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INTECTURE

energy storage in parkstad

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content

- **introduction**

  phenomenon - problem statement – context – design question – research question - objective

- **research**

  context – storage demand – storage methods – possible methods

- **design**

  masterplan – concept – architecture – building technology – system technology

- **conclusion**

context - parkstad

former mining region

currently a shrinkage region without identity

phenomenon

climate change & energy independence

transition towards sustainable energy

phenomenon

massive implementation of solar and wind

renewable intermittency strains the grid

phenomenon

energy storage pops up in built environment

is this the appearance for energy storage?

problem statement

"The massive implementation of intermittent renewable energy sources asks for the realization of energy storage. The architectural possibilities of such artefacts have not yet been studied."

research question

"Which local conditions in Parkstad can be utilized for visible energy storage and what are the spatial requirements that flow from these possibilities?"

objective

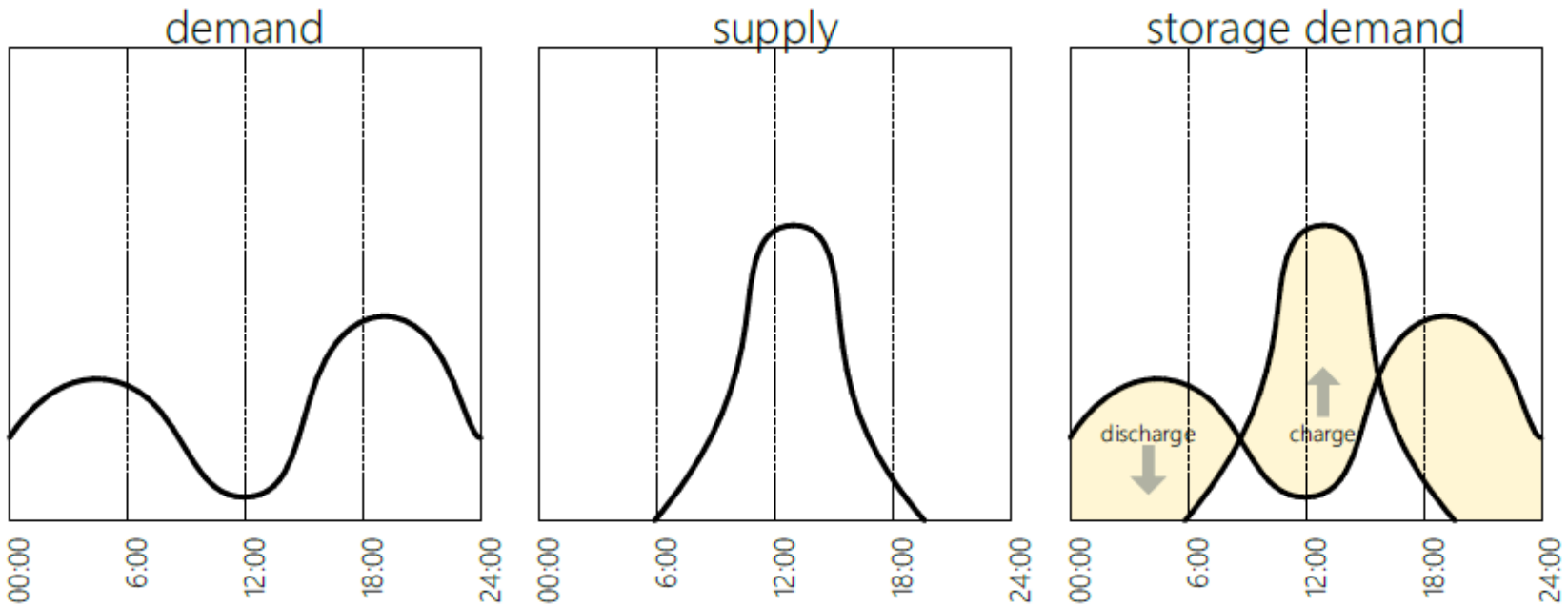
"Creating an energy storage building/facility
which uses a visible method of storage
adding a building which influences the landscape"

research

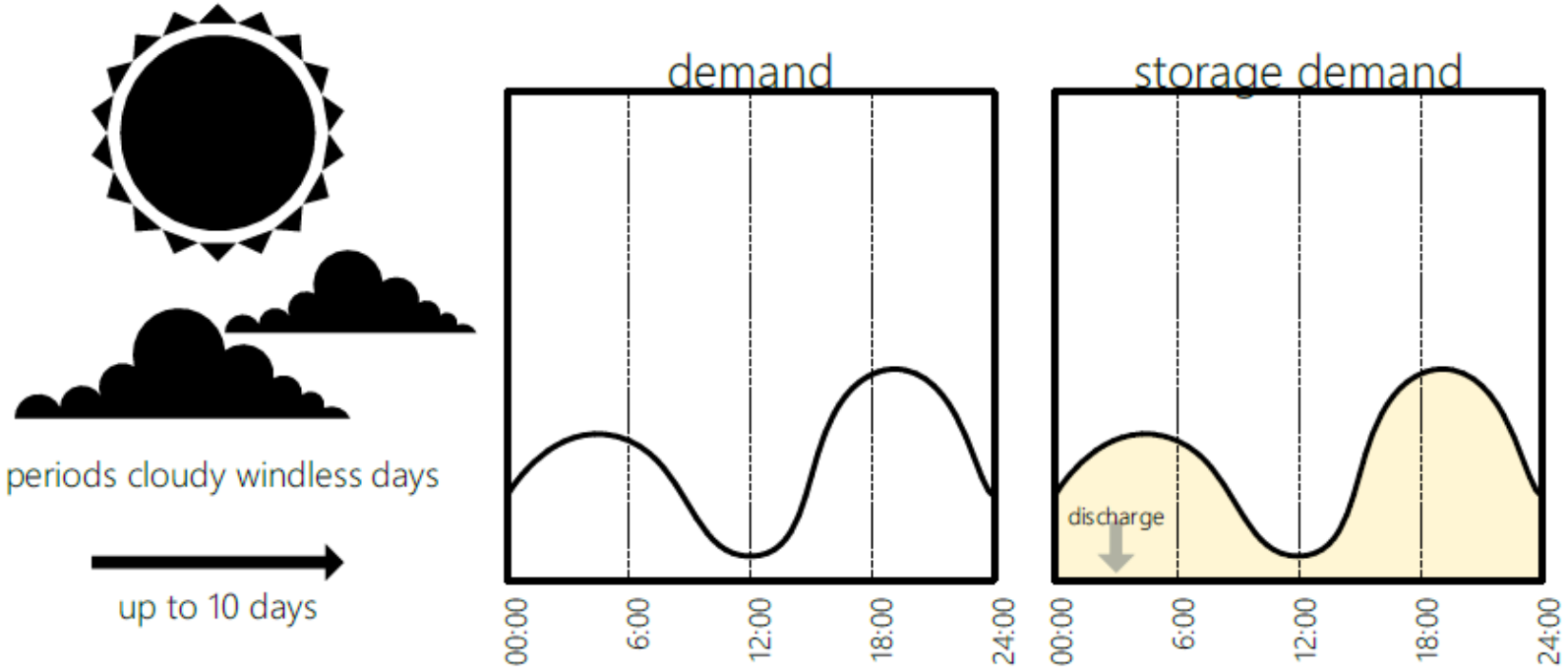
research

- **storage demands**
  - daily demand
  - inter seasonal demand
  - incidental demand
- **local conditions**
  - natural and artificial hills
  - little surface water
  - mining relicts
- **storage methods**
  - matrix of methods
  - method assessment
  - possible methods

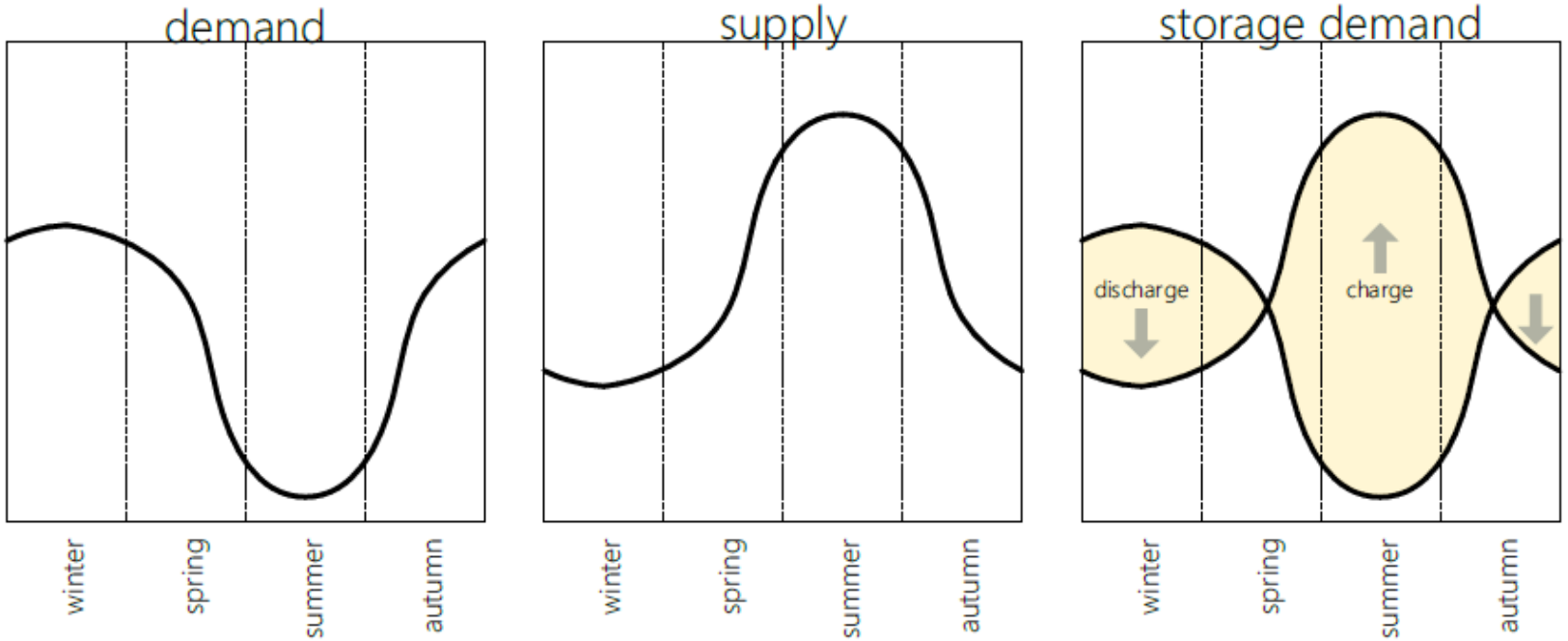
storage demand



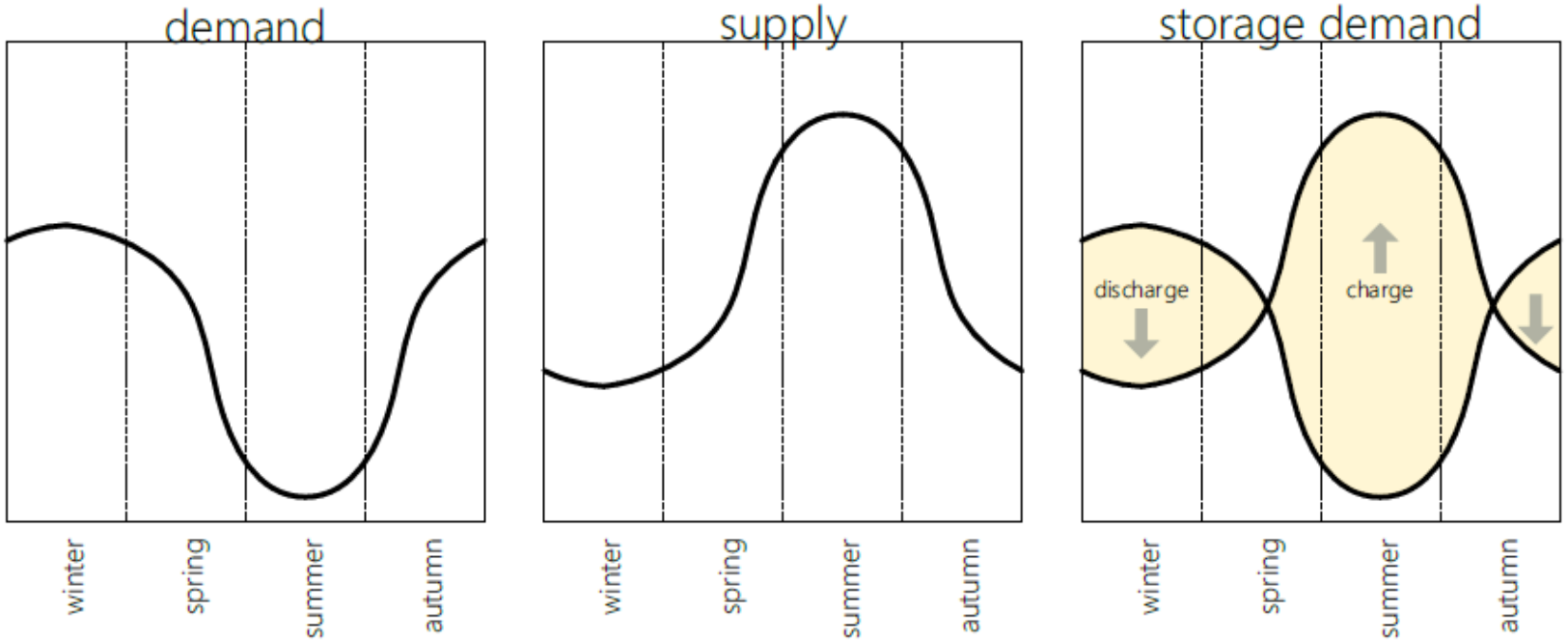
storage demand



storage demand



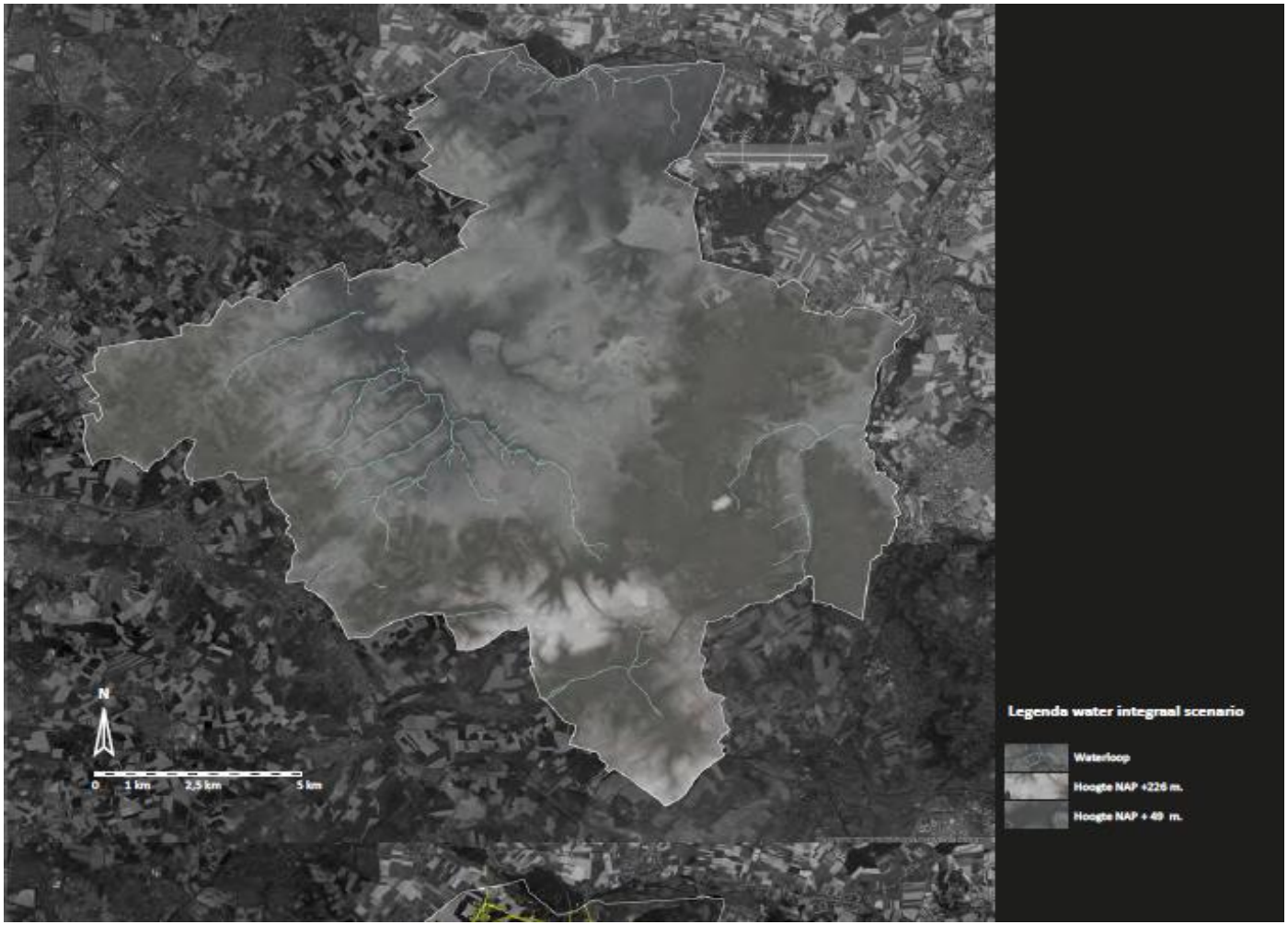
storage demand



local conditions

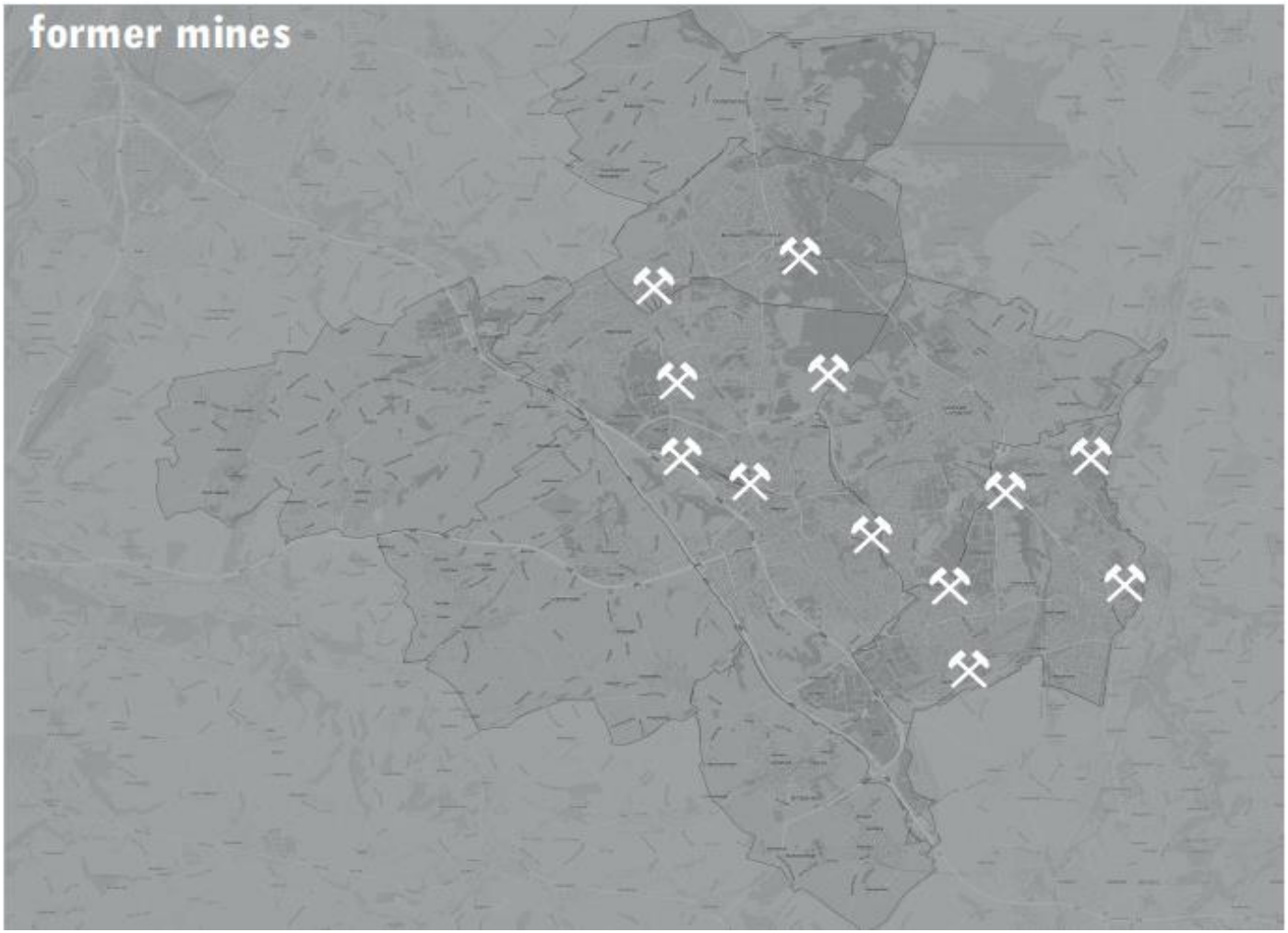
hilly landscape of natural and artificial hills

local conditions



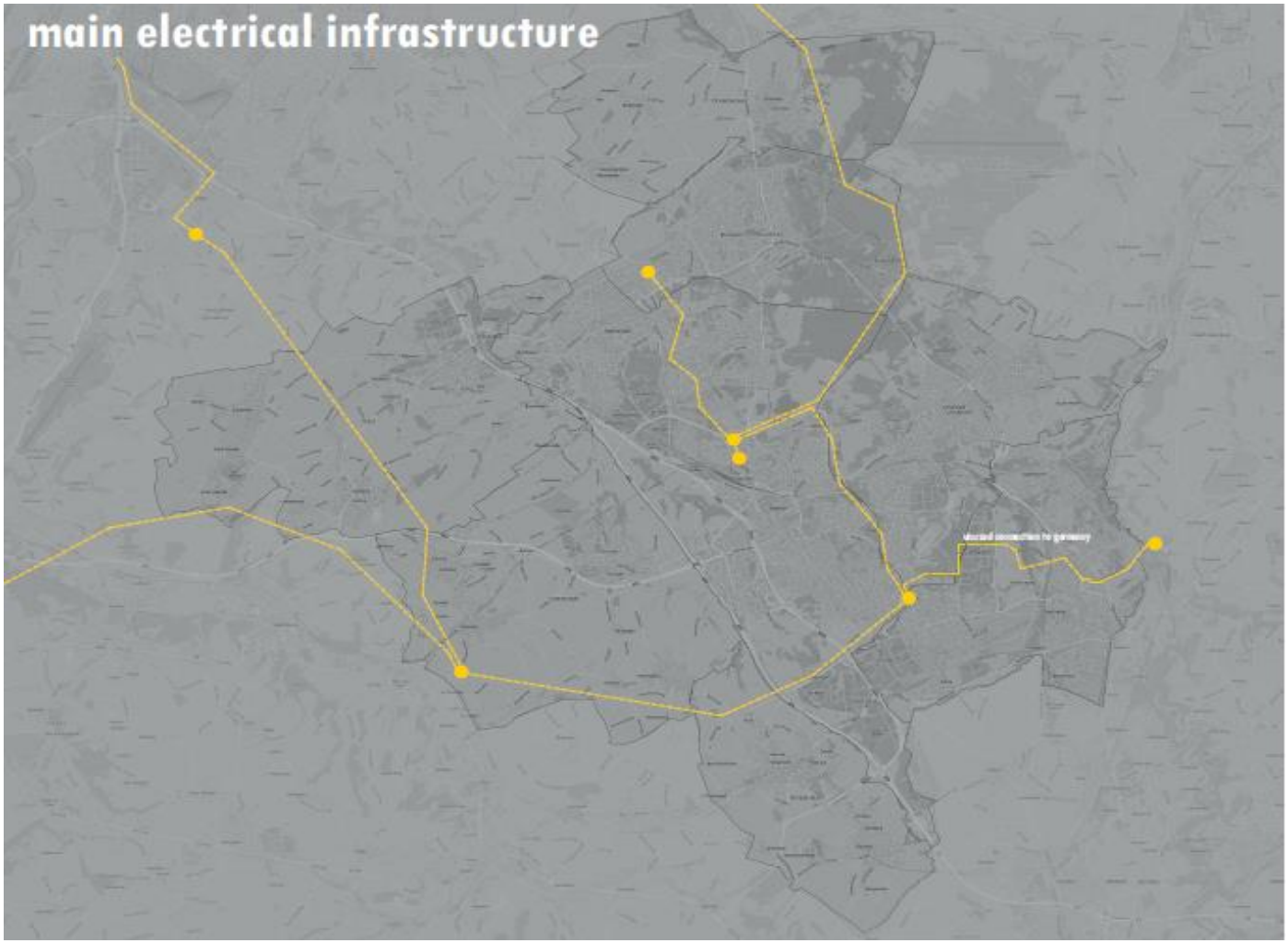
little relative height difference

local conditions



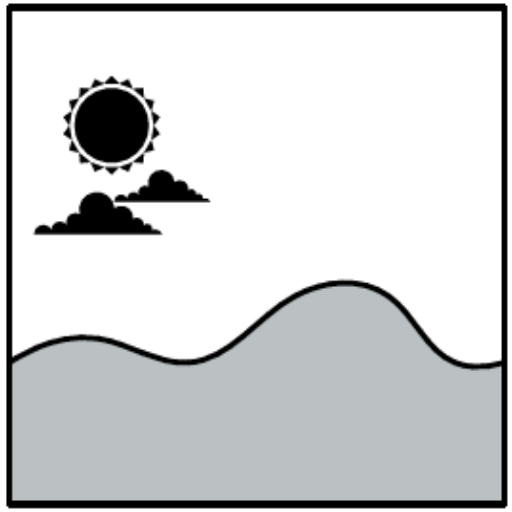
mines spread across the area

local conditions

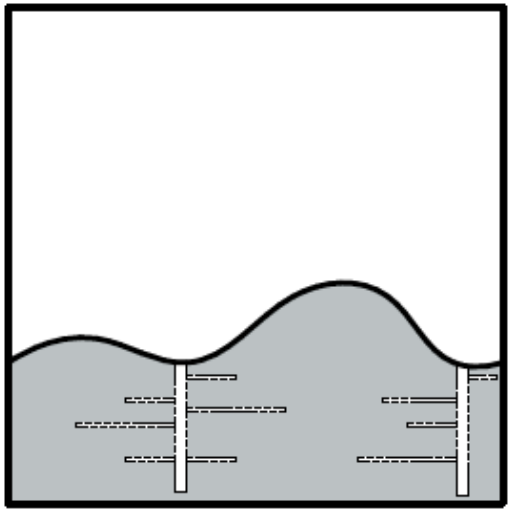


extensive high voltage grid

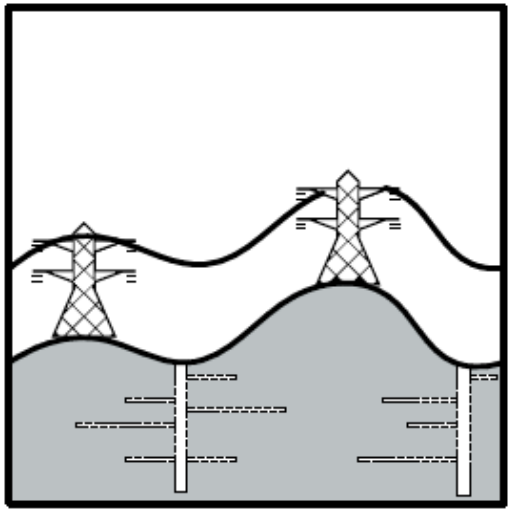
local conditions



height differences



subterranean mine relics



extensive high voltage grid

- M mechanical storage
  - caes compressed air storage
  - flywheel storage
  - gravitational storage
  - hydraulic storage
  - pumped hydro storage
- E_c elektrochemical storage
  - flow flow battery storage
  - rechargeable battery
  - ultra battery
- E_m electromagnetic storage
  - capacitor storage
  - super capacitor storage
  - superconducting magnetic energy storage
- C chemical storage
  - bio biofuel
  - hydrated salts
  - H_2 power to hydrogen
  - CH_4 power to gas
- B biological storage
  - glycogen
  - starch
- T thermal storage
  - brick storage heater
  - cryogenic
  - N_2 liquid nitrogen storage
  - NaCl molten salt storage
  - pcm phase changing materials
  - seasonal thermal storage
  - steam accumulation

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  - caes compressed air storage
  - flywheel storage
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  - N_2 liquid nitrogen storage
  - NaCl molten salt storage
  - pcm phase changing materials
  - seasonal thermal storage
  - steam accumulation

method assessment

- **ability for long term energy storage**

  can the system store energy for a long period without significant energy losses?

- **visible dynamic component**

  does this method have a component which shows whether the system is charged?

- **scalability for bulk storage**

  can this method be a scaled to provide central storage for a region?

- **maturity**

  is the technique established, which doesn't require technological breakthroughs?

- **suitability**

  can it materialize in parkstad?

method assessment

Method assessment analysis	Electricty storage for hours	Visible dynamic component	Scalability for bulk storage	Maturity	Applicability in Parkstad
Mechanical storage					
Compressed air	**Y**	**Y**	**Y**	**Y**	**Y**
Flywheel	N	N	Y	Y	Y
Gravitational	**Y**	**Y**	**Y**	**Y**	**Y**
Hydraulic	Y	Y	Y	N	Y
Pumped hydro	**Y**	**Y**	**Y**	**Y**	**Y**
Electrochemical					
Flow battery	Y	N	Y	Y	Y
Rechargeble battery	Y	N	Y	Y	Y
Ultra battery	Y	N	Y	N	Y
Thermal					
Molten salt storage	Y	Y	Y	Y	N
Steam accumulation	Y	N	Y	Y	Y
Chemical storage					
Biofuels	N	N	Y	Y	Y
Hydrated salts	Y	Y	Y	N	N
Power to hydrogen	Y	Y	Y	N	N
Power to methane	Y	Y	Y	N	N

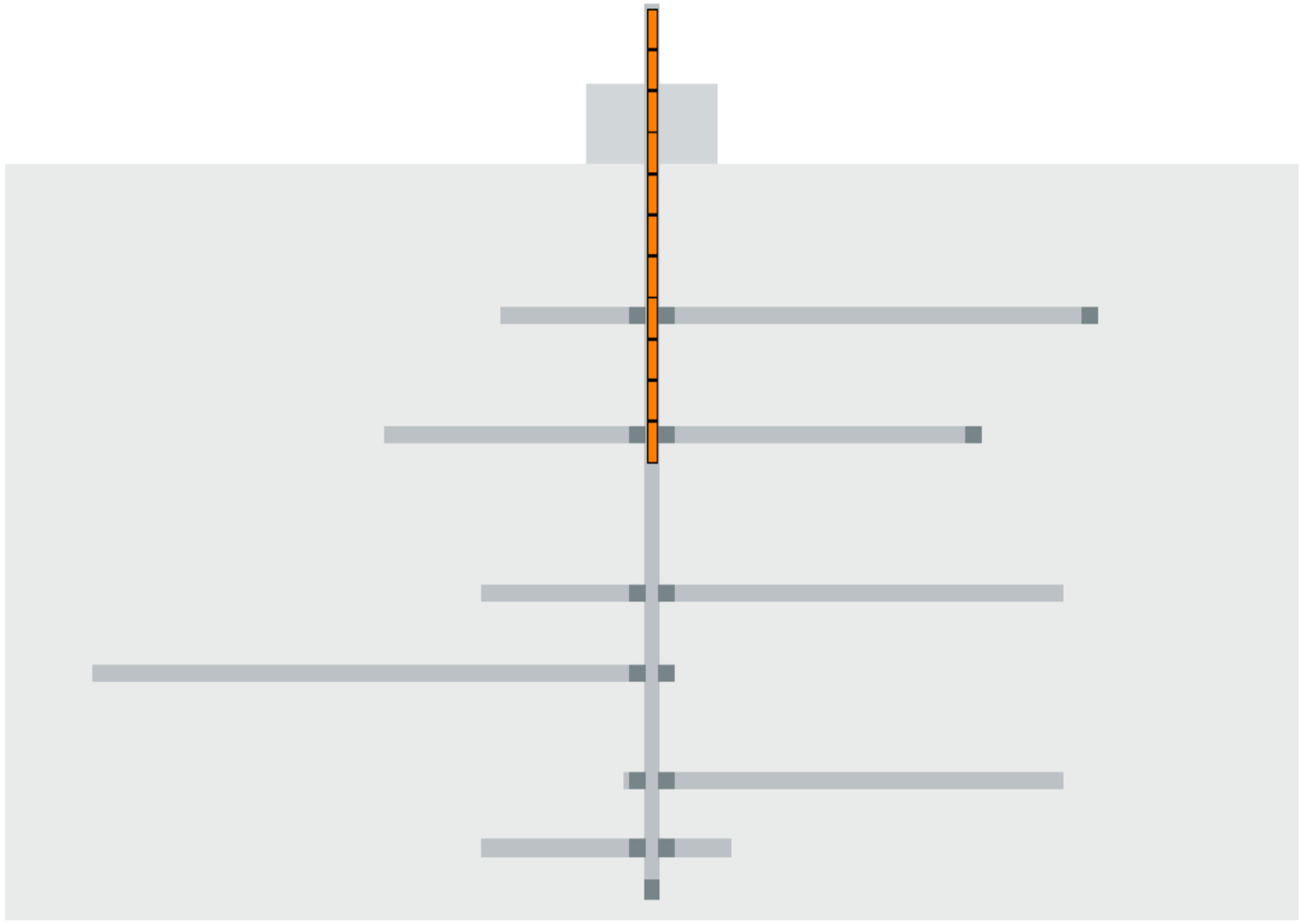
method assessment

compressed air storage

pumped hydro storage

gravitational storage

gravitational storage by raised mass

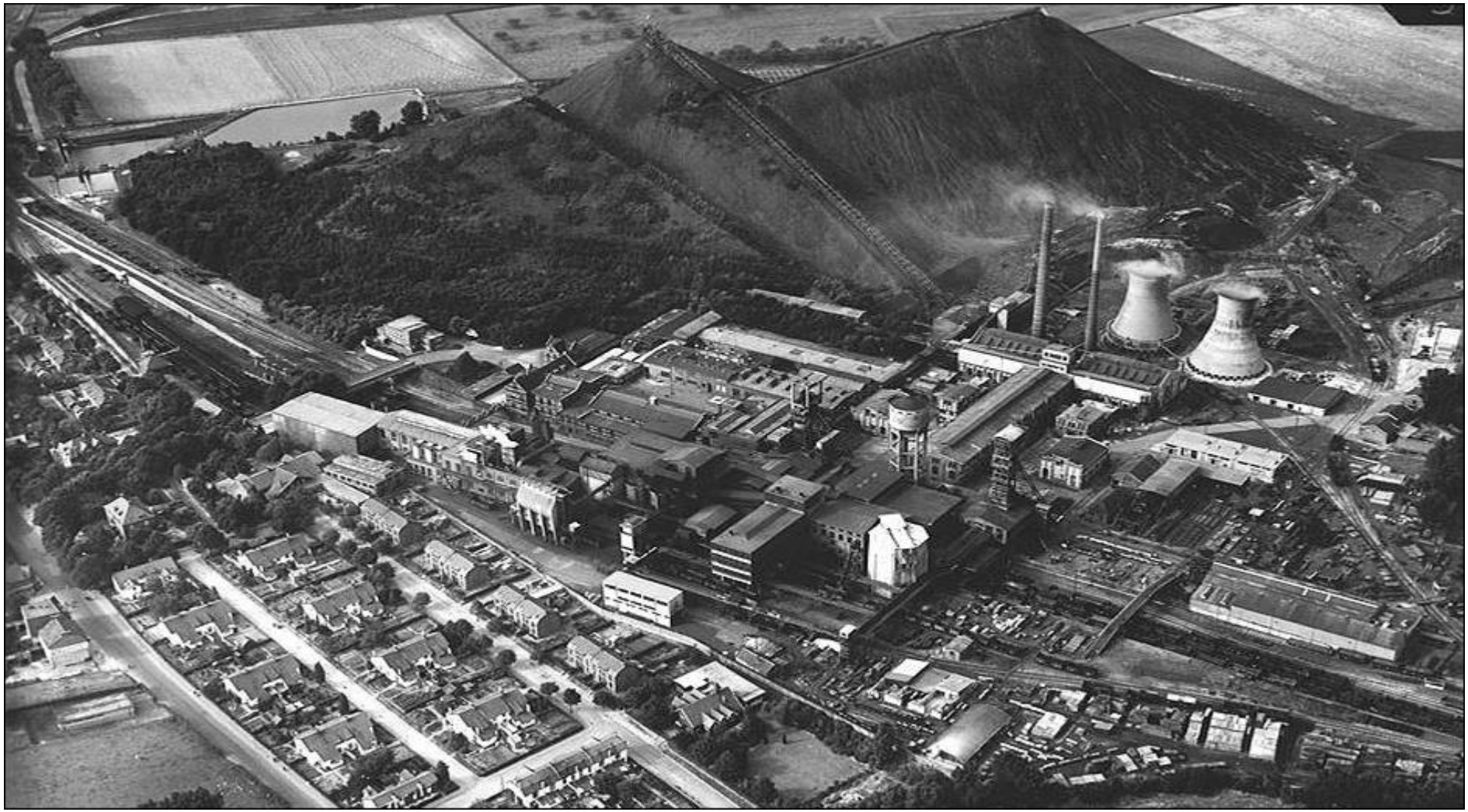


design

design question

"How can visible energy storage be applied in Parkstad, while using local conditions and defining the landscape?"

site

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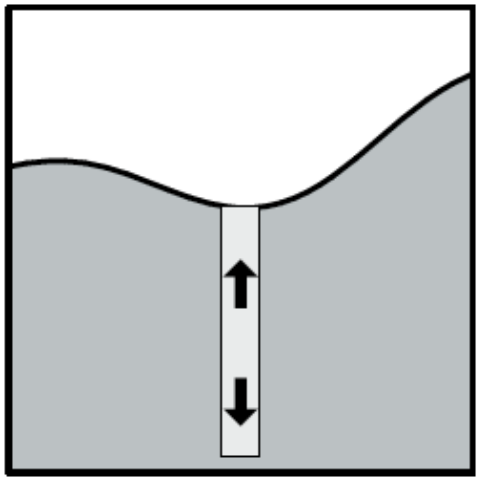
site

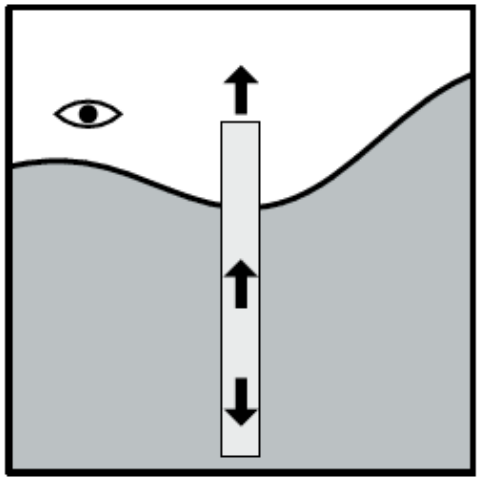
masterplan

masterplan

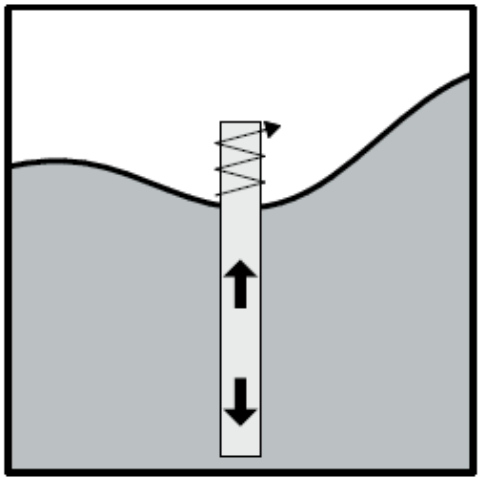
concept



using the deep shafts for gravitational storage

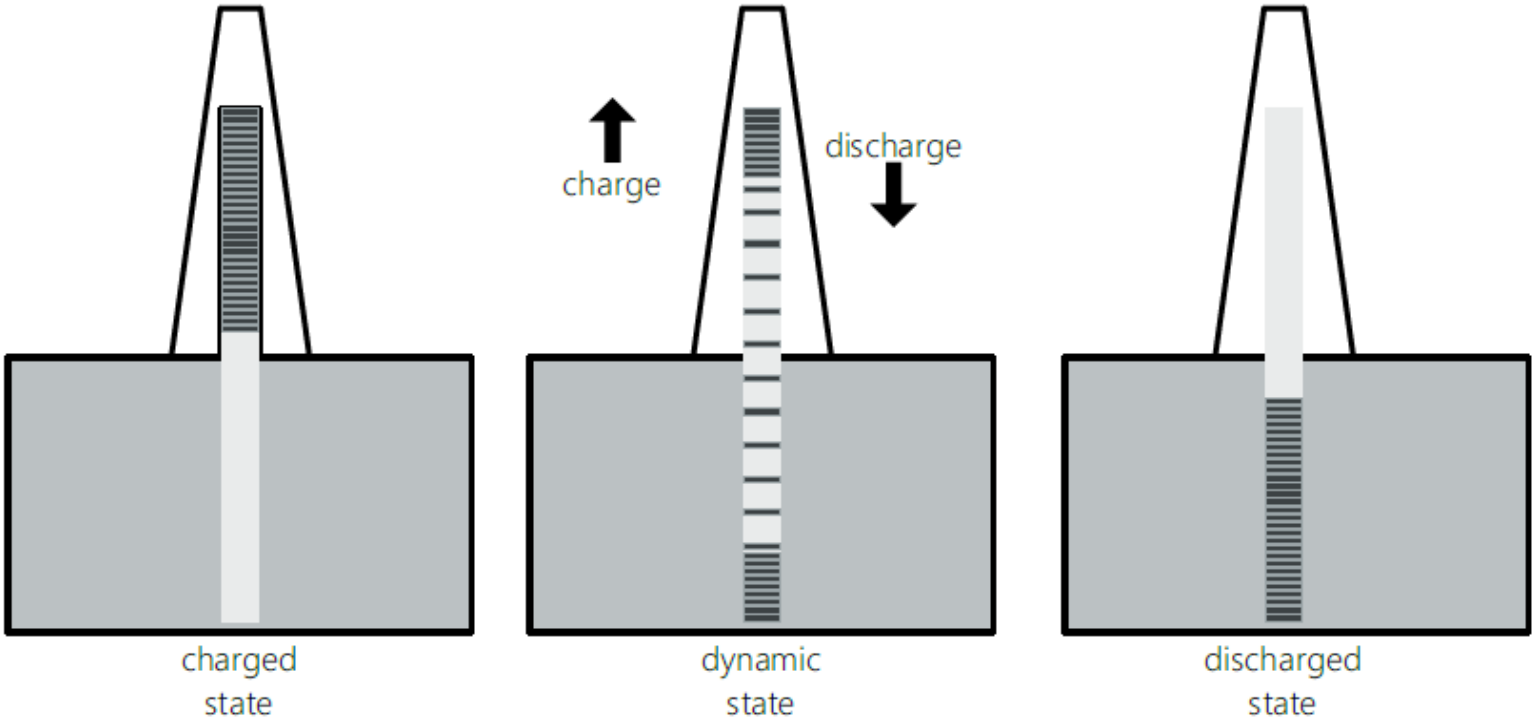


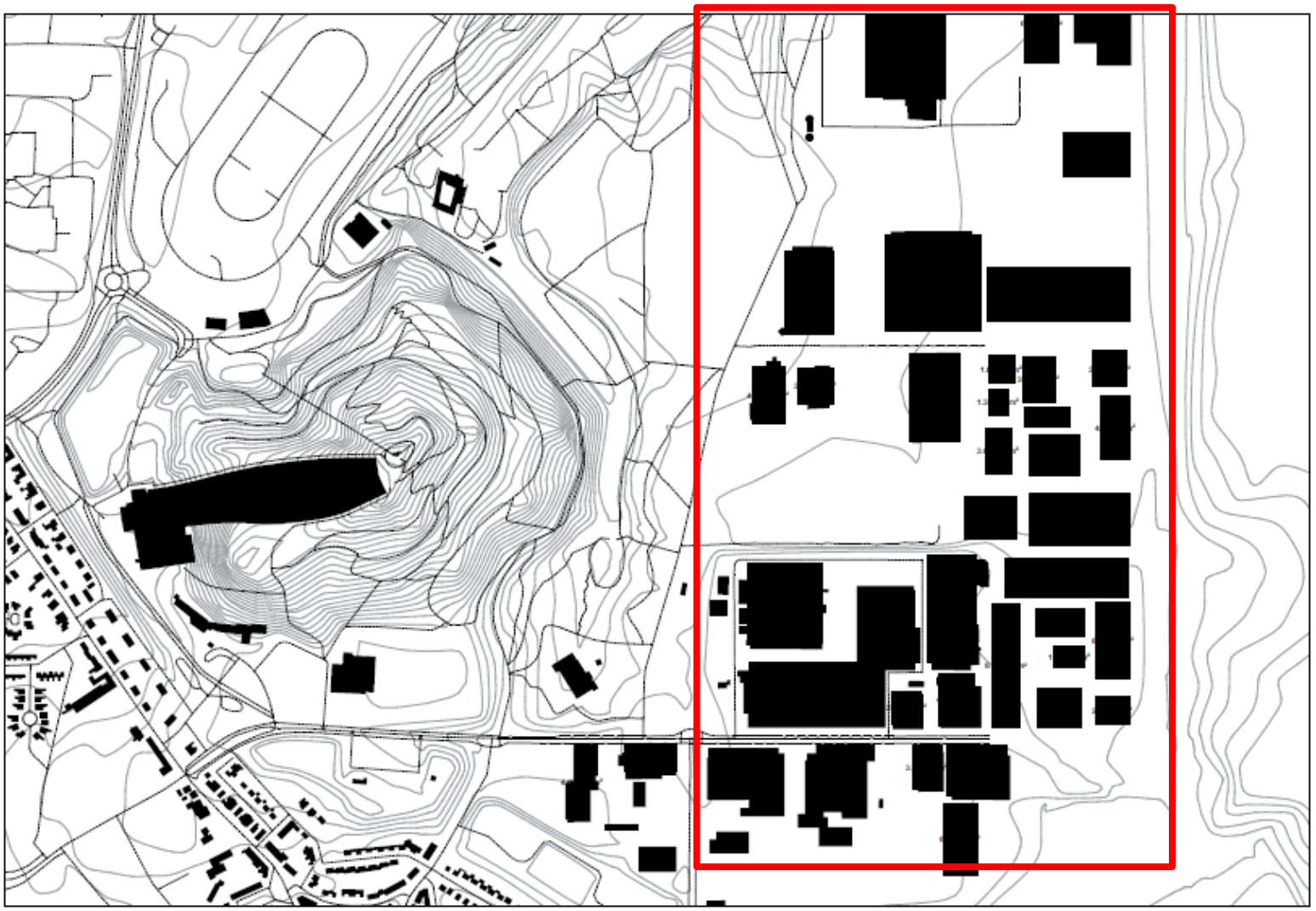
extending system above surface to expose the storage process



combining with secondary function as viewing tower

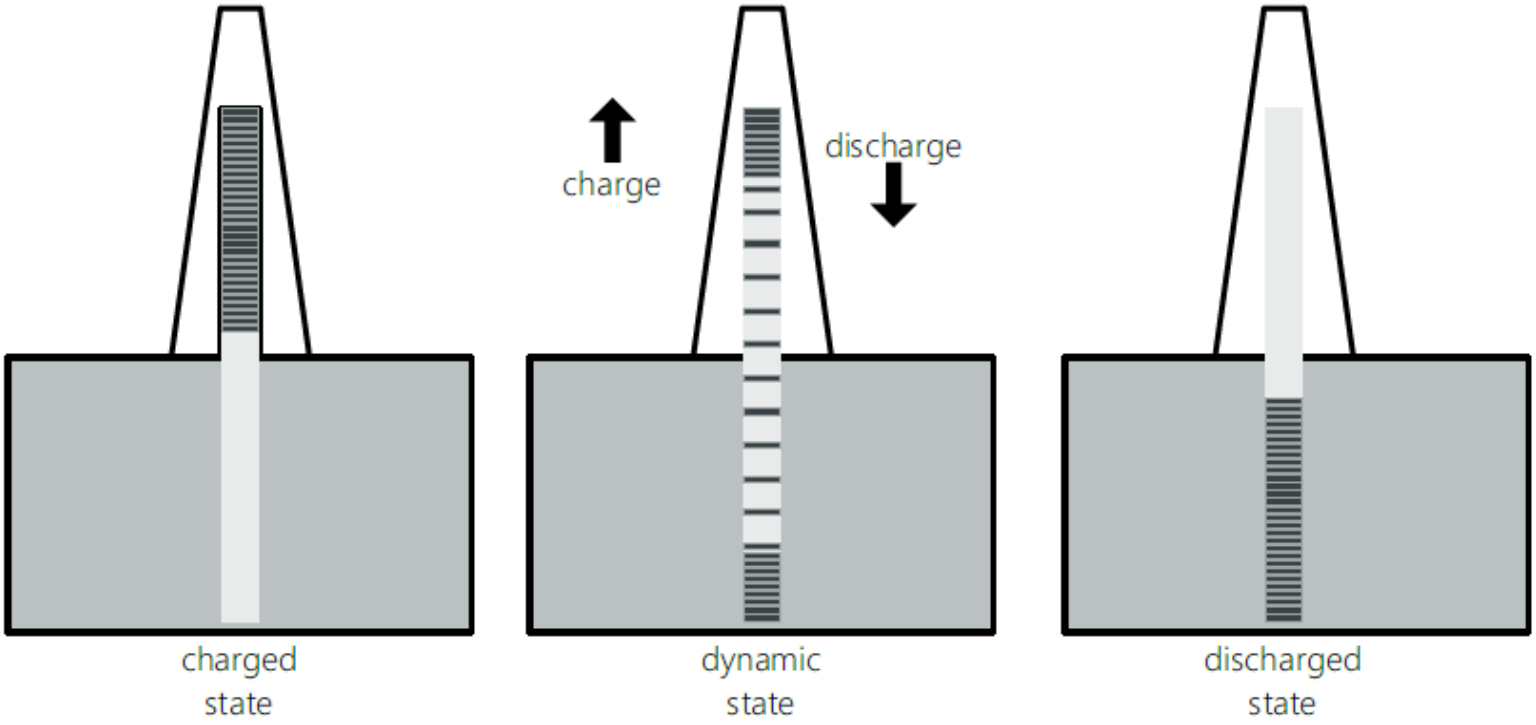
functionality





20.000
households
daily

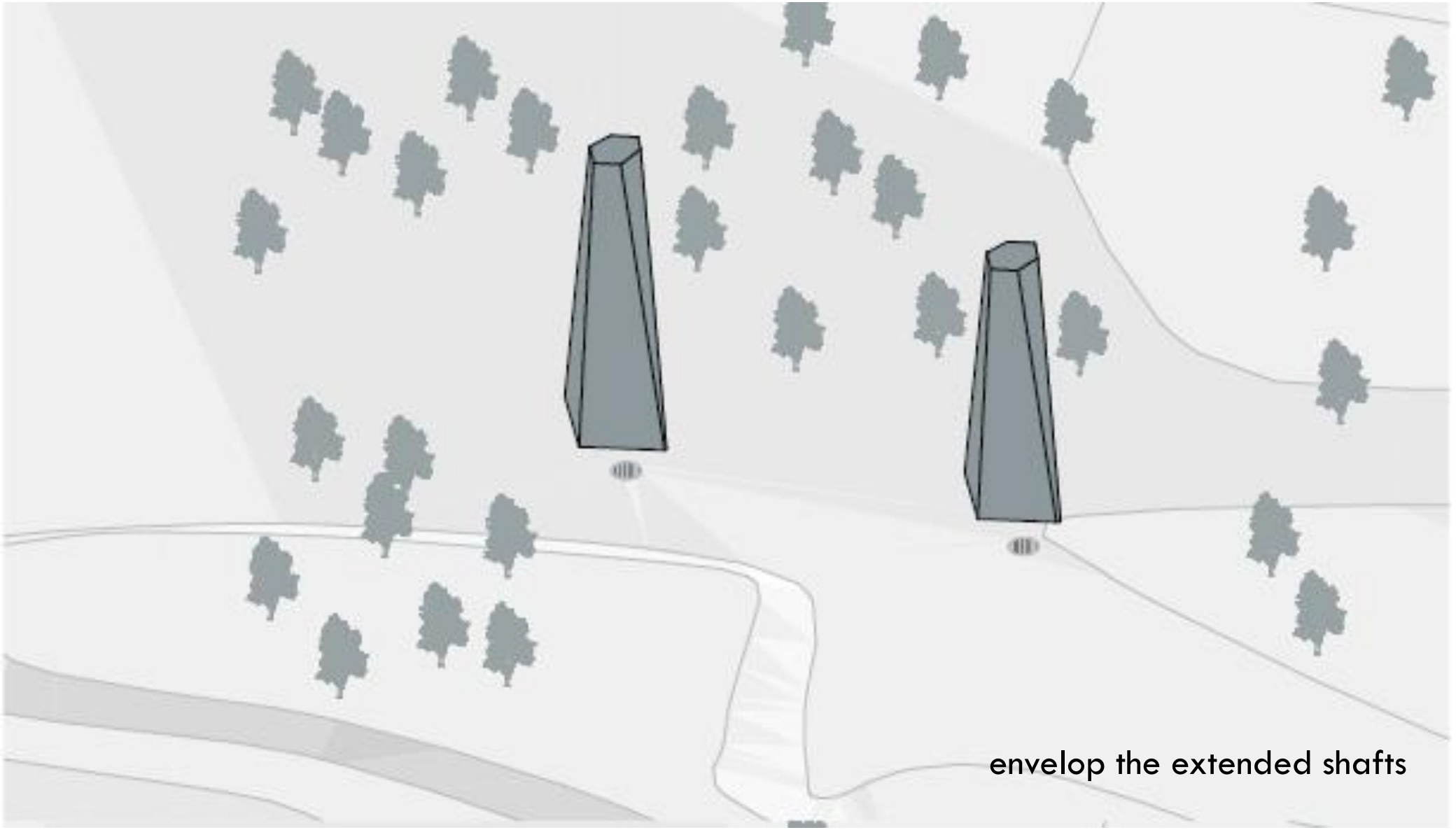
functionality

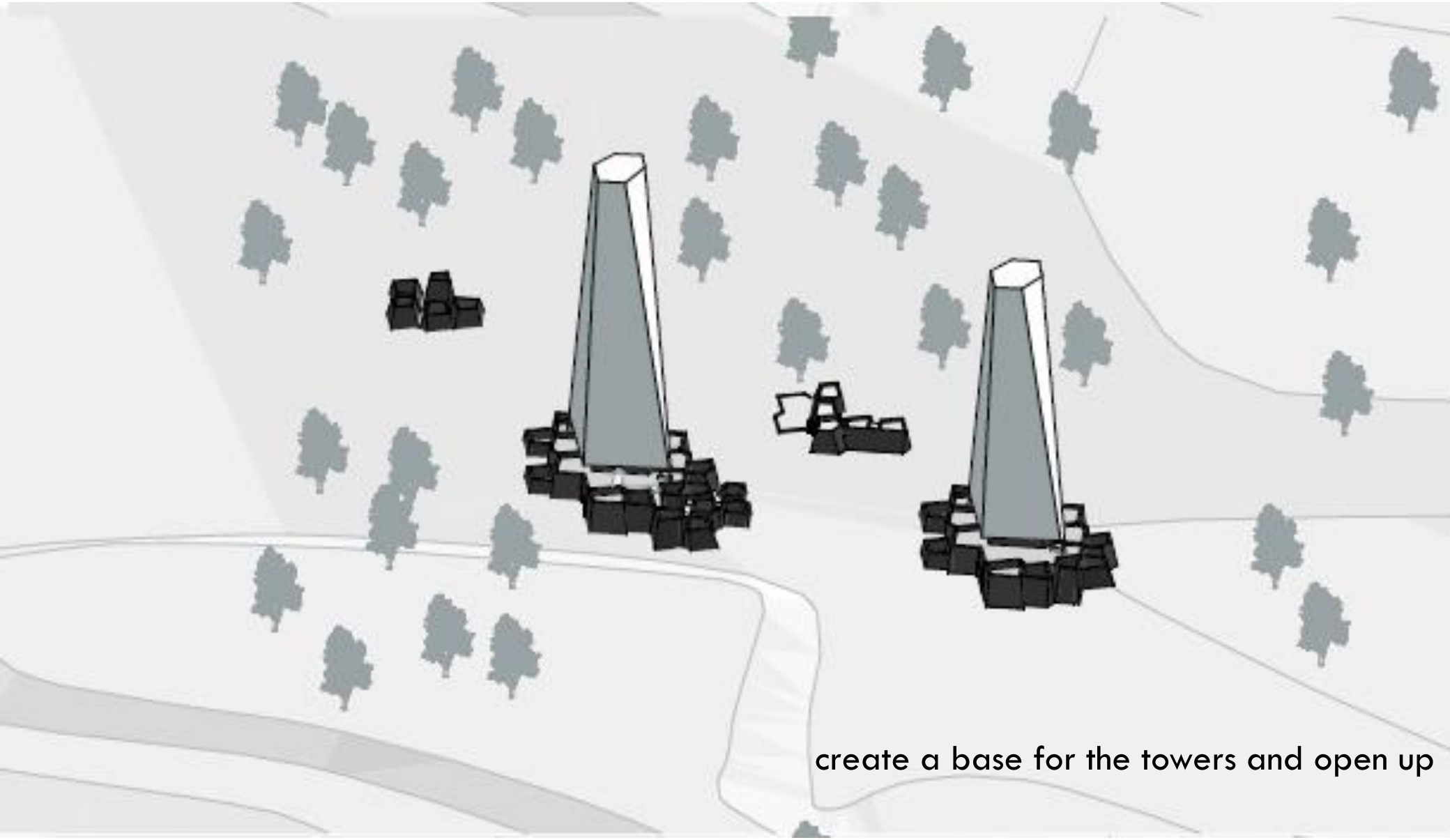


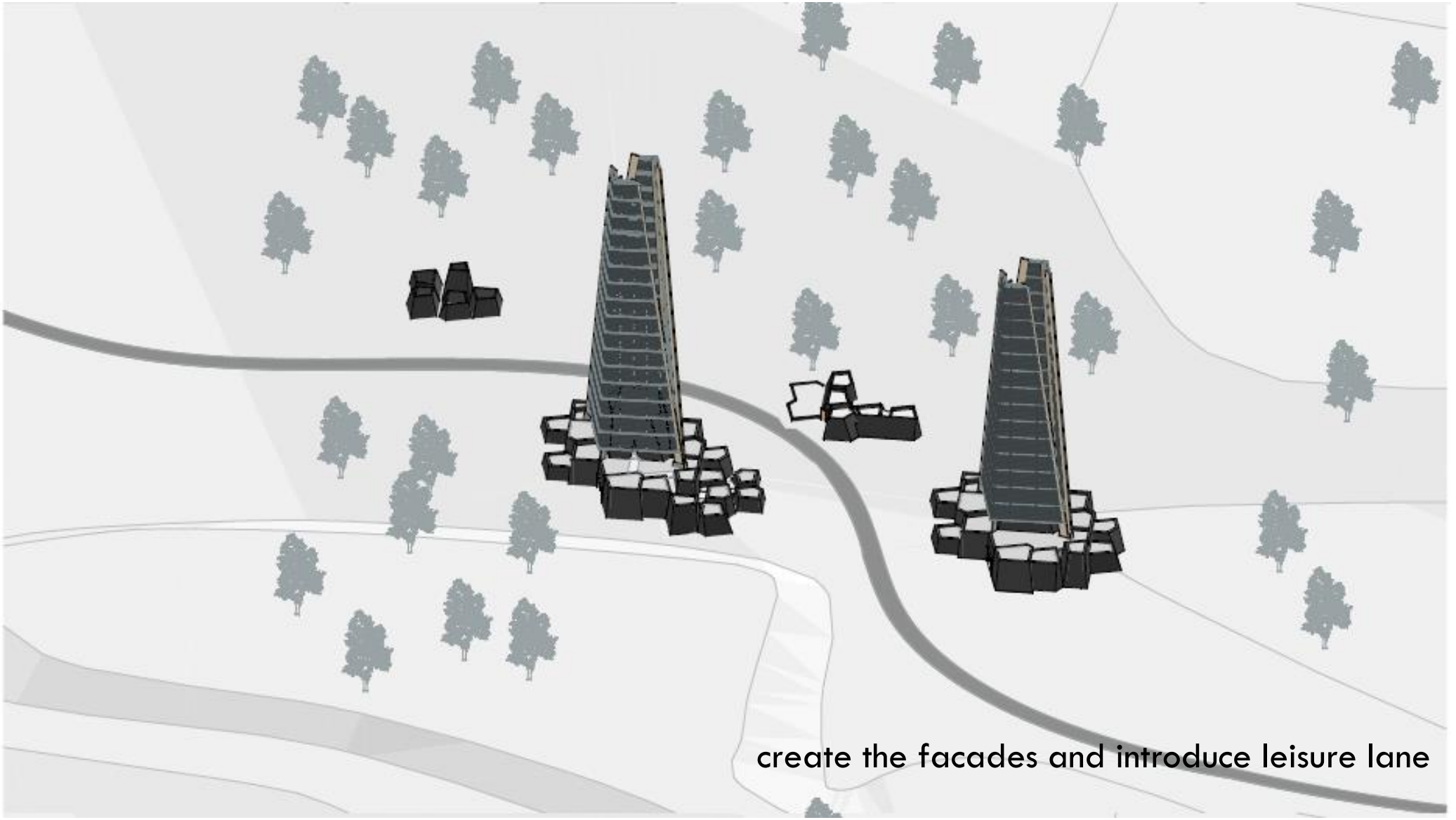
20.000 households
daily

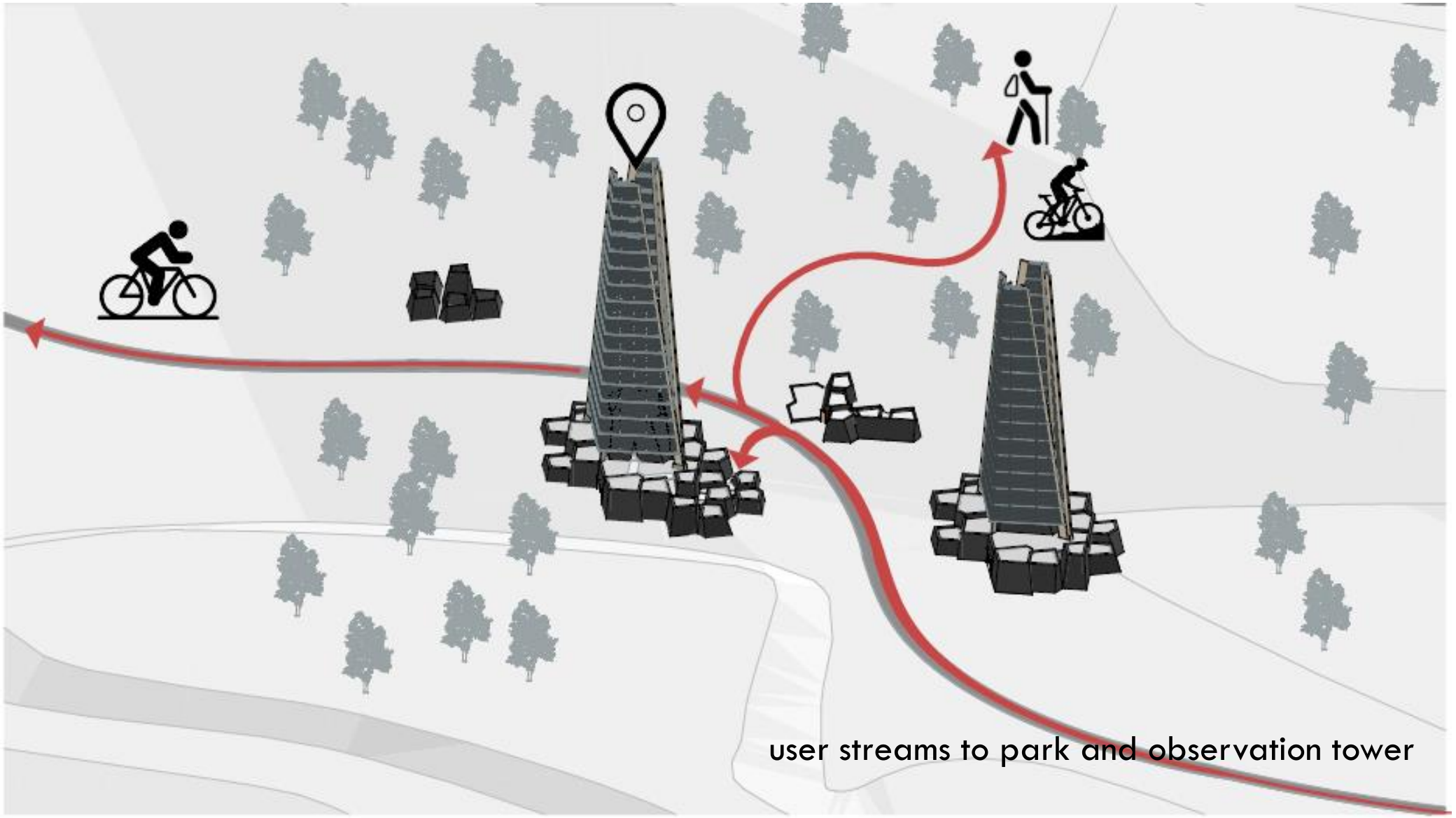

start off with two fixed shafts


extend shafts above surface


envelop the extended shafts


create a base for the towers and open up


create the facades and introduce leisure lane


user streams to park and observation tower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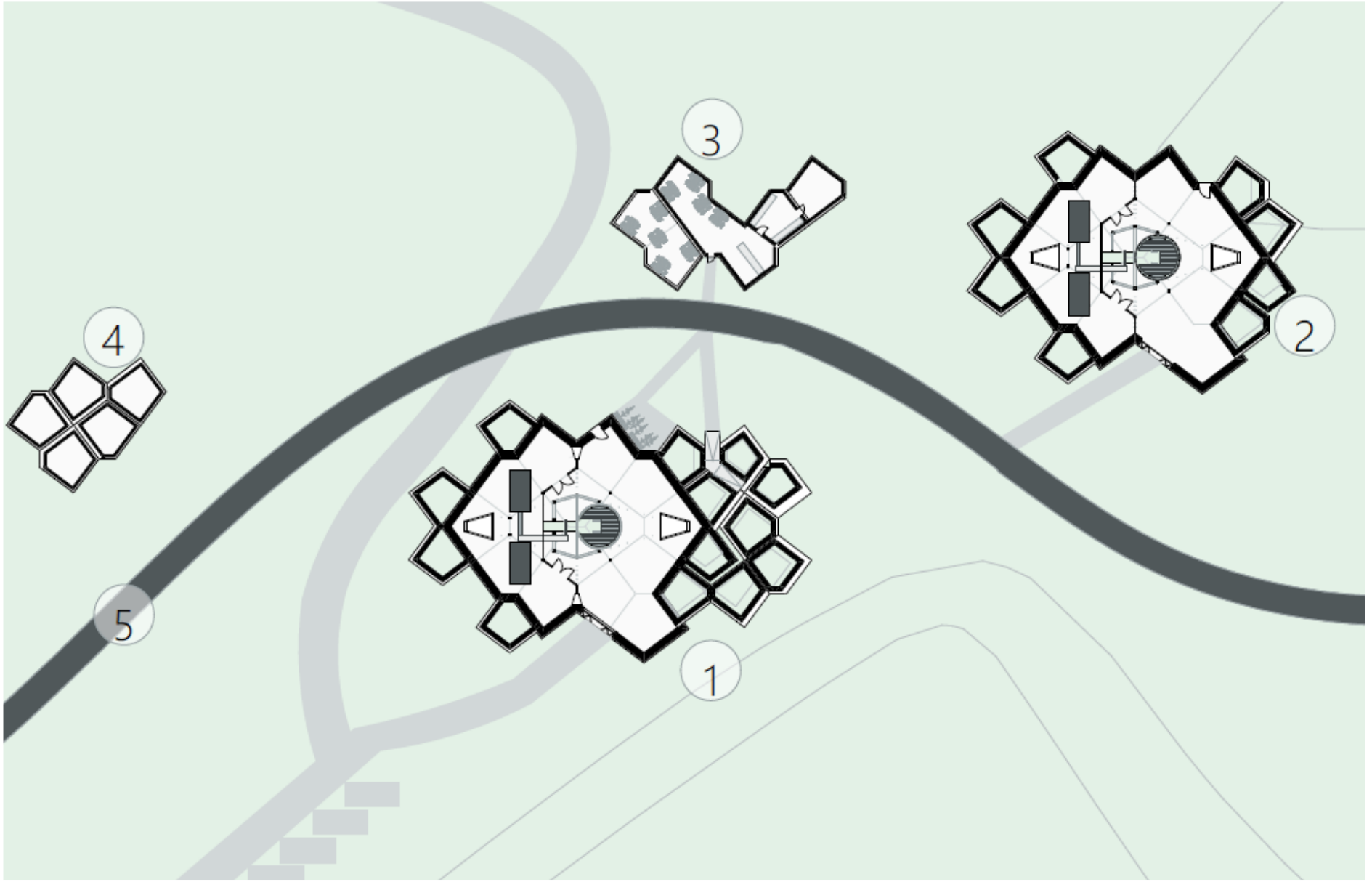
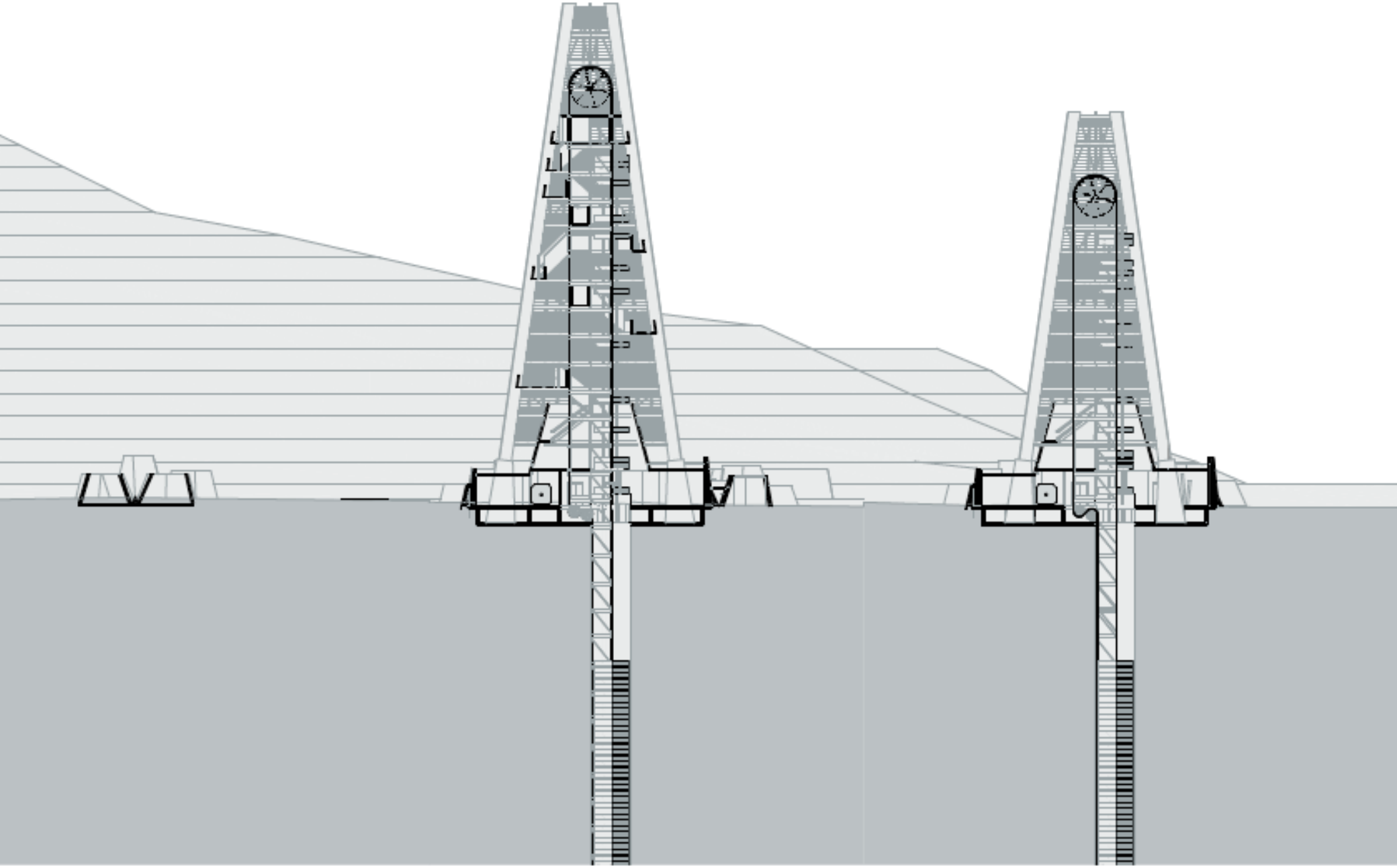
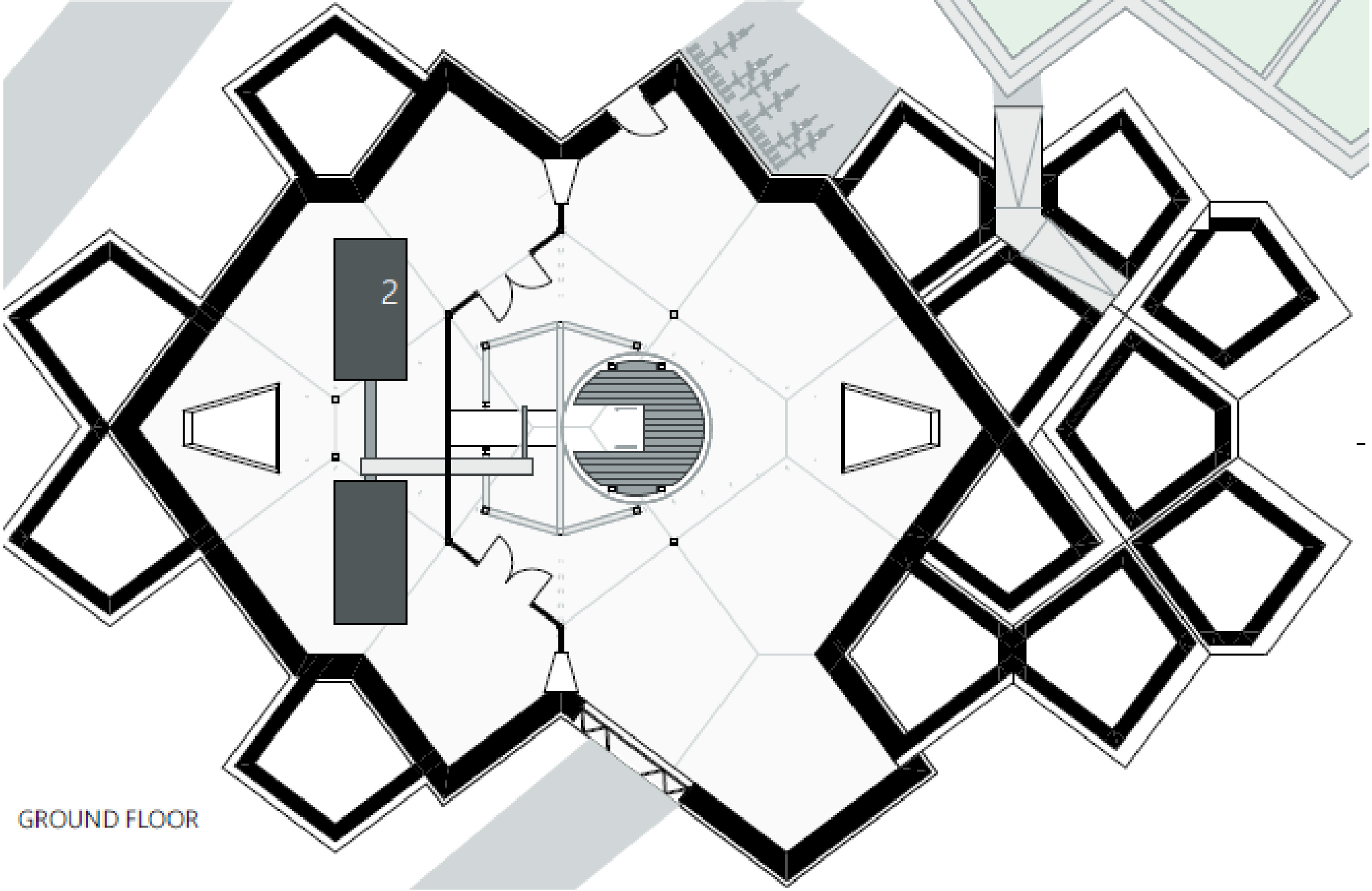
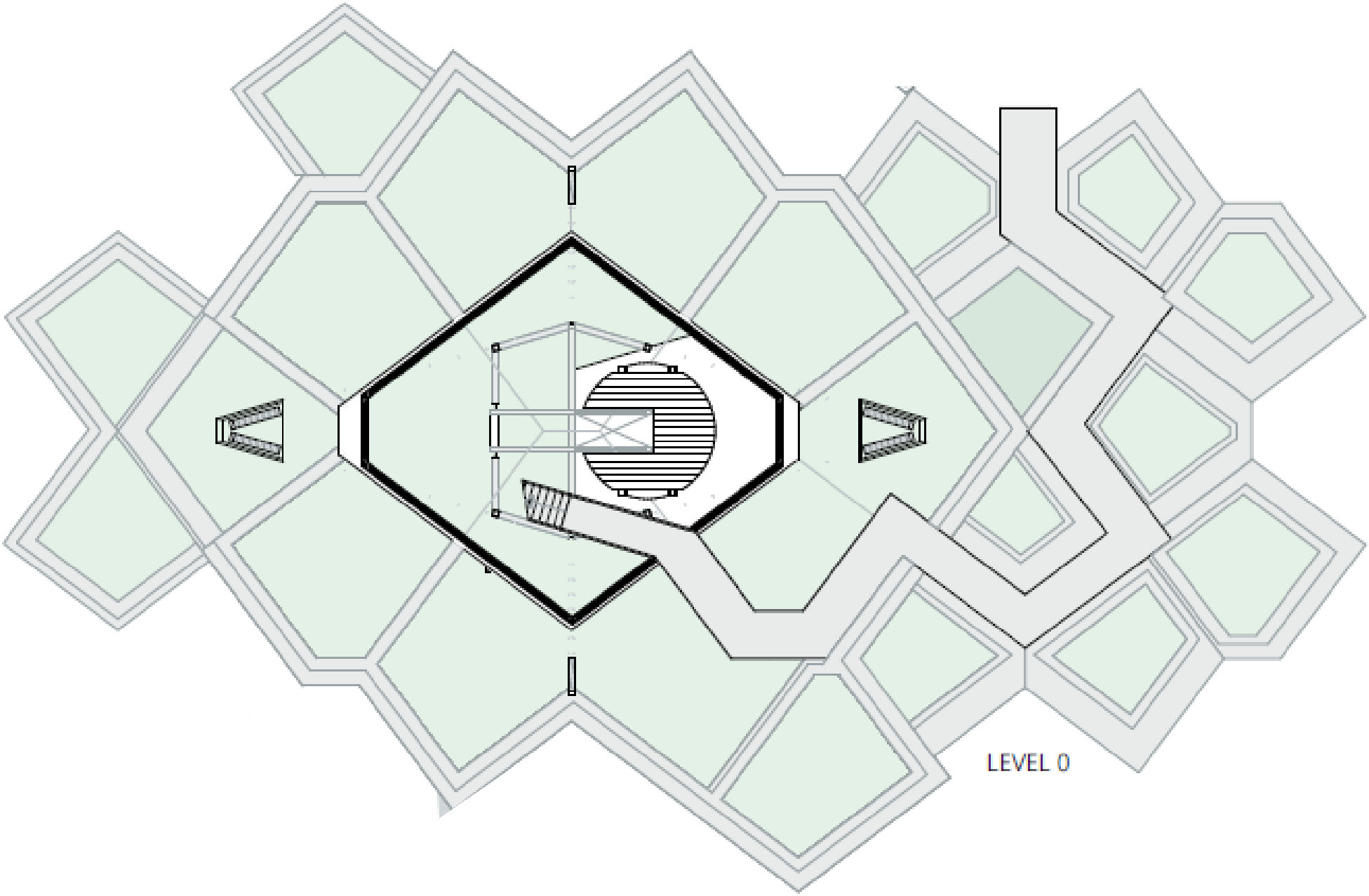
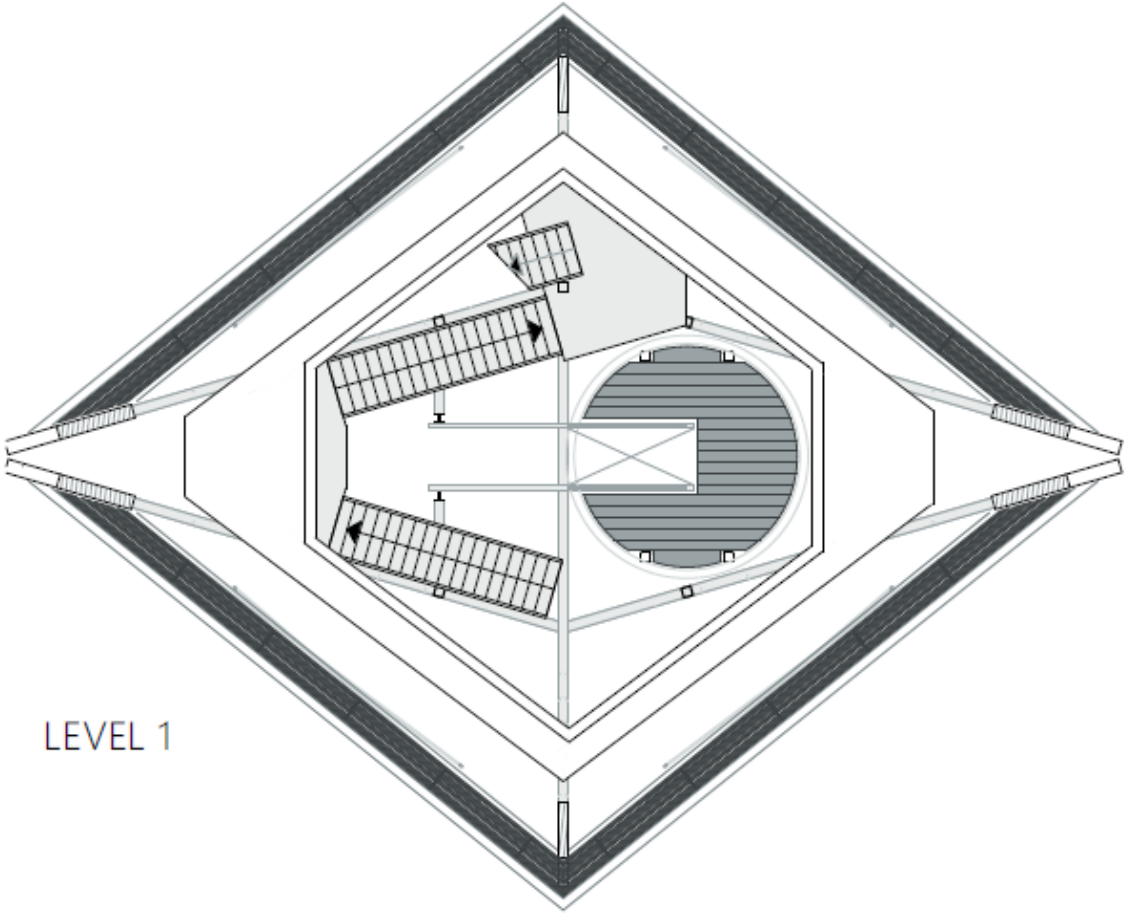

3
2
4
1
5

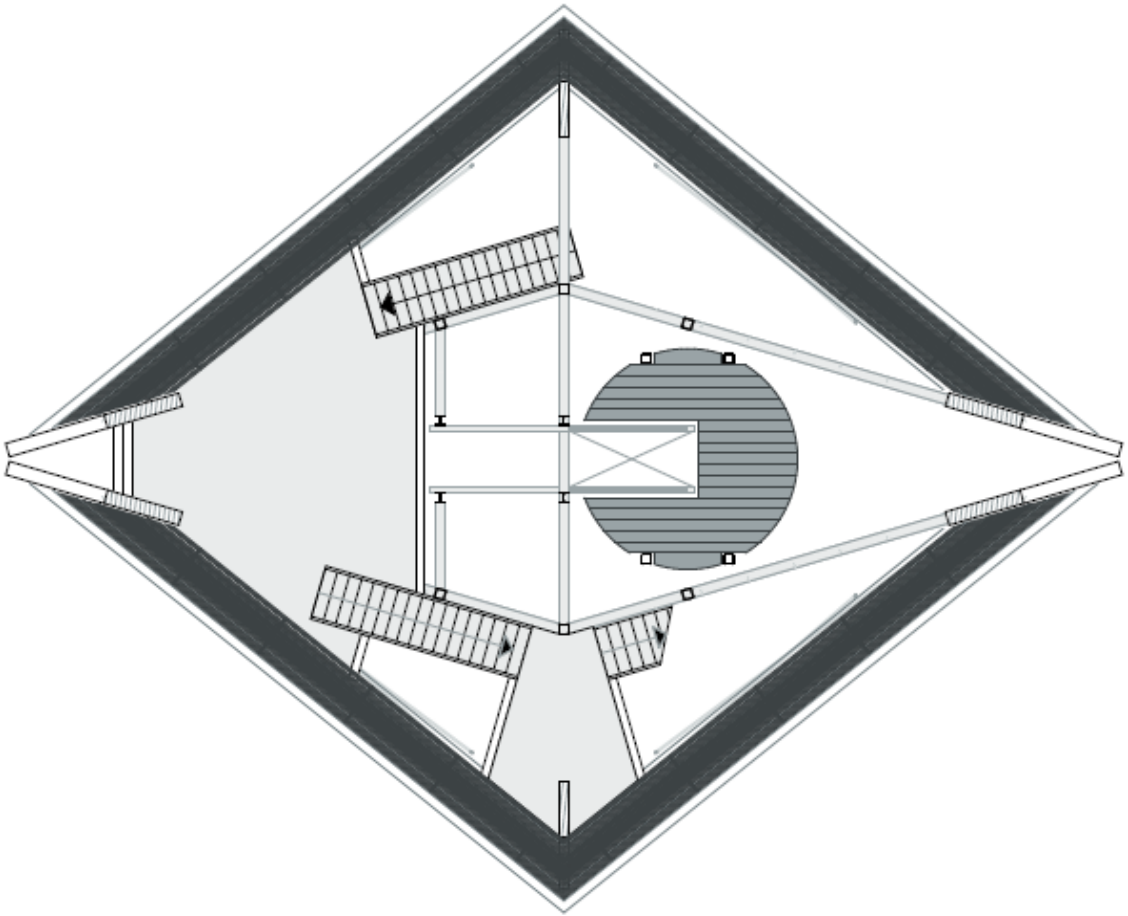


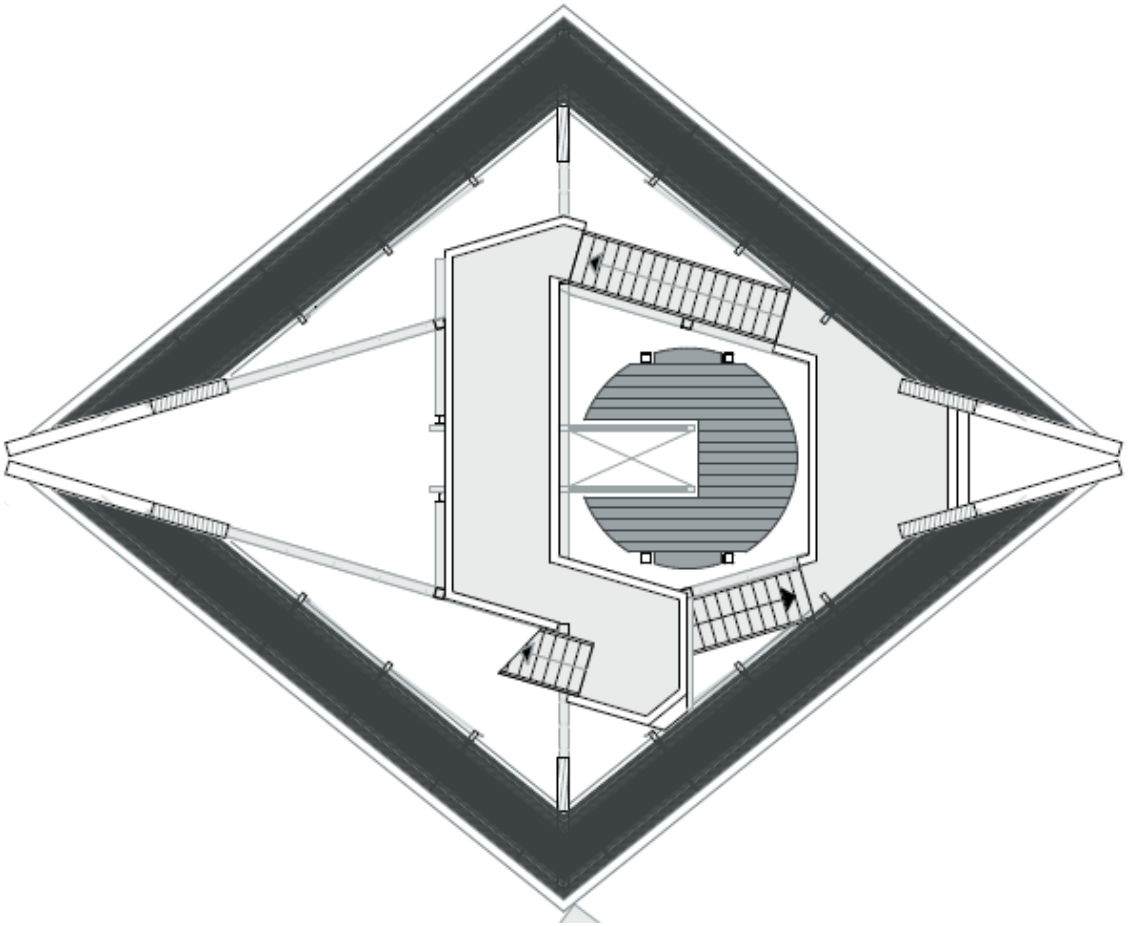


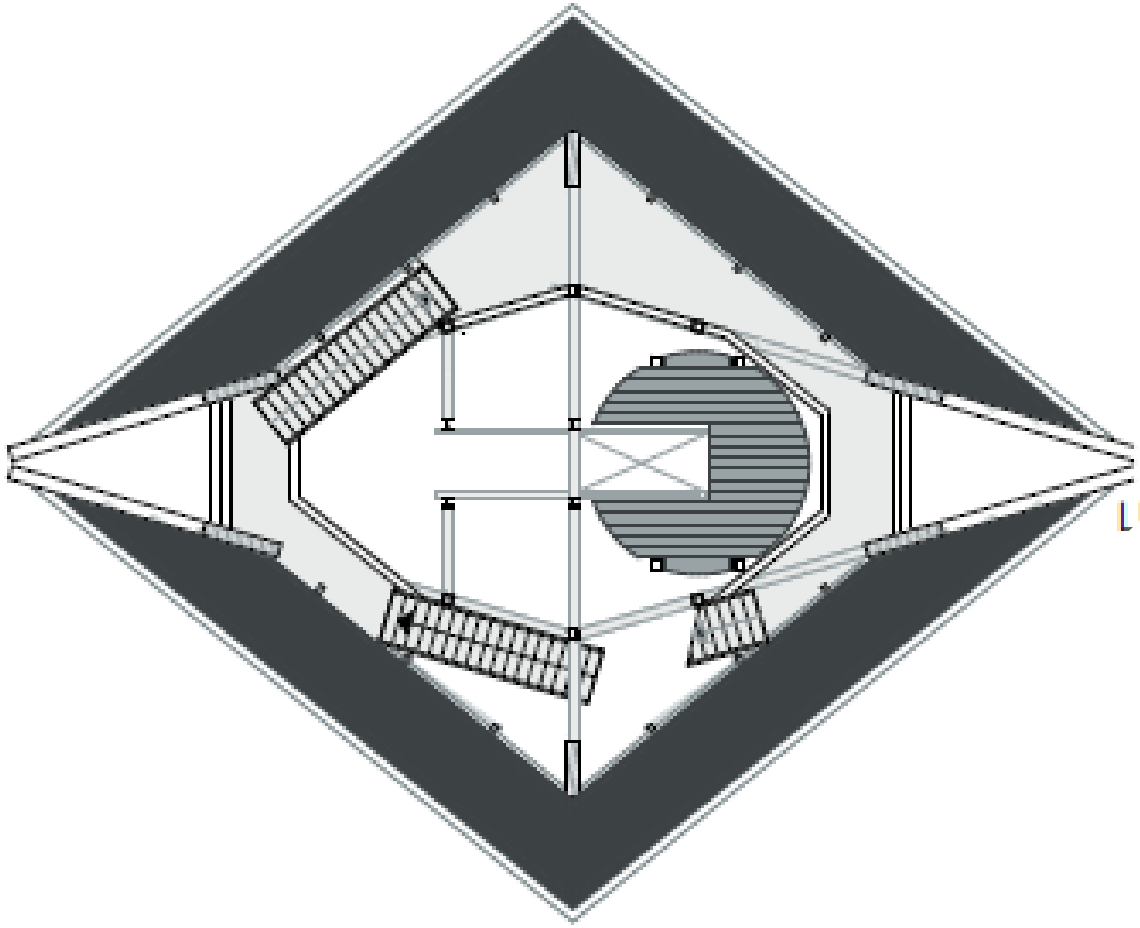
GROUND FLOOR

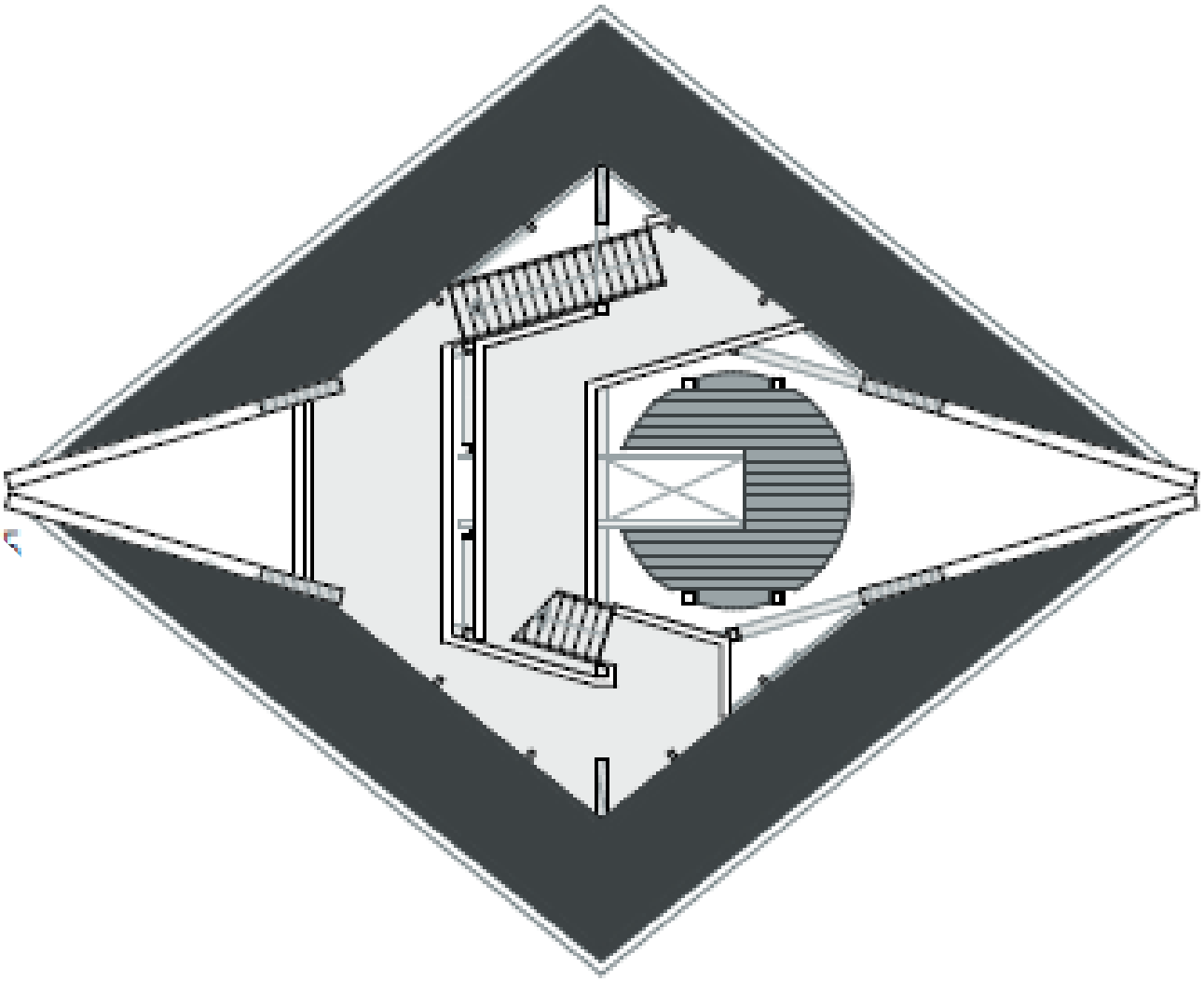

LEVEL 0

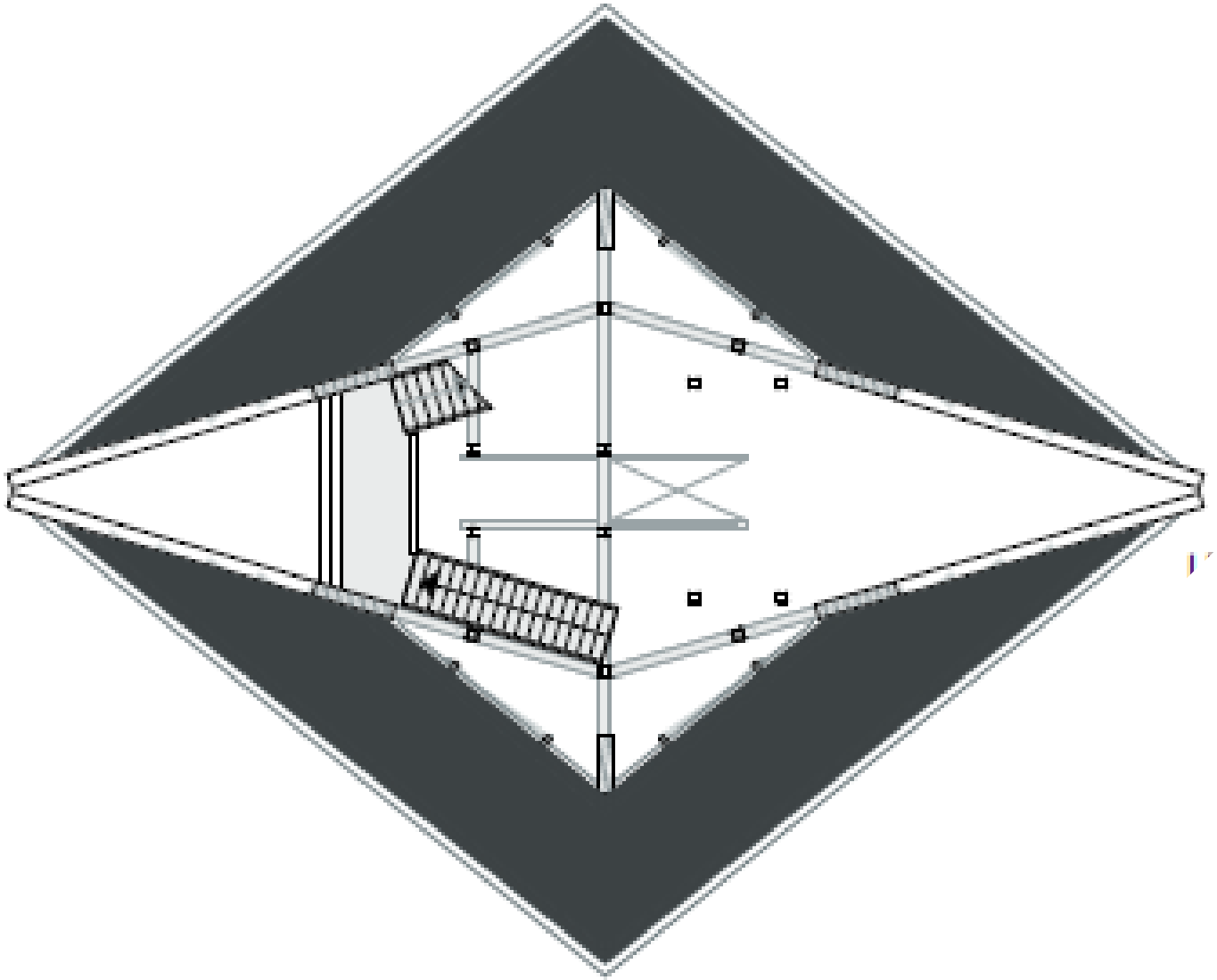

LEVEL 1

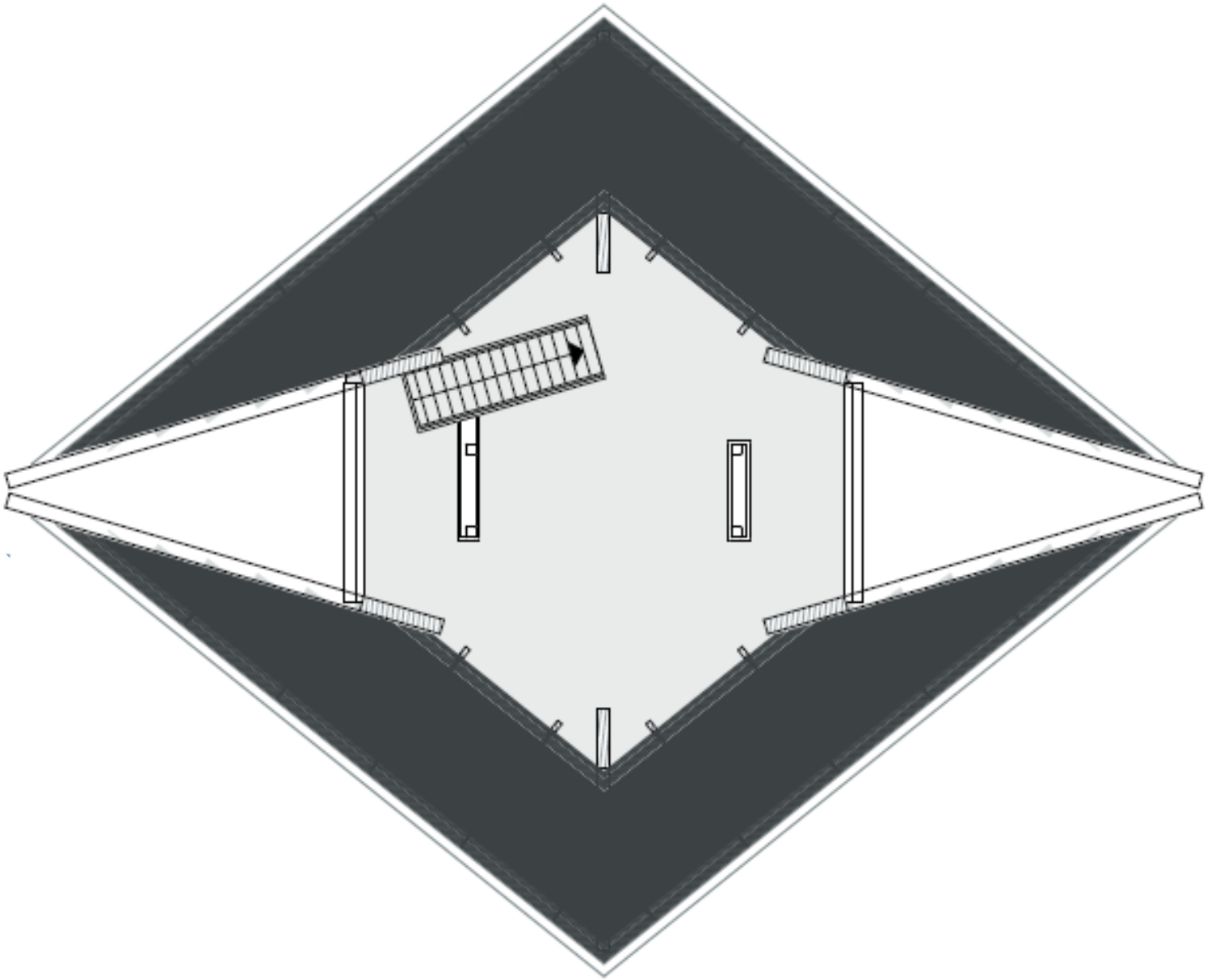


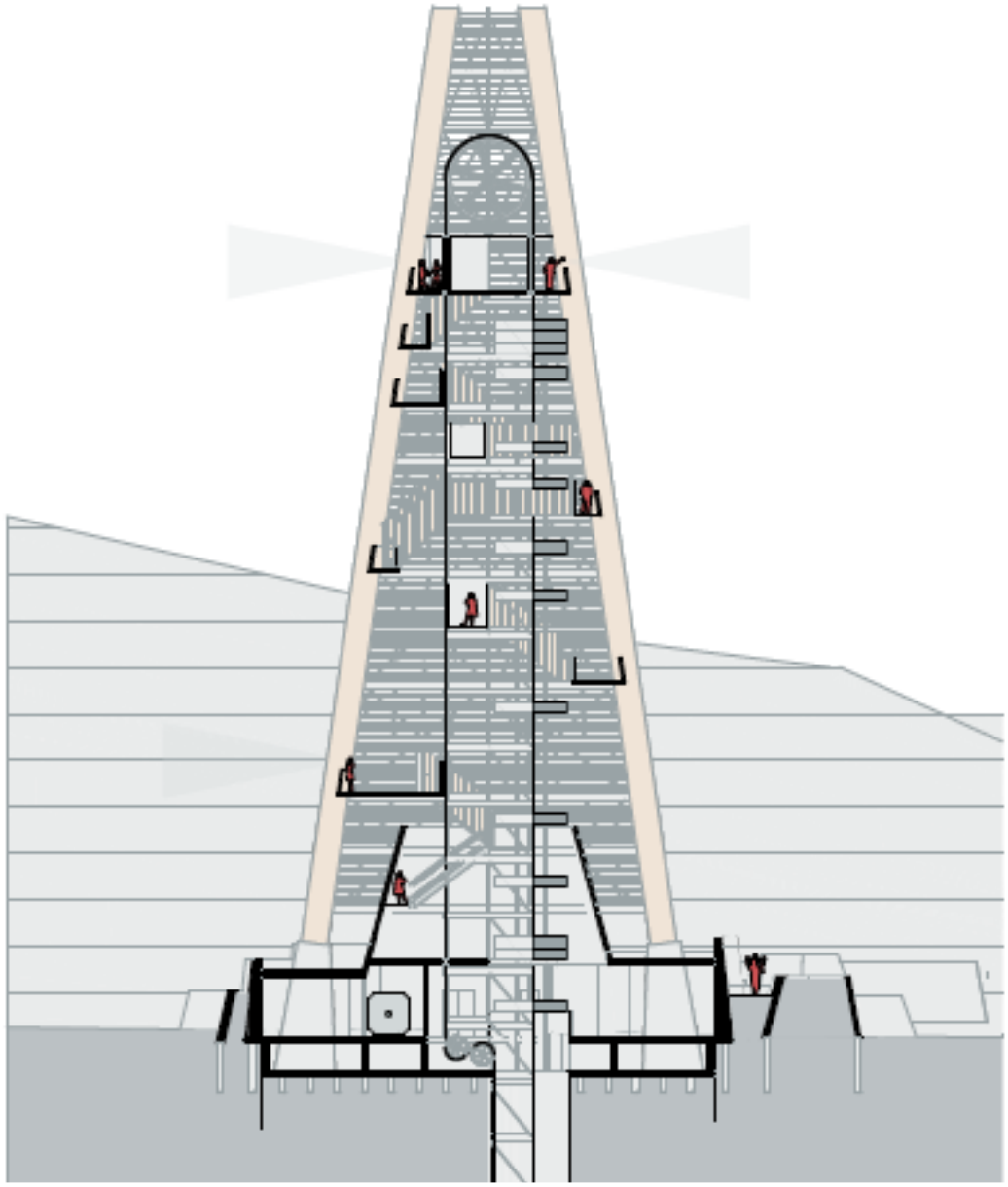


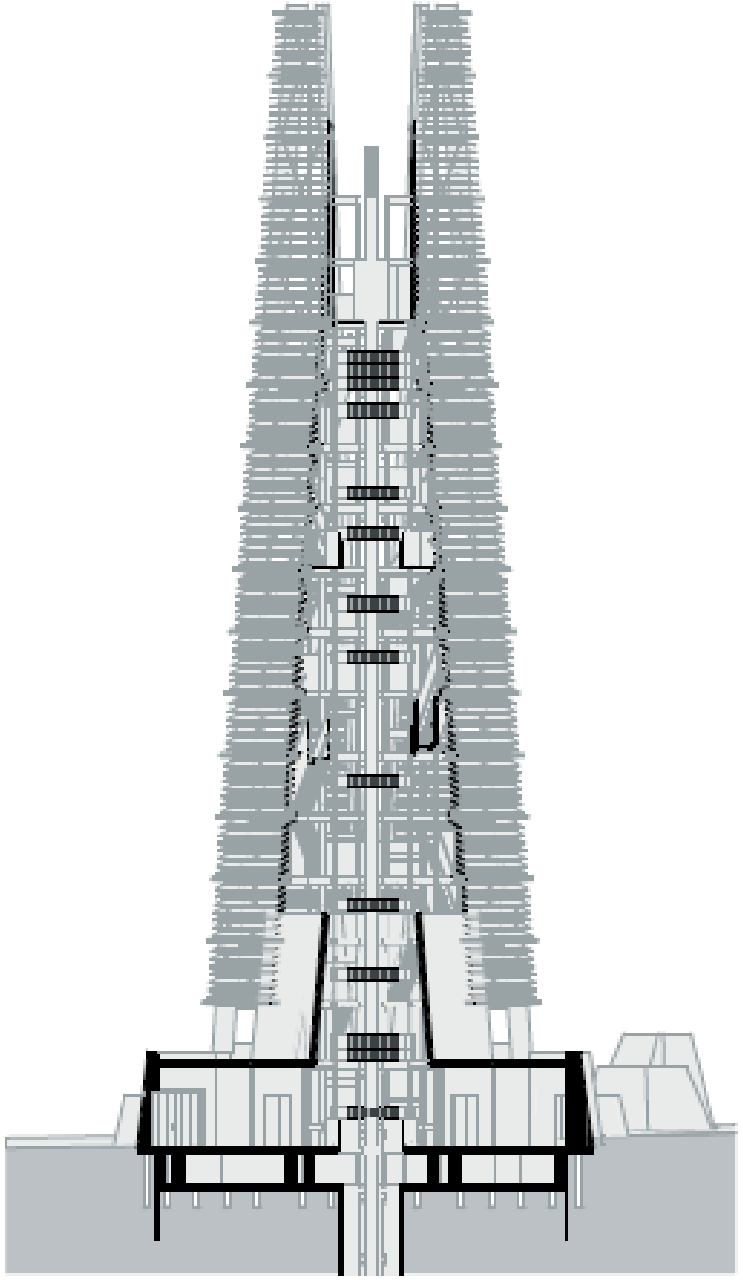


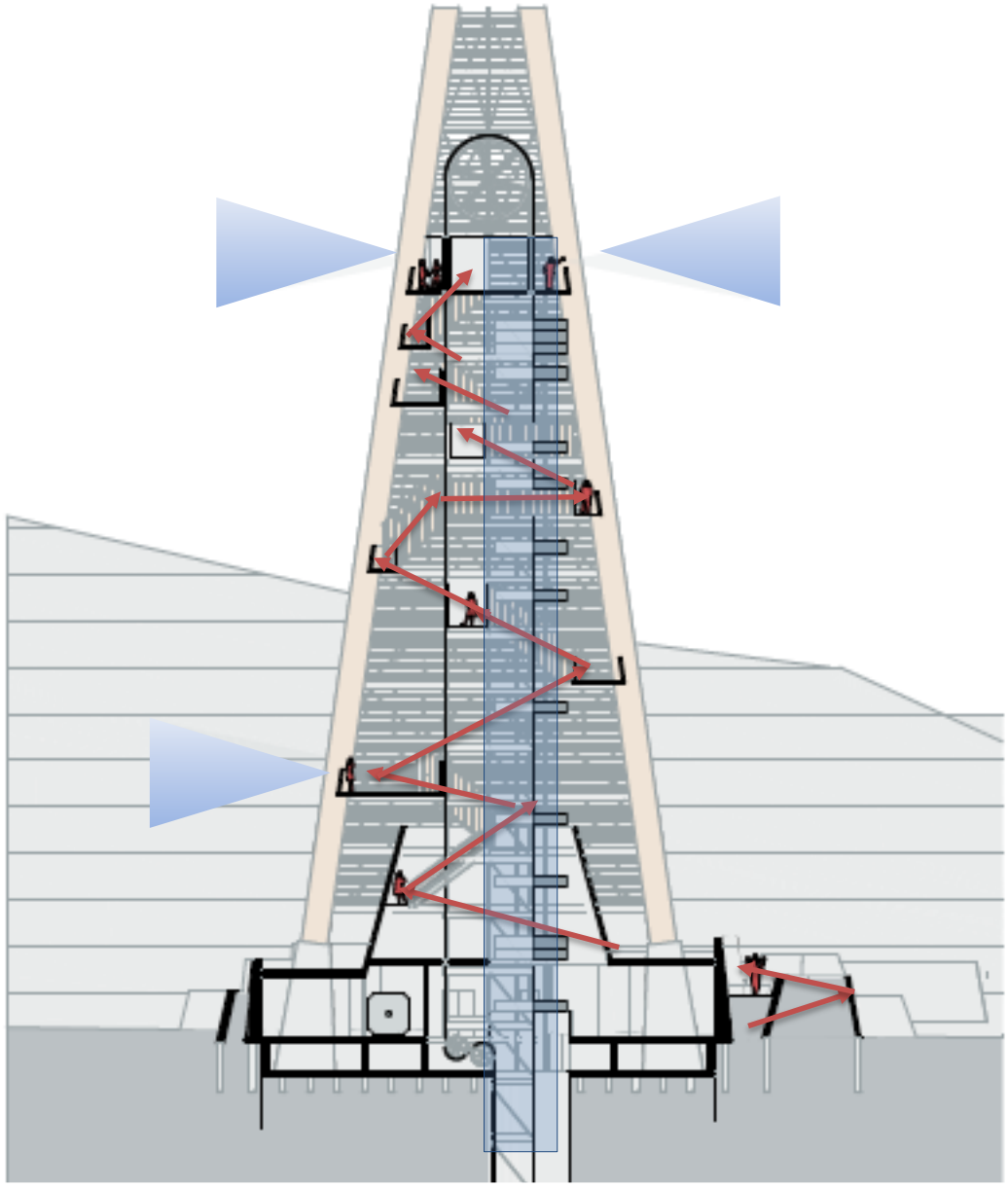


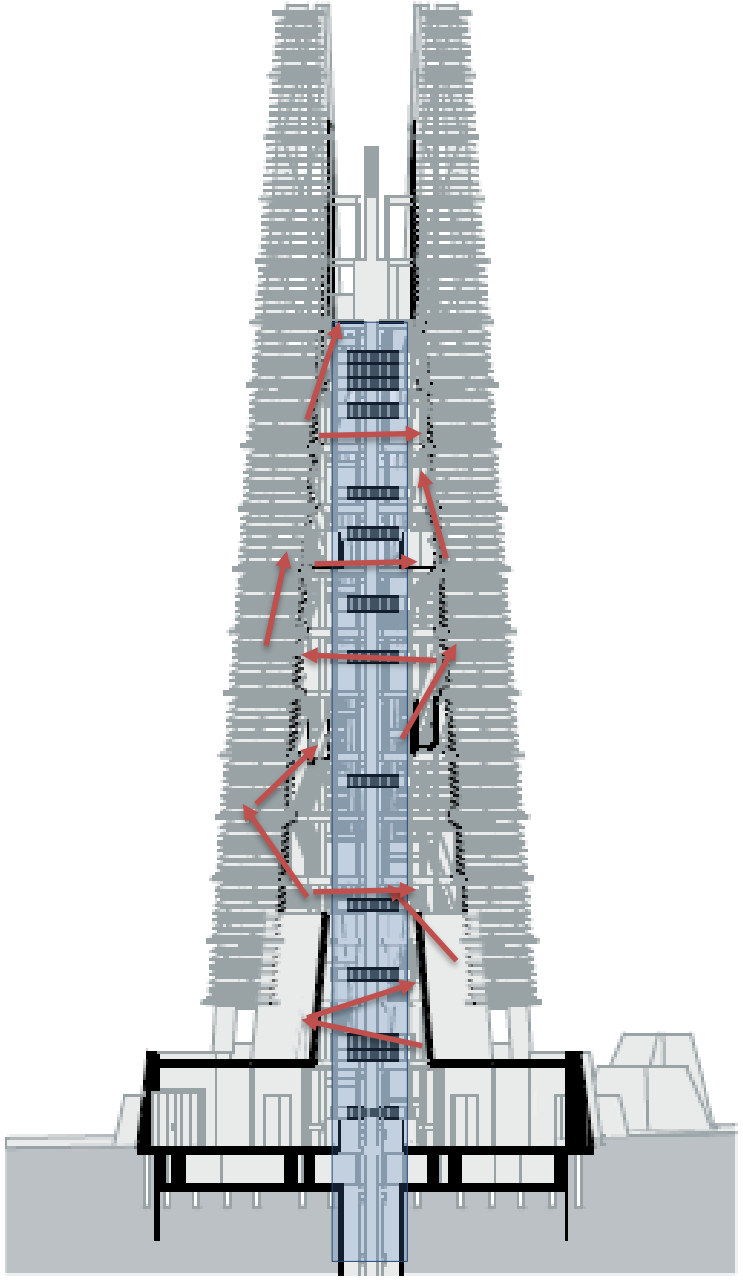












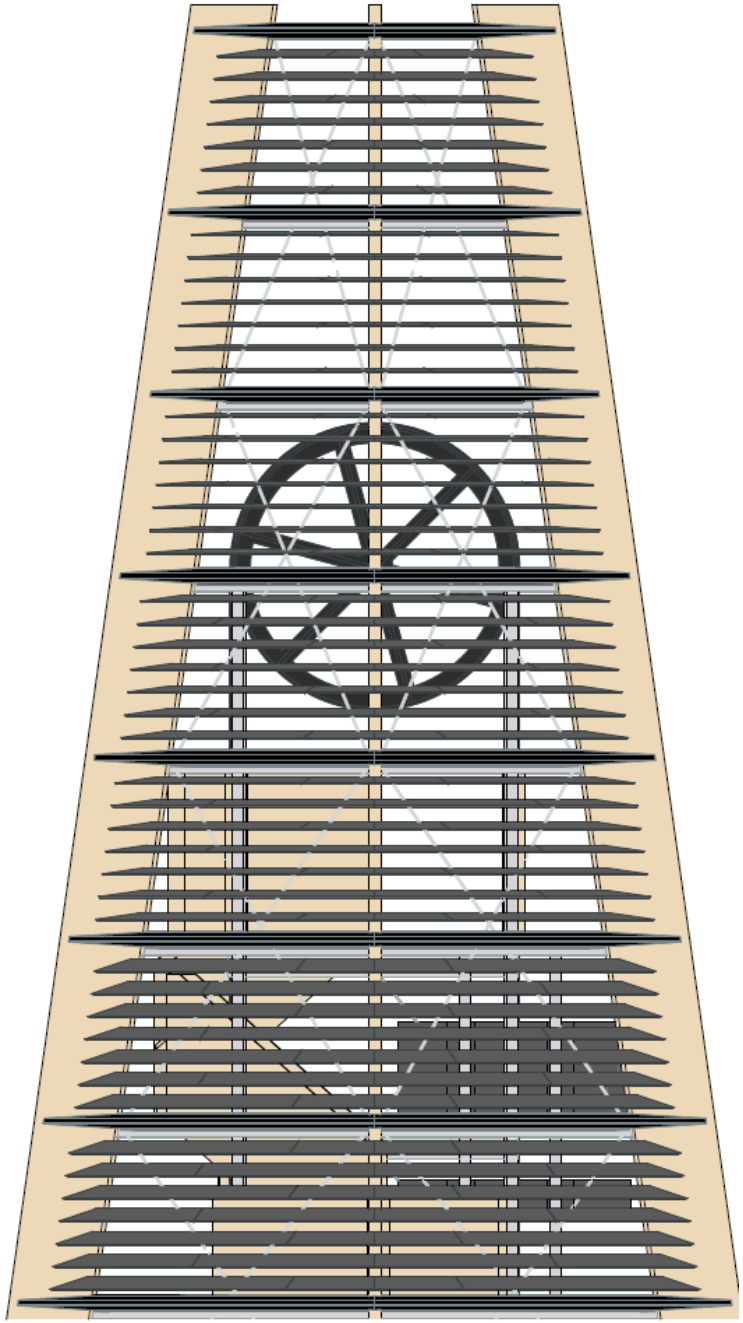
building technology

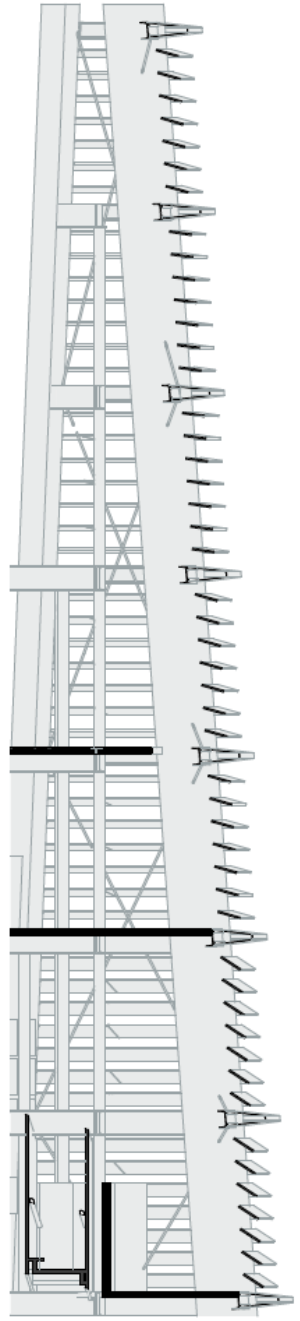
facade cladding

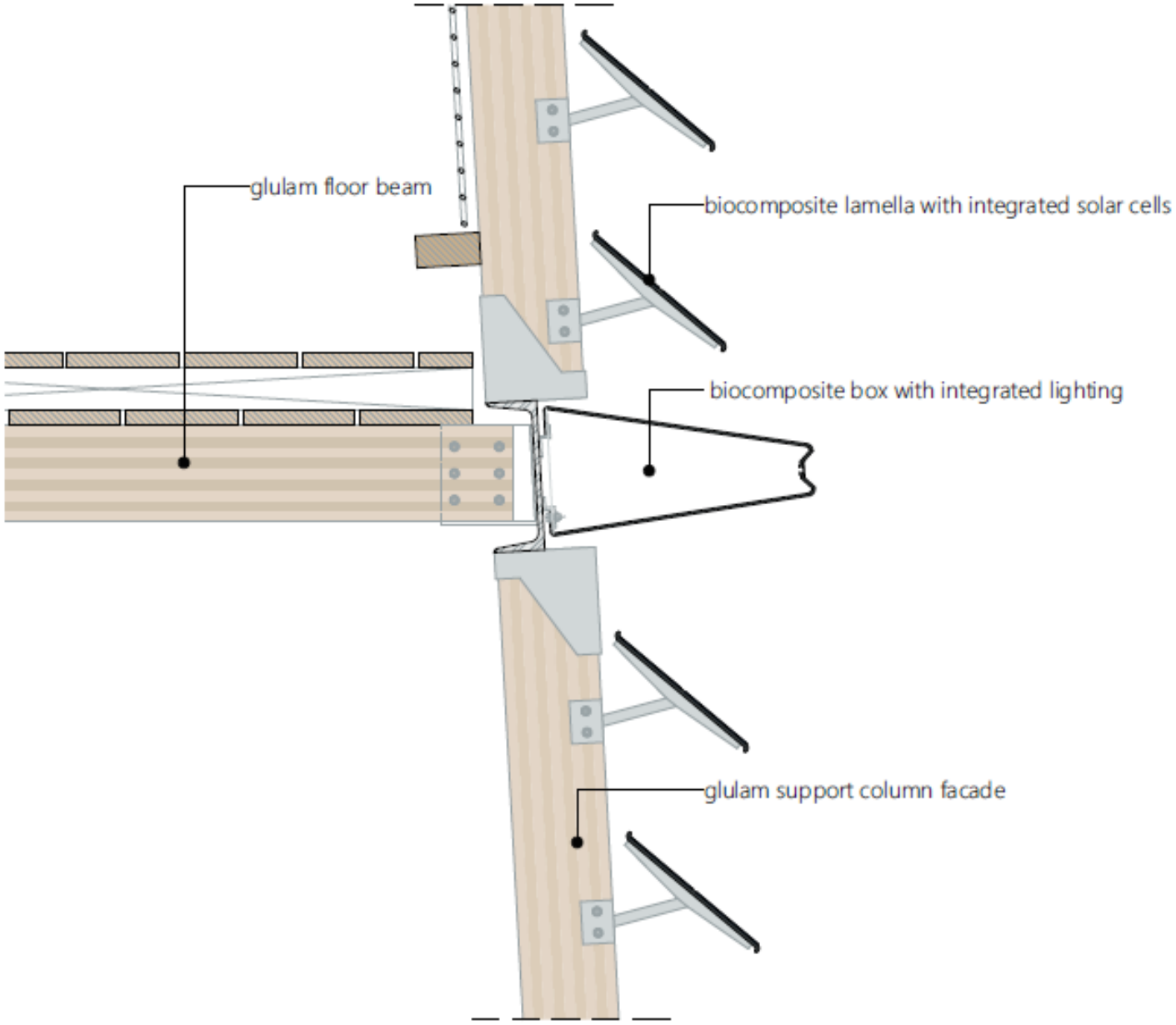
bracing structure

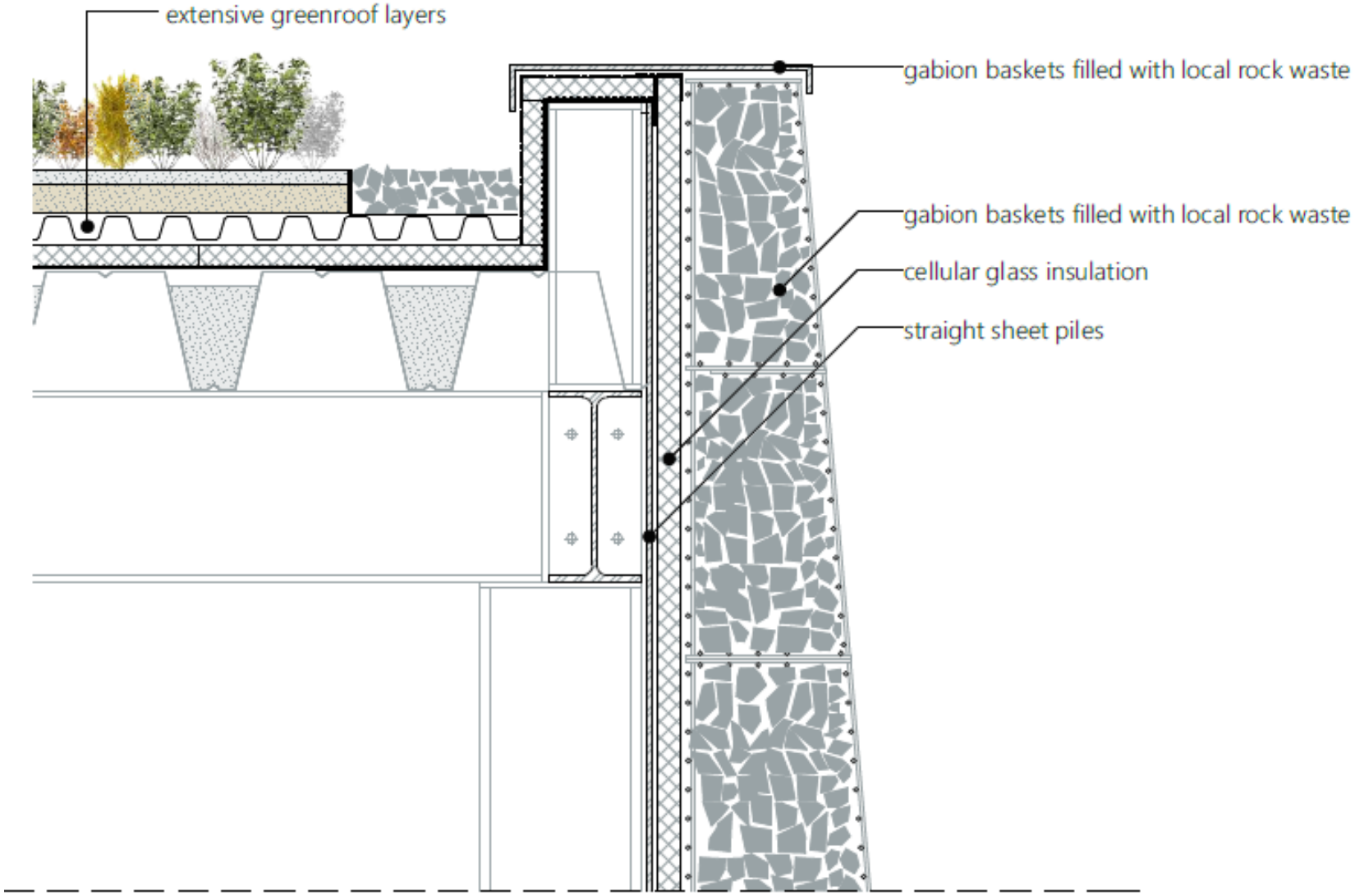
steel core

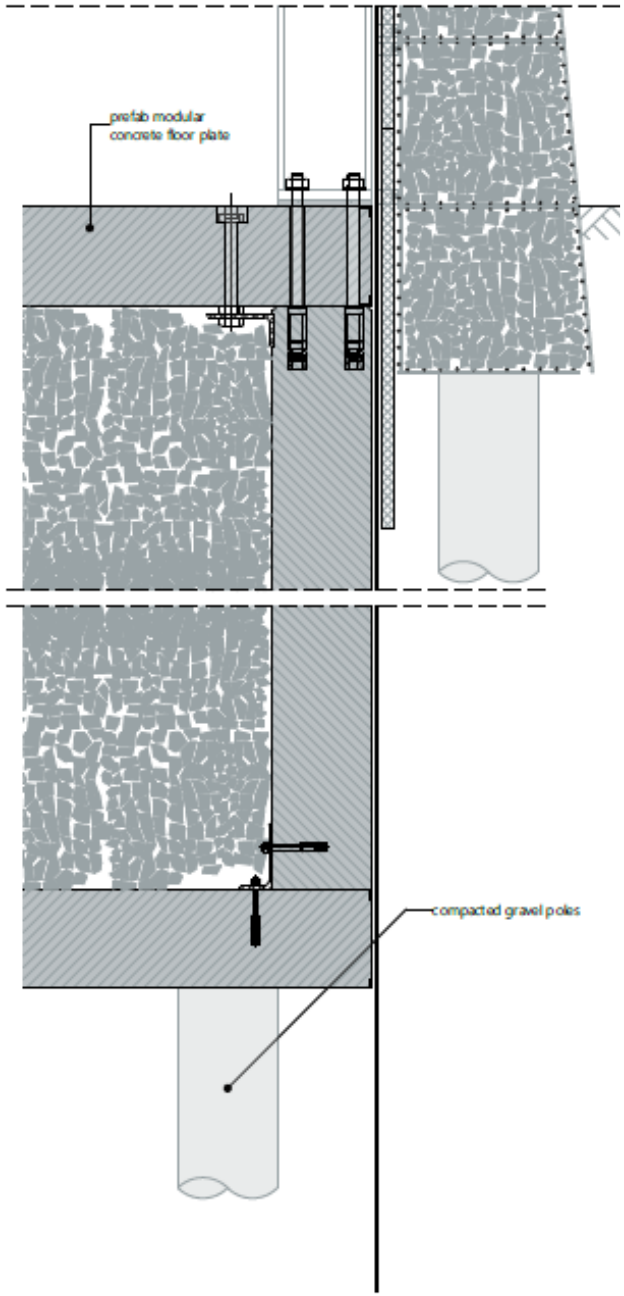
stone base

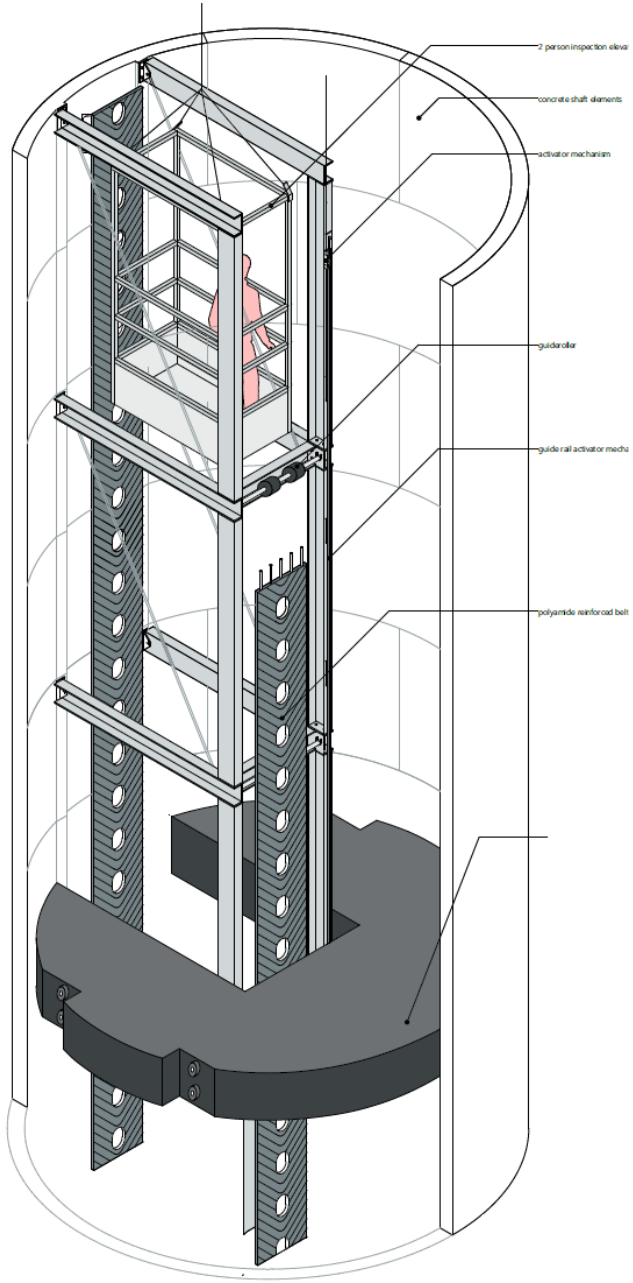


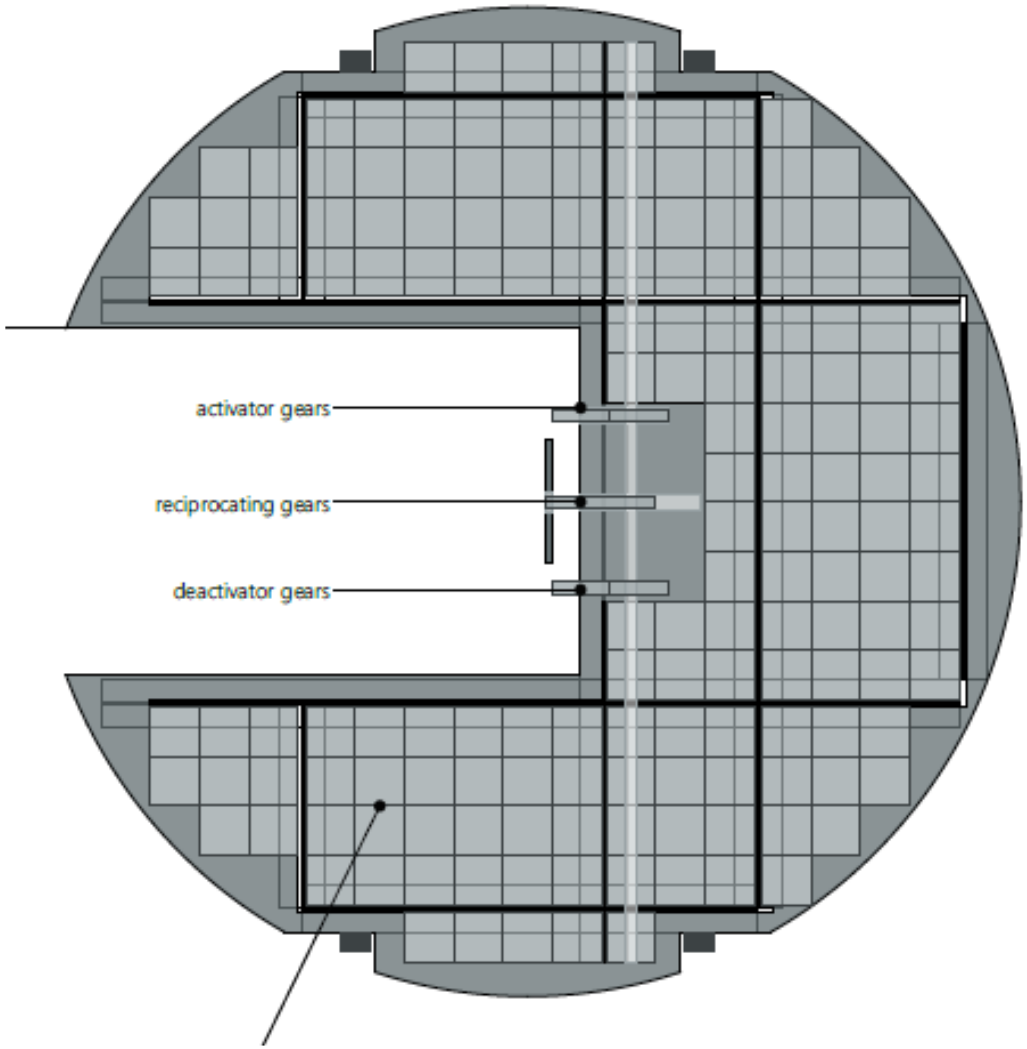



glulam floor beam
biocomposite lamella with integrated solar cells
biocomposite box with integrated lighting
glulam support column facade

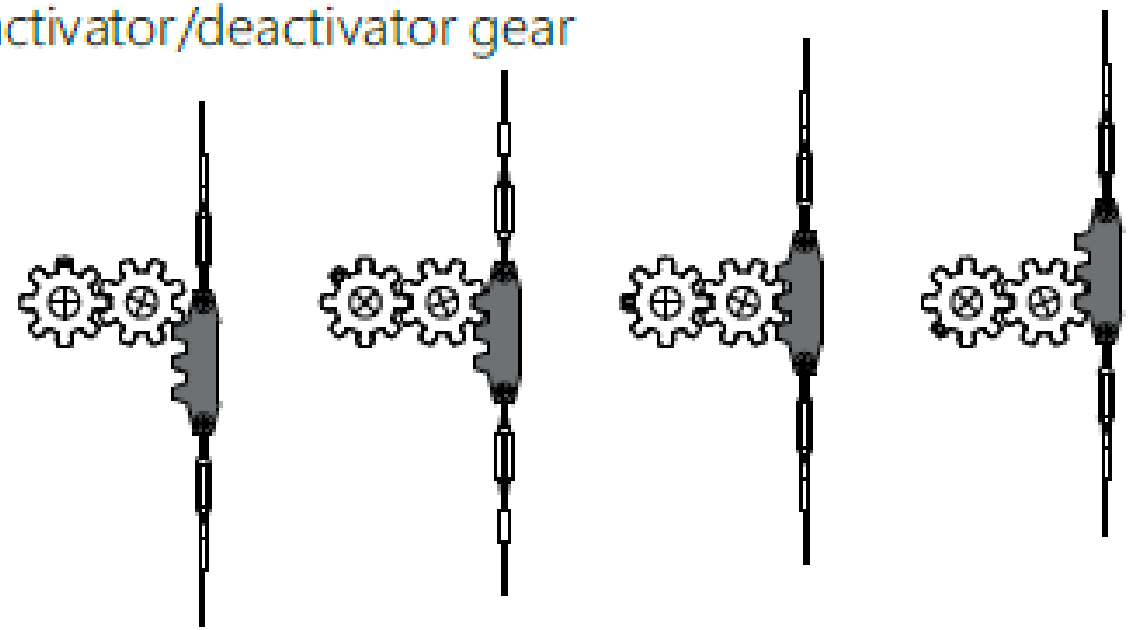

extensive greenroof layers
gabion baskets filled with local rock waste
gabion baskets filled with local rock waste
cellular glass insulation
straight sheet piles


prefab modular
concrete floor plate
compacted gravel poles

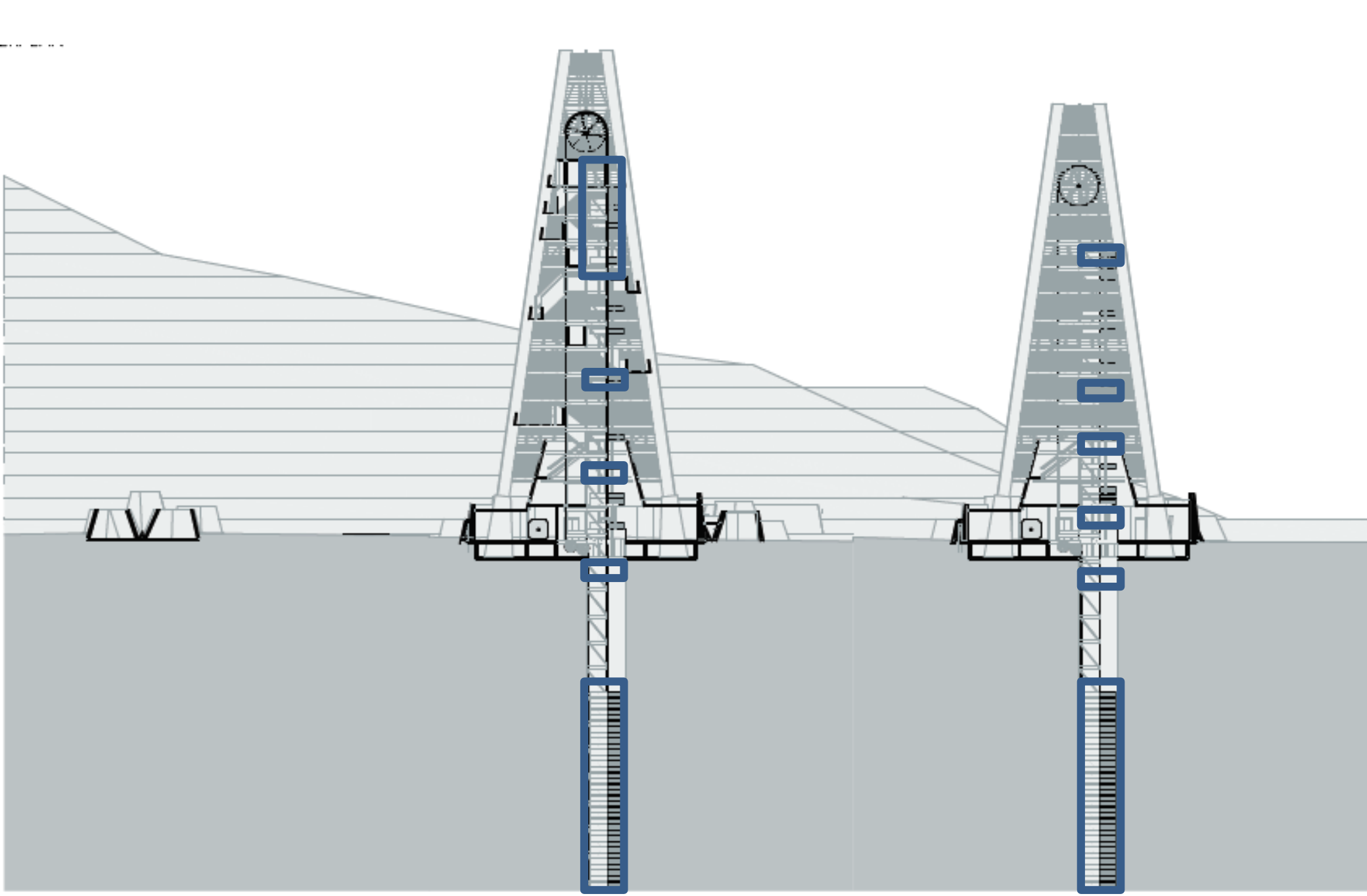

2 person inspection eleva
concrete shaft elements
activator mechanism
guideroller
guide rail activator mechu
polyamide reinforced belt


activator gears
reciprocating gears
deactivator gears

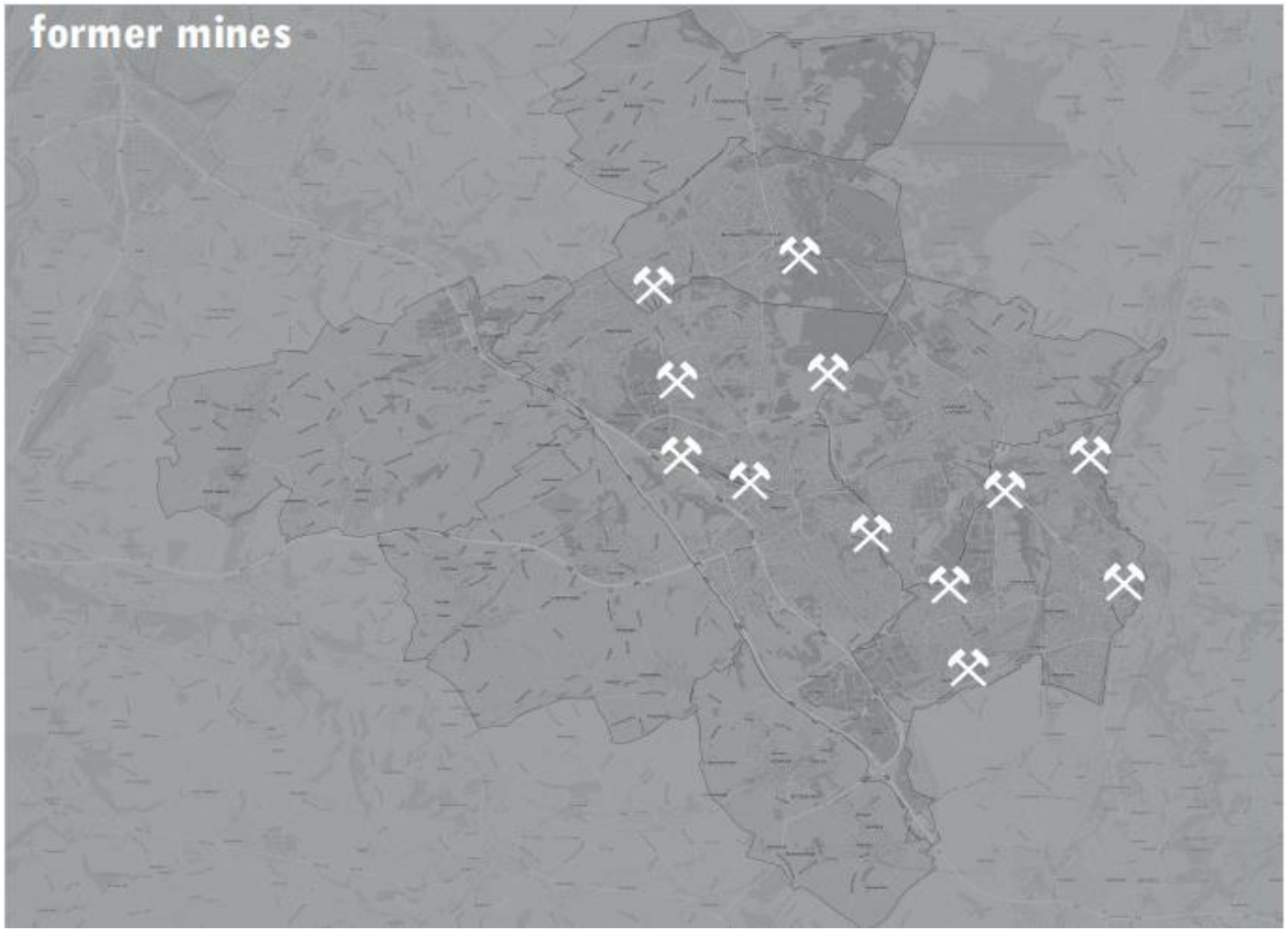
activator/deactivator gear



reciprocating gear



one more thing


former mines

more than 400.000 households daily

any questions?

image sources

- http://www.nenedirvikipedi.com/ingilizce/global-warming-ile-ilgili-ingilizce-cumleler-24770.html
- https://www.magnuscmd.com/spain-road-to-energy-transition-prequel/
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