TROLL RESEARCH STATION

Updated Project Proposals week 3

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IAP Workshop
Q3 2026
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Problems
- Extreme daylight conditions
- Circadian rhythm disruption
- Small confined spaces that need adaptable lighting

Goal:

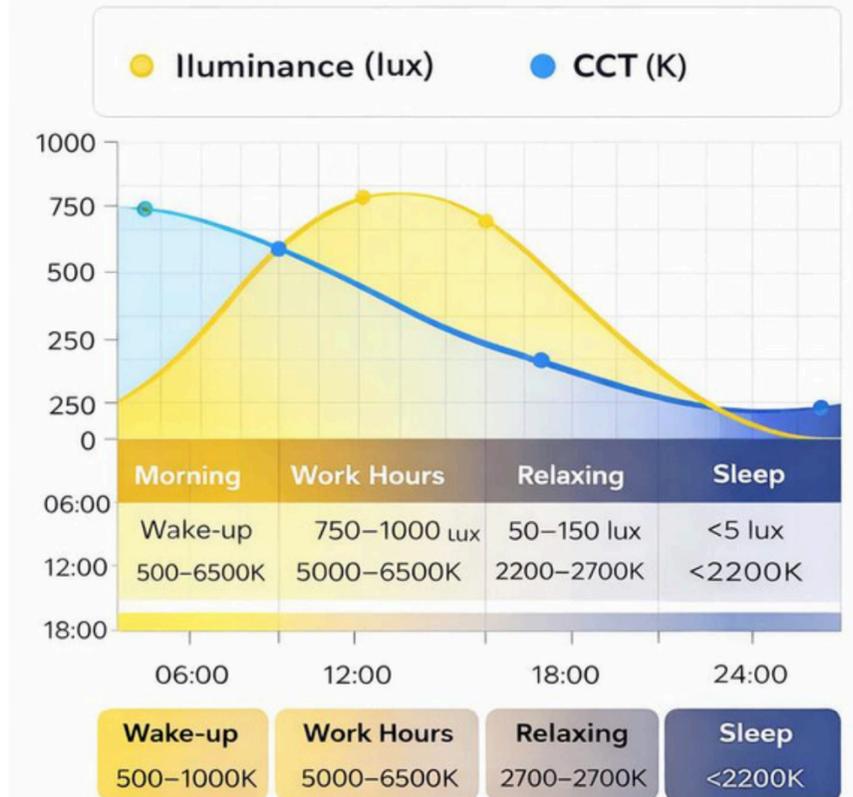**To create an adaptive lighting system that supports health, work performance and wellbeing.**

Artificial light must...

- simulate **natural daylight cycles**

- adapt to different **situations and activity's** inside the container.

24-Hour Circadian Lighting Cycle

	Morning	Work Hours	Relaxing	Sleep
Wake-up	750–1000 Lux	50–150 lux	<5 lux
500–6500K	5000–6500K	2200–2700K	<2200K

Wake-up	Work Hours	Relaxing	Sleep
500–1000K	5000–6500K	2700–2700K	<2200K

Circadian Lighting Requirements

Activity	Physiological Goal	Illuminance (lux)	CCT (K)
	Stimulate cortisol	500–1000	5000–6500K
Deep Focus Work	High alertness	750–1000	5000–6500K
	Social comfort	200–350	2700–3500K
	Reduce stimulation	50–150	2200–2700K
	Melatenin production	0–5	<2200K
	Sleeping Fight Sleep	0–5	<2200K

LIGHTING | SYSTEM LAYERING

Zone	Lighting Layer	Purpose	Illuminance (Lux)	CCT (Kelvin)
Work	Task lighting	Focus, detailed work	750–1000 lux	5000–6500 K
Work	Circadian lighting	Increase alertness during daytime	500–800 lux	5000–6500 K
Lounge	Ambient lighting	Comfortable social atmosphere	200–350 lux	2700–3500 K
Bed	Circadian lighting	Support sleep cycle and relaxation	0–50 lux	1800–2700 K
Circulation	Navigation lighting	Safe night movement	1–10 lux	1800–2200 K

Daylight overcast

Sunlight at midday
Fluorescent lamp

Halogen lamp

Candle light

LIGHTING | LAYERS

Circadian lighting

Ambient lighting

Navigating lighting

Relaxing
21.00 - 22.00

Sleeping
22.00 - 7.00

Dining
20.00 - 21.00
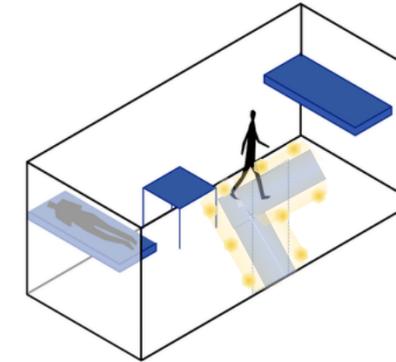
Relaxing / Exercising
18.00 - 20.00

1 h

1 h

2 h

9 h

00.00

18.00   06.00

12.00

Hygiene
7.00 - 8.00

1 h

Working
14.00 - 18.00

4 h

1 h

4 h

1 h

Dining
8.00 - 9.00

Dining
13.00 - 14.00

Task lighting
(individual)

Working
9.00 - 13.00
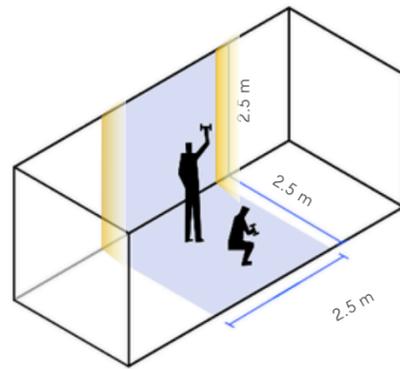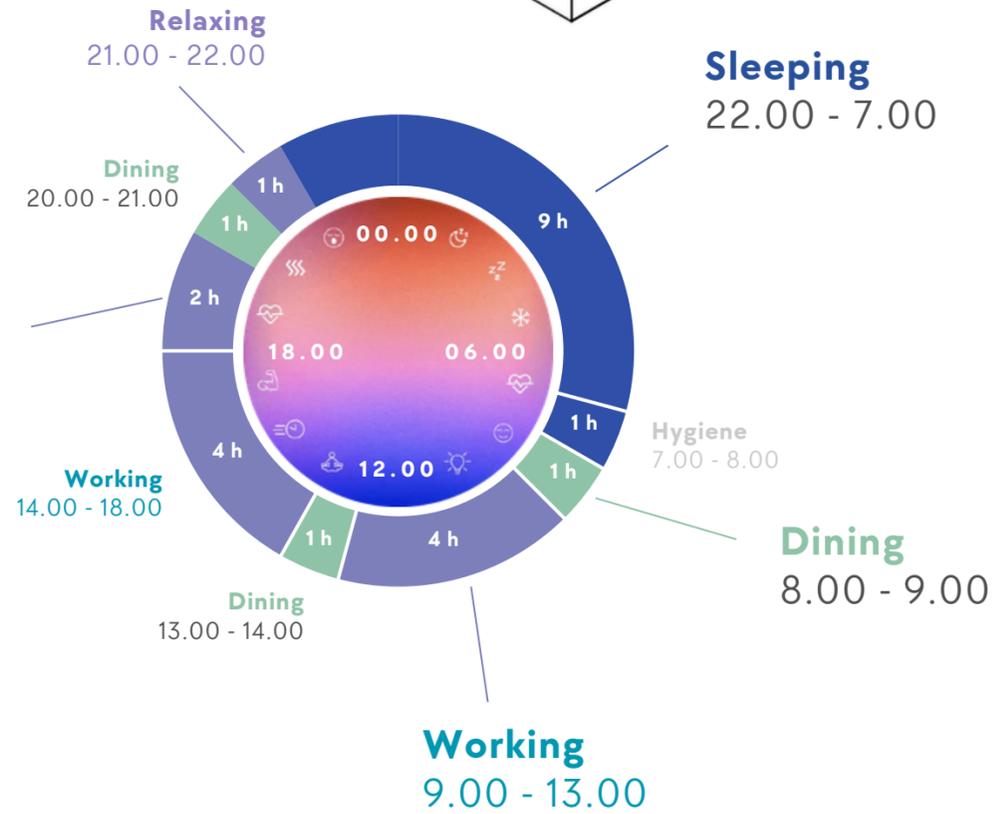
Navigating lighting

Task lighting
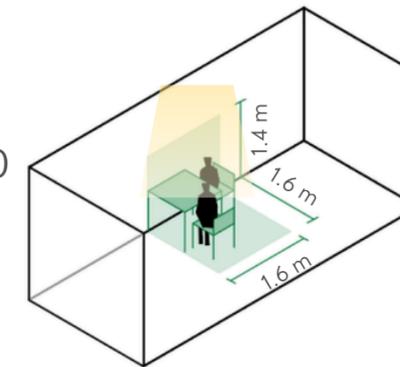
LIGHTING | AI-SUPPORTED (& PERSONAL) LIGHTING SYSTEM

System with..
Sensors → AI model → lighting adjustment & personal lighting system

Inputs (basic data):
· physiological signals (pupil dialation, heartrate etc.)
· time of day
· activity
· occupancy

Outputs:
· illuminance (lux)
· color temperature (CCT)
· LED activation in zones
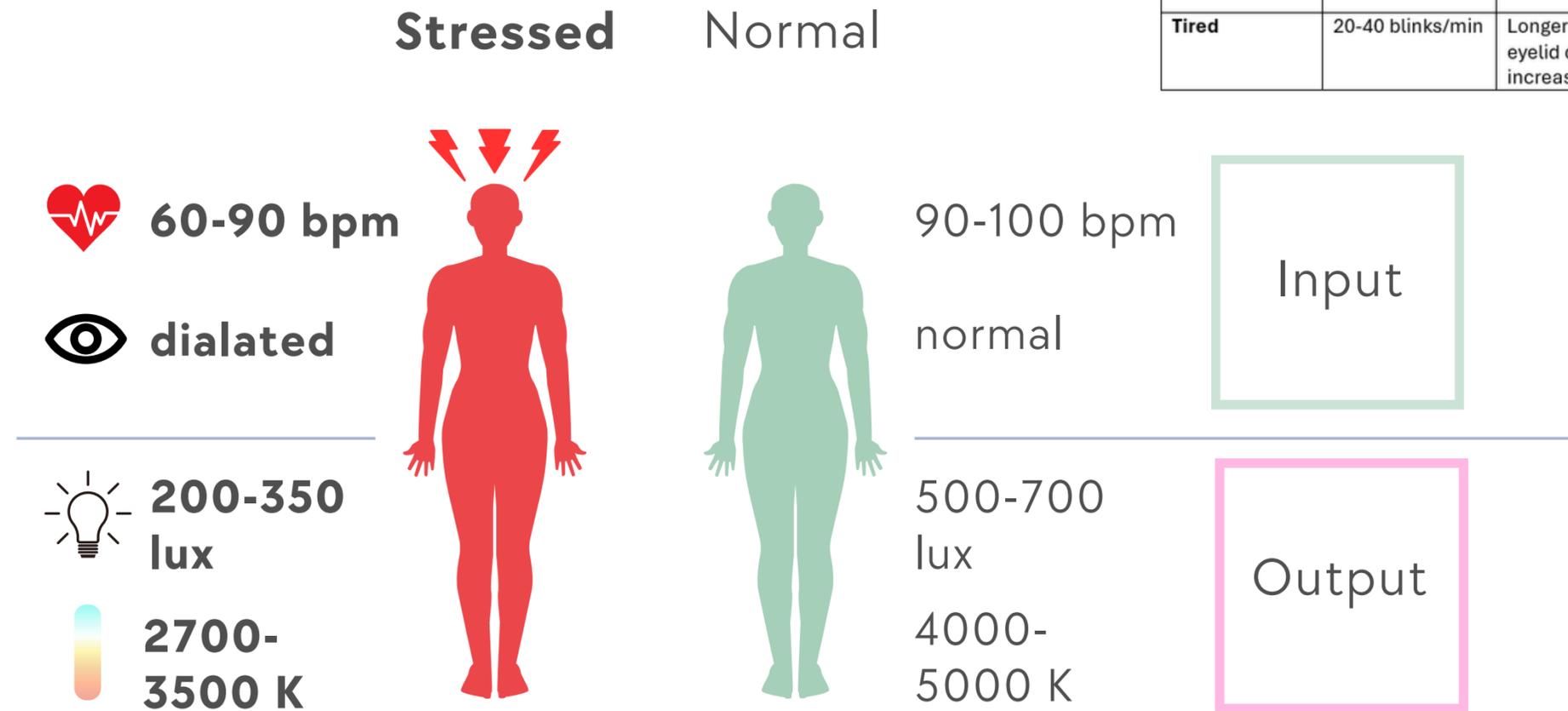
heart_rate_bpm

Physical state	Range	Notes	Lighting changes
Calm/relaxed	60-80 bpm	Resting heart rate	Nothing
Stressed	85-110 bpm	Higher than normal	reduce intensity, warmer light (+/- 3000 K)
Tired	50-65 bpm		If person needs to stay awake -> cooler color temperature (5000–6500 K) and 500–1000 lux

pupil_mm

Physical state	Range	Notes	Lighting changes
Calm/relaxed	2-4 mm ('normal' lighting)	Pupil is smaller than stress state	Nothing
Stressed	4-6 mm		reduce intensity, warmer light (+/- 3000 K)
Tired	2-3 mm	Smaller but unstable	If person needs to stay awake -> cooler color temperature (5000–6500 K) and 500–1000 lux

blink_rate_per_min

Physical state	Range	Notes	Lighting changes
Calm/relaxed	10-20 blinks/min	Natural blinking	Nothing
Stressed	20-35 blinks/min		reduce intensity, warmer light (+/- 3000 K)
Tired	20-40 blinks/min	Longer blinks, eyelid closure increases	If person needs to stay awake -> cooler color temperature (5000–6500 K) and 500–1000 lux

Stressed   Normal

60-90 bpm   90-100 bpm

dialated   normal

200-350 lux   500-700 lux

2700-3500 K   4000-5000 K

Input

Output

DISTRIBUTION STRATEGIES
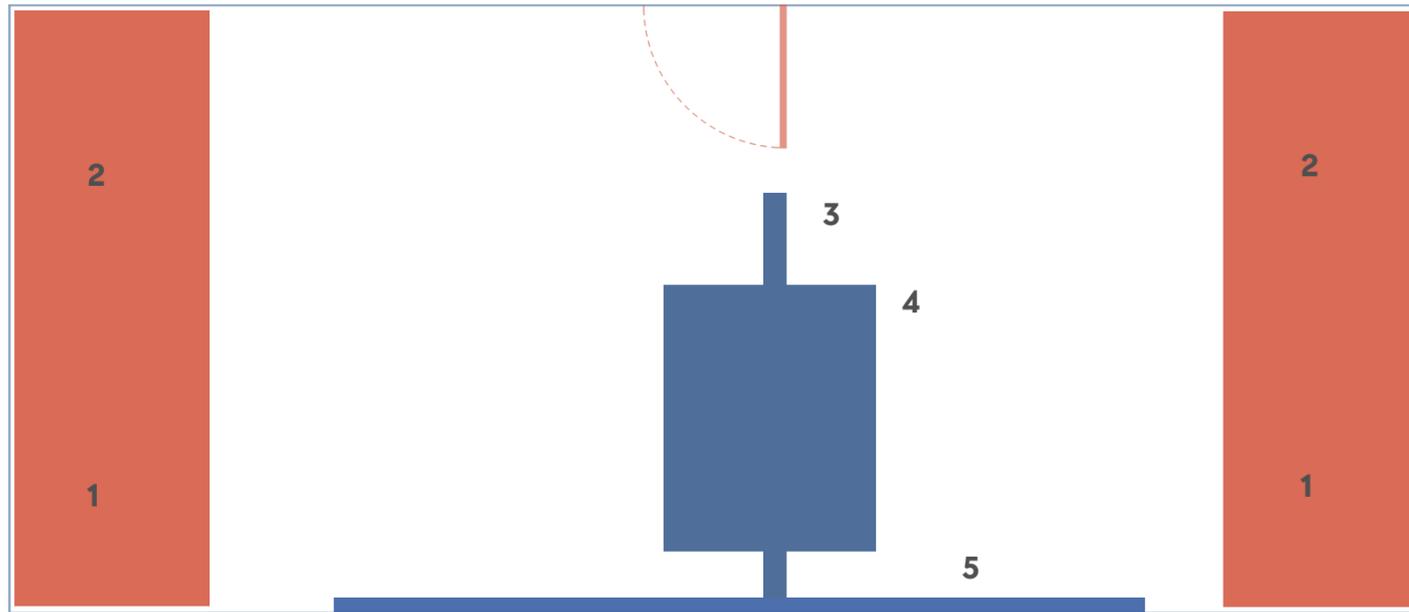
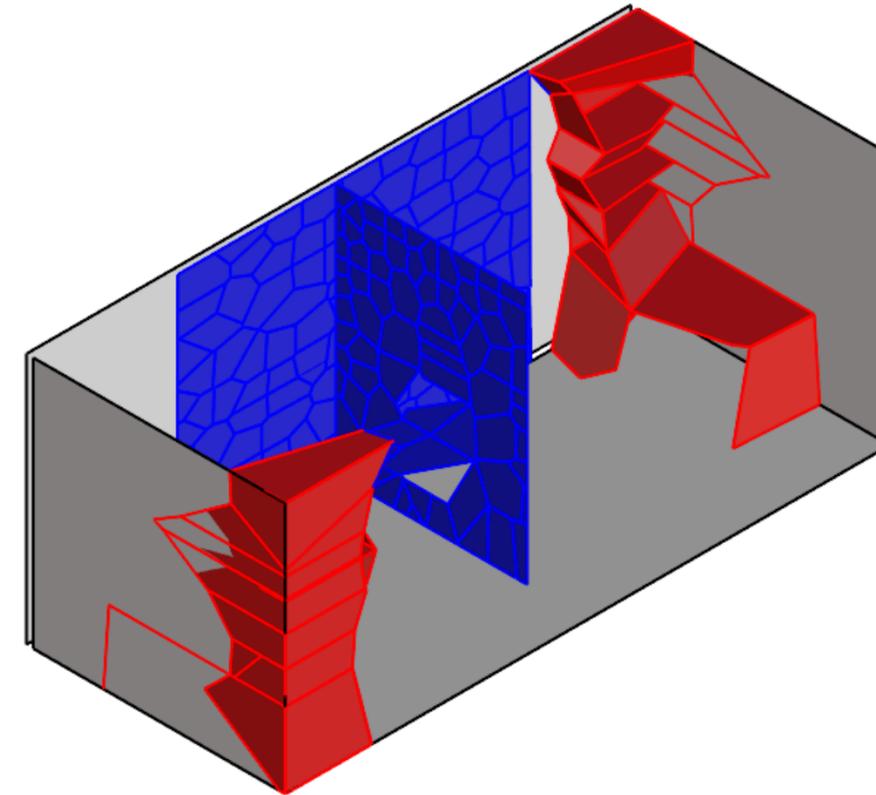**Legend**

"Permanent" furniture

More space-consuming and/or fixed furnitures are placed in peripheral spaces

1. Storage 2. Bed and workstation

Temporary furniture

Furniture in the center of the container is easily reconfigurable and can be folded to a surface, for maximum clearance of the space

3. Partition wall 4. Dining table 5 Multipurpose wall

Necessities

- Separate beds with integrated personal storage
- Adjustable modules for user-driven spatial reconfiguration to enable environmental personalization and reduce visual monotony
- Foldable partition to subdivide container into two private rooms. For increased privacy and psychological benefits during prolonged isolation
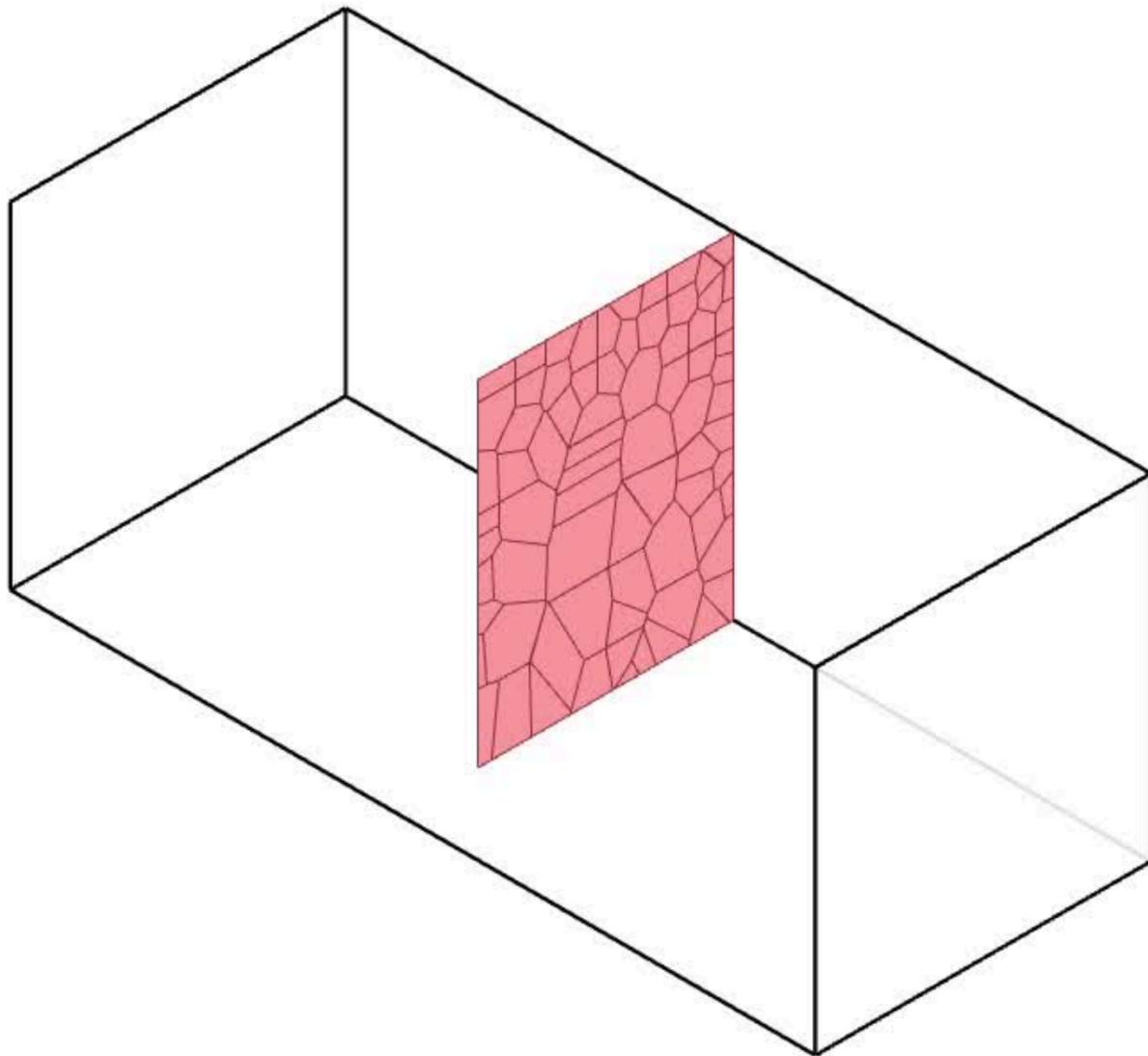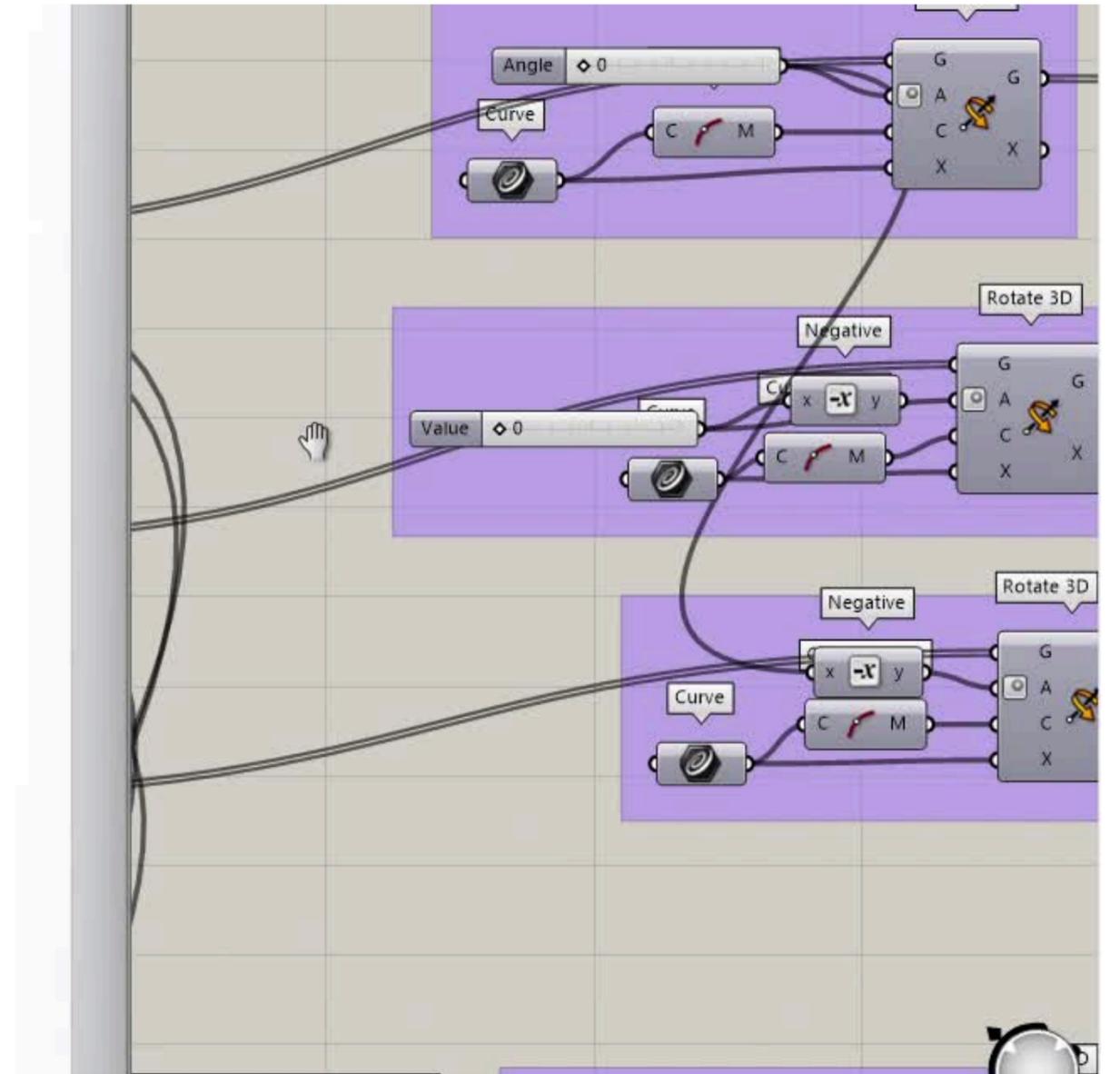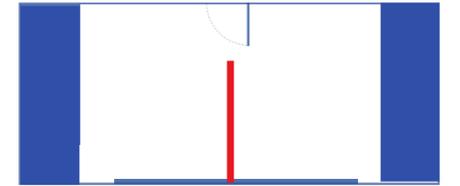
container key plan
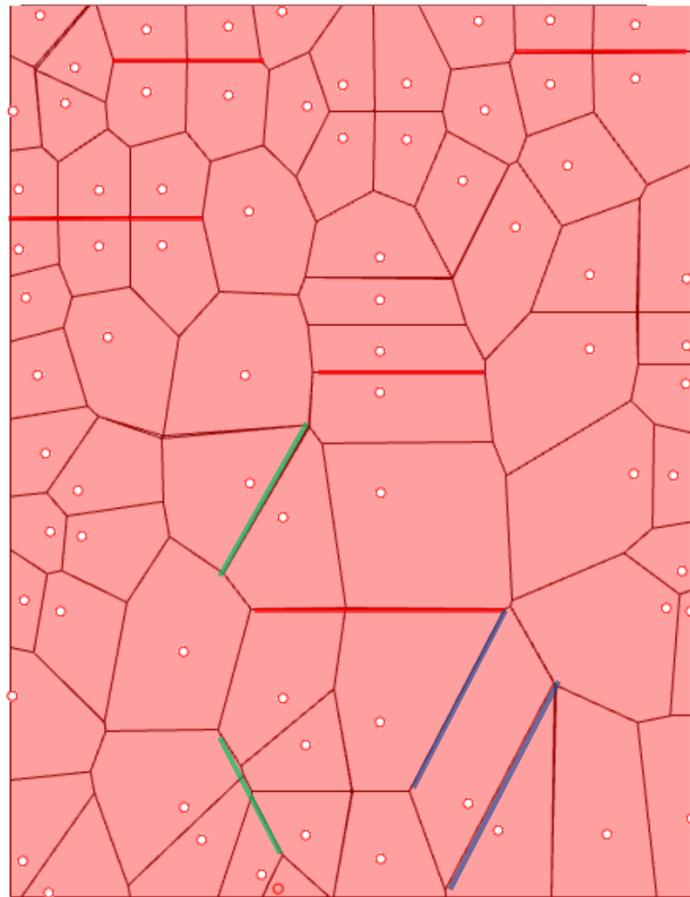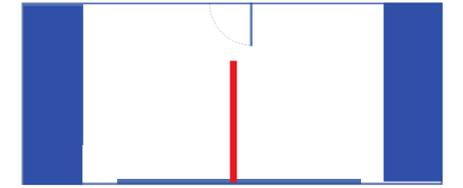
container key plan

Right elevation

2d voronoi generation

shelves modules

lighting modules

table modules

seating modules
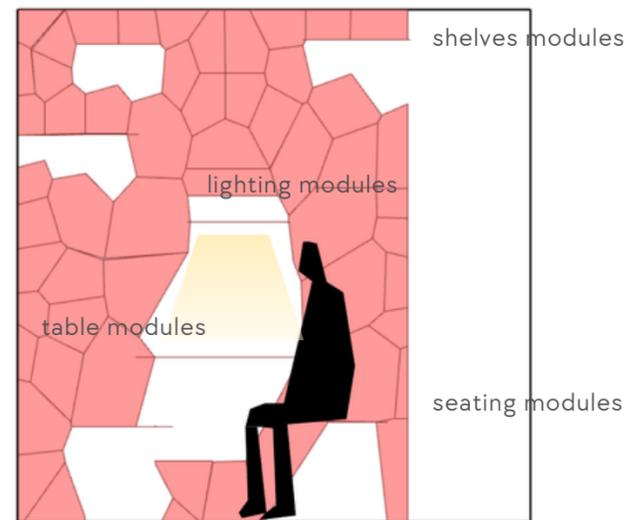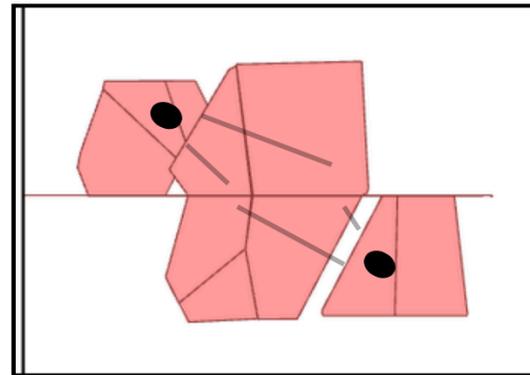
Plan view and right elevation

Geometrical and functional configuration
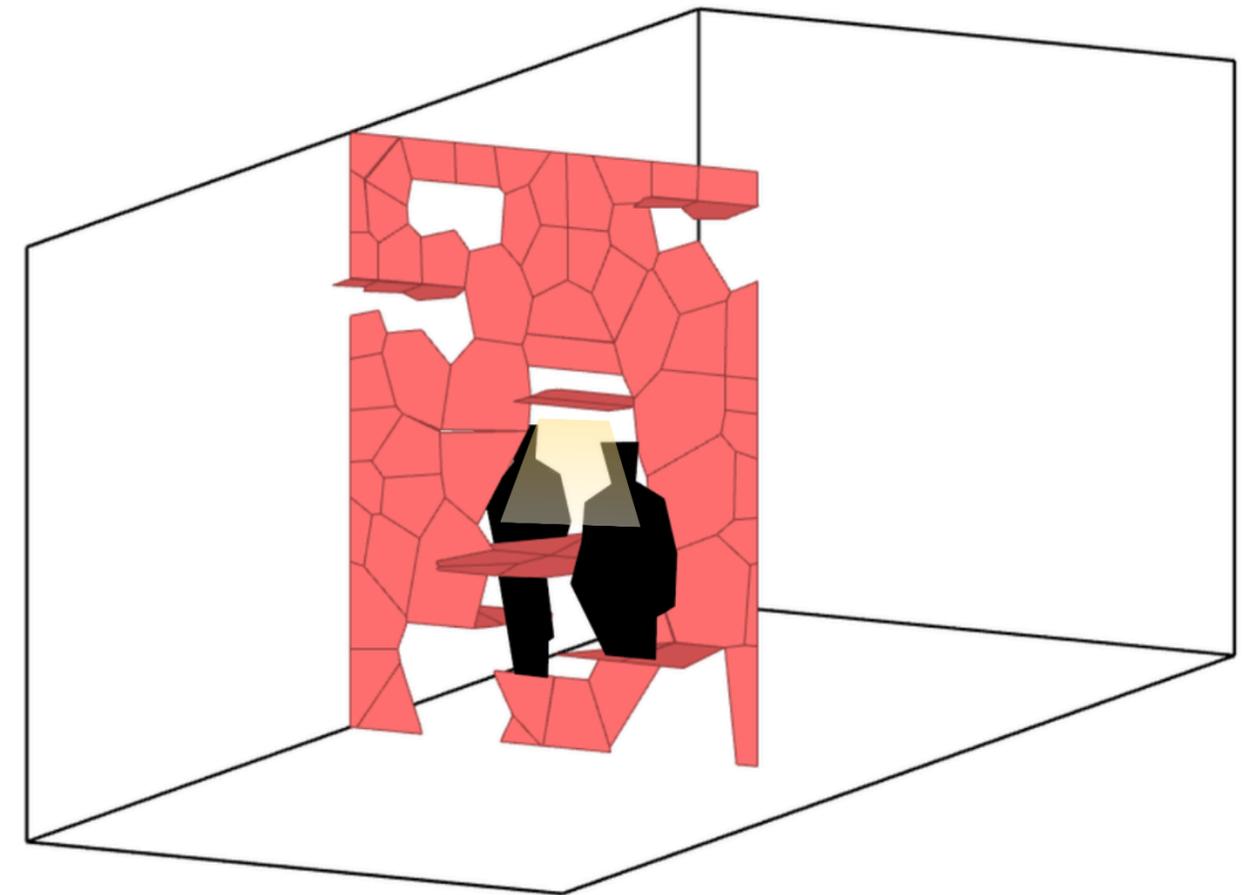
Perspective view NE

Visual permeability

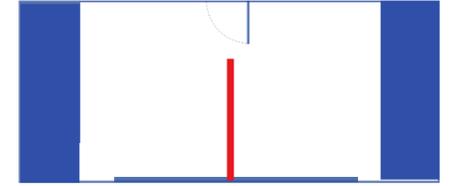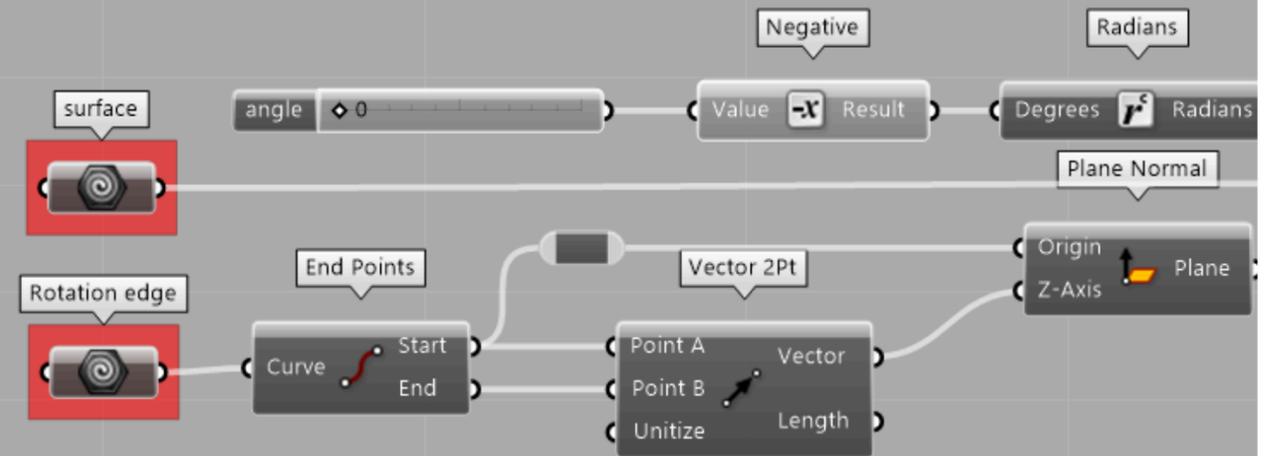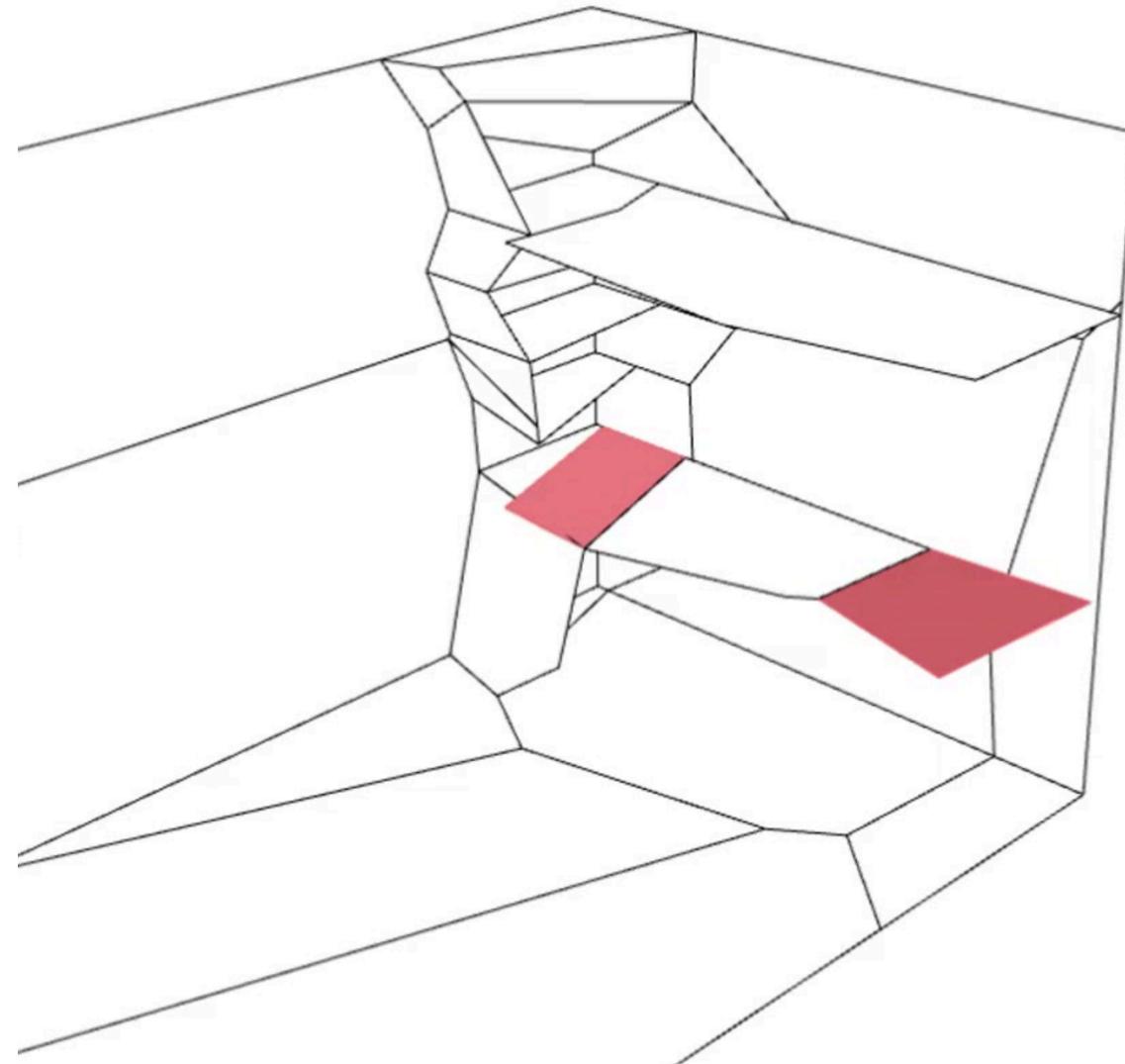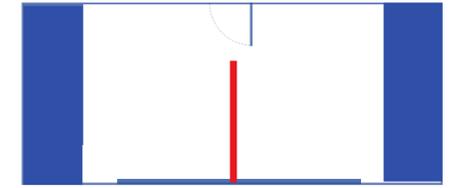# 01 ADAPTIVE FURNISHING |
FOLDABLE DESK

desk leg

Select one of the baked surfaces in Rhino and add them to the "Surface" box

draw a line in Rhino, where the surface should hinge and add to "Rotation edge"

Change the "angle" value and see the geometry move in Rhino

surface

angle ◇ 0

Negative

Value -x Result

Radians

Degrees Radians

Plane Normal

Rotation edge

End Points

Curve Start
End

Vector 2Pt

Point A Vector
Point B
Unitize Length

Origin Plane
Z-Axis

headrest

Select one of the baked surfaces in Rhino and add them to the "Surface" box

draw a line in Rhino, where the surface should hinge and add to "Rotation edge"

Front | Top

container key plan

Desk can be folded into lounge chair
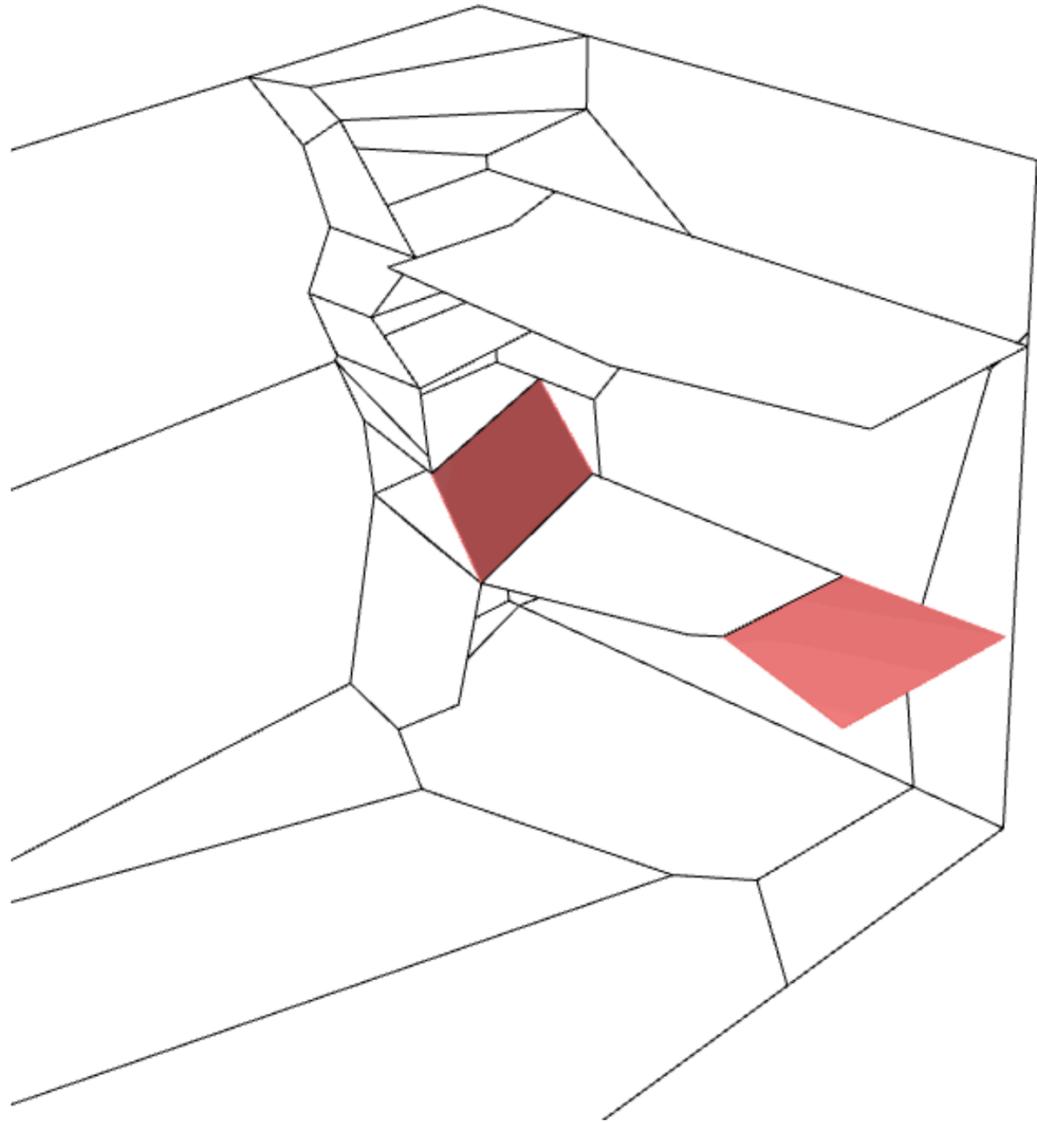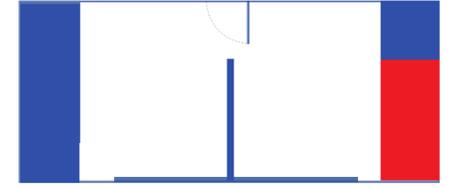
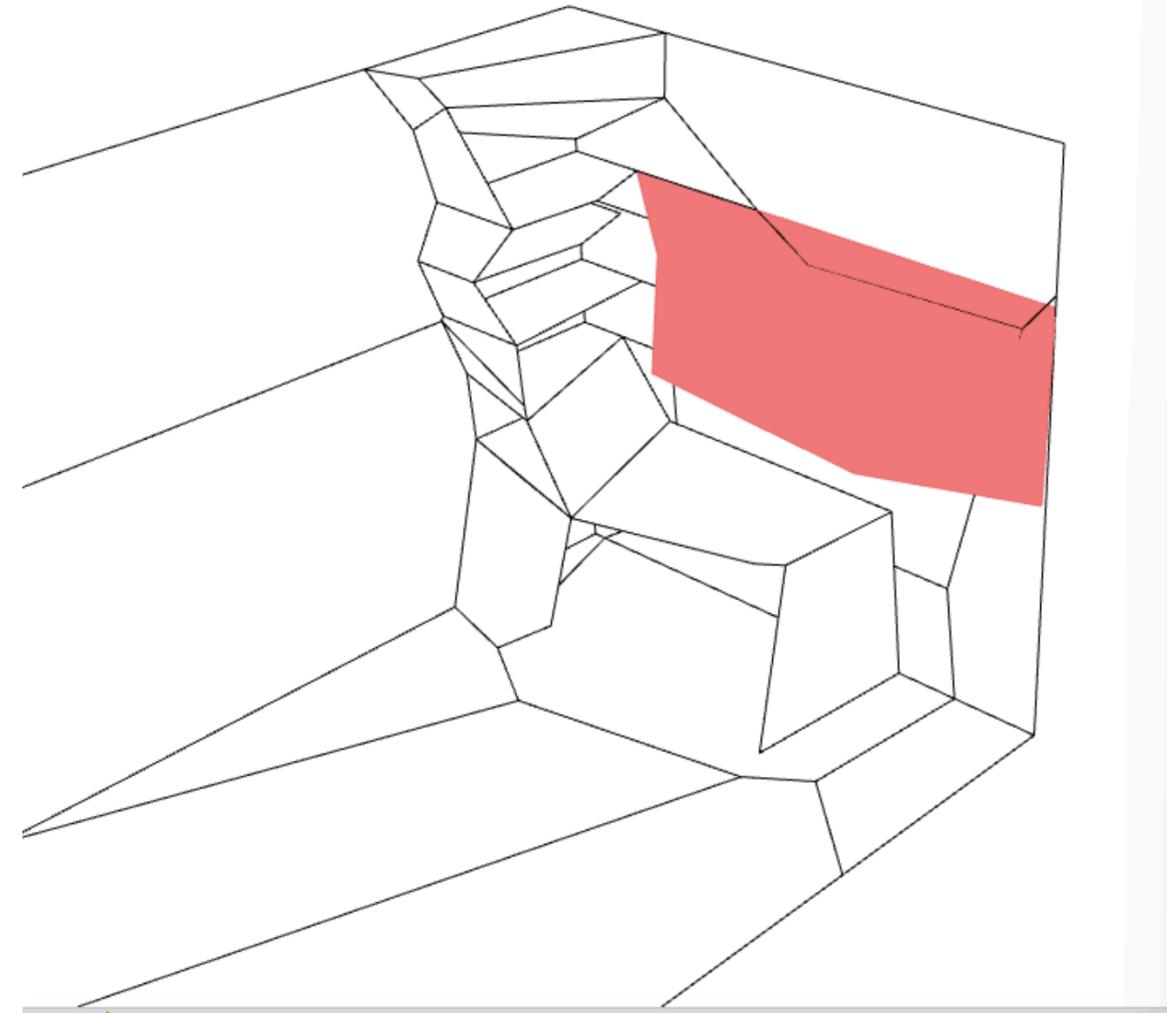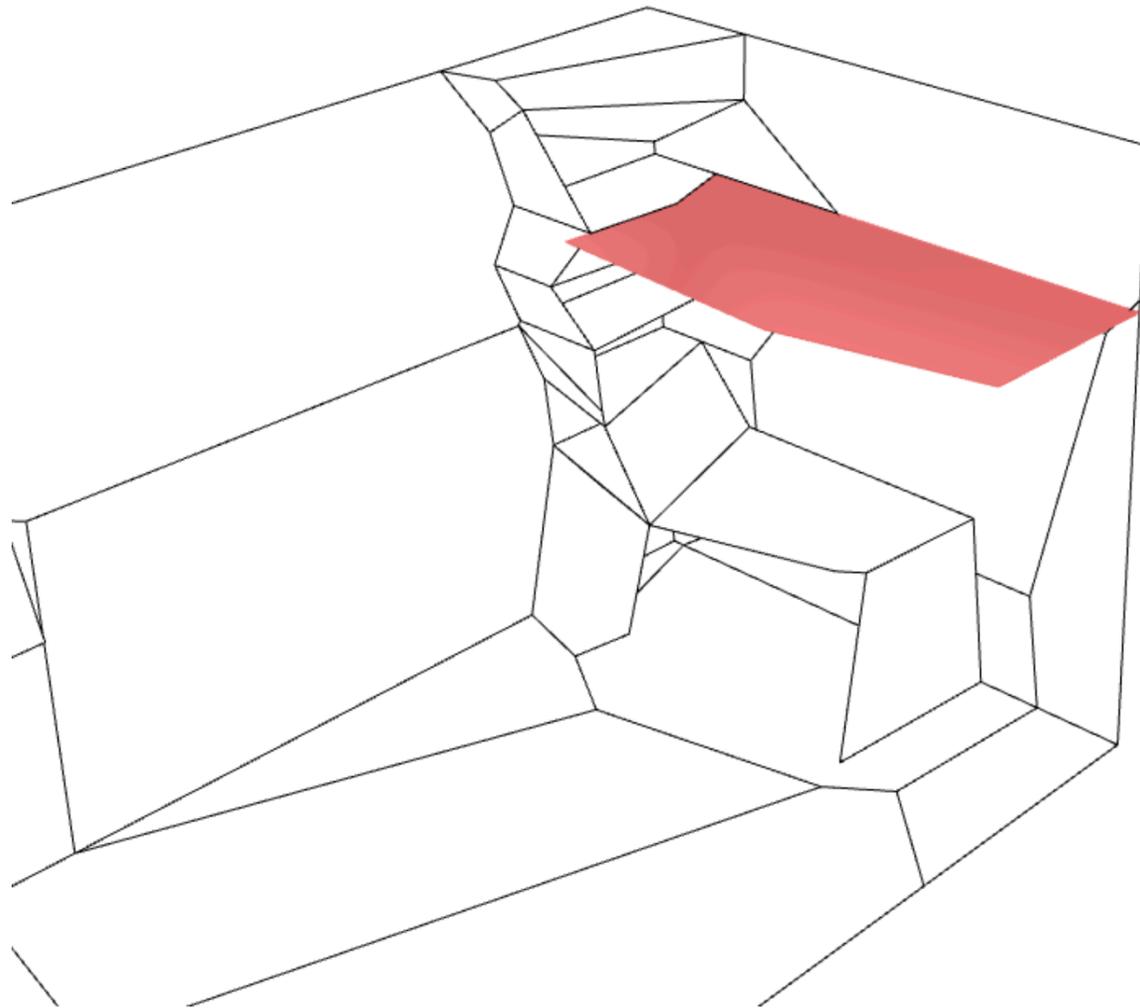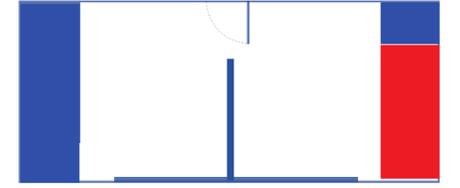# **ADAPTIVE FURNISHING |**
FOLDABLE DESK

Desk can be folded into lounge chair
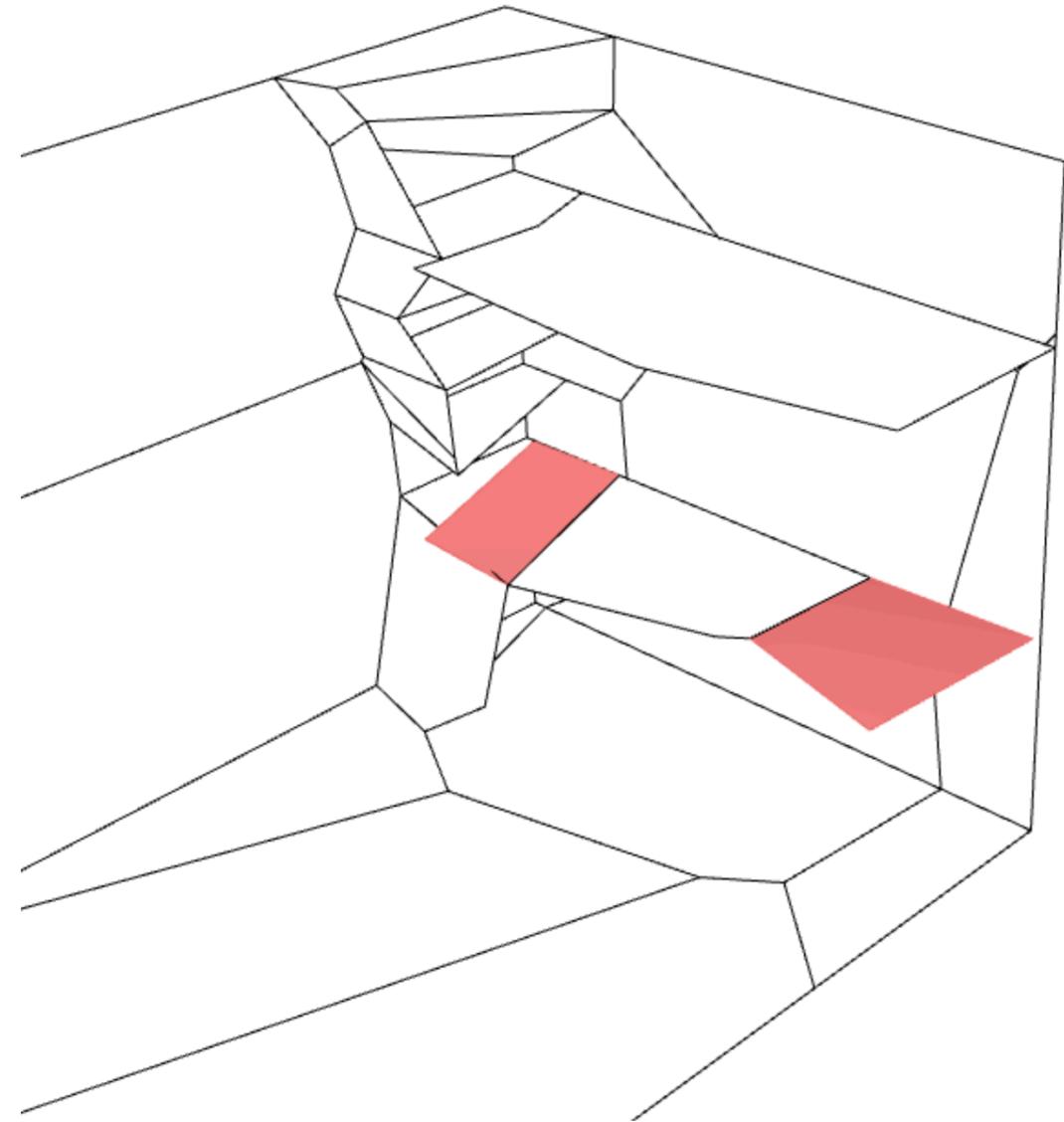
ADAPTIVE FURNISHING |
FOLDABLE BED

**Bed can be folded against the wall
Aligns with the shelves**

container key plan
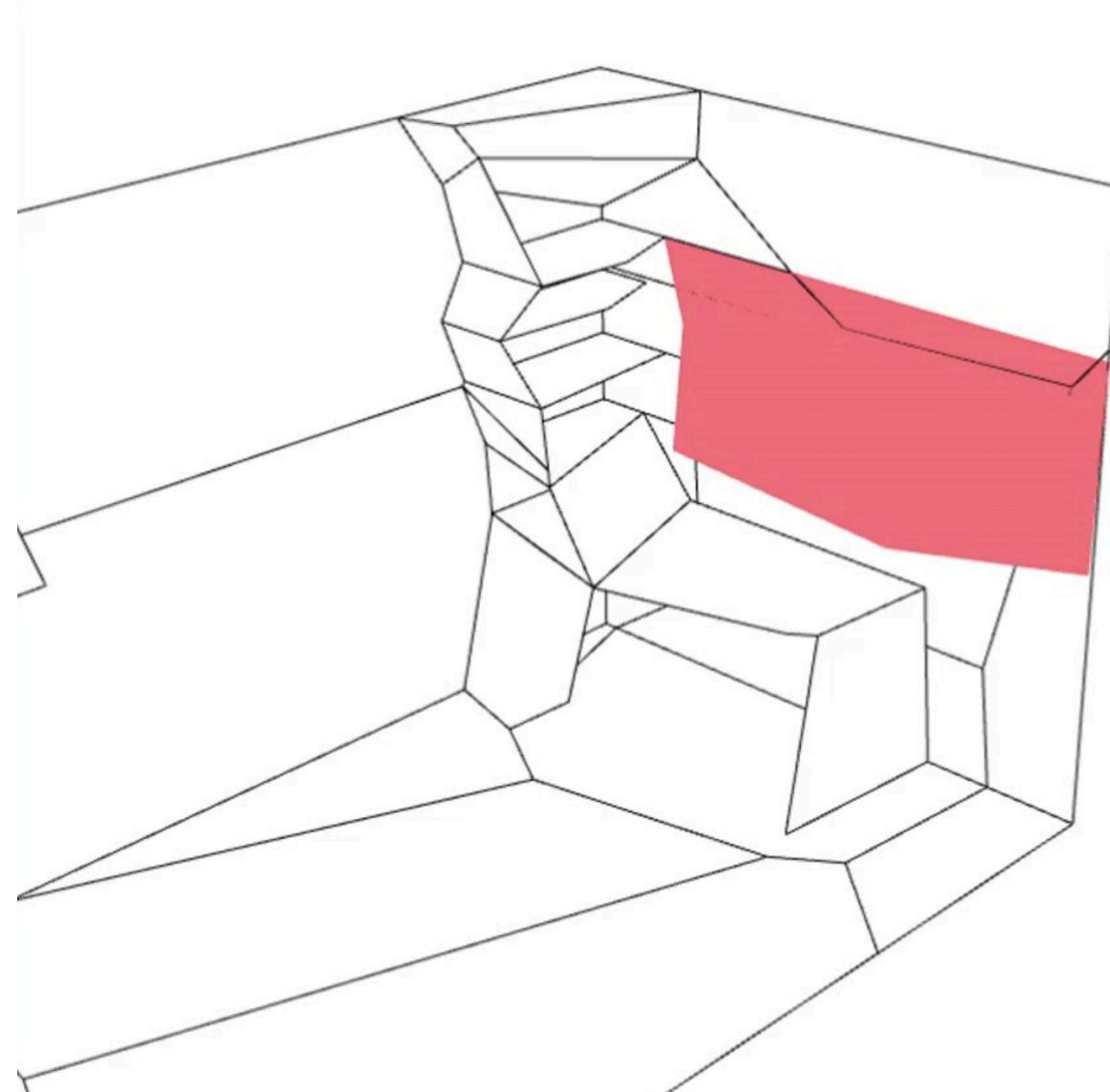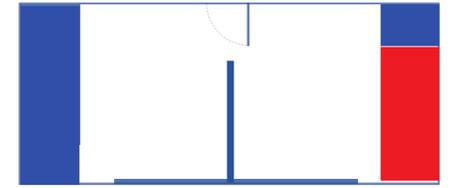
Bed can be folded against the wall
Aligns with the shelves, start thinking about what is the most
representatiove fragment to represent

Thank you for your attention !