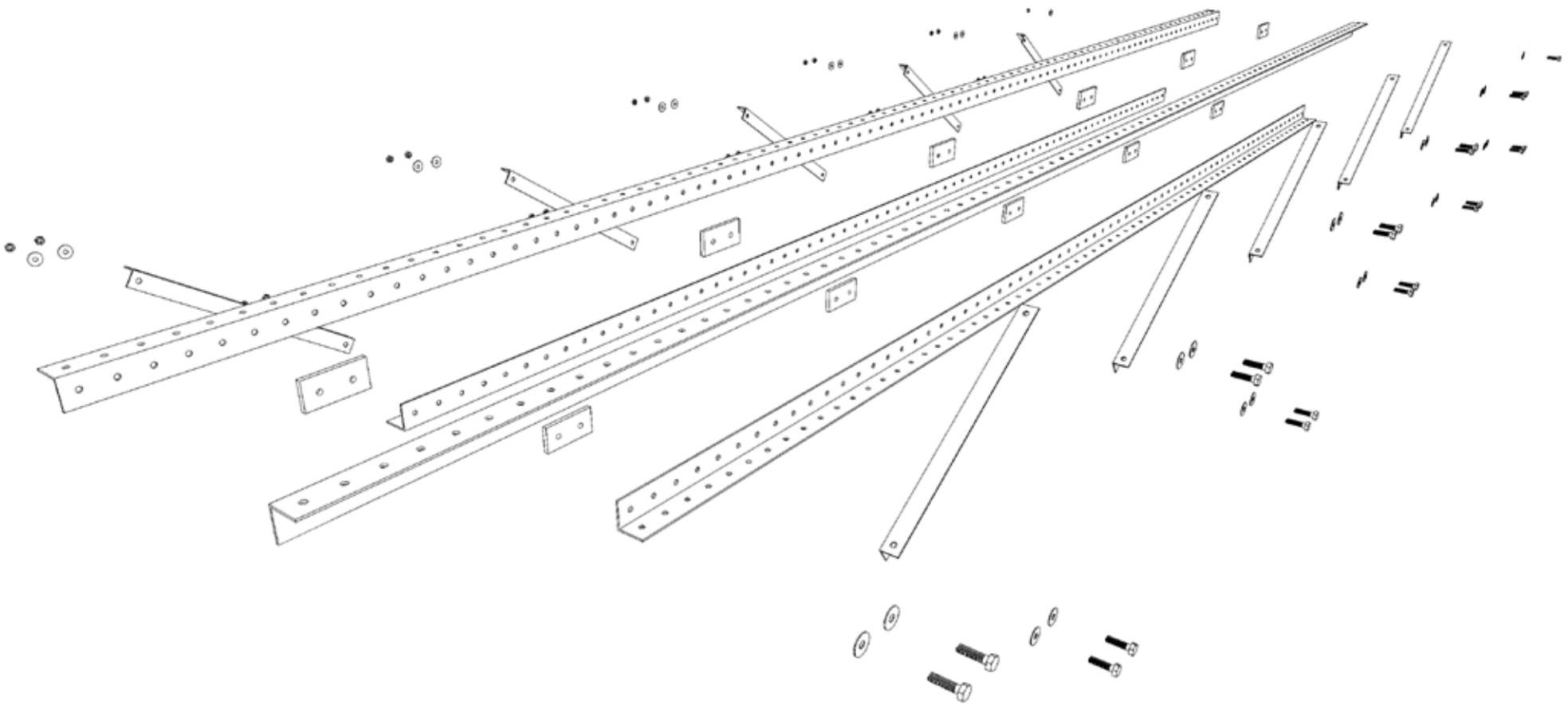
0 50 100 200 mm



1 Hinge: Type H4 galvanised mild steel hinge fastened to composite steel truss with M8 nut and bolt
2 Hinge: Type H3 galvanised mild steel hinge fastened to bottom chord of composite steel truss with M8 nut and bolt
3 Turnbuckle: Galvanised steel turnbuckle secured to hinge [H3]
4 Truss: Composite steel truss
5 Fixing: D2 duplex fixing clip secured to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws 4.3mm predrilled holes using a small amount of graphite grease
6 Roofing material: Brownbuilt 406 mm profile steel roof sheeting @ min 1° pitch with Globalcoat finish to both sides

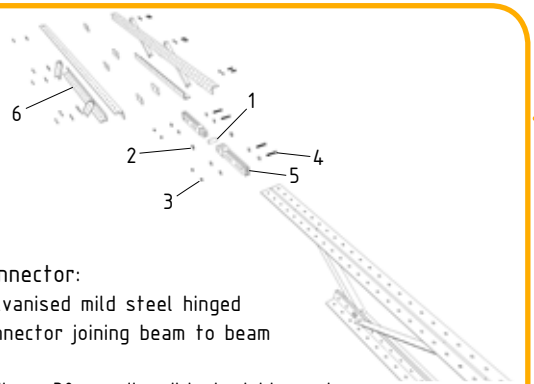






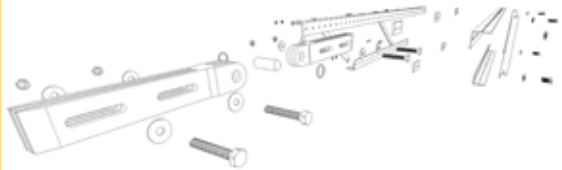
Assembly of composite steel webbed truss

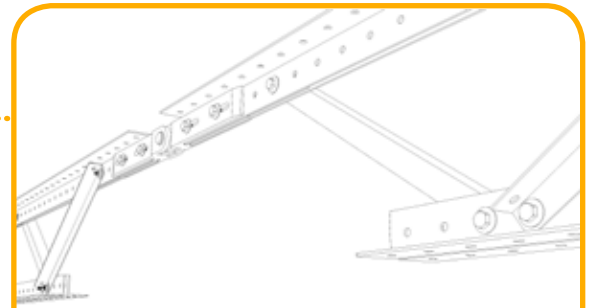
Truss composition of cold formed angle irons (50 x 50 x 3,5 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9 mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 450 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

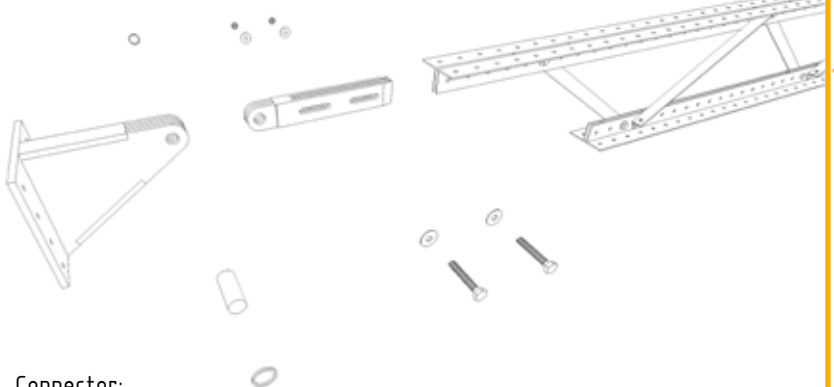


Connector:
Galvanised mild steel hinged
connector joining beam to beam

1 Hinge: 30 mm dia mild steel hinge pin
2 Fastener: Stainless steel circlip
3 Tamper proof nut: Galvanised high tensile steel series 76 M8 Guard-Nut
4 Fastener: High tensile steel M8 bolt
5 Hinge: Type H5 galvanised mild steel pivoting hinge
6 Truss chord: 50 x 50 x 3,5 mm cold-formed steel angle iron used as top and bottom chord of truss.

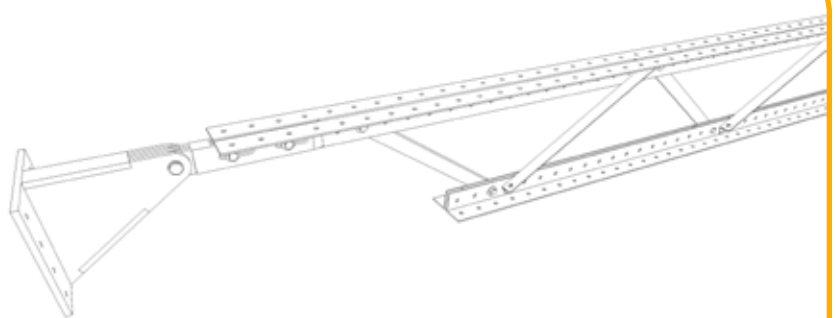




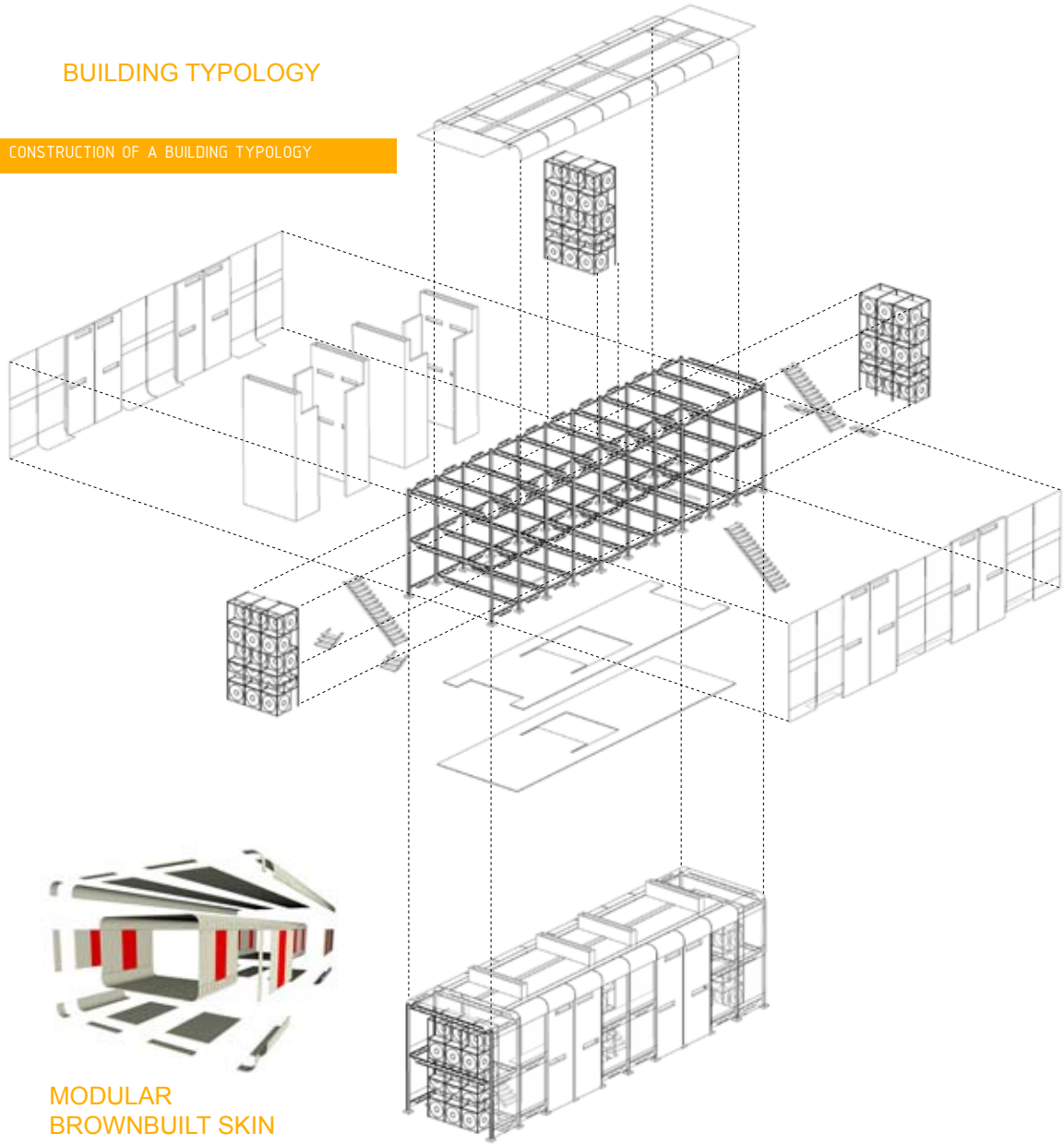


Connector:
Galvanised mild steel hinged connector joining
beam to hinge H1 secured to steel lattice column

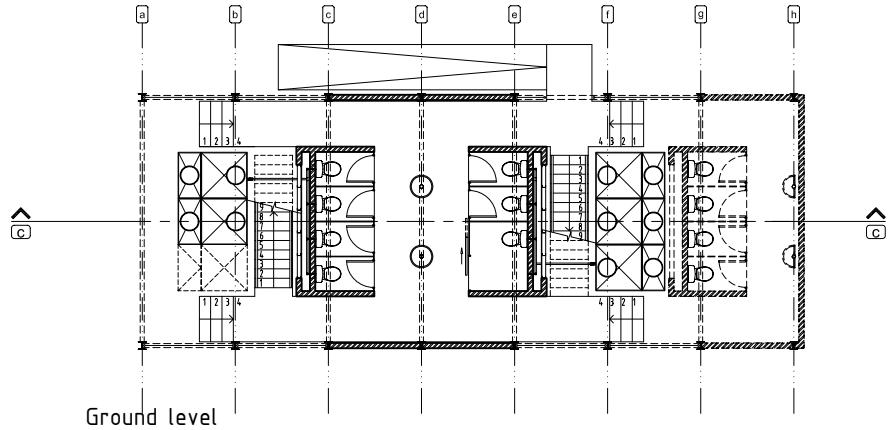
component parts as described elsewhere



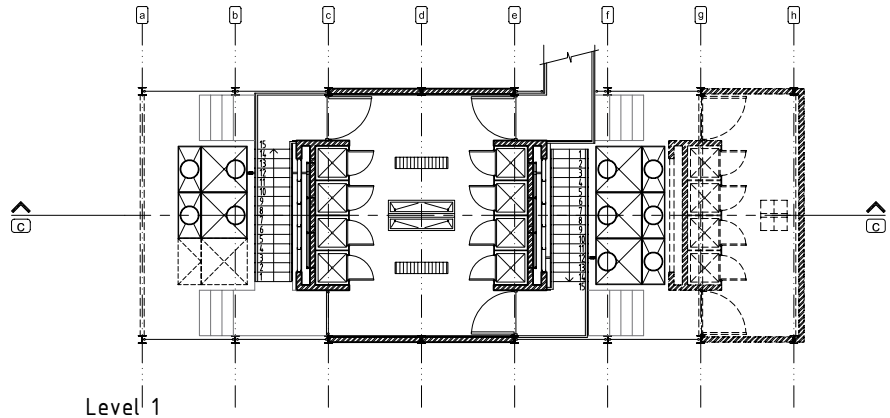
CONSTRUCTION OF A BUILDING TYPOLOGY



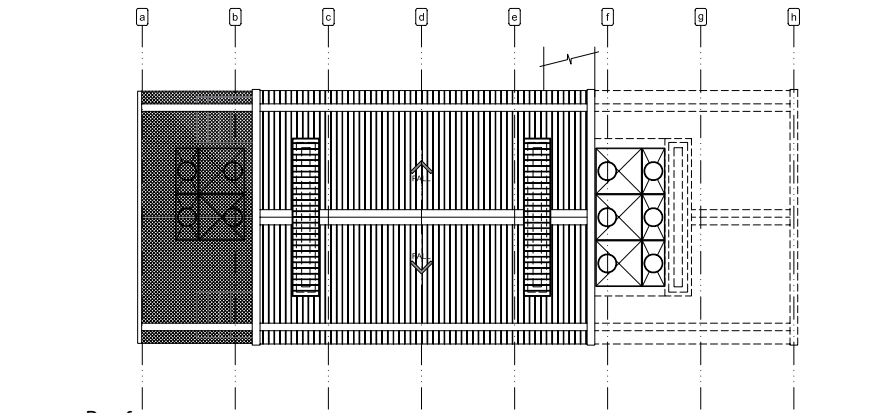
MODULAR
BROWNBUILT SKIN



Ground level



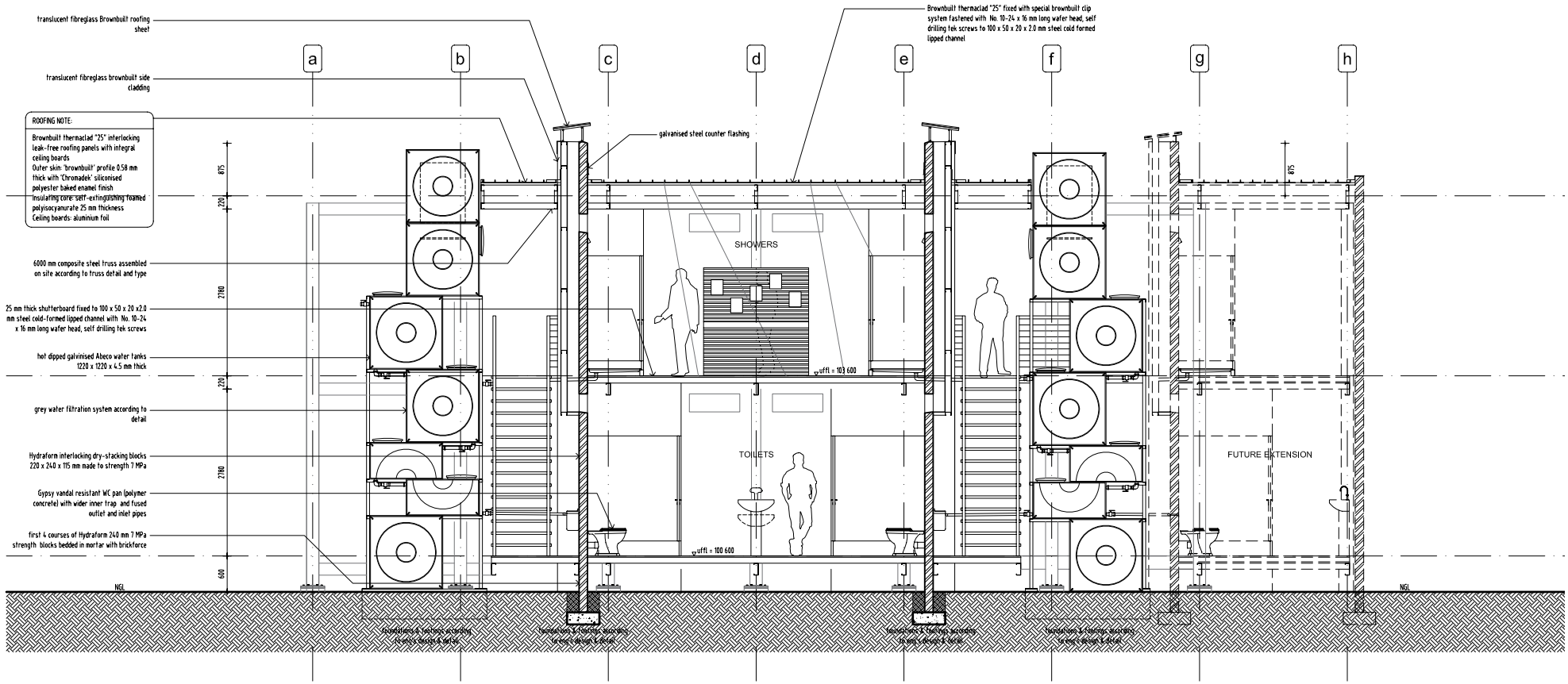
Level 1



Roof

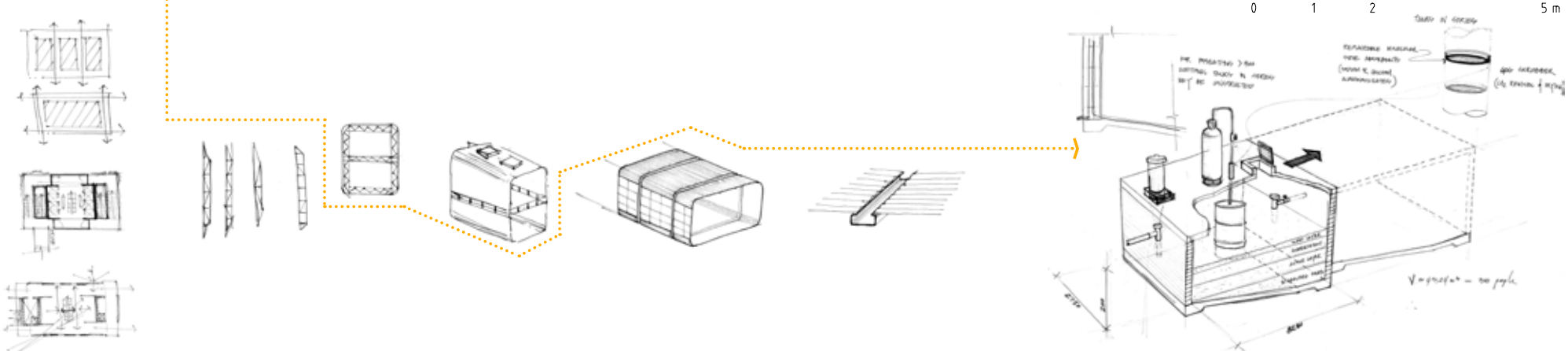
Ablution facilities

0 1 2 5 10 m

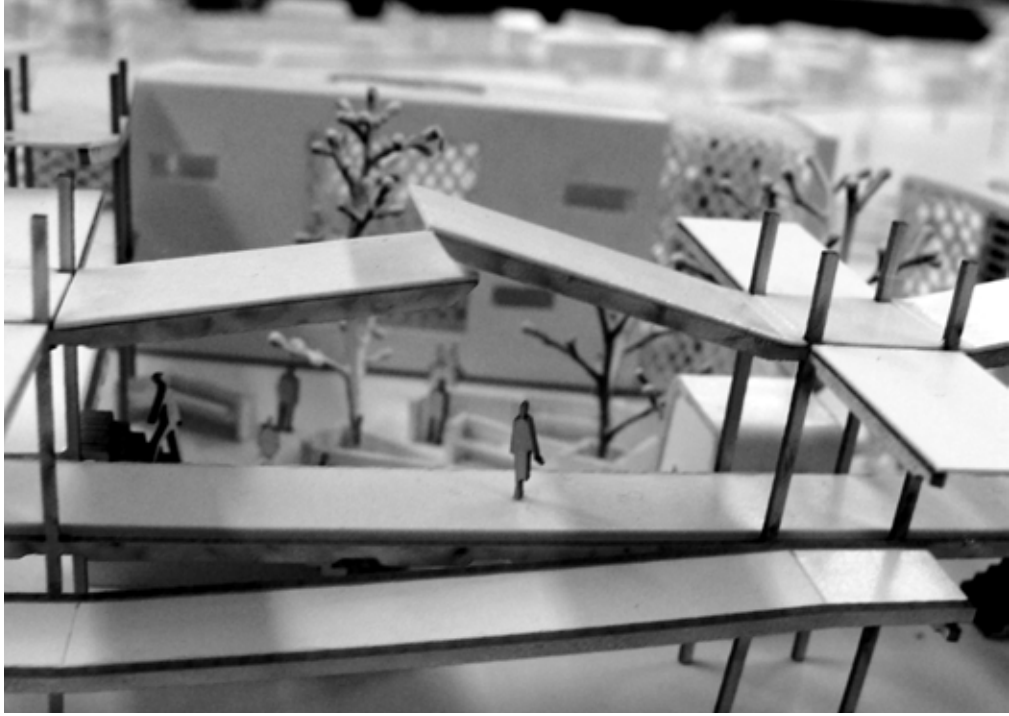


section through ablution facilities

0 1 2 5 m



MODEL - DAYTIME



MODEL - NIGHTTIME