

CHAPTER

08

This chapter aims to introduce the technical, structural and environmental concepts and considerations informed by the final design development.

8.1. CONCEPTUAL APPROACH

As part of the concept of refuge, the architectural intervention aims to facilitate the need for shelter and protection while developing the skills and potential of the marginal community. Most of the technical and environmental concepts follow through from the design development. Firstly the re-use of materials from the excavated site into concrete elements within the structural design; the act of building underground/subterranean to introduce a moderate indoor climate; the use and re-use of water; and the development of active and passive strategies through the natural and new structural slope.

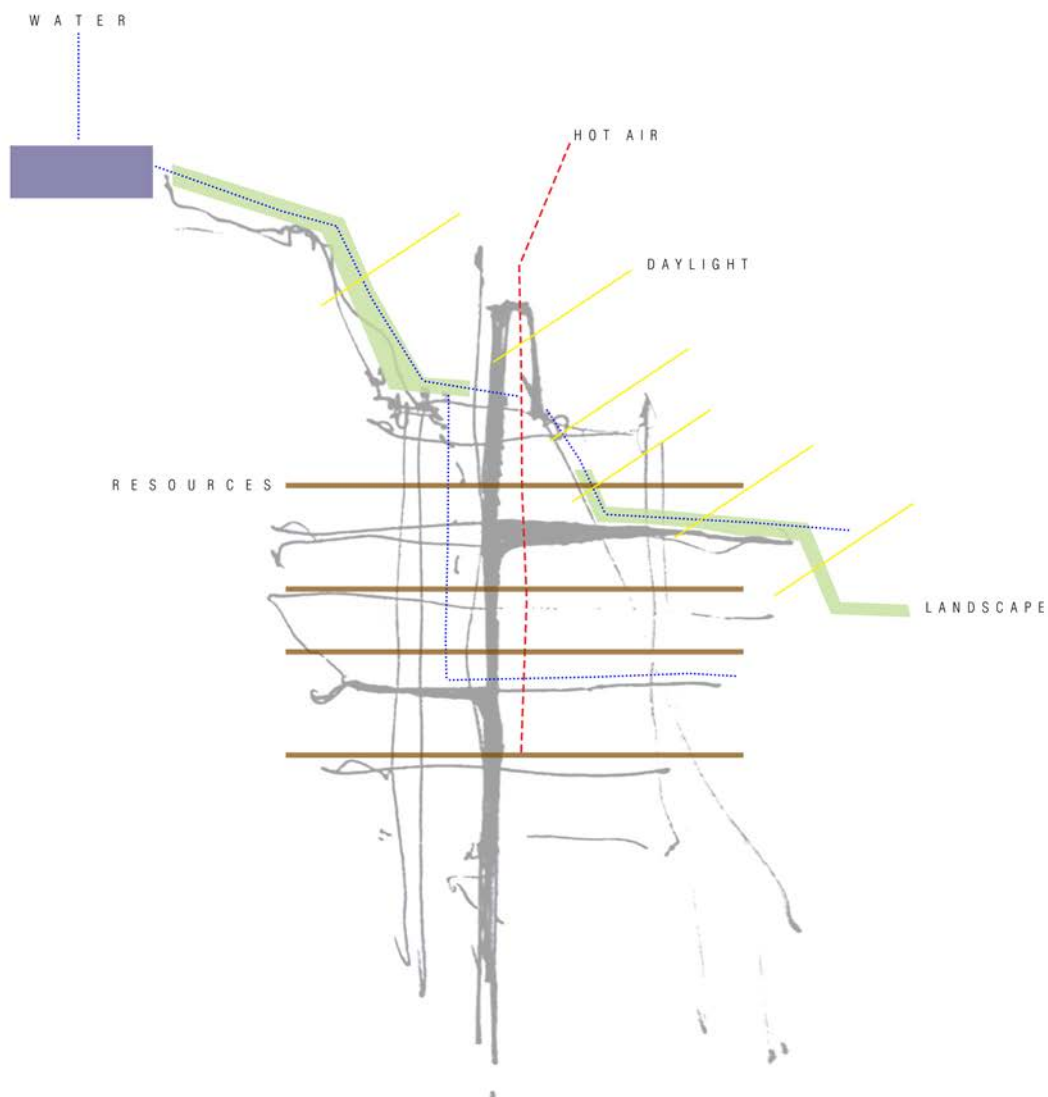


Figure 166: Structural and environmental concept in section. (2016)

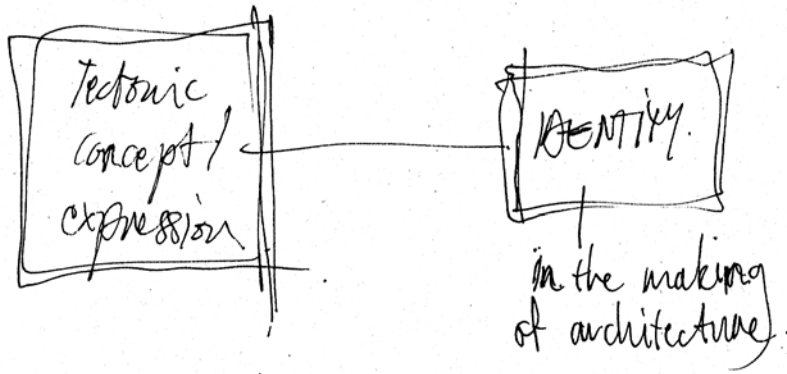


Figure 167: The tectonic expression relates to identity. (2016)

8.1.1. STRUCTURAL CONCEPT

Based on the architectural objectives and the robust nature of the proposed structure, materials consist mainly of cast in-situ and precast concrete, masonry, stone and structural steel. This decision is purely based on the concept of protection and refuge. A grid of cast in-situ fins forms part of the primary structure with masonry infill; and the secondary structure consists of a steel framework replicating the shapes of the fins for internal support of roofs. Thermal mass is created through infill earth as well as stone walls mainly on the northern side of the structure. Retaining walls are made of concrete - as mentioned before, the blasted quartzite is crushed on the site of the Econoslag crushing plant to produce most of the aggregate used in the concrete structural elements.

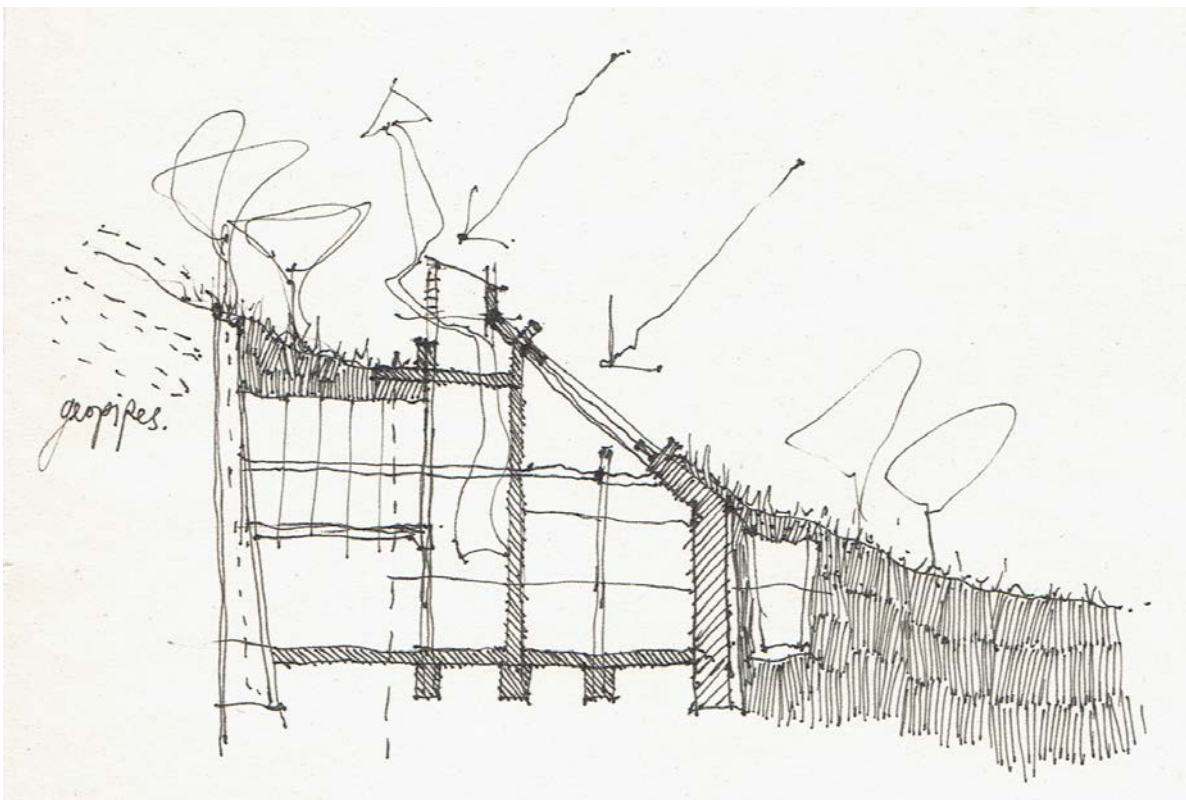


Figure 168: Initial exploration of structure in section. (2016)

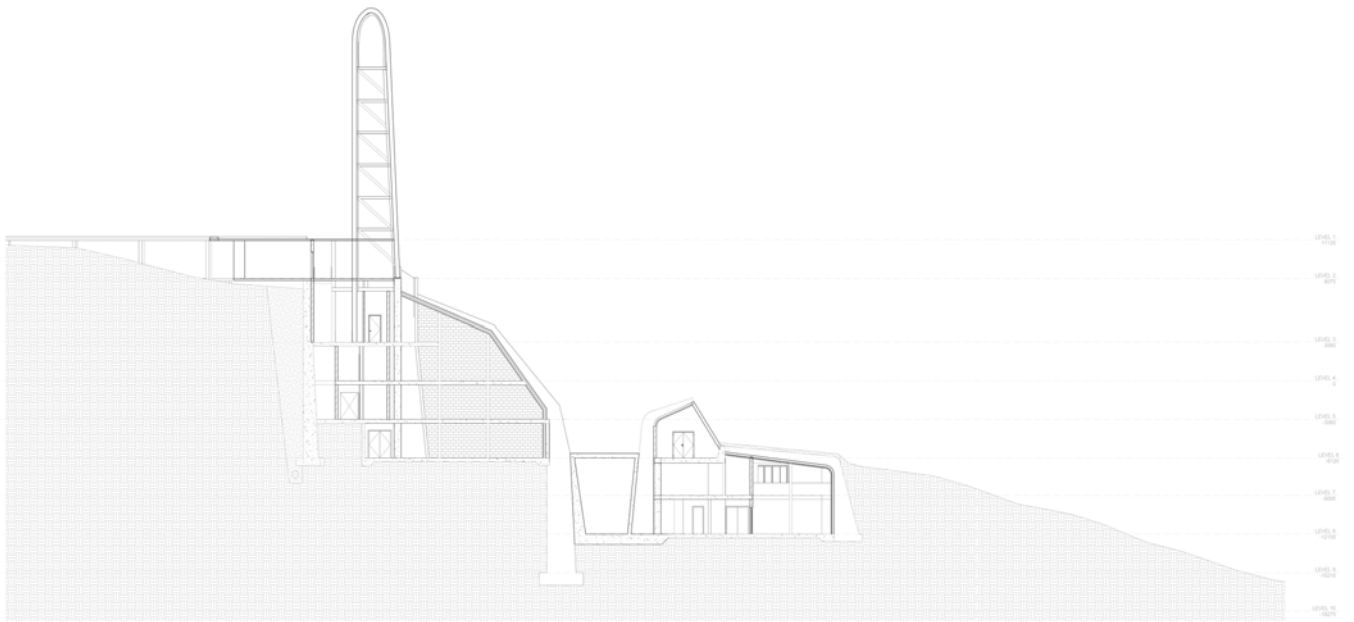


Figure 169: Main structural section (A). (2016)

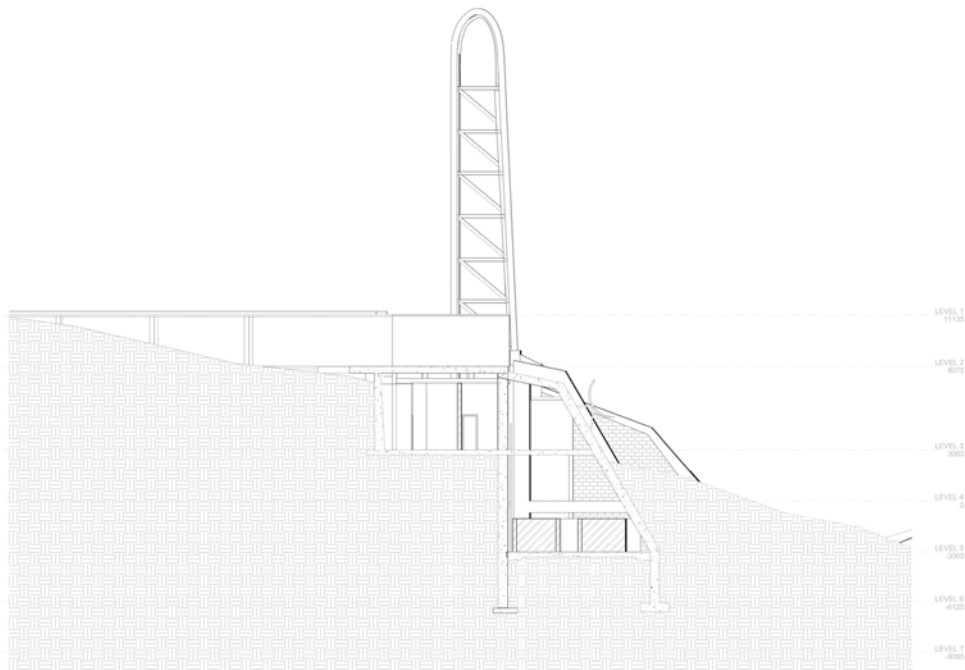


Figure 170: Structural section (C). (2016)

8.1.2. STRUCTURAL EXPLORATION

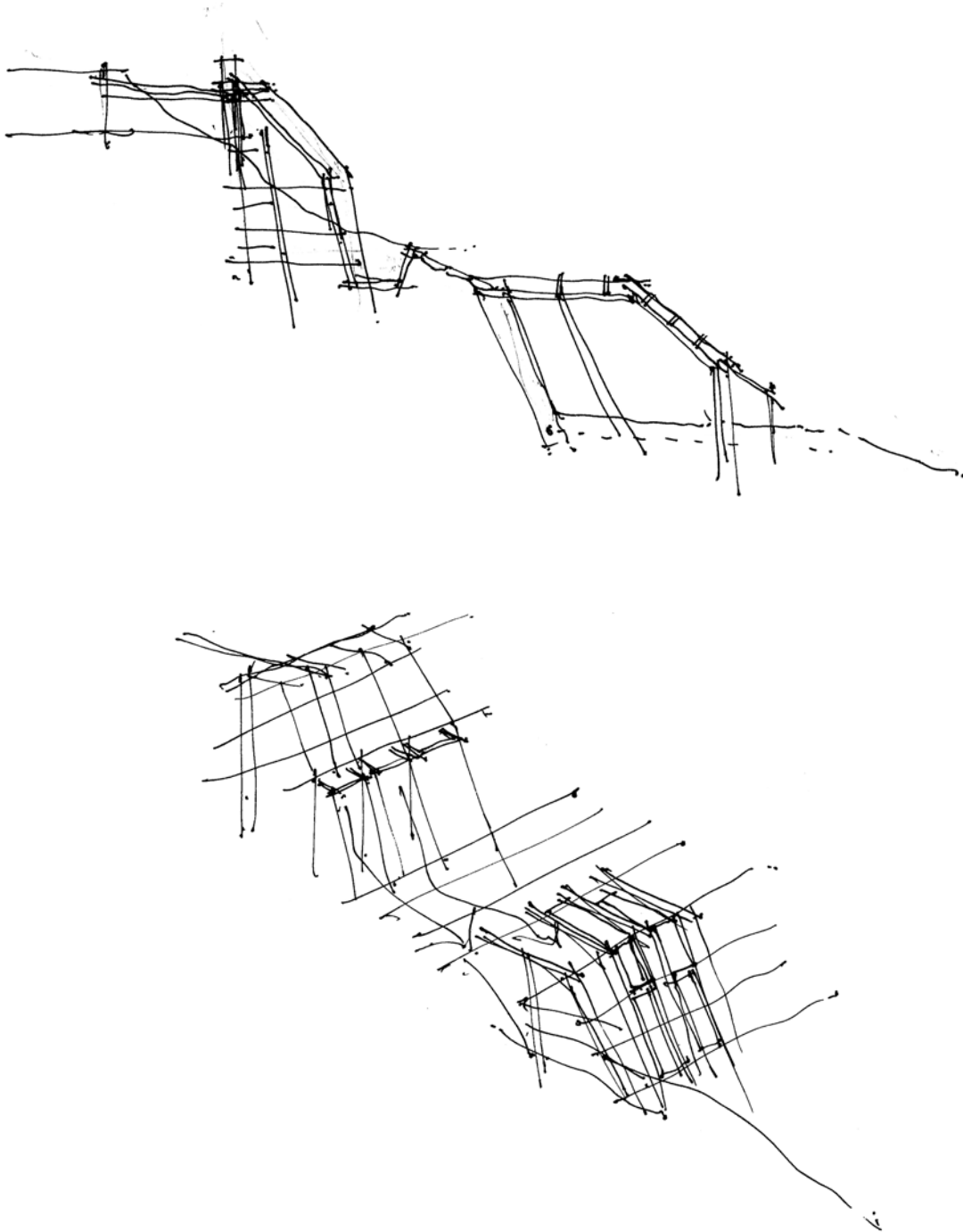


Figure 171: Structural explorations. (2016)

8.1.3. DETAIL EXPLORATION

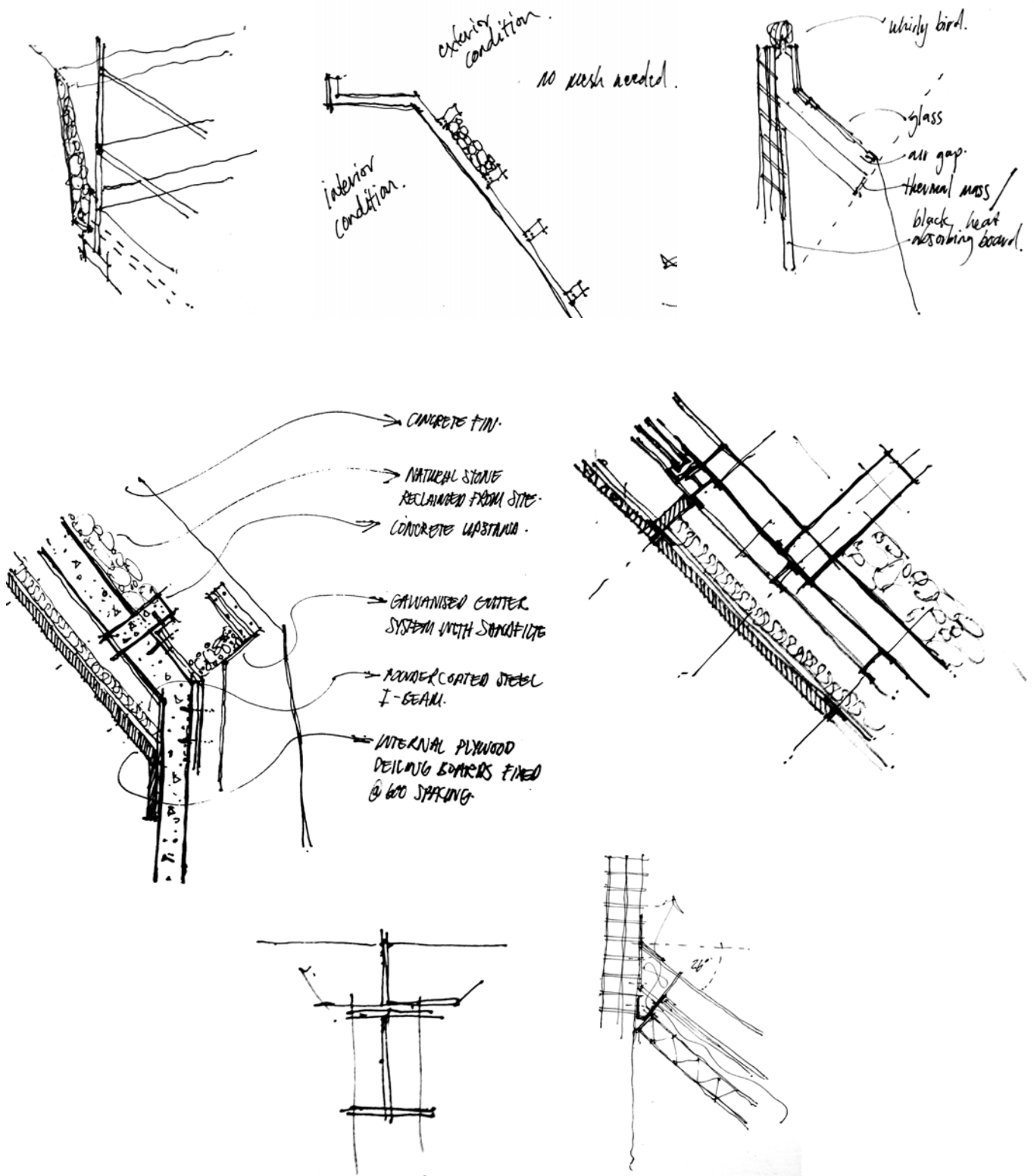


Figure 172: Detail explorations of roof and wall junctions. (2016)

Figure 173: Workshop roof junction detail. (2016)

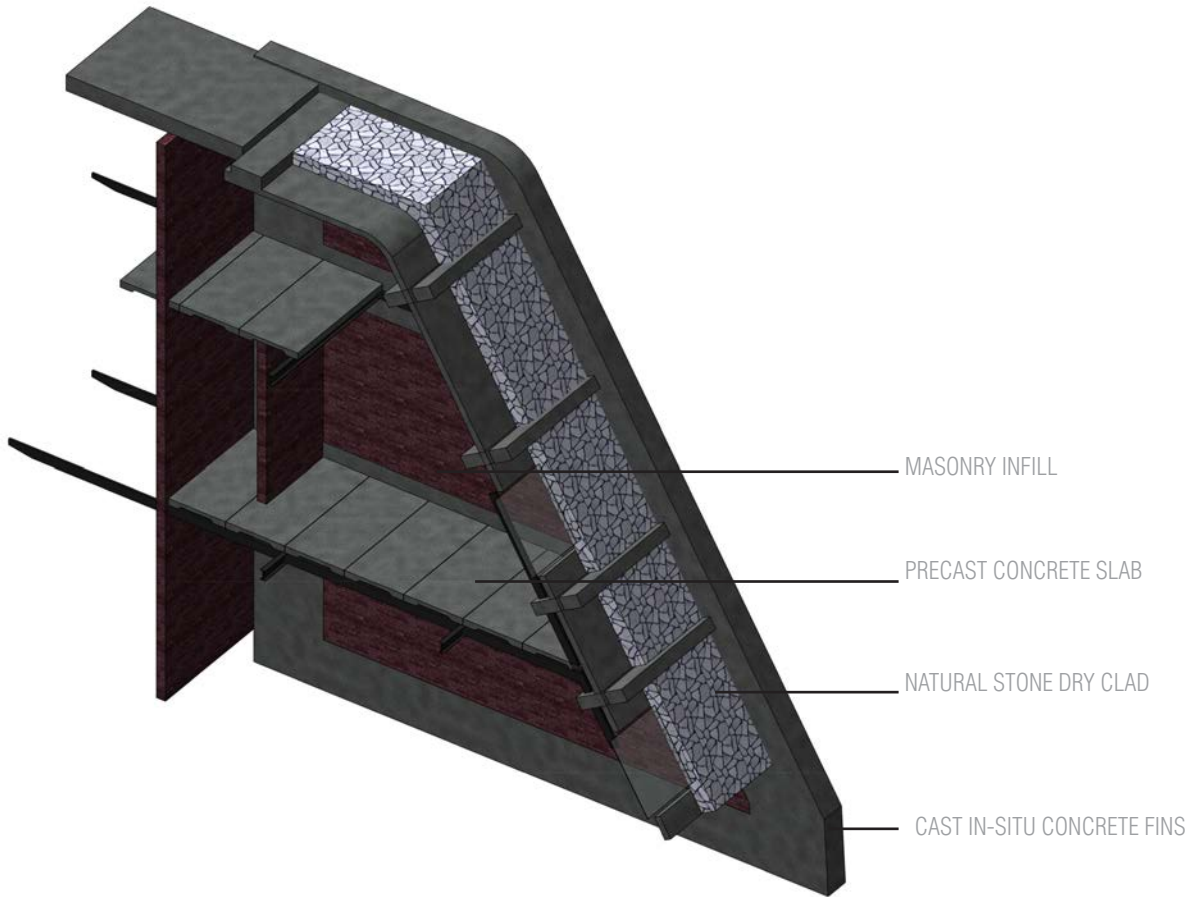
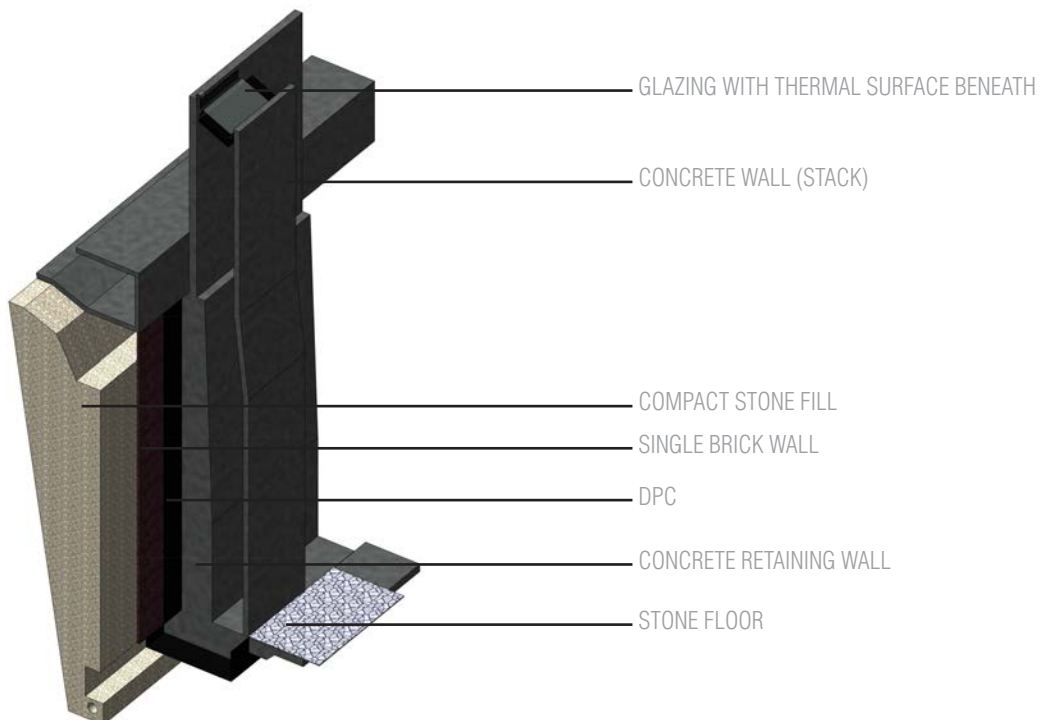


Figure 174: Archive floor and wall junction detail. (2016)





8.2. STRUCTURAL PRECEDENT: CAMDEN STATE PARK HOUSE

“The Camden State Park house demonstrates how unique and interesting details can be incorporated into a basic, straightforward design, yielding a house that looks distinctive but is architecturally unpretentious and uncomplicated. Its simplicity also helps the house blend in well with the natural environment of the park” (Ahrens, et.al. 1981:22).

LOCATION: Camden State Park,
Lynd, Minnesota
ARCHITECT: Architectural Alliance
ENGINEER: Bressler Armitage Lunde
CONTRACTOR: Bladholm and Hess
CONSTRUCTED: June 1980

GROSS AREA: 1,640 sq. ft. (148 ca)
STRUCTURE: Reinforced concrete block walls, precast concrete roof, concrete slab-on-grade floor

EARTH COVER: 80% on roof at 18 in. (46 cm)
80% on walls

INSULATION: Roof—4 in. (10 cm) rigid insulation
Walls—4 in. (10 cm) rigid insulation

WATERPROOFING: Butyl membrane

HEATING DEGREE DAYS: 8,000
HEATING SYSTEM: Passive solar, wood, electric backup
COOLING SYSTEM: Natural ventilation

CONSTRUCTION COSTS*:

Site work	\$ 4,800
Concrete masonry	27,340
Waterproofing	15,300
Carpentry	23,780
Heating plumbing	18,080
Electrical	4,630
Interior finishes	6,700
General requirements	5,545

TOTAL \$106,175

*These costs reflect special MHFA Demonstration Project requirements and local construction industry conditions.

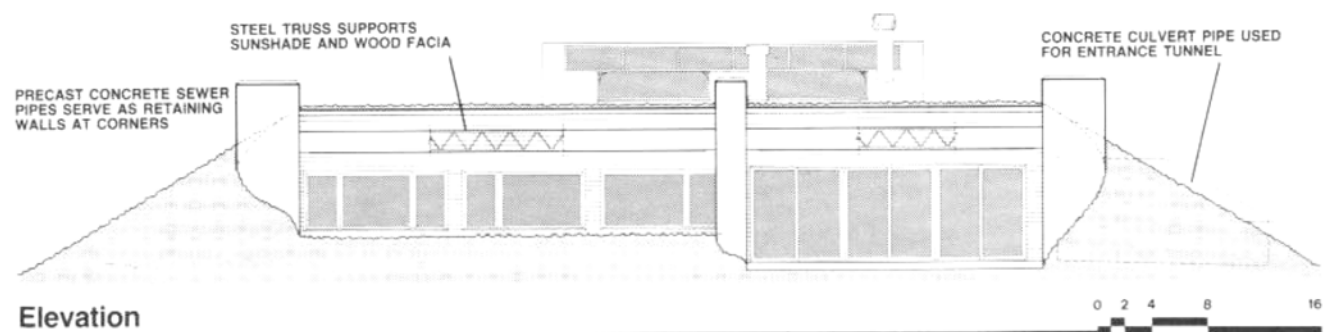
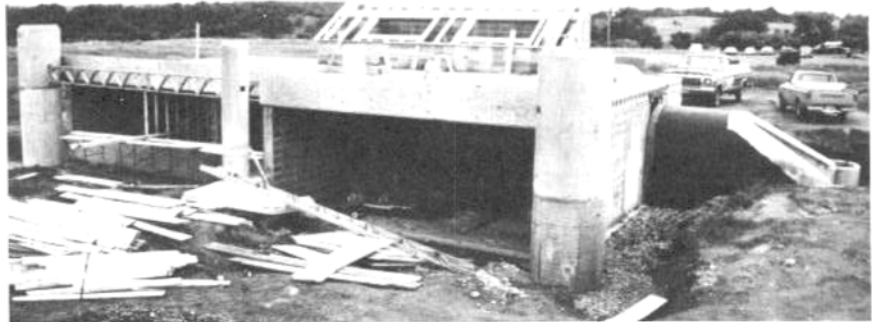


Figure 175: Camden State Park house. (Ahrens, et.al. 1981:25)

With simple construction, sufficient layers of insulation and passive solar strategies, this house reduces energy consumption as an earth-sheltered structure. "It is expected that the passive solar gain, combined with energy conservation aspects such as earth sheltering and automatic motor-operated nighttime window insulation on the major glass areas, will significantly reduce the heating demand of the house" (Ahrens, et.al. 1981:22).

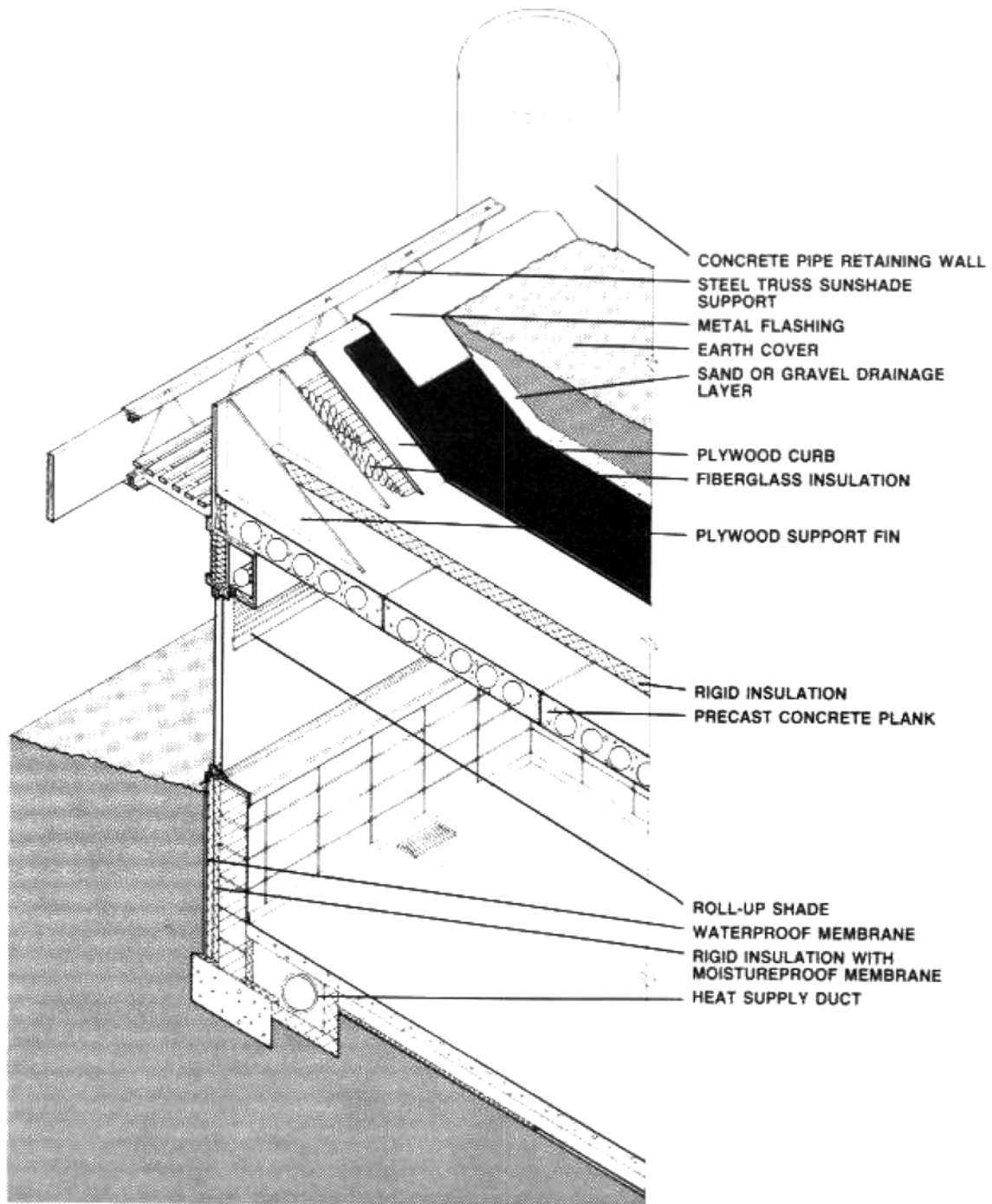
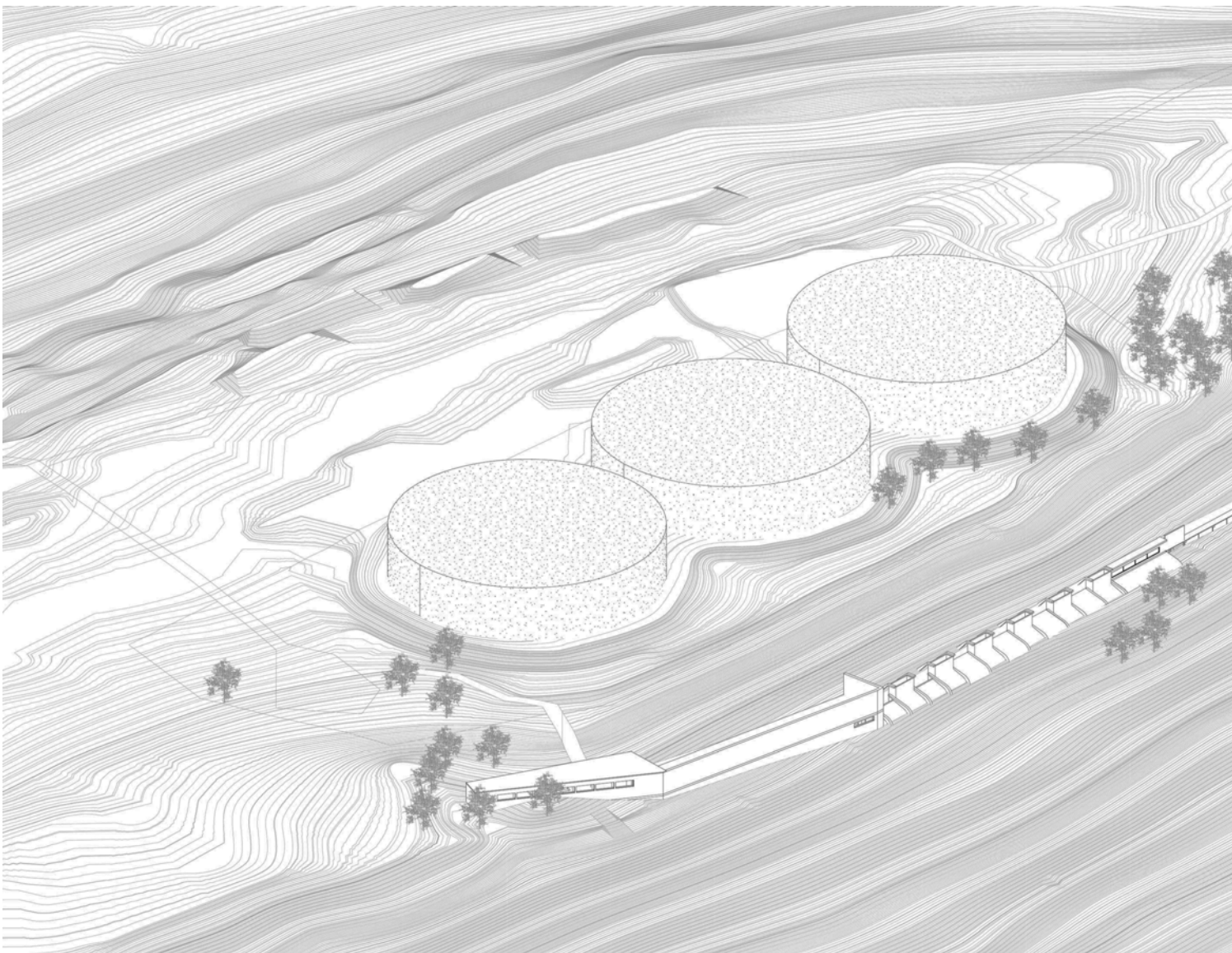
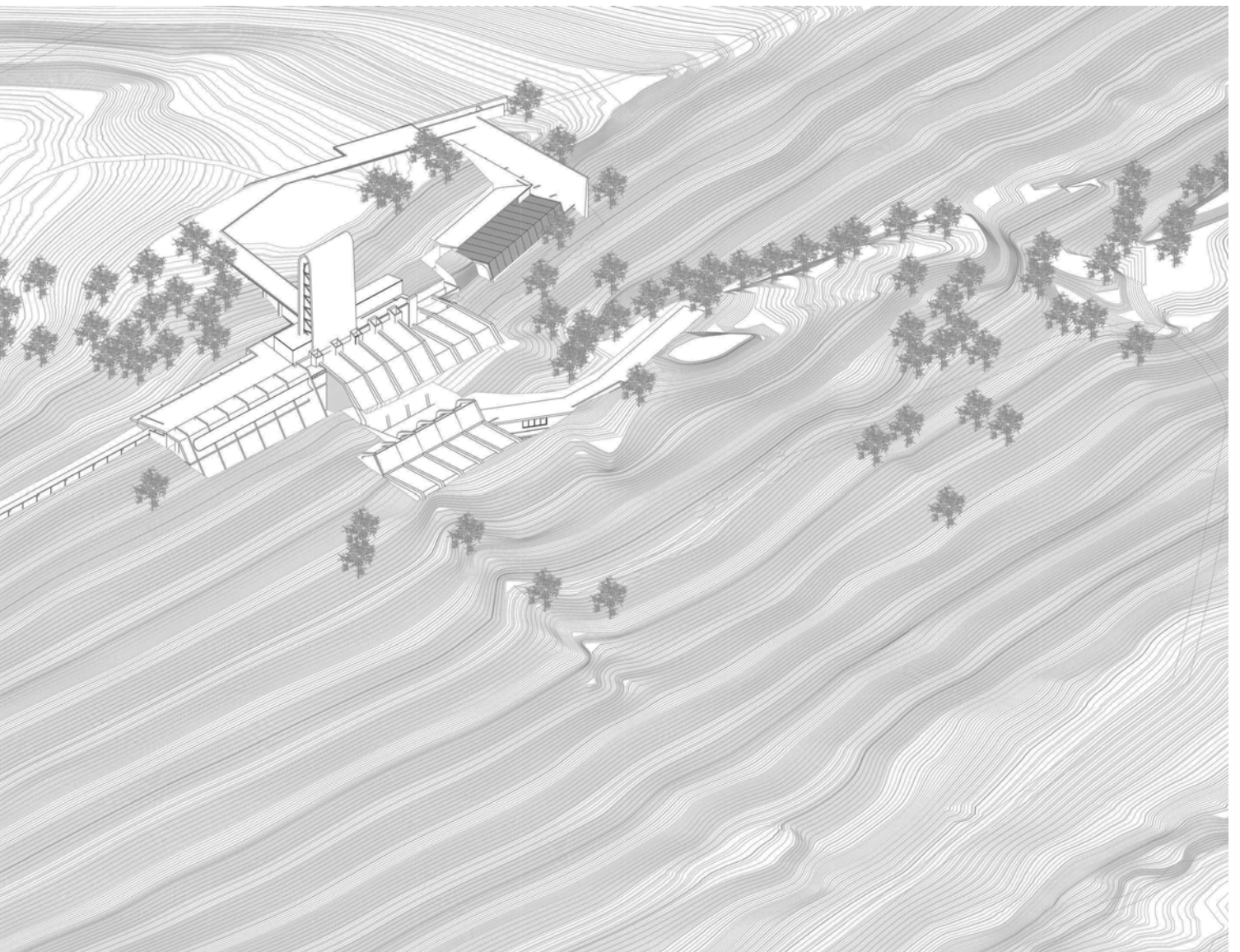


Figure 176: South wall/roof detail of the Camden State Park house. (Ahrens, et.al. 1981:24)

Figure 177: Three-dimensional structure within context. (2016)





8.3. FINAL DETAIL OF OBSERVATION DECK

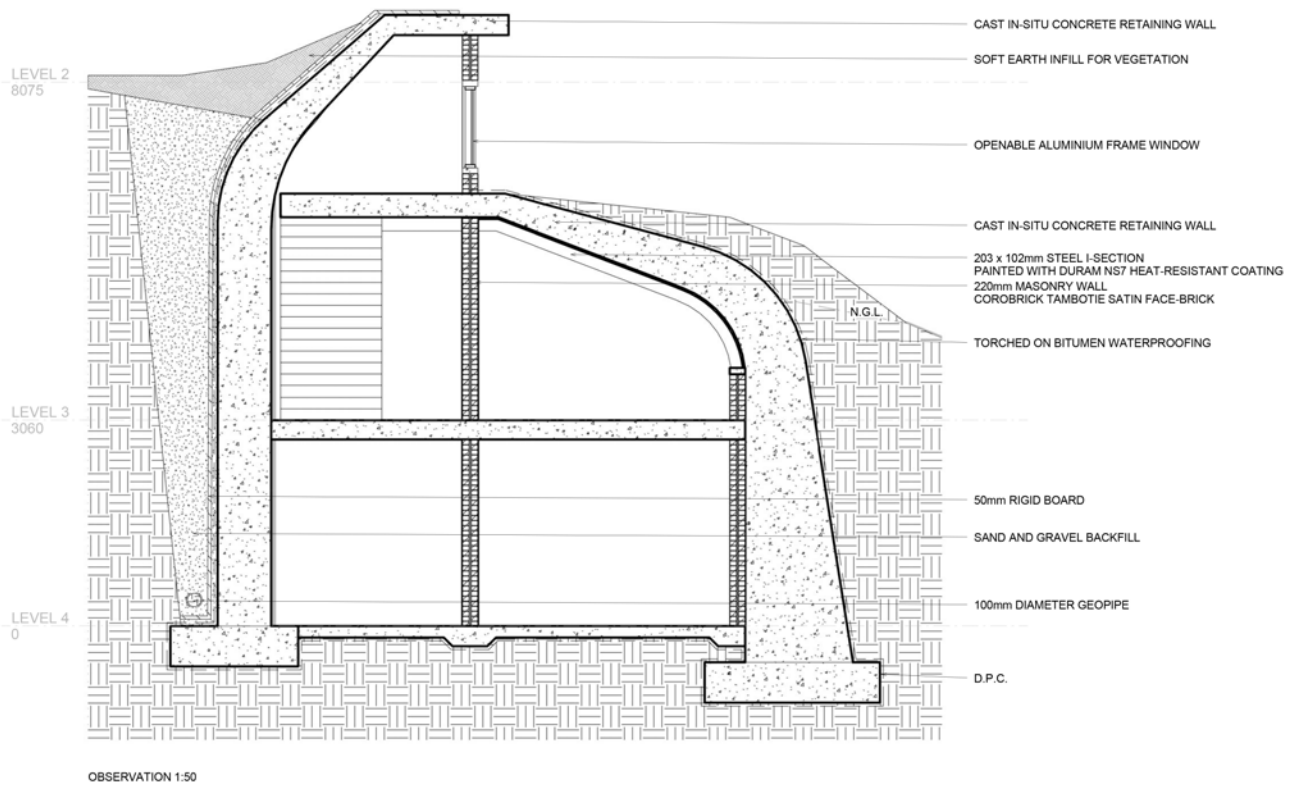


Figure 178: Construction detail of the observation deck. (2016)

8.4. ENVIRONMENTAL CONSIDERATIONS

In the overall design of the structure, energy and hot water is primarily provided through solar heat collectors attached to the structural fins of the energy chamber, as well as solar panels placed on the top surfaces of the reservoirs (electricity for lights, lifts, turbines, water pumps and other mechanical equipment).

Geothermal pipes (in combination with radiators) are installed on the southern side of the workshops and energy chamber to use the southern wind for air-intake in order to provide either heating in winter or cooling in summer (radiators are installed on each floor as it is multi-storey). Trombe assisted stacks are already part of the structural intervention and will assist in removing hot air from the workshops in summer.

Biodigesters are constructed on the southern side of the laboratory (near the main kitchen) in order to use high energy waste (high calorific value) to produce additional electricity.

The treatment of grey- and black water is primarily dealt with through the use of constructed wetlands. This treated water is mainly used for the irrigation of plants.

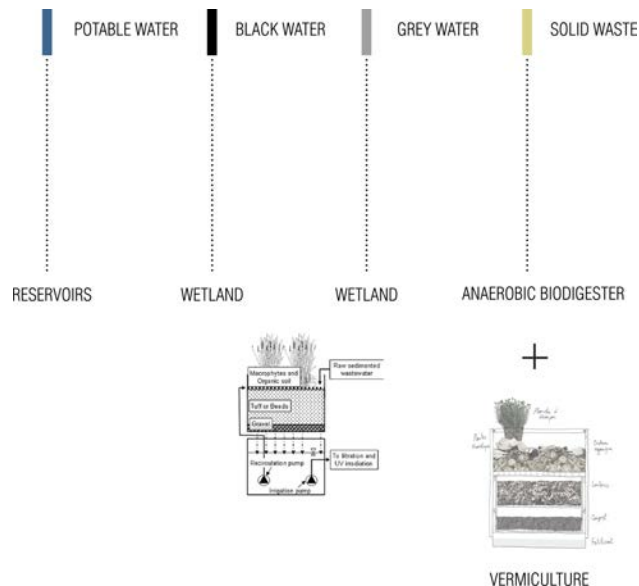


Figure 179: Water and waste strategies. (2016)

GEOHERMAL: HEATING AND COOLING

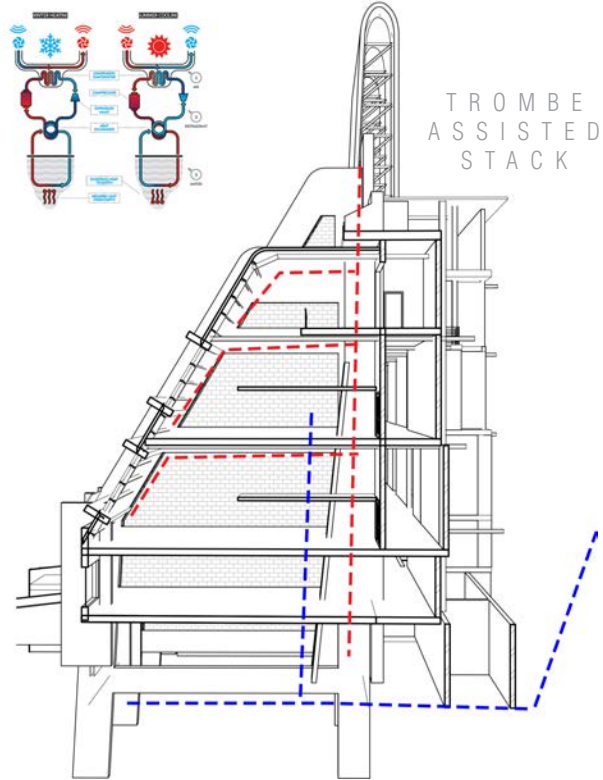


Figure 180: A 3D illustration of the workshops' heating and cooling strategy. (2016)

AIRBRICKS

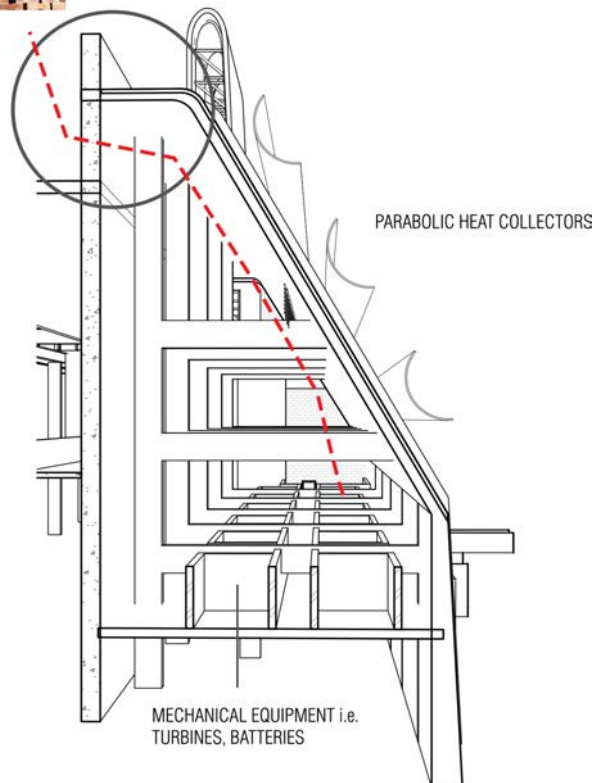


Figure 181: A 3D illustration of the energy chamber. (2016)

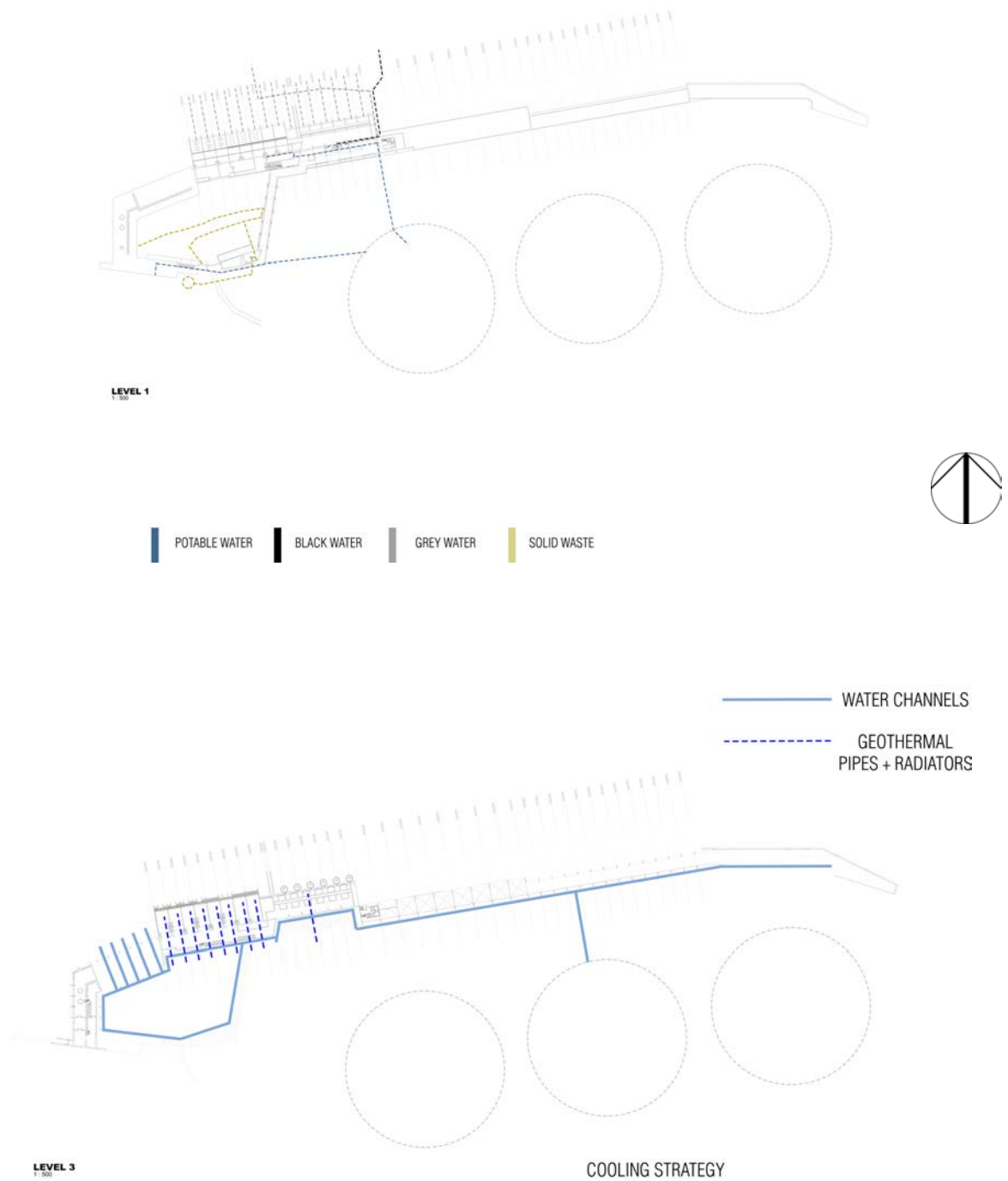


Figure 182: Plan configurations with environmental and passive strategies illustrated. (2016)

8.4.1. RESERVOIR ENERGY CAPACITY

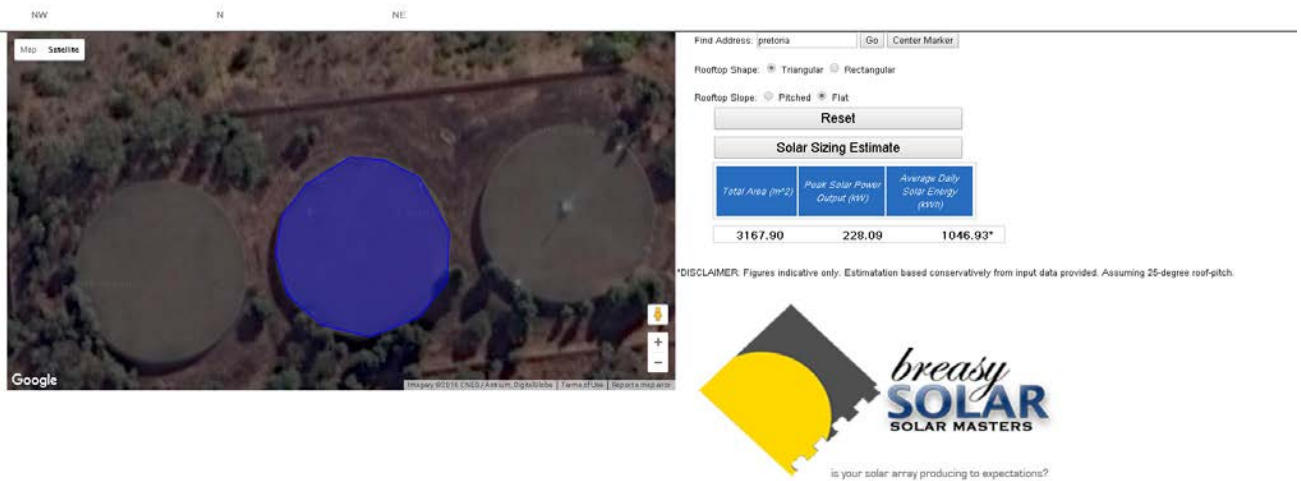


Figure 183: The energy capacity of one reservoir surface covered with solar PV's. (Solar Masters [sa])

8.4.2. CALCULATIONS

CALCULATIONS

Solar PVs'on reservoirs:

Total area: 3167m²

Peak solar output: 228kW

Average daily solar energy: 1046.93 kWh

X3 reservoirs = 3140.8kWh per day

Occupancy:

E1: Place of detention – 2 persons per bedroom

D4: Plant room

H2: Dormitory – 1 person/5m²

B3: Low risk commercial – 1/15m²

J3: Low risk storage – 1/50m²

A1: Entertainment and assembly – 1/m²

400kWh/m²

RAINWATER CATCHMENT FROM ROOFS AND LAWN:

8251.4m² + 4000m²

RESERVOIRS VOLUME CAPACITY:

11879147221.386m³

WATER TANK SIZES:

Tank 1: 1736.9m³

Tank 2: 940,8m³

WATER DEMAND (Low-flow installations):

Showers: 12 (4.5litres per minute)

Toilets: 35 (3.2 litres per minute)

Urinals: 11 (2 litres per flush)

Basins: 65 (4.5litres)

15min peak factor per day

= 300m³ per month