Chapter 5 Technical Solutions

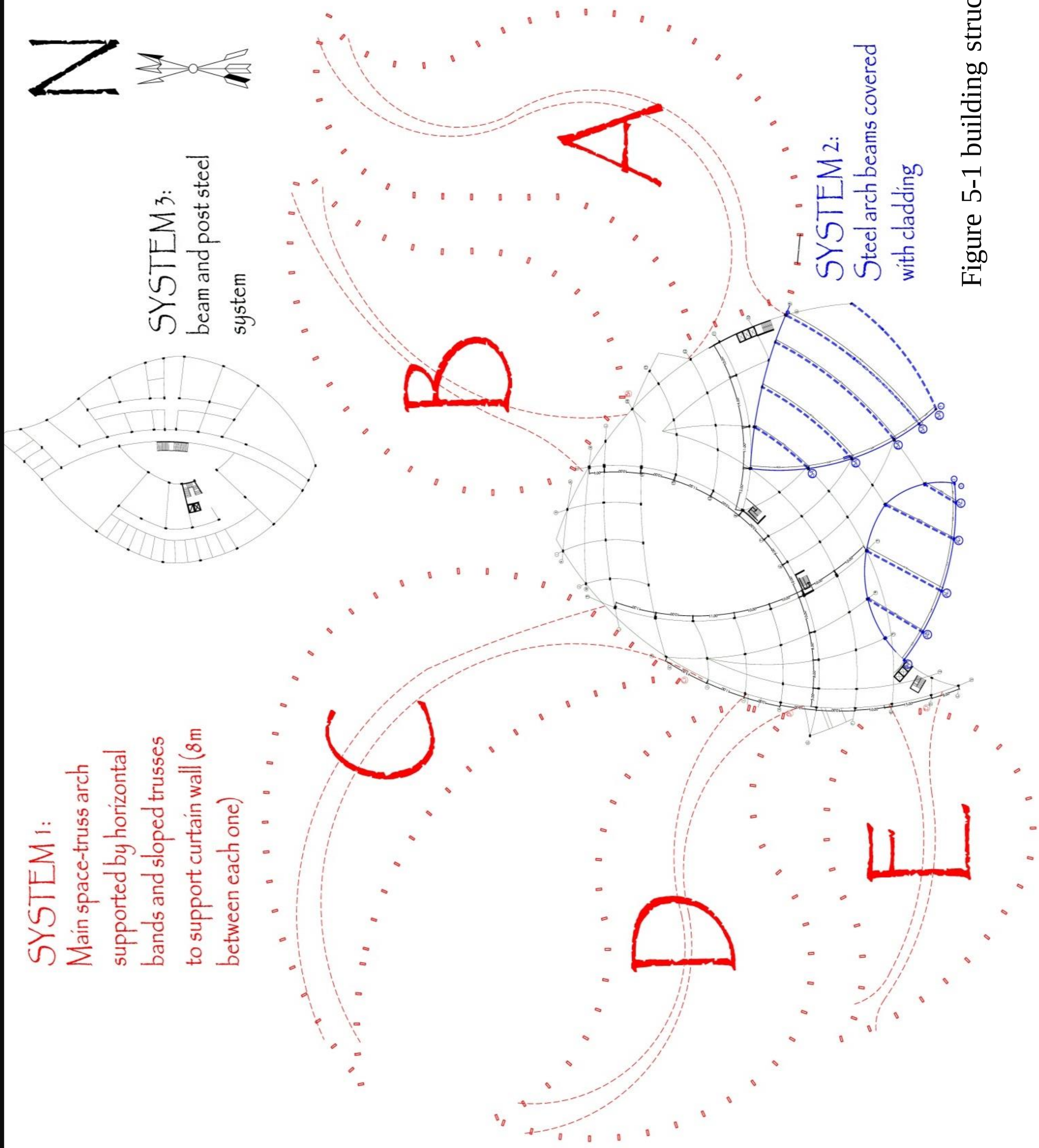

Figure 5-1 building structures

Building Structures

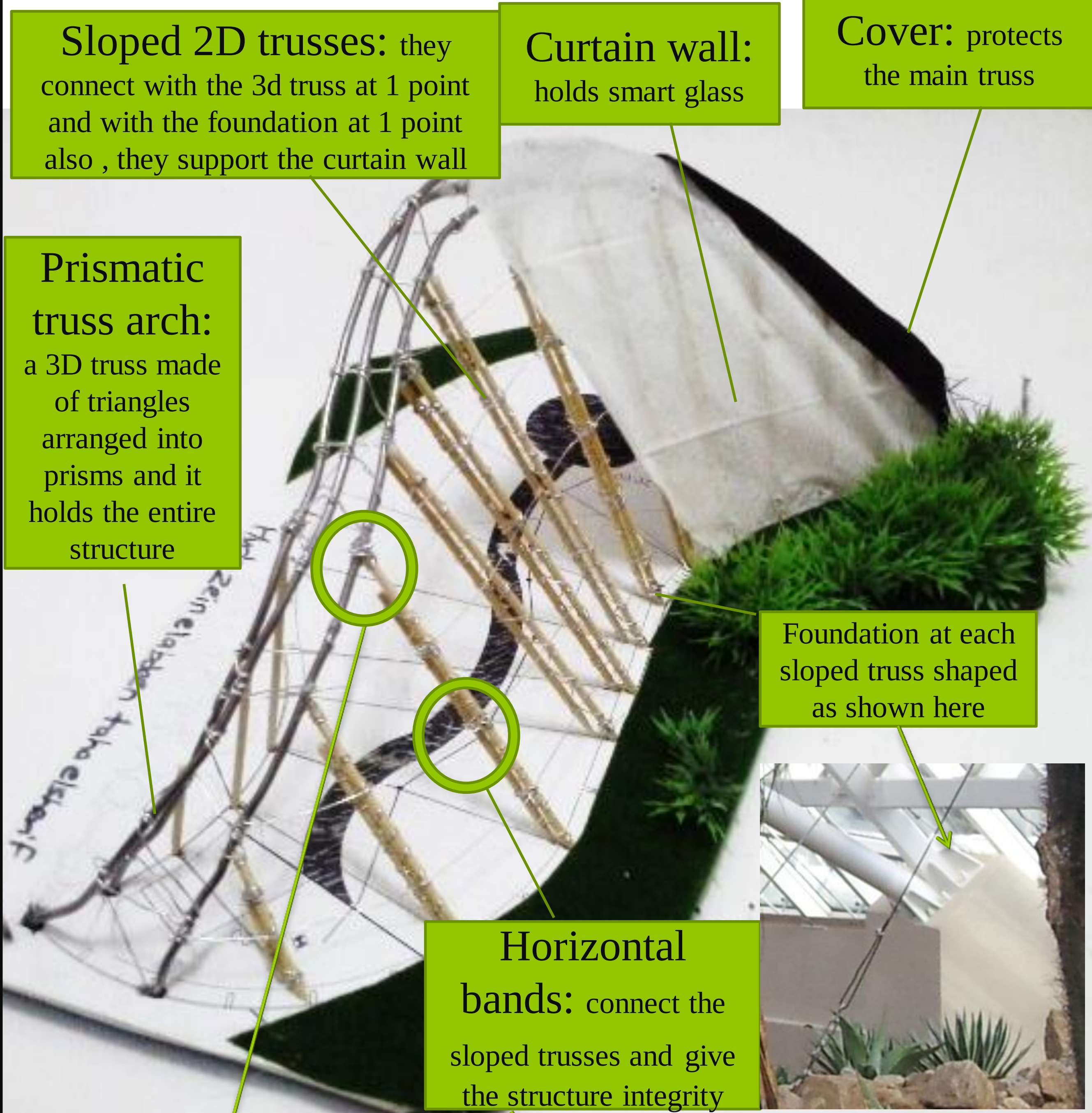

Figure 5-2: structure cutaway model

Figure 5-3: Connection detail 1

Figure 5-4: Connection detail 2

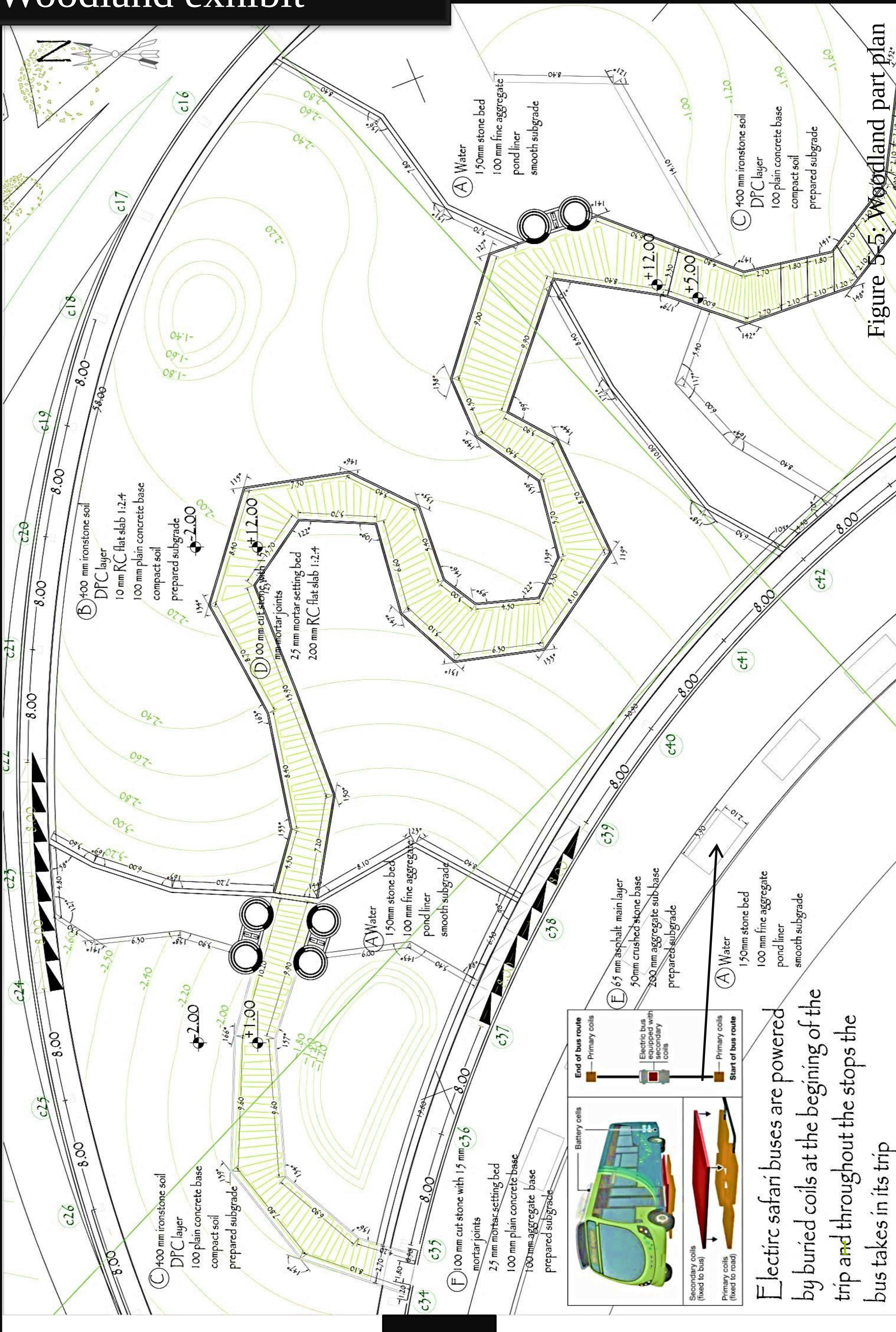

Figure 55: Woodland part plan

Electirc safari buses are powered by buried coils at the begining of the trip and throughout the stops the bus takes in its trip

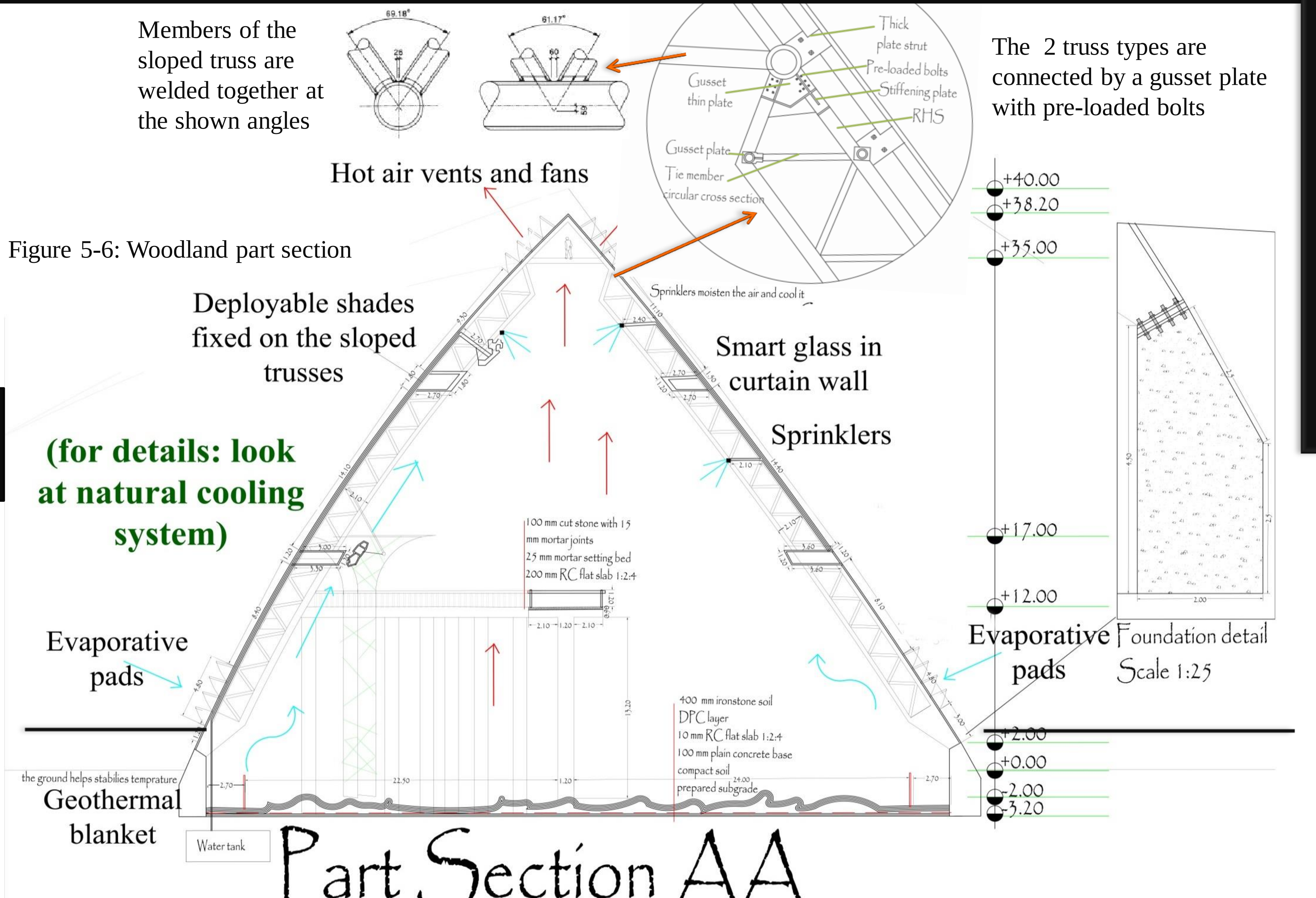

Figure 5-6: Woodland part section

Montane exhibit

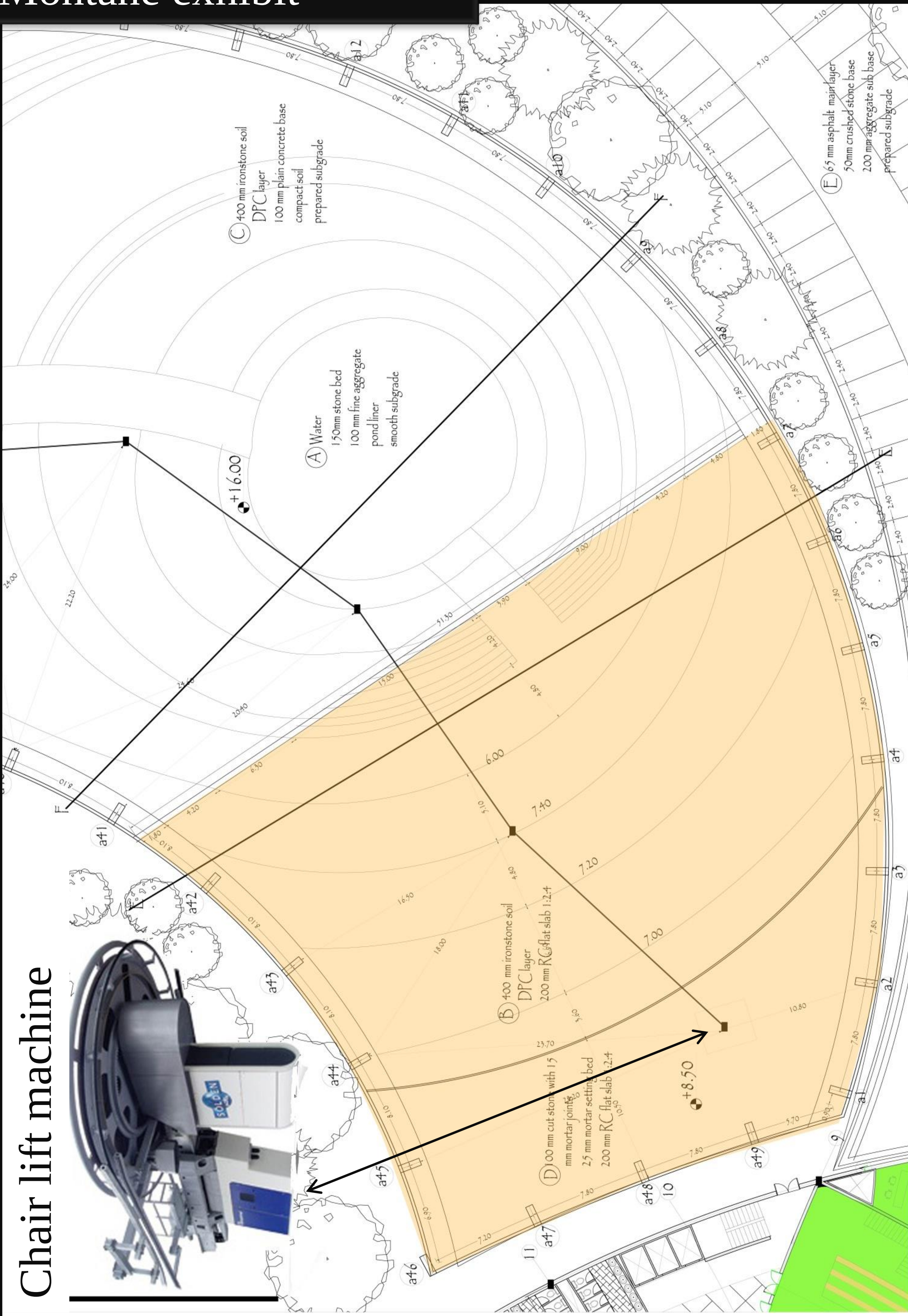

figure 5-7: montane part plan

Note: orange section has the energy center under it while the rest of the mountain has a hardcore base

Chair lift machine

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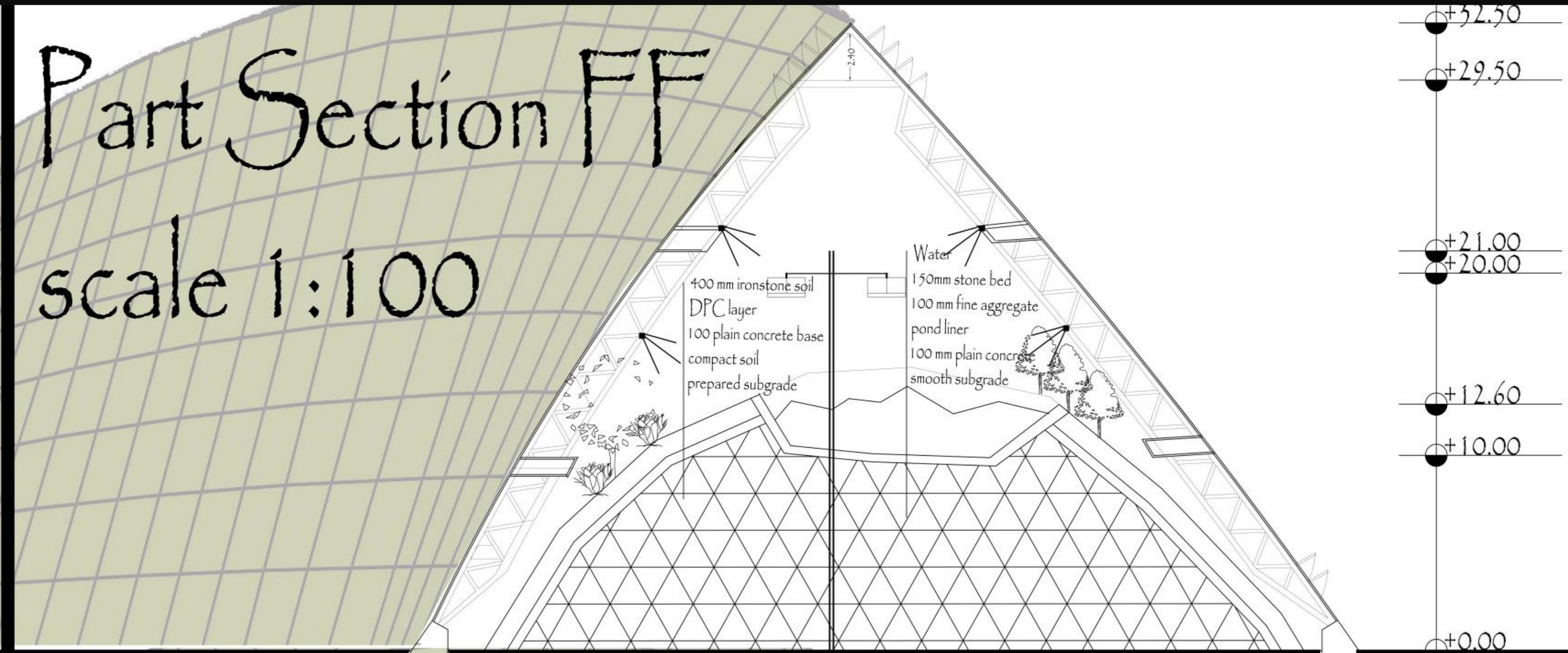

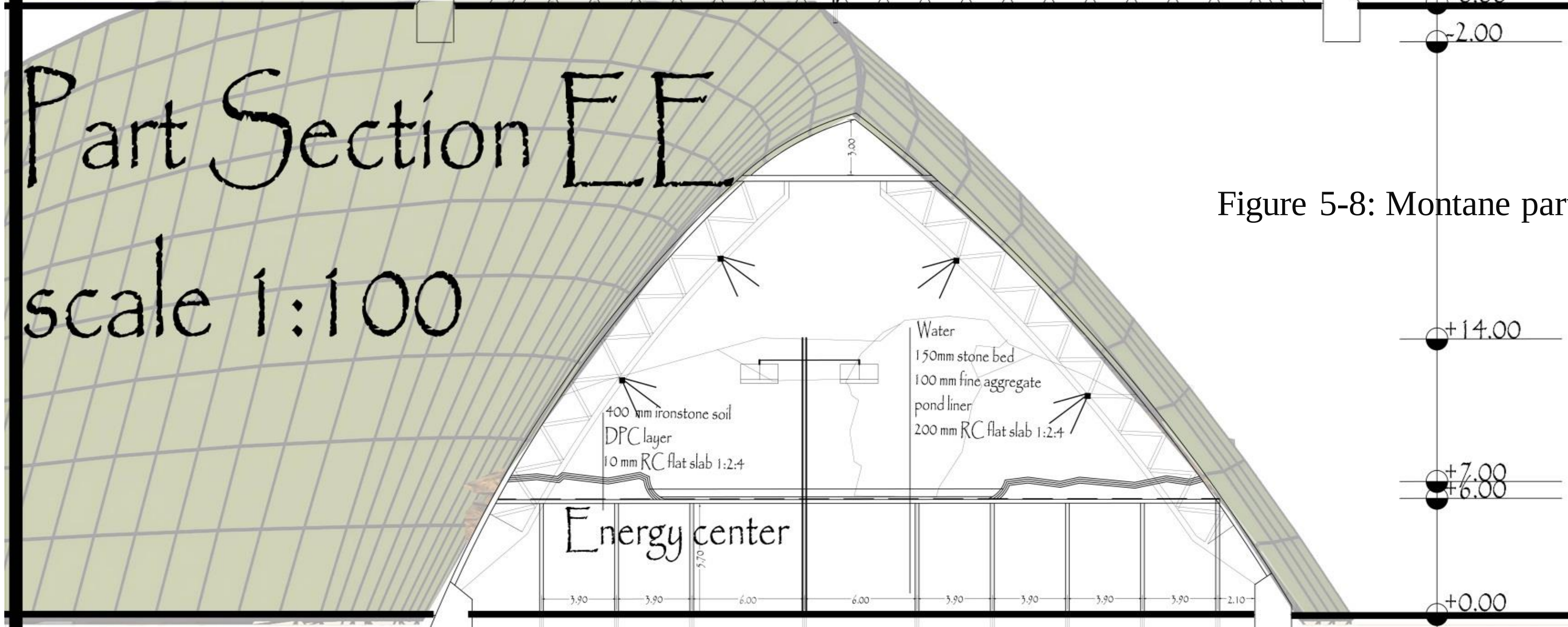

Figure 5-8: Montane part sections

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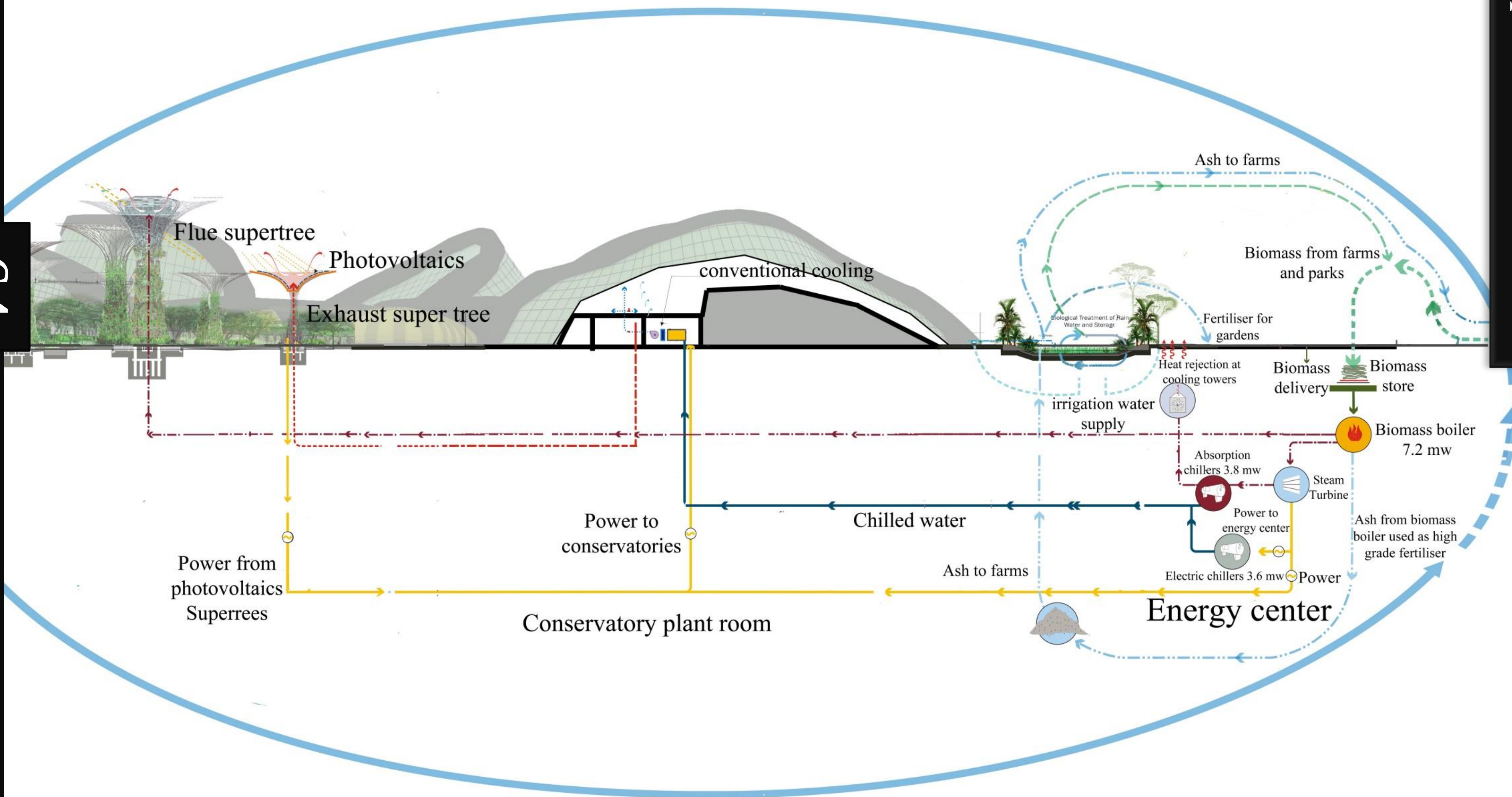
The enhanced ecosystem

Figure 5-9: water, drainage, sewage and electricity site

Figure 5-10: Site's ecosystem section

Main components: waste treatment area that has biomass burner, filter ponds, energy center that controls the greenhouses and the supertrees that produce energy and exhaust flue gases



Ecosystem details

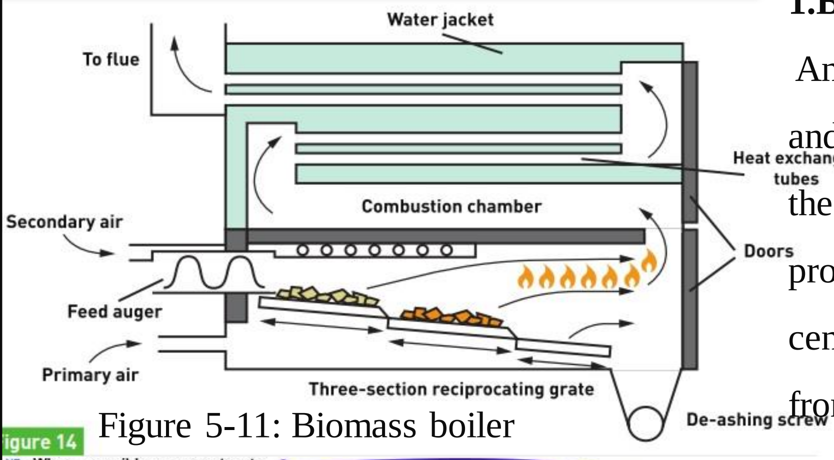


Figure 5-11: Biomass boiler

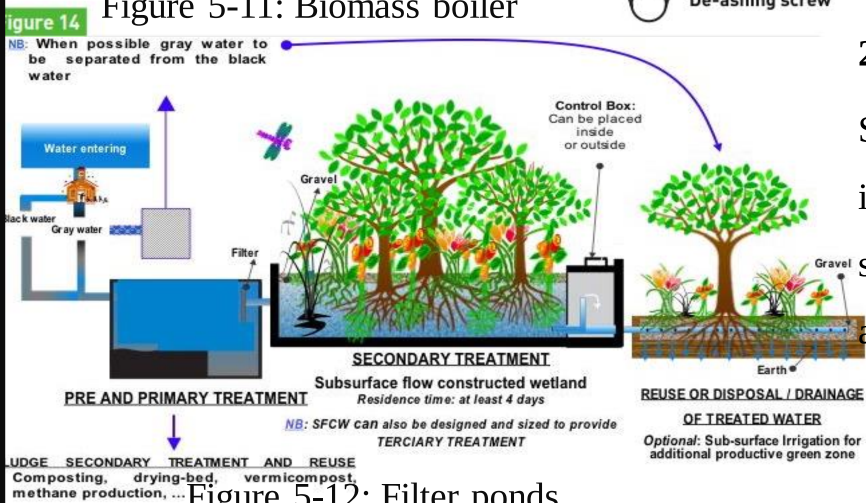


Figure 5-12: Filter ponds

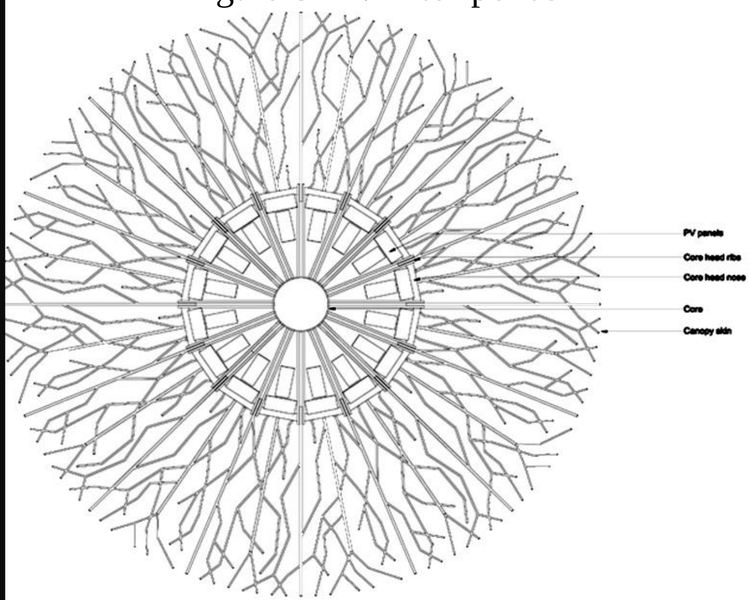


Figure 5-13: supertree Plan

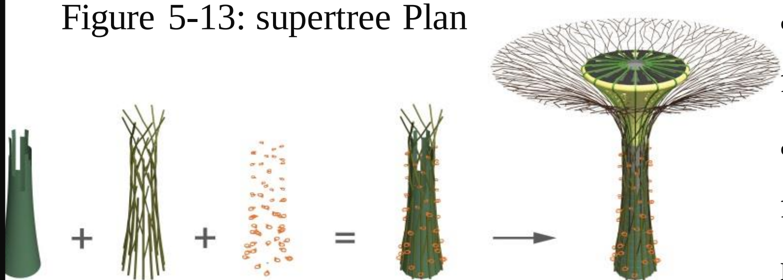


Figure 5-14: Skin layers covering supertrees

1.Biomass boiler:

Animal & plant waste is collected and burned at a biomass burner in the waste treatment area, energy produced is sent to the energy center while the flue is ejected from the super trees.

2. Filter ponds:

Storm water and sewage water is filtered at the filter ponds, sludge is used as a fertilizer and water used for irrigation.

3. Supertrees:

The supertrees are made of hollow tube concrete columns that are covered with wall panels to give it a fan shape, then its is covered with metal rods to mimic tree branches and finally planting panels to hold the vines. Solar panels are fitted on the core head. Their heights range from 25-50 m and some function as exhaust for flue while others generate power and collect water. They are also fitted LED lights that glow at night.

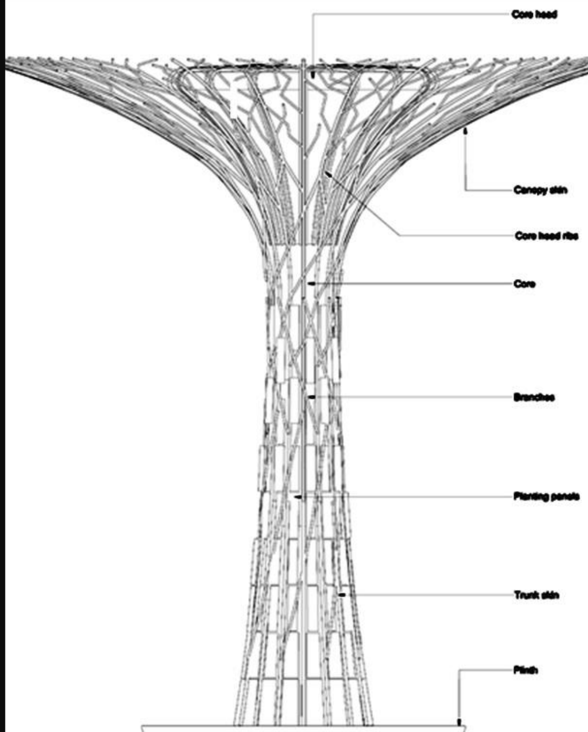


Figure 5-15: supertree elevation

Section: the foundation is made of concrete piles that range depending on the height of the super tree

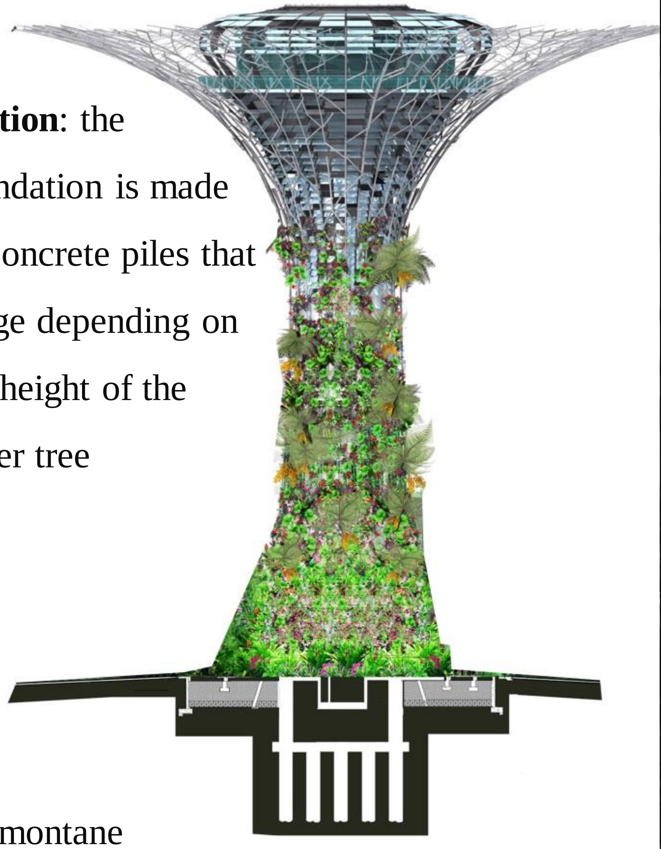


Figure 5-16: supertree section

4. Energy center:

Located under the artificial mountain in the montane bio dome (orange area).

Energy comes from biomass boilers, supertrees and the main electric grid if needed. The energy center houses the chillers, coolers, heaters and water tanks to control the temperature, humidity and sun radiation in each exhibit by controlling:

1. Deployable shades

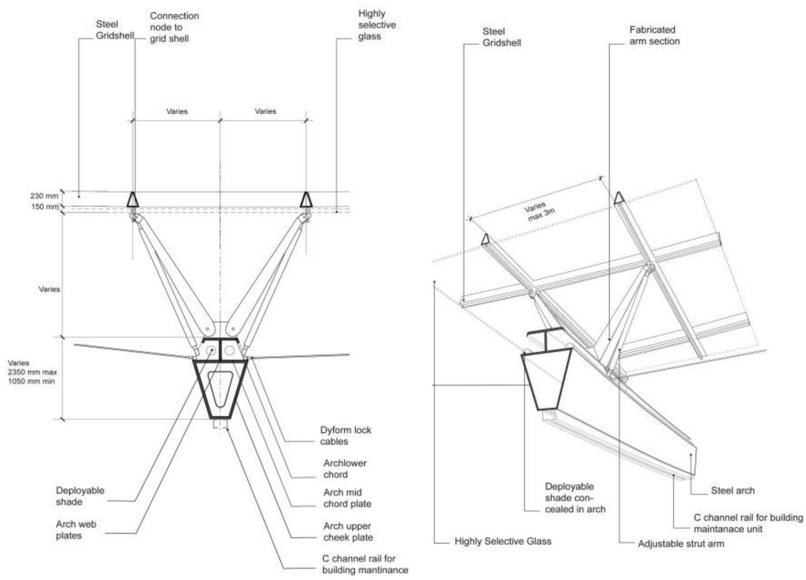


Figure 5-17: Deployable shades

Natural cooling system

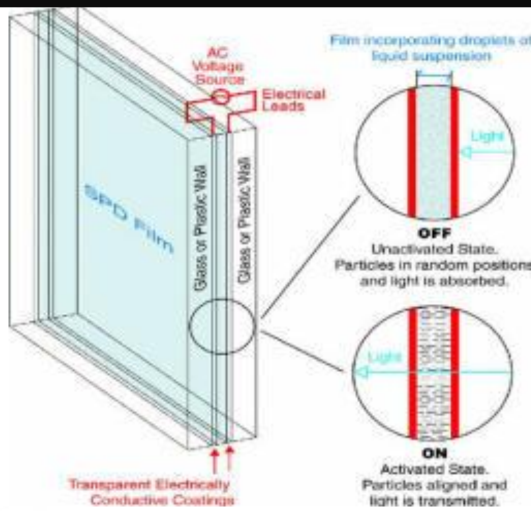


Figure 5-18: Smart glass

2. Smart glass

Is naturally opaque but becomes transparent when a current runs through it, the control system decides the transparency depending on the radiation needed

3. Evaporative cooling pads

Straw pads fixed with fans cool the air entering the exhibit by increasing its humidity.

(look at part section)

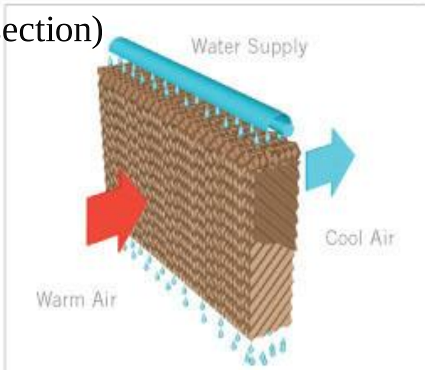


Figure 5-19: evaporative pad mechanism

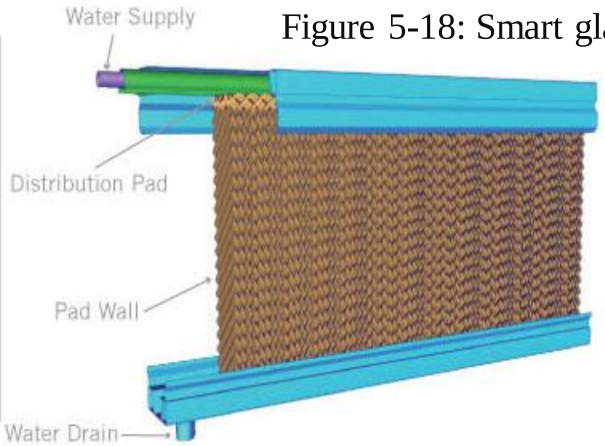


Figure 5-20: evaporative pad components

4. Hot air vents and fans:

hot air rises because it is lighter than cold air. Fans at the top of the exhibit help suck the hot air out to speed up the process.

5. Fog and mist system:

sprinklers fixed near the plants and visitors cool the air by increasing the humidity. Water is supplied from the ground tank.

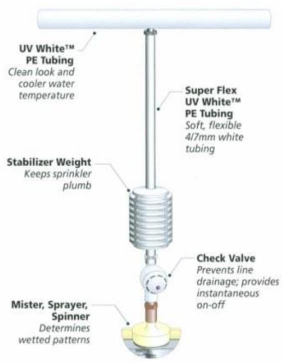


Figure 5-21: Fog system sprinkler

7. Geothermal cooling:

The animal areas are mainly underground to help keep the tempratures cool in the summer and warm in the winter by taking advantage of the ground as a thermal blanket (look at woodland section)

1

Hydronic radiant floor cooling :

Why did I choose this system?

Cooling the exhibits' entire huge air volumes would be a waste when it is only needed at the visitor level. So cooling from below is more sustainable.

Figure 5-22: hydronic system view

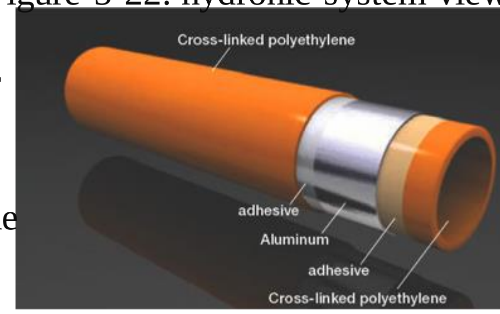


Figure 5-23: hydronic system pipes

System details:

- ❖ It is a air-water system that uses plastic tubes full of cold water embedded in the concrete to cool the floor and surrounding area (concrete core system). Water is cooled using a cooling tower at the roof and chiller at the basement in the HVAC room.
- ❖ It separates the tasks of ventilation and thermal space conditioning by using the primary air to fulfill the ventilation requirements and the secondary water system to thermally condition the space; it reduces the amount of air transported.
- ❖ The entering chilled water temperature should be above the room dew point, by at least 1.5 K to allow for control tolerance, in order to avoid any possibility of condensation forming on the cooling surfaces. Typically, chilled ceiling systems have a flow water temperature of 14–15°C and a temperature increase across the exchange device of 2–3 K. The dehumidifying capacity of the air supply is also important for control of the dew point and, in consequence, a design margin of the order of 20 per cent should be provided.
- ❖ Because of the properties of water it uses less than 5% of the energy a fan would need to remove the same amount of thermal energy.

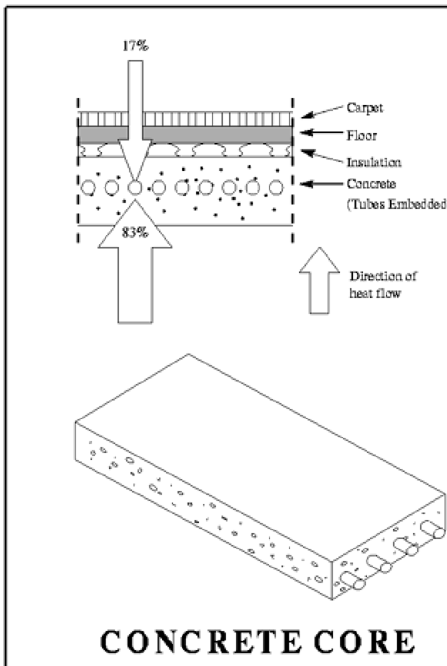


Figure 5-24:

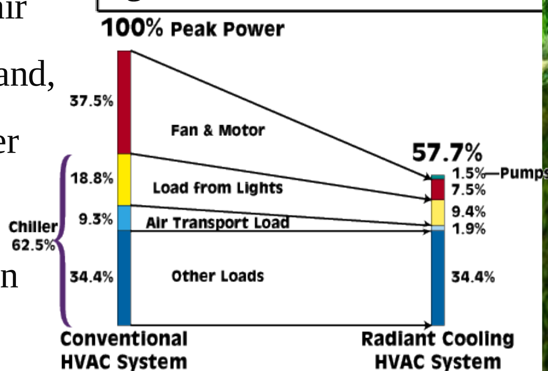


Figure 5-25: energy consumption