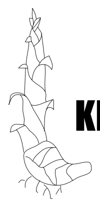


KEBON KOPI RESORT

Thesis project in Architecture,
AAHM01
by Josefine Nyberg
LTH 2012-2013

Advisor: Laura Liuke
Examiner: Christer Malmström

This is a project learning about adapted materials for adequate living situations in disaster prone and tropical climate areas, by knowledge from past generations.

Indonesia has in the past few years seen more than its fair share of natural disasters, from volcanic eruptions to tsunamis to earth-quakes and more. We enter in the recovery from the effect of extreme weather and disasters when it already is a ***fact.*** *We need to plan for future disasters to create a better response.*

Organic resort development,
Kebon Kopi, Borgor.

Thank You. Sahabat Bambu and BambuBos for the generosity and for giving me the possibility to visit various sites and treatment facilities. Especially to Andrea Fitrianto for guiding me during the stay and for all inspiration. I also want to thank the team from IBUKU for letting me stay at their sites learning and studying bamboo architecture. And last but not least, Laura Luike, LTH, for all time and guidance.

1. INTRODUCING THE PROJECT

INTRODUCTORY SUMMARY

The project's departure is based on a general interest of adapted materials in disaster prone and tropical climate areas. A reaction from the negative impact of ground-built heavy brick or concrete dwellings, neither adapted to the climate or the risk for disaster. Not only resulting in material damage and for many people backsliding into poverty but also the los of the local wisdom and their traditions.

The starting point for this began during my 4th year of my studies, participating on a course at the HDM department, taking place in Philippines. Working with the project my interest for issues of suitable and accessible materials started to grow. This brought me to questions about adapted architecture and materials in areas with extreme climate and risk for disaster and how to plan for future disasters. I started my investigation and bamboo as a material came into my interest.

The focus has been to find a method dealing with these questions through the exploration of the existing site and facts of disaster woven together with traditions and cultural heritage. The combination of these three key elements brings out the potential values on the site through a resort project built in bamboo and natural materials.

BACKGROUND

Two hundred million people have been affected by natural disasters and hazards in the last decade. For every person who dies, some 3000 are left facing terrible risks (Aquilino, 2011, p. 7). Poor communities worldwide face the risk, exposed to repeated cycles of loss and recovery. They build on fragile sites and in the path of natural disasters. Recovery from the effects of extreme weather and climate is getting more and more expensive and the need to recover more frequent. For many families this means backsliding further into poverty.

It is an old truism that earthquakes do not kill but buildings do. The shift to new materials and techniques is almost universal, as poor communities come to associate new building practices with a better lifestyle. But this change has never been translated in either material or economic terms into safer homes or future. Buildings made in modern style do not withstand disaster well and the recovery costs increases. The older traditional homes were adapted and if destroyed easily and quickly restored by help from neighbors and family with local materials. Many families never fully recover today, but instead live at a greater risk in homes that have been poorly built, repaired or maintained. Poverty is a disaster such as an earthquake or tsunami. To reduce the impacts of future disasters long-term solutions need to be addressed (Aquilino, 2011, p. 254-263).

Changing to role of building homes to the government or the private sector results in the loss of local knowledge and wisdom among the people. We find resettlements being abandoned, due to that it is placed to far from the original location or that the inhabitants were not included in the process and resulting in an unpersonal building with the wrong size or number of rooms needed etc. Instead shifting the construction and knowledge back to the people, for them to learn but also by using their wisdom is one way to disaster-reduction (Aquilino, 2011, p. 77).

The loss of knowledge and local wisdom for people living in poor communities increases the risk for disaster. This is a key point for my research of how to build with bamboo on a site, Kebon Kopi, outside Bogor, Indonesia. How can we reintroduce a material that is seen as the poor mans timber and not attractive to the people?

The project

My work started with a field trip to Indonesia, visiting various bamboo developments and treatment sites. While visiting the NGO, Sahabat Bambu and the local enterprise, BambuBos, outside Bogor, I was introduced to a resort project. The project is based on two sites: *Lalandon*, with treatment facilities and nursery and the other site in *Kebon Kopi* where a natural resort is planned.

To address the loss of knowledge this is one of BambuBos attempts to reintroduce the material and knowledge among the people. On the Kebon Kopi site the resort is planned in bamboo architecture, trying to inspire people to use the material that grows on their doorstep. The program was set up by the owner of the land, Drs. Didi Widayadi. I found the program for the site vague and I started to think of the possibilities with this project and the site to formulate my program for this site.

The approach

The approach to a complex issue of disaster needs to be addressed with caution and humility. The critical question when humans define natural disasters is addressed here by avoiding the typically assumed or even expected monumentality that demonstrates the dramatic power of man over nature. Could we instead ask the question as how to use the environment as a resource and to find a new way of acting with a holistic understanding of natural disasters? Wouldn't it be more appropriate to approach this project by experience, wisdom and acknowledge the history of disasters?

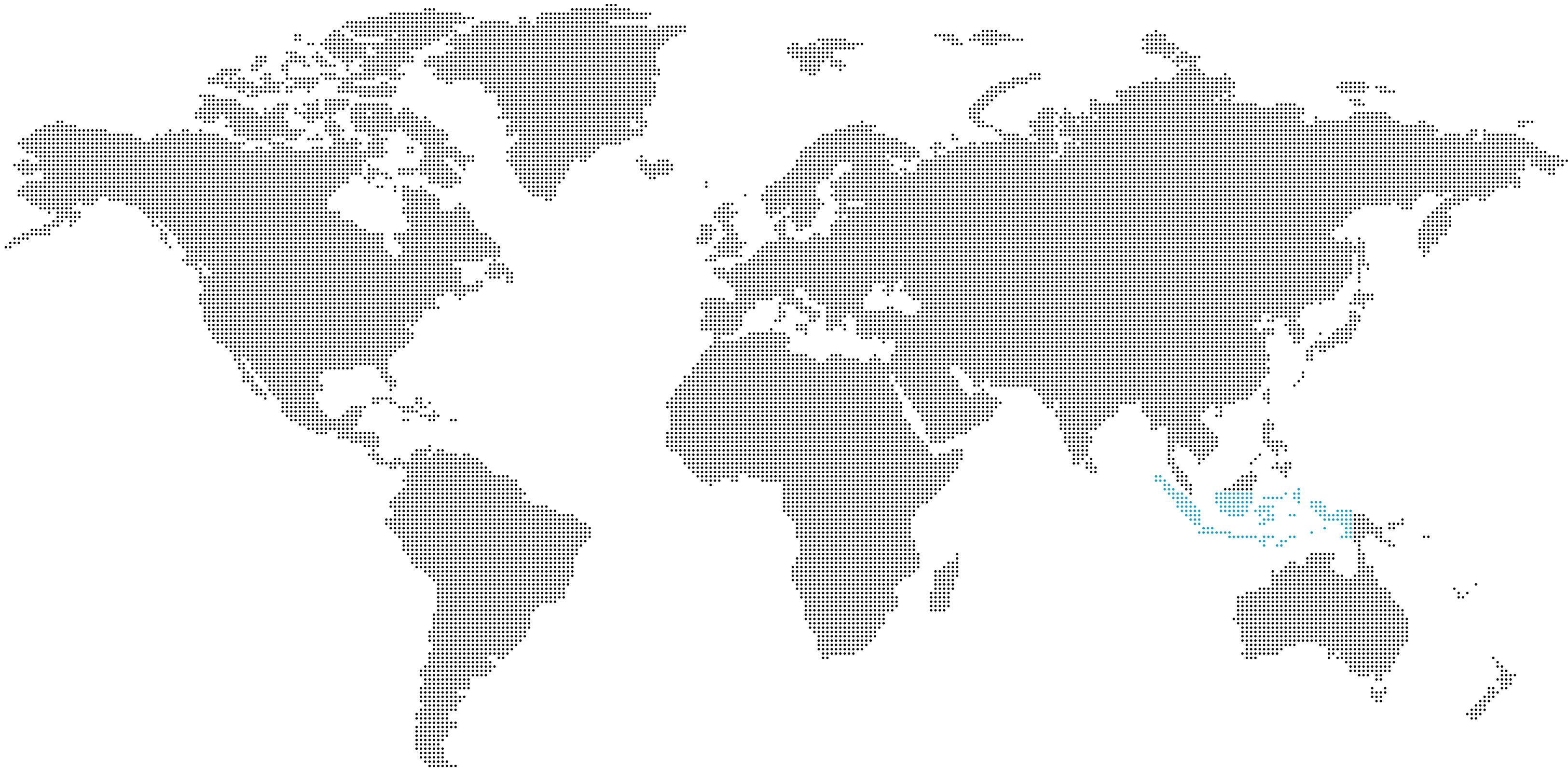
The resort

The resort will be designed with the knowledge of local wisdom and tradition, with local materials and local artisans. It will be created in a flexible way and adapted to the terrain and environment. The characteristic landscape of today will be reinforced to maintain the heritage, the biotope, the natural disaster resistance and the community jobs. Natural resources will be introduced in the facilities to reach self-sufficiency. The goal is to meet the present requirements, responding to disasters and generate local knowledge of building with bamboo. The building process will be improved to include training local builders and engaging local markets, which create many skilled jobs and promote active participation and creative input in the process. This increases future capacity affording the community a greater sense of being a part of the project.

Why bamboo?

Bamboo can be used as alternative material to build homes that are environmentally friendly and resistant against many disasters (Schefold, 2008, p. 154).

My intention is to encourage the use of bamboo in contemporary architecture and design to demonstrate the potential of bamboo as a building material. Successful cases will elevate the status of bamboo, especially among people from where it originates, therefore promoting the development of this valuable local resource. This could mean that traditional skills are preserved and improved and contribute to welfare and our climate.



2. GENERAL BACKGROUND

The Indonesia archipelago lies on the equator line and is located at:
- 6°N to 11 °S latitude
- 95° to 14 0° E longitude

AREA:
total:1,919, 44 0 km2
land: 1,826, 44 0 km2
water: 93 ,000 km2

GEOGRAPHY:
Archipelago of 17,508 islands (6,000 inhabited)
3/4 of Indonesia contains of five main islands: Sumatra, Java, Kalimantan (Southern Borneo), Sulawesi (Celebes), and West Papua (The Western end of New Guinea), which also includes 4/5 of the population.

POPULATION (2011):
245.325.638 inhabitants
About 6% of population are living on Java Island.

RELIGION :
Muslim 88%
Protestant 5%
Roman Catholic 3%
Hindu 2%
Buddhist 1%
other 1%

ETHNIC GROUPS:
Javanese 45%
Sundanese 14 %
Madurese 7.5%
coastal Malays 7.5%
other 26%

INDONESIA

ADMINISTRATIVE REGIONS:

30 provinces, 2 special regions and 1 capital city district.

JAVA:

Java is an island of Indonesia. With a population of 135 million, and is the world's most populous island, and one of the most densely populated places on the globe. Java is the home of 60 percent of the Indonesian population. The Indonesian capital city, Jakarta, is located on western Java.

ADMINISTRATIVE REGION:

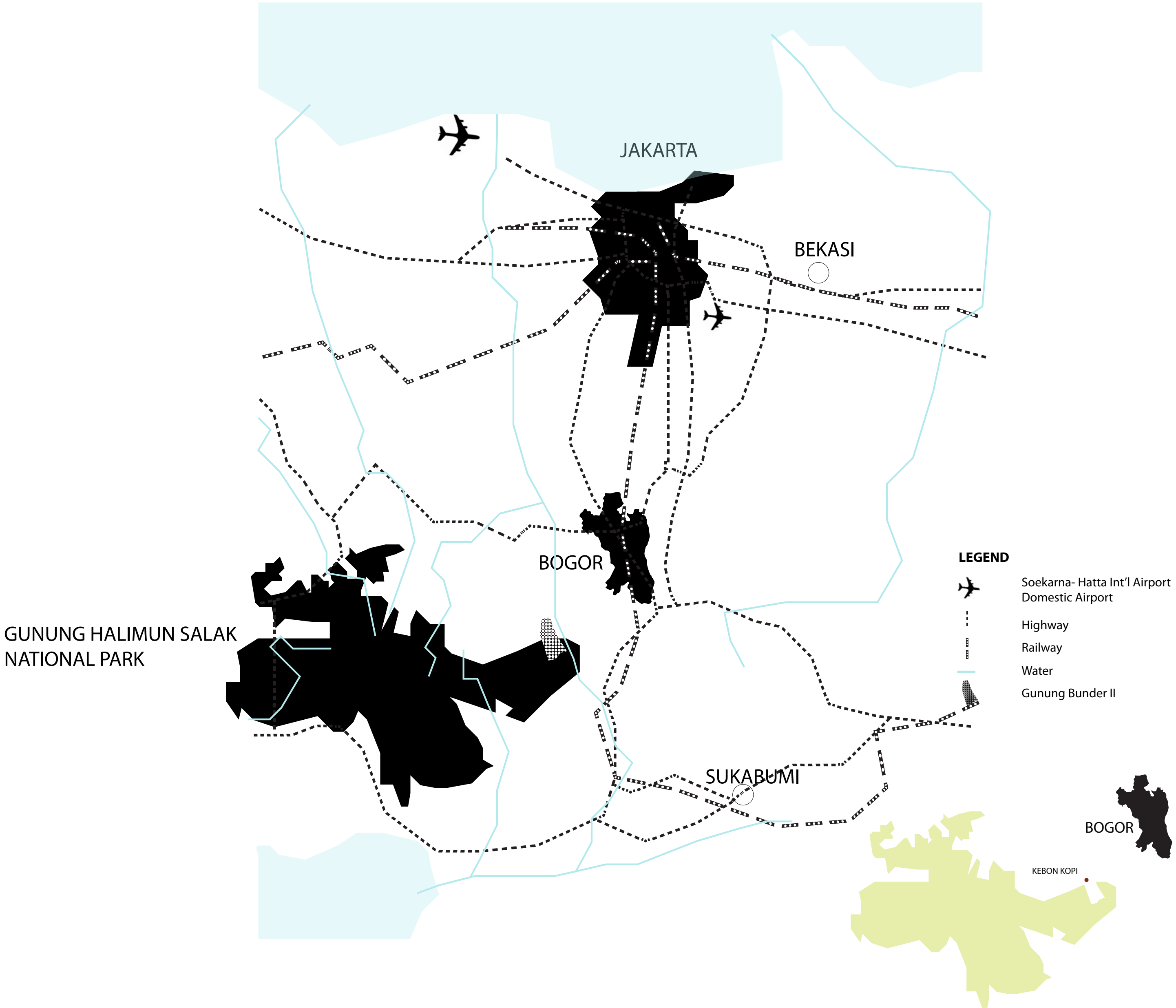
JAWA BARAT

Sundanese: with a population of over 43 million, is the most populous and most densely populated province of Indonesia.

DISTRICT:

GUNUNG BUNDER II

Gunung Bunder is a mountain village in the district *Pamijahan*. Bunder mountain area has an altitude between 750-1050 meters above sea level. In the region we find one of the gates to Gunung Halimun Salak National Park.



JAKARTA:

Jakarta is the country's economic, cultural and political centre, and with a population of 10,187,595 as of November 2011, it is the most populous city in Indonesia and in Southeast Asia, and is the twelfth-largest city in the world and has an area of 661 square kilometers.
Population density per km² (2010) : 14,561.

BOGOR:

Latitude -6.58'S Longitude + 106.79'E
Distance from Lund: 11000 km

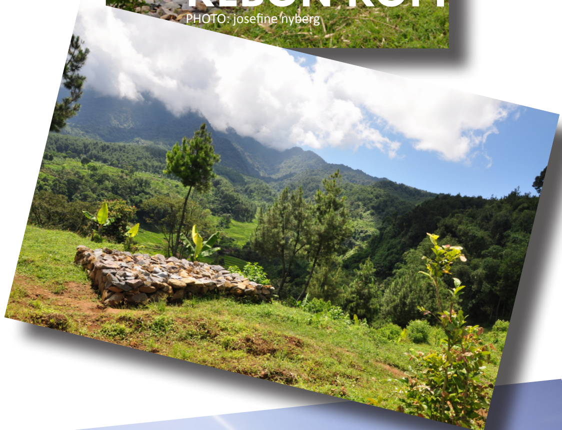
The city is located 60 kilometers south of Jakarta. Bogor itself is recognized as a municipality, it is an important economic, scientific, cultural and tourist center as well as a mountain resort. Bogor spreads over a basin near volcanoes of Mount Salak, which peaks at about 12 km south. Mount Salak *(Indonesian: Gunung Salak)* is one of the most accessible volcanoes from Jakarta and has not erupted since 1935. Several rivers flow through the city toward the Java Sea. The largest ones, Ciliwung and Cisadane, flank the historic city center. 949,066 people were registered in Bogor 2010. The average population density is about 8,000 people per km² and it reaches 12,571 persons per km² in the center and drops to 5,866 people per km² in the southern part.

GUNUNG HALIMUN SALAK NATIONAL PARK:

Latitude -6°48'S Longitude +106°29'E
Governing body: Ministry of Forestry
The National park cover a 400 km² conservation area that was established 1992. The park has several waterfalls, craters and camping grounds.

To get to the Gunung Halimun Salak National Park from Jakarta, you go by train or bus to Bogor. From Bogor by local minibus, ojek or angkot to one of the National park entrances (Central Intelligence Agency, 2012, Portal Nasional Republik Indonesia, 2012).

JAVA BARAT



SAHABAT BAMBU AND BAMBUBOS (B- BAMBU, O- ORGANIK, S- SUNGAI (river)

The NGO Sahabat Bambu is based in Yogyakarta but with treatment facilities as well in Selman, Kalasan, and the recent one in Lalandon, Ciapus, Java. Together with the local community in Lalandon, BambuBos was formed in December 2011, by Sahabat Bambu. Sahabat Bambu mainly produces treated bamboo poles but also houses and furniture. They collaborate with bamboo ecologists, treatment specialist, bamboo artisan, construction experts and bamboo farmers in order to change the perception and knowledge of bamboo. They arrange several activities and projects such as bamboo treatment training, bamboo construction and bamboo cultivation training.

BambuBos intention is to revive the image and value of bamboo in the townships where it has faded. This is made through the social enterprise in partnership with the villagers. Bamboo is expected to be a solution to environmental damage as well as improve the community's livelihoods. The utilization of bamboo is managed by reforestation efforts and environmental friendly harvesting collaborating with local bamboo farmers.

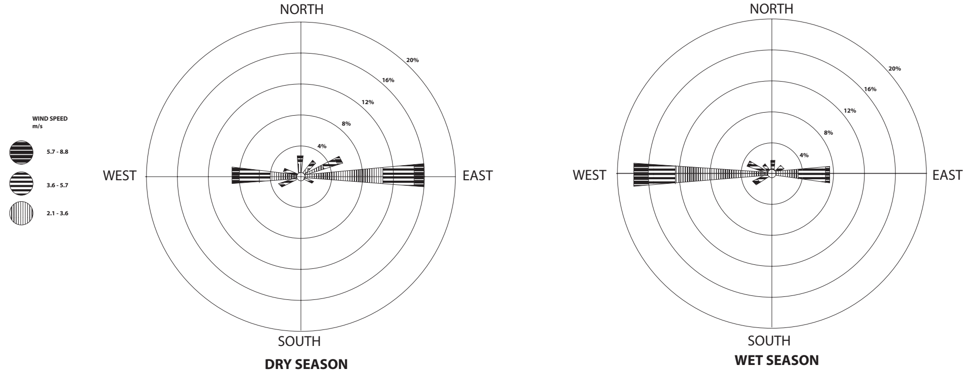
THE SITEs

BAMBUBOS's is today working on two sites, in Lalandon and Kebon Kopi, south of Bogor on the slopes of the volcano Gunung Bunder, that is part of Mount Salak.

The site in Lalandon is positioned along the river Ciapus and its appearance is due to excessive sand and stone mining. In Lanandon we find the bamboo nursery and management of seedlings and clumps, the treatment facilities and the production of bamboo. They also have bamboo training, preservation, construction and manufacturing of crafts. Planned constructions on the site are a community bridge, a community washing area, a bamboo guesthouse and a private bamboo villa.

The site, Kebon Kopi (Coffee garden), is located on the edge of the National Park, Di Taman Nasional Gunung Halimun Salak. In Kebon kopi, we find the site for the organic resort.

Bogor, Indonesia - wind



INDONESIA:

Indonesia has a warm and humid climate with two main seasons: rain season between October to April and dry season between April to October. The relative humidity is 80-90% during morning time and 40-60% during daytime. Temperature fluctuation are between 23 ° in nighttime and 32 ° in daytime. Precipitation is usually high, especially in the western regions, Java and Sumatra, with less rainfall in the eastern regions. Rainfall may reach to 600 mm per month within the rainy season. Monthly radiation could reach more than 6000 W/m2. The wind has two main directions: southeast wind from April to October and northwest wind from October to April.

Characteristics of humid tropical climate are high temperature and humidity, low average wind speed, high solar radiation but overcast. There is no significant change between night and day and different seasons regarding temperature and relative humidity.

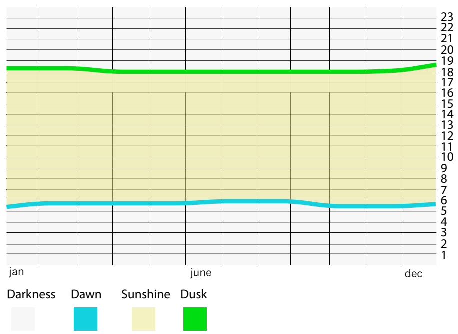
BOGOR, climate summary:

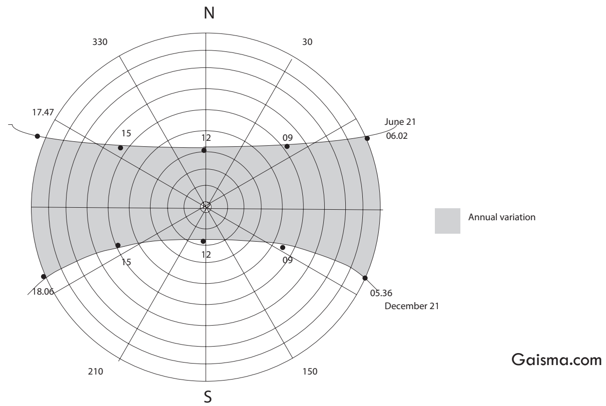
The climate is equatorial, and more humid and rainy than in many other areas of West Java – the average relative humidity is 70% and the average annual precipitation is about 1700 mm, but more than 3500 mm in some areas. Most rains fall between December and February. Because of the weather, Bogor is called the “Rain City”. The temperatures are lower than in the rest of Java: the average maximum temperature is 25.9 °C and daily fluctuations (9–10 °C) are rather high for Indonesia. The wind has two main directions: east wind (April to October) and west wind (October to April). The wind is relative low with an average wind speed of 3-5 m/s, with the strongest winds in-between June, July, august and September (dry season) (Weather Online, 2012, Gaisma, 2012).

Bogor, Indonesia - Solar energy and surface meteorology

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	4.19	4.29	4.80	4.83	4.71	4.56	4.80	5.24	5.60	5.34	4.78	4.58
Clearness, 0 - 1	0.39	0.40	0.46	0.49	0.53	0.54	0.55	0.56	0.56	0.51	0.45	0.43
Temperature, °C	24.70	24.75	25.05	25.33	25.26	24.96	24.64	24.81	24.98	25.08	24.92	24.78
Wind speed, m/s	3.31	3.33	2.66	3.02	3.97	4.34	5.29	5.38	4.93	3.71	3.09	2.69
Precipitation, mm	453	372	405	426	332	200	196	264	338	316	359	359
Wet days, d	17.3	14.3	16.0	15.9	14.1	11.9	9.1	8.5	8.6	12.4	17.2	18.5

Bogor, Indonesia - sun





Summer solstices (June 21st): The sun rises at 06.02 and moves over north until it sets at 17.45 in west. At 12.00 the sun stands at 60° north.

Winter solstices (December 21st): The sun rises at 5.36 and moves over south until it sets at 18.05. At 12.00 the sun stands at 70° south.

NATURAL DISASTER

The countries of East Asia and Pacific (EAP) suffer greatly from the adverse physical, social and economic impacts of natural disasters. Some 82% of all lives lost and 85% of all those affected by disasters since 1997, live here. Factors such as climate change; urbanization and environmental degradation have increased the severity and rate of natural disasters.

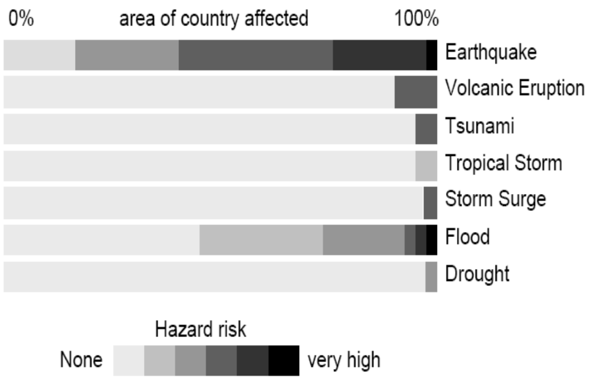
Indonesia is situated in one of the most active disaster hot spots in the world. Between 2001 and 2007 alone there have been more than 4000 occurrences of disasters including floods (37%), droughts (24%), landslides (11%), and windstorms (9%). Indonesia is among the top 35 countries that have high mortality risks from multiple hazards with about 40 percent population living in areas at risk. For a country that has a population of more than 245 million, this percentage yields a figure of more than 90 million people potentially at risk. In addition to a higher intensity of meteorological events such as floods and droughts, climate variability has also influenced the food production pattern and outputs, bringing additional uncertainty in the event of disaster.

The unacceptably high loss of lives, human anguish and economic reversals led to a World Bank policy review in 2007 expanding the traditional emphasis on post-crisis damage assessments and reconstruction to disaster prevention and risk reduction through a series of development and policy initiatives with governments across the region (Ballestero, 2008, p. 2).

Indonesia is located along the "Ring of Fire", an unstable collection of tectonic plates surrounding the Pacific Ocean, which have caused many of Indonesia's recent natural disasters, from the massive tsunami in 2004 to six earthquakes measuring over 7 on the Richter scale within the last years.

ALL NATURAL HAZARDS RISKS IN INDONESIA

The chart below shows the degree of exposure to natural hazards and the percentage of area affected. Tsunamis and storm surges are a threat to coastal regions, particularly gulfs, bays, and estuaries. Flood hazard results from river floods and torrential rain. Drought is caused by major deviations from the normal amounts of precipitation. Frost hazard depends on elevation and latitude.



2006, Munich Reinsurance Company, Geo Risks and Research Department(c)

Between 2000 and 2010,
typhoon in Indonesia left over

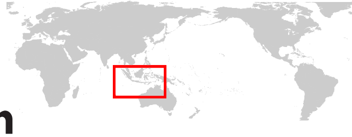
380 killed
31423 injured and missing
311611 evacuated
669792 affected people

79660 houses heavily damaged
4236 schools heavily damaged
35 worship places severely damaged
34 health facilities severely damaged

1 bridges damaged

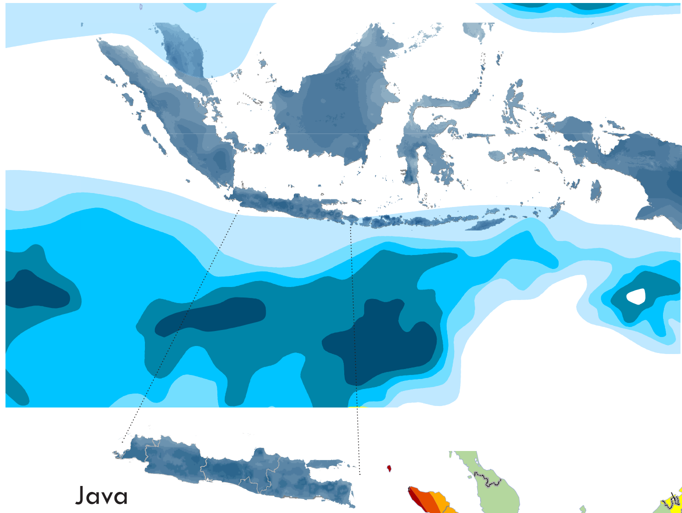
80 ha of rice fields damaged

41,949,467 million IDR
(approximately US$ 4,661 million)
in damage



tropical storm

The main variable of Indonesia's climate is not the temperature or air pressure, but rainfall. Typhoons and large-scale storms pose little hazard to Indonesia waters.



Between 2000 and 2010,
earthquake in Indonesia left over

8479 killed
52948 injured and missing
2529672 evacuated
191673 affected people

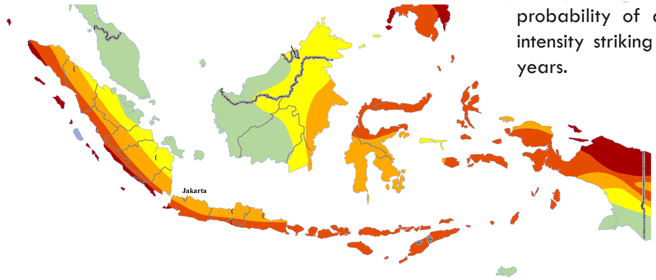
875322 houses heavily damaged
16468 schools heavily damaged
342 worship places damaged
1230 health facilities damaged

60 bridges damaged
45 km of roads damaged

815,497 million IDR
(approximately US$ 151.5 million)
in damage

sesmic activity

The islands lies on the edge of the Pacific, Eurasian and Australian tectonic plates, making the site of recurrent seismic activity including earthquakes and associated tsunamis causing displacement and destruction to the population of Indonesia.



Between 2000 and 2010,
volcano eruption in Indonesia
left over

12 killed
1273 injured and missing
173481 evacuated
1062 affected people

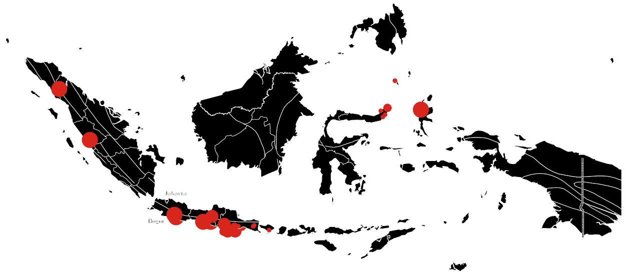
364 houses heavily damaged
2 health facilities severely damaged

2 bridges damaged
0.3 km of roads damaged

21,406 million IDR
(approximately US$ 2.37 million)
in damage

vulcanic activity

Indonesia is a volcanically active country, containing numerous major volcanoes. It has 130 active volcanoes that are part of the Pacific Ring of Fire and has suffered the highest numbers of eruptions producing damage to the land. Indonesia's most active volcanoes are Kelut and Mount Merapi on the island of Java. The country's volcanism is due to the subduction of the Indo-Australian plate.



Between 2000 and 2010,
landslide in Indonesia left over

1973 killed
4939 injured and missing
87910 evacuated
120171 affected people

114359 houses heavily damaged
41 schools heavily damaged
12 worship places severely damaged
4 health facilities severely damaged

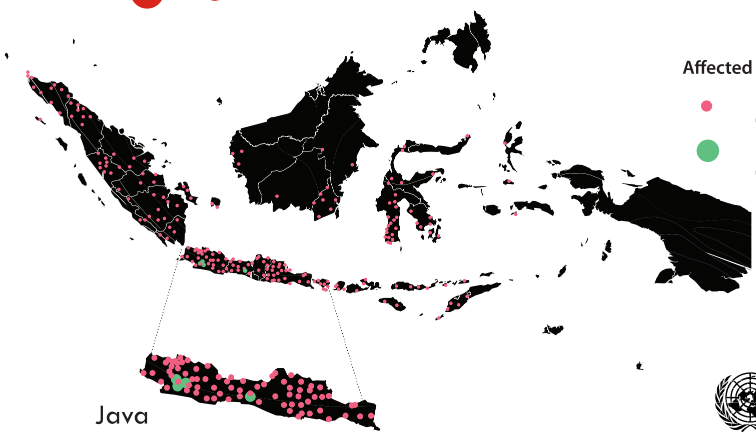
17 bridges damaged
199.63 km of roads damaged

107 ha of rice fields damaged
10 ha of forests damaged
260 units of irrigations damaged

1,364,179 million IDR
(approximately US$ 151.5 million)
in damage

landslides

Floods and landslides are common in Indonesia, which is densely populated and prone to frequent heavy rains.



ANALYSIS
- natural disaster risk

Based on OCHA statistics.

3. HERITAGE

DISASTER

Disaster: a natural or man-made (or technological) hazard that has come to fruition, resulting in an event of substantial extent causing significant physical damage or destruction, loss of life, or drastic change to the environment.

Natural disaster: a consequence when a natural calamity affects humans and/or the built environment.

Disasters are seen as the consequence of inappropriately managed risk. These risks are the product of a combination of both hazard/s and vulnerability. Hazards that strike in areas with low vulnerability are not considered a disaster, as is the case in uninhabited regions (Ballesteros, 2008, p.2).

Human vulnerability, and often a lack of appropriate emergency management, leads to financial, environmental, or human impact. The r esulting loss depends on the capacity of the population to support or resist the disaster: their resilience. This understanding is concentrated in the formulation: *"disasters occur when hazards meet vulnerability"*. A natural hazard will hence never result in a natural disaster in areas without vulnerability.

Various disasters; earthquake, landslides, volcanic eruptions, flood and cyclones are natural hazards that kill thousands of people and destroy billions of dollars of habitat and property each year. The rapid growth of the world's population and its increased concentration often in hazardous environment has escalated both the frequency and severity of natural disasters. With the tropical climate and unstable landforms, coupled with deforestation, unplanned growth proliferation, non-engineered constructions, tardy communication, poor or no budgetary allocation for disaster prevention, developing countries suffer more or less chronically by natural disasters (Ballesteros, 2008, p.5).

Vulnerability

Hazards that strike in areas with low vulnerability are not considered a disaster. With the loss of old knowledge, wisdom and traditions the frequency for disaster escalates. It is an important, but difficult, challenge for every society to maintain their cultural heritage to be able to learn from the history rather than to take revenge on it.

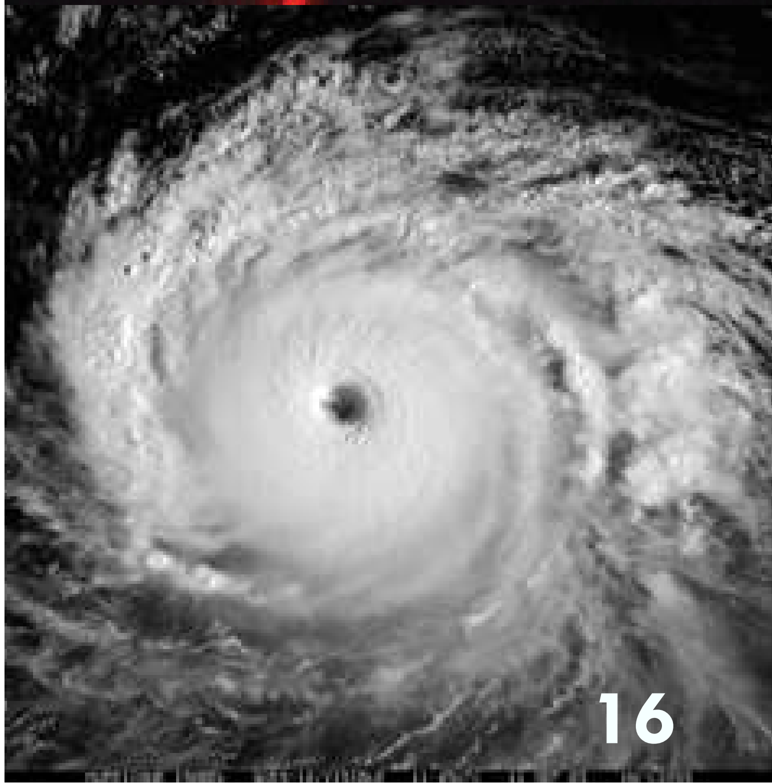
Heritage is not only a matter of buildings but also of all original life and styles, landscapes, languages, traditions and fairytales and it is an indispensible asset to all communities (Waterson, 1997, p. 106).

If natural disasters are difficult to prevent or control, hazards resulting from human activities can be avoided, and the vulnerability to both natural and human-made disasters can be reduced, thus lowering the overall risk threatening.

Heritage has often a significant role to play in reducing the impact of disasters on lives, property, and livelihoods, before, during and after the disasters. For instance, research in areas affected by seismic activities has shown that buildings constructed with traditional techniques have proven very resilient to quakes, when well maintained. An appropriate use of the land and the conservation of forests, on the other hand, have been identified as major contributors to preventing landslides and floods, which cause each year more casualties than earthquakes in many parts of the world.

Intangible heritage can decrease vulnerability. Arcom, (arsitek komunitas, architects based in Yogyakarta), speaks of local wisdom, in this case after the eruption of Mount Merapi, outside Yogyakarta. The eruption can be seen as a holistic circulation that starts with awareness of indicators - evacuation - eruption - return - harvest - and back to awareness. The locals living around the mountain believe that the mountain does not want them any harm, instead that it is giving something to the future. The locals will never see an eruption as a disaster (ARKOM, 2012). Does this mean that with local knowledge and wisdom this area transforms from vulnerable to not vulnerable?

In volcano areas in Indonesia there been ways of reading the nature for hundred of years. When a hot cloud approaches a bamboo forest, bamboo culms explode and create a cracking sound that can be heard kilometers away. A natural warning system for the locals that it is time to evacuate. The local wisdom is disappearing and one of the reasons is that the bamboo forest used to dominate the slopes for long until the massive planting of cash crop.



Indigenous Achenese (Indonesian tribe) knew the warning signs of a tsunami, when the sea withdrew they should do the same and run towards the hills, as certain people in Vietnam knew how to read the bamboo's movement before a typhoon would appear. It is a testimony to the way in which traditional knowledge can save lives but these are traditions and heritage that start to disappear. The oral traditions of isolated people are lost in the urban communities (Aquilino, 2011, p. 38). This makes them more vulnerable for disasters but also the view upon whether it is a disaster or not or just a natural cycle, changes.

"As we enter a new and uncertain world, which nature is less predictable and climate change threatens more frequent and severe natural crises, we should afford these ancient ways of understanding nature more respect in the process and practice of disaster mitigation. For local wisdom is indispensable." by Andrea Fitrianto.
(Aquilino, 2011, p. 38).

Traditional Indonesian houses with modern materials.
PHOTO: Roxana Waterson

ARCHITECTURE and tradition

Cultural heritage, local wisdom and know-how

The goal should not be to copy the traditional architecture in to a pastiche, in which a particular shape is used as a signal of cultural identity. To retain the significant and appropriate ways of architecture, the intangible values are important. A study in vernacular and traditional architecture gives us valuable knowledge.

Indonesia has more than 17000 islands of which nearly 1000 are permanently habited, containing 1128 tribes and is one of the most culturally riches and diverse regions of the world (Waterson, 1997, p. 1).

The reminiscence of indigenous architecture depends on many factors; the sensitive assistance and encouragement from governments, on the self-confidence of the tradition, their ability to resist the homogenization of the Western influences and the standardizing modernization, but also the intangible significance of the house and the social relationships. It is easier to destroy a tradition than to bring it back, or to legislate against its disappearance. The preservation of a few outstanding buildings would not in itself ensure the maintenance of a tradition. Often the motive behind the government support is to boost tourism. The restored buildings, as well as being a part of the national heritage, becomes designated “Tourist Objects” (Waterson, 1997, p. 236).

Indonesia has been stroked by many disasters destroying intangible and natural heritage and cultural properties, but heritage is also lost in the modernization with changes of social structures and different trends of living spaces and privacy.

Housing were traditionally the responsibility of the community in Indonesia. However most of the people no longer build traditional homes. The modern house, with its masonry walls, concrete columns and beams, ceramic-tile floor, and tiled roof, is unfortunately often fatal during earthquake, flooding or tsunami and built in materials that are not adapted to the climate and becomes unhealthy (Aquilino, 2011, p. 35). The non-adapted ground built houses of stone or concrete is a development from a history of colonialism, islamization and growth of the Indonesian economy leading to massive building programs and mass production (Waterson, 1997, p.28). In fact the traditional architectural styles of the regions are, to greater or lesser degrees rather well adapted to the local environment and make clever use of locally available materials (Waterson, 1997, p. 73).

Vernacular architecture in Indonesia

Traditional and vernacular architecture in Indonesia originates from two sources. One is the great Hindu tradition brought to Indonesia from India via Java. The second is an indigenous architecture predating the Hindu epic. Due to that the Indonesian houses has always been using bamboo and timber the oldest vernacular buildings we find today are not more than 150 years old. However stone carving on walls from the 9th century in Hindu and Buddhist temples, in central Java, reveal close correspondences between the domestic architecture of that time and contemporary vernacular forms which are still being built today. The vernacular architecture of Indonesia belongs to an ancient building tradition that can be found throughout of islands in South-East Asia and parts of the mainland.
Distinctive style elements in traditional Indonesian architecture consist of wooden and bamboo constructions, raised over ground on piles or plinths. Houses with big domination roof structures enclosing a pile-built modular opened platform, sometimes without walls or saddle-backed roofs often with outward sloping walls and gable-ends. The houses and settlemnt patterns are influenced by different symbolic values originating from the nature or spiritual ideas.

Adapted architecture

Due to different natural disaster risks and Indonesia’s hot and wet monsoon climate, traditional dwellings have developed to respond to natural environmental conditions.

Pile-built houses has distinct advantages in a monsoon climate lifting the building off the ground and it serves a number of purposes: it allows breezes to moderate the hot tropical temperatures; it elevates the dwelling above storm water runoff and mud; it allows houses to be built on rivers and wetland margins; it keeps people, goods and food from dampness and moisture; lifts living quarters above malaria-carrying mosquito’s; reduces the risk of dry rot and termites; and it gives protection for animals beneath, such as water buffalos, and space for storage and work area or playground for children (Aquilino, 2011, p. 35).

The big roof- structures allows storms and the heavy tropical rain to quickly sheet off, and large overhanging eaves keep water out of the house and provide shade in the heat. In hot a humid areas houses are transparent and have typically openings under the roof and a rather open, slatted floor, which are frequently made of lengths of split bamboo. This flooring was also made to drive away insects, by lightening a small fire under the house at dusk, as well as fumigating the thatch and taking care of the trash (Waterson, 1997, p. 83). The walls and windows are made in light and transparent materials to provide with good cross-ventilation.

The surrounding vegetation is important for minimizing the risk of flooding or landslides but also for the thermal comfort. Buildings surrounded with vegetation make the air cold and controls the wind speed and the solar radiation. The natural environment is a factor that minimizes the energy consumption.

Houses are geological adapted, with light and flexible materials, outward leaning walls adding stability to the whole structure. The buildings are made in a post and beam structural system that take load straight to the ground. The walls are light and non-load bearing and the buildings are placed on seismic isolators, often pillars placed on a stone. The top walls are often hung from the beam and the bottom walls rest on the huge beam at the floor level. The roof is commonly a truss and crossbeam structure, with no interior trusses, which forms an opened and usable space. Local materials are used for reconstruction and the building techniques are movable and reversible and the buildings are put together without nails, (mortis and tenon joints and wooden pegs are used for the construction) which make them often capable to being dismantled and reassembled in a new location. A pile-build house can even be lifted intact from its foundation stones and carried to a new site (Waterson, 1997, p. 76-78). This kind of geological adapted architecture we can find in Aceh, north Sumatra. Achehnese houses are wooden constructions raised on posts and placed on natural stones, flexible to withstand earthquakes and tremors. The house is for them a movable property. When an Achehnese sells his house, this means that the purchaser removes it to his own place (Schefold, 2008, p.25). On Nias island, the architecture is adapted to the high frequencies of earthquakes. The wooden buildings are built on pillars with outward leaning walls. Constructed with a series of vertical posts but also with diagonal bracings in-between, in both directions of the building. This creates a stable three-dimensional structure. The piles rests on top of their foundation stones, which gives extra flexibility to withstand earth tremors, the building can move on its stone without damage. It also makes the piles less vulnerable to rot and termite attacks (Waterson, 1997, p. 82, Schefold, 2008, p. 179).

Traditional material

Vernacular houses are mostly found in rural areas and built in natural materials. The buildings are organic statements in complete harmony with the environment and are a reflection of the natural world.

Common materials are:
- Bamboo, processed into various forms of production materials, such as poles, rods, splits, strips, shingles and mats (woven strips), and then fastened with lashing and other bamboo carpentry techniques to form structures, walls, ceilings and ground coverings.
- Coconut wood
- Ijuk (sugar palm fiber)
- Timber
- Thatch: Ijuk, palm leaves and grass
- Stone

Adapted materials such as palm leaf thatch is more sustainable and easier to maintain and absorbs the heat, providing a much cooler space than inferior imported corrugated- iron or zinc roofs. A bamboo shingle roof lasts 40 years or so much longer than zinc roofs and ijuk roofs can last up to 100 years (Waterson, 1997, p. 75-85). Balinese thatch made of alang-alang (grass), can last up to 50 tropical rainy seasons, but today it is hard to find good quality due to the lack of knowledge producing it (Waterson, 1997, p. 86). Woven mats of palm leaf or bamboo is used instead of glass, and there is no risk for shattered glass during an earthquake. The weaves are flexible and strong in high winds and provide a mellow light and good cross-ventilation (Aquilino, 2011, p. 76).

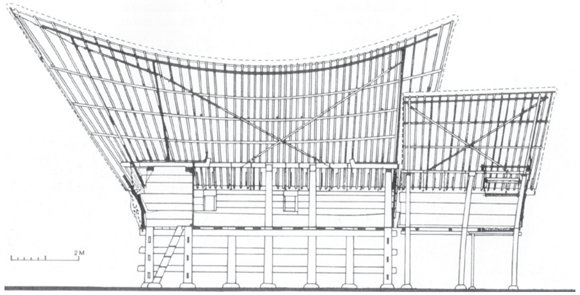
The maintenance of buildings made of natural materials are cheaper and most of the materials are found outside the doorstep or in the next kampung (village).

Pile- built house with slatter floor, buring trash and smoking the mosquitoes away (Waterson, 1997, p. 89).

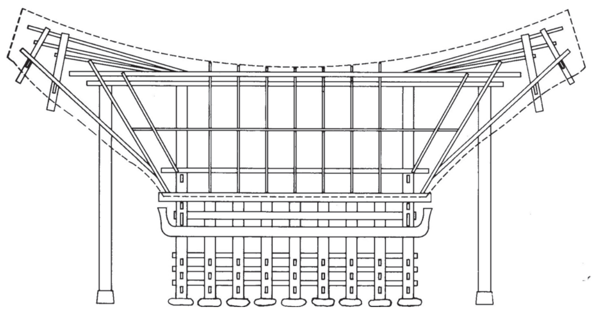
Traditional house, West Sumatra. The roof is built on a truss and crossbeam structure, and traditionally thatched with ijuk, palm fibre, lasts up to 100 years. PHOTO: Roxana Waterson (Waterson, 1997, p. 77)

Acheh house transported in South Sulawesi. PHOTO : Walter Imber (Waterson, 1997, p. 80)

Minangkabau house, outward leaing walls and gable-ends (Waterson, 1997, p. 75).



Toba house, absence of posts running through the building, the angeled rafters to produce the projecting gable, and the diagonal ties reinforcing the roof (Waterson, 1997, p. 76).



Framing structure of a Toraja house, shows how the eves are built out and supported by free standing posts (Waterson, 1997, p. 79).

Symbolism

Inhabited space is never neutral in Indonesia; it is cultural constructions of one kind or another.

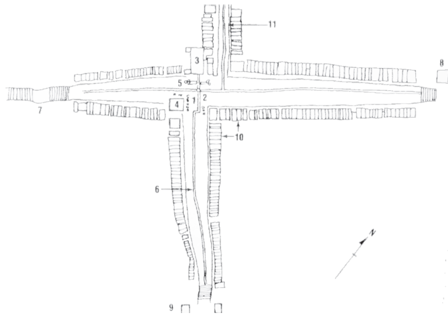
Aceh was the first part to receive Islamic influences and fused with older cosmological ideas. There the house may be seen to reflect a division into three layers; the sacred upper floor, often the space for heirlooms, the middle world inhabited by humans, and the nether world inhabited by animals and lower deities. The area beneath the house is the most unclean part, where rubbish and animals are stalled. Vertically the space is divided into female and male with a central space in-between. Houses in many tribes are planned with a central, strong heart (awu). Most indigenous belief systems of the Indonesian archipelago share the same concept of a three-tiered cosmos, where the most important room is always the highest floor (Waterson, 1997, p. 78).

We find position of houses and settlements after the relation to cardinal points, in the direction of east and west, with the common association of the rising sun with life and the setting sun with death. Sometimes the direction is based on other concepts, such as upstream - downstream, head and tail of an island or towards a mountain (Waterson, 1997, p. 93, Schefold, 2008, p. 25).

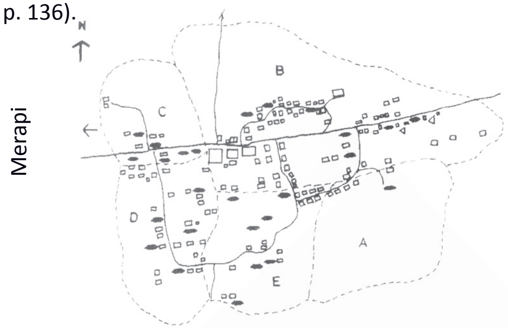
In Hindu cosmological ideas we find buildings that are laid out within an enclosed courtyard, and a number of interconnecting yards, laid out from cardinal points. Most of them in form of pavilions, and the daily life take place almost entirely in open air (Waterson, 1997, p. 97-98).

Geographical metaphors can be applied to the interior of the house, in this case in Bali. Two raised floors run on either side of the central gutter or passage. The floors slopes down somewhat from the walls towards the center. The higher part is called gunung (mountain) and is the most honored part, where people sleep, while the lower and least honored part, near the center, is called sawah (rice field). This terminology creates a sort of landscape in the house, which is a reflection of the natural world (Waterson, 1997, p. 94).

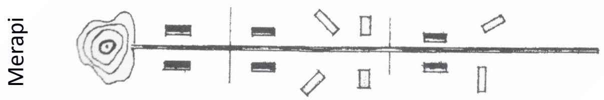
During the building process ceremonies are often taking place. The building does not only have a practical value; it has a spiritual significance as well. The series of ceremonies that accompany the building of a house is indeed to give the house a life, it is in some tribes considered as a living being, a man, an animal or a plant (Waterson, 1997, p. 121). In many cases a buildings form and structure is planned after a body, the owner, the wife or even after a water buffalo. This we find in Balinese-, Sasaw-, Malays-, Bina- tibes and many more. And in case of "death" of the house, in case of fire or disaster, ceremonies (funerals) are held (buy traditional priests), and the houses are often restored again in the believe that the buildings should be remembered and symbolizing continuity (Waterson, 1997, p. 130-136).



Kampung plan of Nias island, after cardinal points (Waterson, 1997, p. 136).



Orientation of the houses in Nagari talang tangah, Mount Merapi (Schefold, 2008, p.113)



Orientation of the houses along the river, Batang bengkaweh, Mount Merapi (Schefold, 2008, p.114)

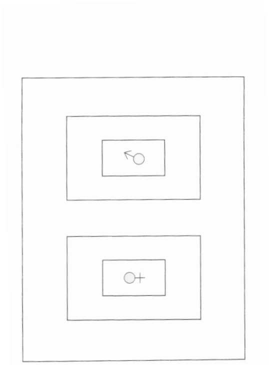
Transformations in Indonesian architectural traditions

The study of inhabited space and its construction and daily use can provide a way in to a whole culture and its ideas. Indonesia has a large Muslim population but the architecture is not Islamic in origin. The gradual spread of Islam through the region from the 12th century onwards introduced another important set of architectural influences, in this instance, however, the changes were more ideological then technological, the advent of Islam did not lead to a introduction of an entirely new building tradition, but rather saw the appropriation of existing architectural forms, which were reinvented or reinterpreted to suit Muslim requirements. The earliest Indonesian mosques draw their inspiration from existing building tradition in Java, and elsewhere in the archipelago.

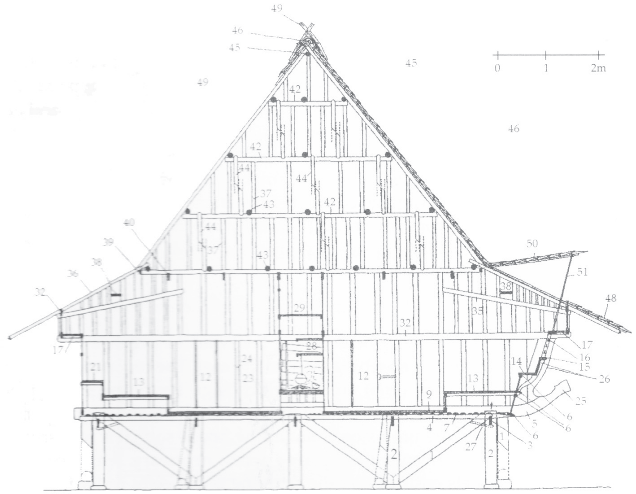
With the colonial buildings in Indonesia, especially the longest period by the Dutch, 1602 – 1945, we can see the culture cross between the western and eastern in building type and form, and also how the buildings are developed to be acclimatized. The Dutch did not directly find the right type for their buildings in Indonesia. Building techniques from 4 seasons Holland were directly transplanted into the warm-humid climate of tropical Indonesia. Flat facade without veranda, large windows, small eaves and no ventilations. This was commonly seen in the oldest part of Dutch walled cities, such as in old Batavia. Batavia with its Dutch channels transformed rapidly into unhabited and unhealthy spaces and with malaria swamps.

Examples show how changes from colonial authorities can be devastating for the structure. One example is when they sought to change the open central hearths traditional houses have. In Toraja houses women as the preparers for food, have an obviously close association with the hearth, the kitchen is placed on the east side of the heart, the side associated with the rising sun and life. The Dutch encourage the moving of the kitchen, due to the danger of fire and the unhealthiness of smoke, into a lean-to or separate shed, and now this pattern is virtually universal. This changed the focus of the house resulting in an increased separation of men and women (now days, men and circumcised boys eat together inside the house, while women and children eat outside at the back of the house or in the kitchen), also the loss of the structures natural function. The household needed to buy lamps for light, blankets for warmth, and mosquito nets for protection against insects. (Waterson, 1997, p. 28) With the introduction of Islam, space within the home changed from an undifferentiated, hearth dominated space. The houses were divided into a front and a backspace, to be viewed as the front room for men and the backspace for women. The changes of built form tell us of the shifts in the form of social relationships (Waterson, 1997, p. 42).

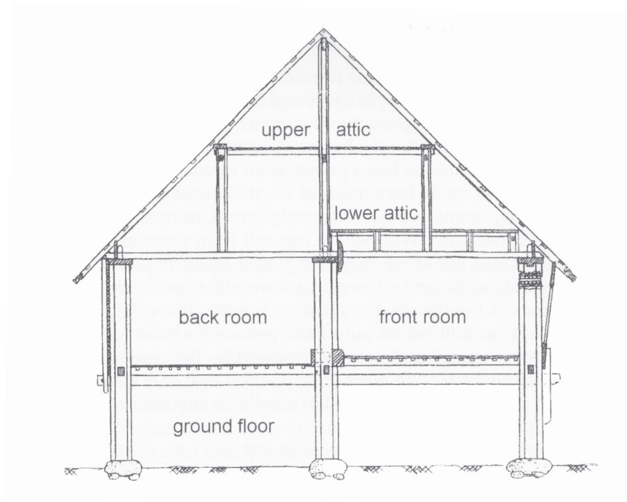
Tightly packed, ground built houses in old Batavia, backing on the one of the canals, which the Dutch built to remind them of their native Netherlands (Waterson, 1997, p. 28).



Typical layout with a fron male space and back female space (Schefold, 2008, p. 402).



View of a house from south Nias, with diagonal bracings in-between the posts and outward leaning walls. The house has a back and a front room and a central hearth (Schefold, 2008, p. 206).



A cross-section showing the three-tied cosmos (Schefold, 2008, p. 402).

Sundanese traditional buildings

In the Middle ages Bogor was the capital of Sunda kingdom and this is the reason why Sundanese architecture is dominating in west Java. In general, the basic design concept of Sudanese traditional architecture blends with nature. Nature is the potential or the force that must be respected and properly used in everyday life. The buildings were shaped into different forms but typical houses were built on pillars such other traditional buildings in Indonesia, normally more than 1 meter in height above ground. The houses were built with a wooden post and beam construction, resting on the foundation stones, combined with bamboo, palm leaves and grass material. The floor plans were divided with to common belief in a three-tied cosmos, and into male and female space with a central heart. The female backspace can be understood as the private space and the male front-space as the public space (Schefold, 2008, p.12) The houses were well adapted to their surrounding, unfortunately a tradition not so common today.

Most of the households in the Gunung Bunder area are today ground built houses of stone, concrete or brick with zinc roofs or roof tiles. The buildings are exposed to the heat, the heavy rain and the materials are no longer adapted the risk of disaster. We find some traditional houses often plastered to last longer with thatched roofs of ijuk, grass or palm leaves. The floor plans of the houses are based on the Muslim life with a front and a back room with a separate block for kitchen and bathroom.

Julang Ngapak, traditional Sundanese building, with a modern touch (traditional houses would be raised on plinths), Eko Prawoto (architect, Yogyakarta).

Suhunan Jolopong, traditional Sundanese building with modern building materials and lime-washed bamboo-weave.

Local (Kebon Kopi) ground-built house with modern materials.

PHOTO: Josefine Nyberg

BAMBOO - a cultural heritage

In many countries bamboo dominates the landscape: it occurs as fences, windbreakers, water pipes, breakwaters, scaffolding, windmills, stalls and buildings. In Indonesia 1956, 35 per cent of all houses were made solely of bamboo and an additional 35 per cent of a mixture of bamboo and wood (Dwinita, 2006, p. 173). Building with bamboo looks back on an ancient tradition in the regions in which the plant grows in abundance. The long tradition of bamboo structures is employed to solve the most varied of building tasks. This has resulted in a wide range of characteristic building shapes and structural details. But the craft of building with bamboo is a subject that is neglected almost everywhere (Dwinita, 2006, p. 12, Dunkelberg, 1985, p. 31). Despite the fact that bamboo has been used as a building material for centuries in Indonesia, the development of bamboo's performance was held back, due to the generally unfavorable perception of bamboo. This inferior social status of bamboo occurs mostly in countries with a colonial history; while in developing countries without colonial experience it is much less a problem. During the colonial era, the Dutch expressed negative opinions towards traditional houses in Indonesia. They judged these to be dark, smoky, overcrowded and unhygienic Dunkelberg, 1985, p. 46). Besides being uncomfortable, dark and humble, the houses were also considered to be a breeding ground for illness and a cause of plague.

An attempt to refine the use of bamboo as a building material was evident from a manual about improved details of bamboo houses for the interest of the health of the inhabitants published by the Department for Health Care of the Population in 1935. However, efforts to improve housing conditions implied infusion of new building techniques and materials, such as the use of corrugated iron roofs and bricks and concrete in the construction (Dwinita, 2006, p. 125). In addition, there are several other factors that discourage bamboo development: the lack of knowledge and technology dissemination in bamboo treatment, inadequate information about bamboo (especially aimed at the business sector), limited Indonesian bamboo research activities (until the establishment of the Indonesian Bamboo Researcher Association in 1995) and capital constraints (State Ministry of Environment, 1998). So-called globalization has also seized hold of architecture: the international style became the synonym for the triumphant advance in architecture and design of an aesthetics advanced by the western world. In course of this development the reputation of bamboo as a building material sank, since materials such as concrete, steel and glass seemed indispensable for a prestigious house after the western model (Vélez, 2000, p. 189). The whole process of housing development has caused a huge impact on our natural surroundings and environment. The supply of building materials has put an indirect pressure on the Indonesian tropical forest.

Bamboo development

Bamboo has always been important for rural communities, but for urban consumers it has had something of an image problem. There is a perception that bamboo is a poor man's timber. However, in recent times, bamboo has been receiving more attention, since advanced technology of bamboo treatment, involvement of expertise in bamboo building technology and modern design application to bamboo products have given bamboo new appearances and performances (Dwinita, 2006, p.90). It has added benefits, by providing a more sustainable alternative to timber, plastic, concrete and other materials.

The Environmental Bamboo Foundation (EBF) is an Indonesian non-profit organization founded by designer Linda Garland in 1993 to protect tropical forests by promoting and demonstrating the many conservation and development opportunities that bamboo offers. This organization is based in Ubud, Bali, and started a new trend in Indonesia, building with bamboo.

PHOTO: Josefine Nyberg

In less than three years EBF helped to put bamboo on the conservation and development agenda of Indonesia while generating an international interest in bamboo that's growing exponentially. The organization brought out preservation techniques and shared to the locals. This was a staring point for the later bamboo movement in Indonesia, with organizations and companies following such as Ibuku (architects and bamboo designers, Bali) and Sahabat Bambu. Today international bamboo workshops and conferences are often held in Bali, with famous bamboo architects attending, such as Simon Vélez.

Unfortunately the most common picture we see in Indonesia is still bamboo structures acting as temporary support for concrete buildings.

PHOTO: Josefine Nyberg

4. BAMBOO - characteristics

BAMBOO - characteristics

The limitation is inherited in the nature of the material and gives the rise to the proportions of the building.

Bamboo is the quickest growing plant in the world and is suitable as construction material after 3 years. It starts to grow again immediately after harvest. (Dunkelberg, 1985, p. 151). The physical and mechanical properties of bamboo, along with its rapid regeneration, makes bamboo a potential material. Bamboo has a hollow interior and is reinforced by diaphragms and it is extremely light and elastic. The skin of the bamboo pole contains an abundant proportion of silicon acid that hardens the surface and protects it from termites, chemical substances and mechanical forces (Dunkelberg, 1985, p. 15). The material is superior in both strength and elasticity and a more stable structure than wood, that has a soft outside and hard core (Dunkelberg, 1985 , p. 205). Bamboo scaffolding is much more elastic than comparable structures of steel. (Dunkelberg, 1985, p. 141).

Sustainability

Ecologically, bamboo grasses are classified as very beneficial for the environment because it produces seven times more biomass than forest trees and converts more carbon dioxide than most plants. Bamboo already helps to protect forests, biodiversity, restore landscapes and fight climate change; it supports the livelihoods of more than 1.5 billion of the world's poorest people, generating more than US$5 billion in annual global trade.

1000 bamboo houses in Costa Rica were produced from 60 hectares of land. To produce the same number of wood dwellings, 500 hectares of tropical rain forest would have to be felled (Vélez, 2000, p. 197). Bamboo is intensely renewable, growing up to 15 m in the first year. While it replaces many tropical woods it helps to protect rainforest. Bamboo is seen as advantageous to the surrounding natural environment, due to bamboo plants' ability to absorb and bind many pollutant gasses and substances in the air, soil and water. If planted on critical land, bamboo can preserve soil water and prevent erosion, landslide and degradation of land quality (Vélez, 2000, p. 58).

A comparison of the energy balances of various building materials (in other words, the energy required to produce a unit of a building material with a certain level of load -bearing capacity) gives an idea of the sustainability of bamboo:
Concrete 240
Steel 1500
Wood 80
Bamboo 30
(Units MJ/m3 per N/mm2; (Janssen, 2000, p.15).

It should be taken into account that the cultivated bamboo species should be able to adapt to the local conditions (or, even better, is indigenous to the area) and that the plantation does not disrupt other plantations or bio-diversity in the surrounding habitat (Schefold, 2008,p. 98).

Construction does not need any cranes or other heavy machinery (Dunkelberg, 1985, p. 39) and the material can grow on the doorstep and long distance transports are not needed. It is easy to process and recycle or to replace individual components in case of restoration Bamboo production leaves no waste products and the leaves can be used as fodder or as insulation (Vélez, 2000, p. 153).

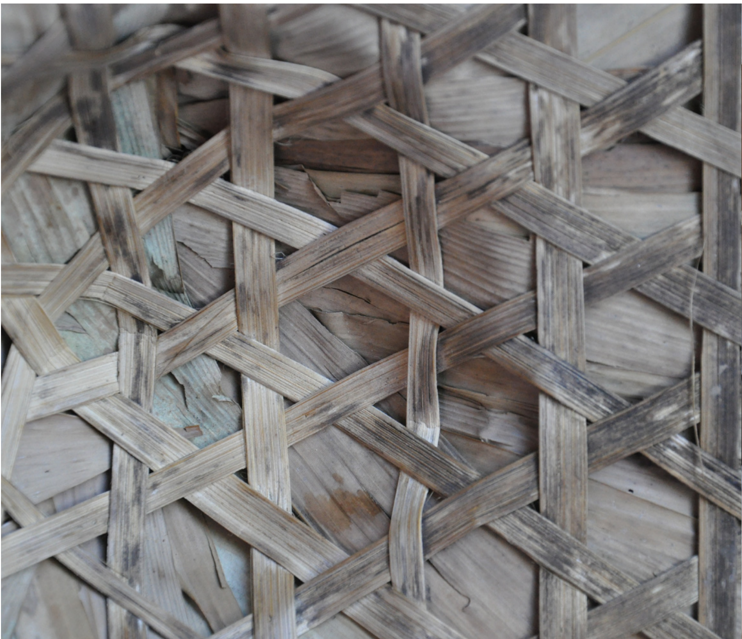


PHOTO: Josefine Nyberg

Disaster resistant

Bamboo buildings withstand earthquakes, landslides and flooding and drizzles strong winds thanks to its flexibility, low weight, high resistance to tension, compression and deflection. Because of the easy process and the large quantities it works well as a material in reconstruction also after disastes. Architects are today working with different construction techniques making the building more resistant to earthquakes among other disasters. Simon Velez is one of them, where in the pavilion, which was build for the EXPO 2000 in Hannover, he designed the sidewalls angled inwards to ensure houses to be earthquake proof and the connecting joints were designed to remain flexible (Vélez, 2000, p. 203).

Local tradition and wisdom provides the knowledge how to build resistant. In the regions in which bamboo grows are by large identical to those regions with the highest population growth rates. (Schefold, 2008, p.12, Dunkelberg, 1985, p. 31).

Community

The building process creates many skilled jobs and it promotes active participation and creative input (Dunkelberg, 1985, p. 39). Re-socialization of bamboo as a building material might increase demands for bamboo, therefore increasing the need for properly managed plantations and cultivation, which can lead to empowerment of bamboo farms in bamboo's indigenous habitations, but also employment and income for the local communities. (Schefold, 2008, p. 99-110). There is possibility for the community to become self-sufficient and produce and construct the housing for themselves and traditional skills are preserved and improved.

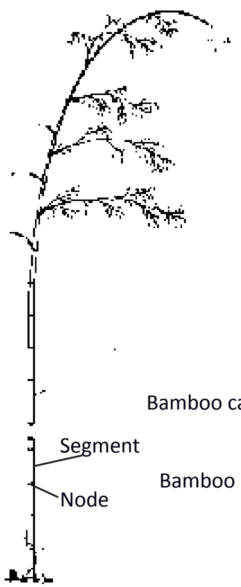
Multi-national organizations and governments may act as indicators of sustainable lifestyles; however, in the end, the successful level is determined by the participation and willingness of the local communities. To adopt a sustainable lifestyle the process must happen from bottom up (Dwinita, 2006, p.124).

The unpredictable patterns of migration make it difficult for the regional governments to provide housing for newcomers, or to cope with a sudden lack of inhabitants. In 2000 about 25% of all households in Indonesia lived in houses below the ideal size of 10 m2 per person as stipulated by the World Health Organization. The lack of affordable housing has partly led to the development of slum settlements, which in Indonesia amounted to 4 million ha in 1996 (Schefold, 2008, p.35). Reintroducing building with bamboo could be a step towards healthy housing.

The bamboo-plant

Bamboo is widely available in Indonesia and of about 1,250 species of bamboo which are well known in the world, 11% is native Indonesian spieces. Most spieces are located in Sumatra (76 species) and Java (59 species). *The most important spiecies are; D. asper, G. apus, G. pseudoarundinacea, B. vulgaris, B. blumeana, G. atter, G. atroviolacea, G. hasskarliana, G. robusta.*

Sumatra: 76 species, Java: 59 species, Bali: 36 species, Papua: 32 species, Sulawesi: 25 species, Kalimantan: 23 species, Sunda Island: 17 species, Moluccas: 14 species.



Differences in cross section of various spieces of bamboo, from thin walled to solid.

Harvest

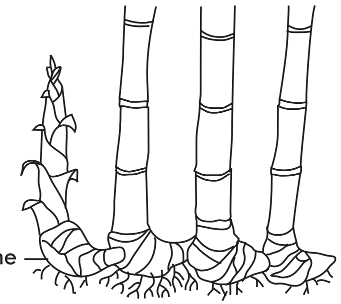
The best season for harvest is after the rain season when the starch content in the bamboo sap is low. Starch is the favorite food for pests (don't harvest during shooting season). 3-5 years old bamboo is suitable for construction. If it is older than 5 years it is harder and the inner culm wall becomes impermeable to the treatment solution. If the poles are not regularly harvested, they push each other and this causes bent poles. In dry season, almost all culms that are 3 years or older can be removed from a clump by cutting them just above a node, about 20 cm above the ground. Some of the younger ones should remain for further nourishment of the rhizome.

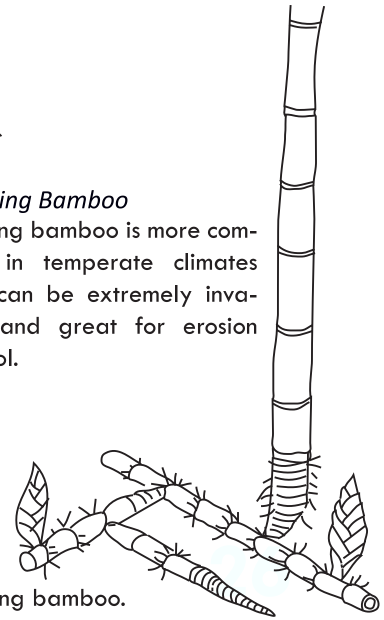
There are 3 different ways to tell the age of bamboo culms:
1) Mostly, culms at the inside of a clump are the oldest.
2) Labeling the new shoots
3) If you are an experienced bamboo harvester you will know the age by knocking on the culm and observe the different sounds.

The culms should be treated soon after been cut, but can be left for a few days standing upright, placed on a stone. Due to the ongoing transpiration by the leaves the culm will loose some of its moisture and also starch. If the bamboo pole is very dry it should be soaked in water for a few days to re-open the vessels for treatment (Garland, 2003, p. 6-22).

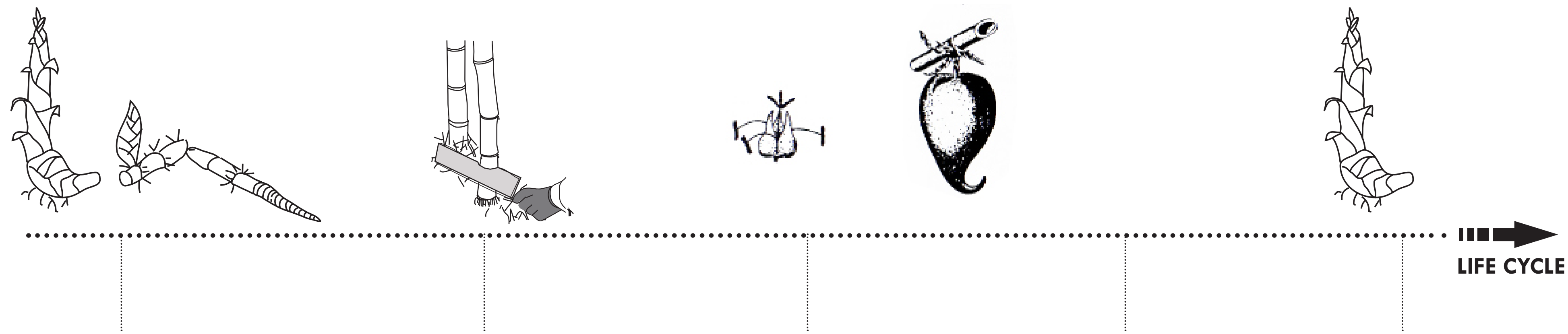
Clumping Bamboo
Clumping bamboos are noninvasive. They do not ruin buildings, they grow very fast when young and the culms are larger than those of the running bamboo. They require little maintenance, although simple clump management will benefit both the growth and the bamboos.

Running Bamboo
Running bamboo is more common in temperate climates and can be extremely invasive and great for erosion control.





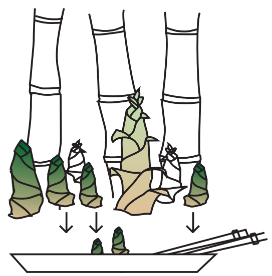
Bamboo grows either as clumps or as running bamboo.



Growth
Bamboo is growing as clumps or running bamboo, naturally from seeds and the growing process starts at the beginning of the rain season.

Cultivating bamboo: In the shooting season, it is important to remove shoots that are going to create overcrowding (many species are edible), to produce straight strong poles for timber use.

Structural material
After three years of growth the canes starts lignifying and silicate, and becomes useful structural timber.



Flowering and fruit
Usually bamboo flowers once in their life, but some smaller species can flower annually.

Death and reproduction
The canes die and fall to the ground only a few weeks after the production of flowers and fruit. The lifespan is determined by the flowering period, which can be up to 100 years or just a few years for smaller species. At the start of the rainy season the first new bamboo plants can be seen on the ground.

To cultivate bamboo is a faster option and can be made through various ways. Clumps can be divided and separately replanted shortly before rain season. Larger species can be cut about 1 meter above ground and planted with a part of the root system (Garland, 2003, p. 6-22, Dunkelberg, 1985, p. 65-66).

Preservation

Properly treated bamboo provides strong, flexible and durable building material able to last over 100 years. Bamboo is vulnerable to factors such as fire, weathering and attacks from pests. Without treatment products made from bamboo can be expected to last for only up to 3 years. An effort to improve the performance of bamboo is through preservation techniques, mainly to prevent cut bamboo from cracking/splitting and weathering (damage by UV and visible light radiation, which causes photo-degradation), and to protect bamboo from fungi and insects (beetles, termites and marine borers), which are still being developed to increase bamboo's durability (Schefold, 2008, p. 93).

Traditional methods in preserving bamboo:

In areas where bamboo is indigenous, traditional preservation methods are used:

- Clump curing: bamboo culms are cut at the base and left in the clump with their crown leaning against neighboring ones for a few days. The bamboo culms are harvested and left, with branches and leaves intact.
- Water storage: soaking freshly cut bamboo culms in running or stagnant water or mud for 1-3 months.
- Soaking and seasoning: involves immersing the culms in stagnant or running water for a few weeks to leach out the starch After this, the wet bamboo stems are air-dried under shade.
- Boiling: boiling green clumps or slivers (for weaving) for 30-60 minutes.
- Lime washing or white washing: painting bamboo culms and mats for houses with slaked lime ($Ca(OH)_2$), mainly for ornamental effect. Lime washing: literally washing with limewater is reported to protect against fungal attack.
- Plastering (of bamboo mats): using mud, clay or sand mixed with lime, cement, or cow-dung for stability.
- Traditional smoking: storing fresh bamboo culms inside the house above a fireplace (traditional Japanese method). The treatment of the culms over fire is effective against fungi and insects.
- Heat treatment: thermal treatment above 150°C.

Chemical method:

The Vertical Soak Diffusion (VSD) method, uses minimally toxic borates as preservatives. It works well with small-plantation situations and community developments in rural villages.

1. First the canes are cleaned on the outside with water, (clay) and brushes.
2. Then placed against a wall to insert an iron rod and punch holes through the nodes except the last one.
3. The bamboo is moved to the concrete basin, standing up and filled with the borax (H_3BO_3) or tim-bor ($Na_2B_8O_{13}x4H_2O$) solution. (The solutions are non-toxic to the environment, but are highly saline).
4. Then the culms are refilled with more of the solution every day for two weeks.
5. After two weeks the last node is broken using a metal punch and the solution flows out on the sloped basin floor into the sump hole.
6. For 4-6 week the culms are drying, depending on how humidity conditions are, in a well ventilated, covered area. It must be in shade, hot sun splits the culms.

The economics of preservation are clear: the price of the bamboo increases by about 30%, but its life increases (Garland, 2003, p 4-24).

PHOTO: Josefine Nyberg

Nursery, Lalandon

Natural furtilizer

Washing station on the site in Lalandon.

Boiling treatment on the site in Lalandon.

PHOTO: Josefine Nyberg

Nursery, Lalandon

Treatment station, Lalandon.

Bamboo seedlings mixed with banana trees to provide the seedlings with shadow.

Lalandon treatment facilitie

The treatment facilities in Lalandon started in the end of 2011. At the end of February 2012 Bambubos were self-sufficient with some guidance from Sahabat Bambu.

This treatment facilitie is providing the projects on the site and the site in Kebon Kopi with bamboo, as the first step. The goal is to change the trend building with bamboo and provide for the local need of bamboo material.

The treatment facilities in Selman and Yogyakarta are today producing 3000 bamboo poles per month and the one in Kalasan, central Java are producing 2000 bamboo poles per month.

Sahabat Bambu mainly threat tree different species that are locally grown and adapted for these areas:

Bamboo Apus (Gigantochloa apus), typically used for roof battens, rafters, walls and matting for walls and ceilings. The average diameter is 5-9 cm.

Black Bamboo (Gigantochloa atroviolacea), mostly for detailing and furniture and the average diameter is 6-10 cm, although there are up to 12 cm.

Giant Bamboo (Dendrocalamus asper) is most suitable for construction, because the large size and weight, but also for flooring boards (laminated). The diameter can reach up to more than 20 cm, but the most common is between 14-18 cm.

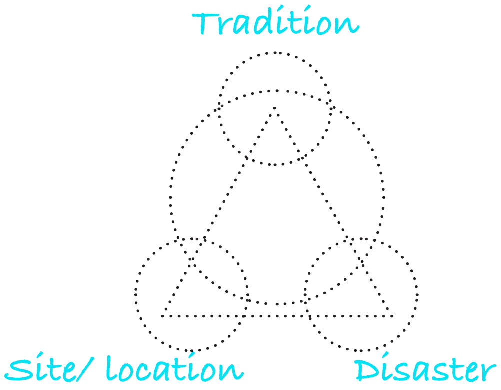
The poles are preserved and sold in lengths of 6 meters.

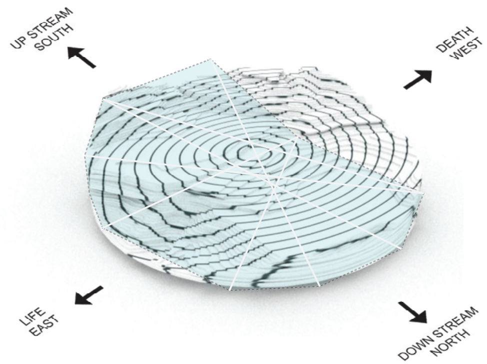
5. THE DESIGN PROPOSAL

Design criterias:

The focus has been to find a method through the exploration of the existing site and facts of disaster woven together with traditions and cultural heritage.

The combination of these three key elements sets the design method. All to be part of minimizing vulnerability.



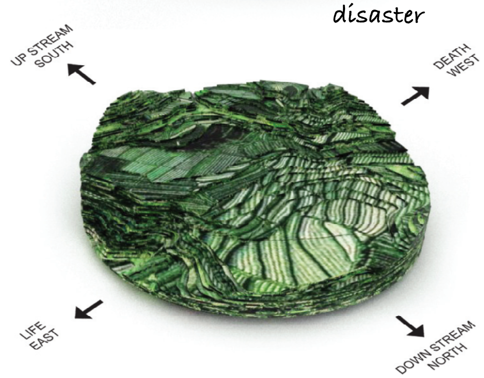


The site:

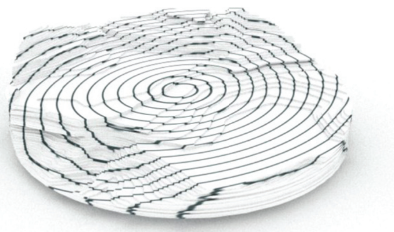
The form is based on the hybrid created of the tree elements.

The idea of circles spreading from a centre, a hearth of the plot, adapted to the site's conditions; terrain, views, risks, climate and the use. The pattern is spreading from the centre in relation to cardinal points representing the ideas of life and death, upstream and downstream together with the parameters of wind and sun. A reflection of the natural world is created and forms the positions of the buildings.

disaster



site/ tradition



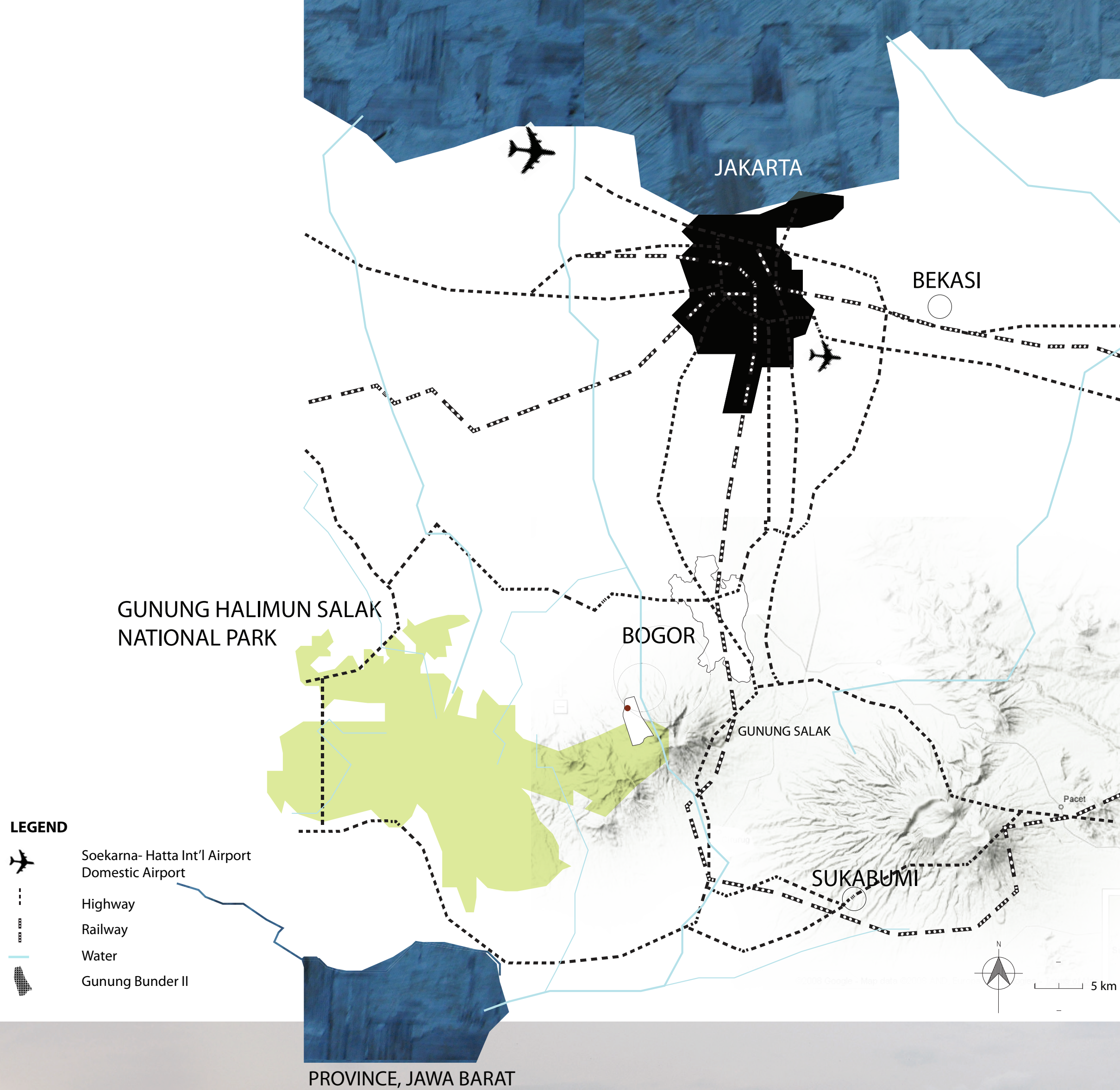
site/ tradition

DEFENITION:
A centre of a disaster (a centre of an volcano, typhoon, epicentre of earthquake etc.), a strong centre and heart in traditional buildings.

GUNUNG SALAK

Gunung Salak highest peak has an altitude of 2100 meters above sea and we find the Kebon Kopi site between 850-796 meters above sea level.

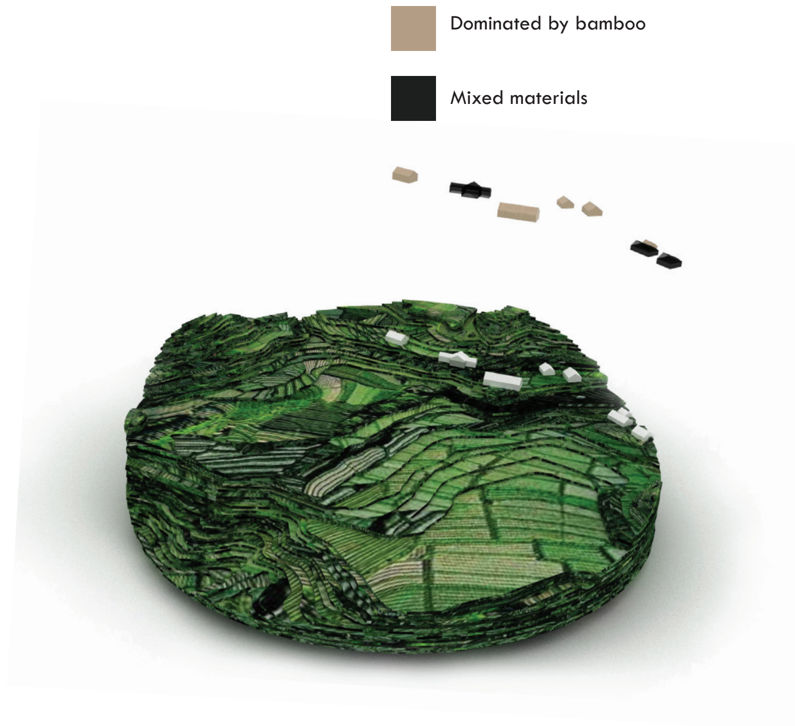
The distance from Bogor center to Kebon Kopi is 29 km, around 50 minutes with public transportation.



View of Gunung Salak from Bogor

LOCATION

PHOTO: Josefine Nyberg



The site

The site has an area of 3,9 ha and differs 48 meters in height from the highest to the lowest point.

The mountain area, all the way to Bogor from the site consists of agricultural land. Where most of it is community owned and community planning decides the use of it. The characteristic landscape and the community-based agriculture will be maintained while their knowledge and local traditions maintain the landscape. The program is adapted to the local environment under the guidance of local farmers to protect the heritage (cultural and natural), the biotope, and the natural disaster resistance and save the community jobs. This will save time and money for the resort as well as it can strengthen the relationships within the community but also with the resort.

Vegetation

The site is planted with local crops, including fruit trees: (papaya, mango, banana, nutmeg etc), herbal trees, vegetables and rice. The higher slopes of the plot consist of planted pine tree forest and native bamboo.

Neighbouring buildings

The buildings next to the site are one to two story dwellings and are made in mixed materials, with concrete, wood, roof tiles and bamboo matting. Bamboo materials dominate one newly built house, while most of the buildings in the community consists of ground built concrete structures with roof tiles. Smaller sheds are mostly made of wood and bamboo.

ANALYSIS, the site

Threats
The site is located on the slopes of the volcano Gunung Bunder, but it has not erupted since 1935. The area is famous for the rainy afternoon climate that increases the risk for flooding and landslides.

Strength
The terraced landscape and agriculture acts to minimize the vulnerability of the site.

The site is located next to the Halimun National Park with numerous waterfalls, craters, hiking and bicycle treks, camping areas, saris (local shops and café) and a diverse wildlife and fauna. You find the entrance to the National park only a few meters away.

The position on the slope provides with views down towards the valleys and the agricultural land all the way to Bogor, and up towards the mountain area.

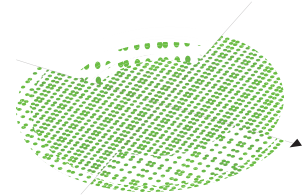
The cultivation provides the resort with a natural atmosphere and brings supplies to the resort.

Opportunity
The natural springs lay the ground for the resort with natural pool facilities and water for the terraces.

A nursery and bamboo plantation will be introduced for decreasing the risk of disaster and to produce materials for the maintenance of the resort.

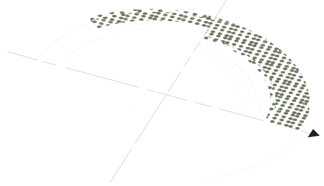
An organic market for guests and community is opened and exhibition of crops and bamboo plants will be incorporated in the natural landscape.

The setting makes it possible for the resort to be planned with bioclimatic design strategies to utilize the tropical climate.

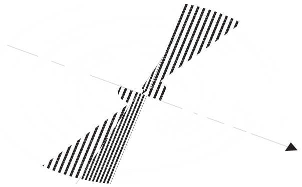


Agriculture

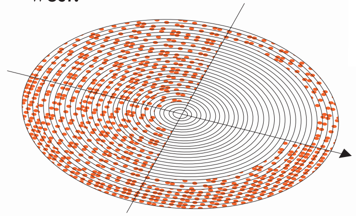
High vegetation, planted pine tree forest and bamboo.



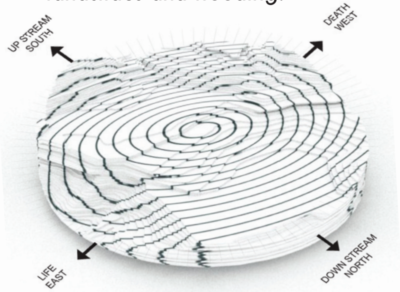
Local population close to the site.

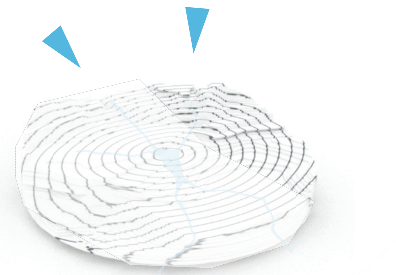


The prevailing wind directions, dry season - east, wet season-west.

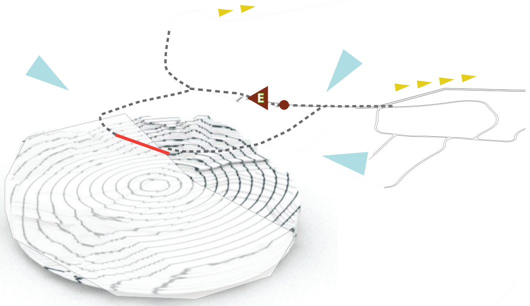


The area with most risk for landslides and flooding.

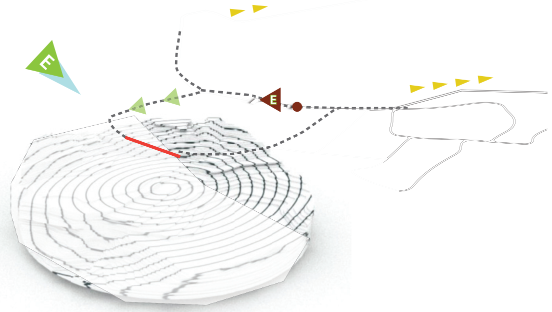




Spring water
Water access, spring water from the mountain area with terraces collecting the water.

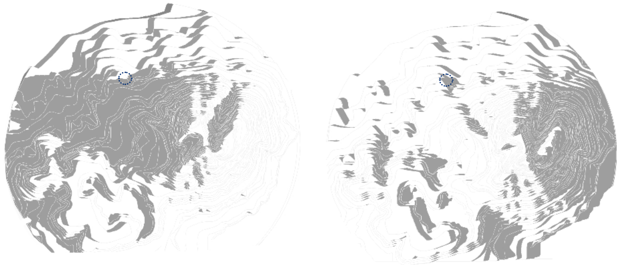


Access
A small gravel road leads to the site today, passing neighbouring houses. The entrance is narrow and undefined. A link is connecting existing roads from the community with the park and camping area.



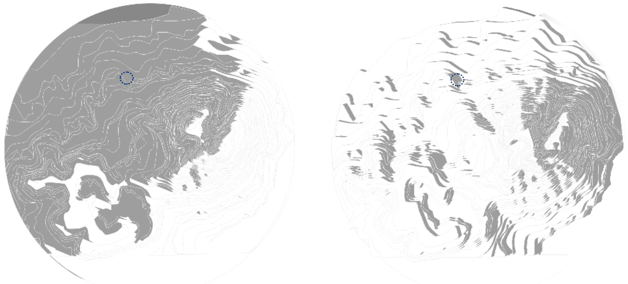
Entrance
From the park a natural entrance for the resort area is created, entering from the top of the site and through the deep pine tree forest out with views over the opened landscape.

Natural borders
The plot has natural borders with the high terrain and vegetation in the south, the row with houses incorporated in the forest and the road and at last the steep border of the site down into a valley.



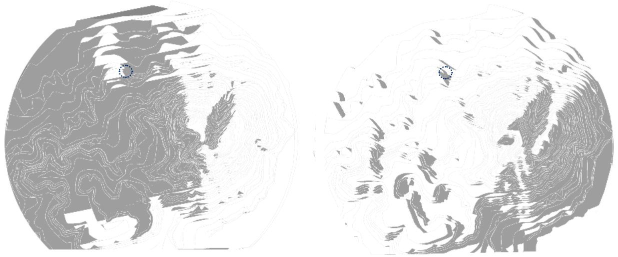
06.00 17.00

October



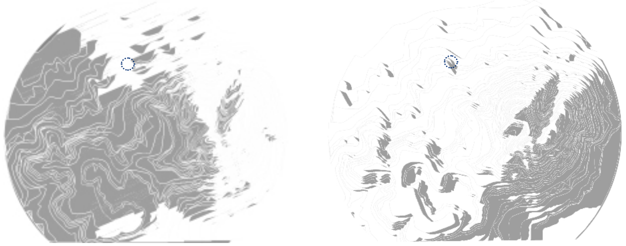
06.00 17.00

January



06.00 17.00

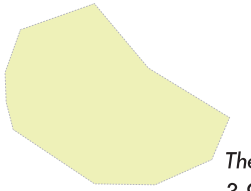
April



06.10 17.00

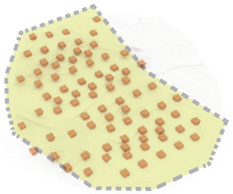
July

Gunung Salak

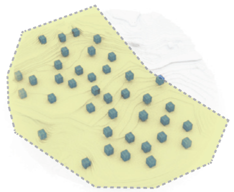


The size of the plot is 3,9 ha

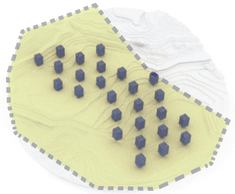
The density types are based on an average unit of 65 sqm. With the relation 60/40 % for private (rooms and services)/ public space.



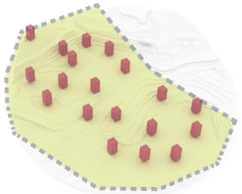
1 story buildings, 5070 sqm



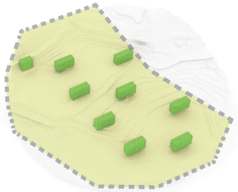
2 story buildings, 2535 sqm



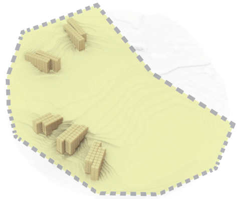
3 story buildings, 1690 sqm



4 story buildings, 1267 sqm



4 story buildings, 1267 sqm



Mixed typoligy, 1690 sqm (4,3 % of the plot)

Density

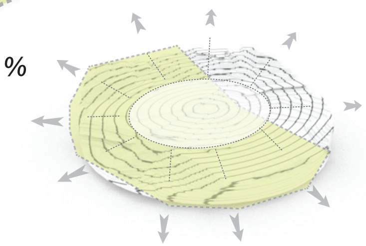
The chosen density type is the mixed typology, placed on the slopes of the site, decreasing the impact of the agricultural land.

Dusk and Dawn

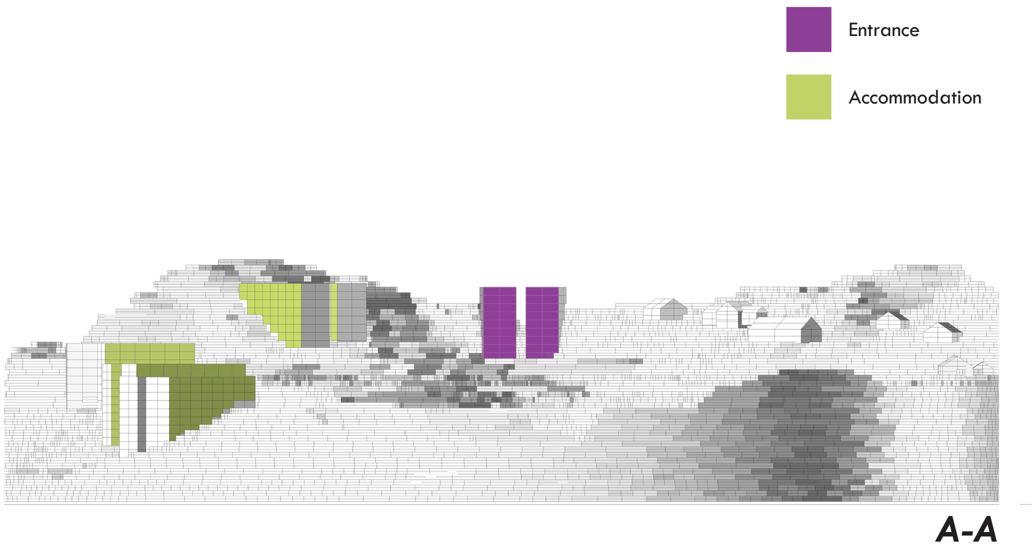
The days are longer close to the winter solstice (December 21) with sun raising at 05.32 the 1st of October and 05.49 the 1st of January. The sun sets at 17.42 in October and 18.11 in January.

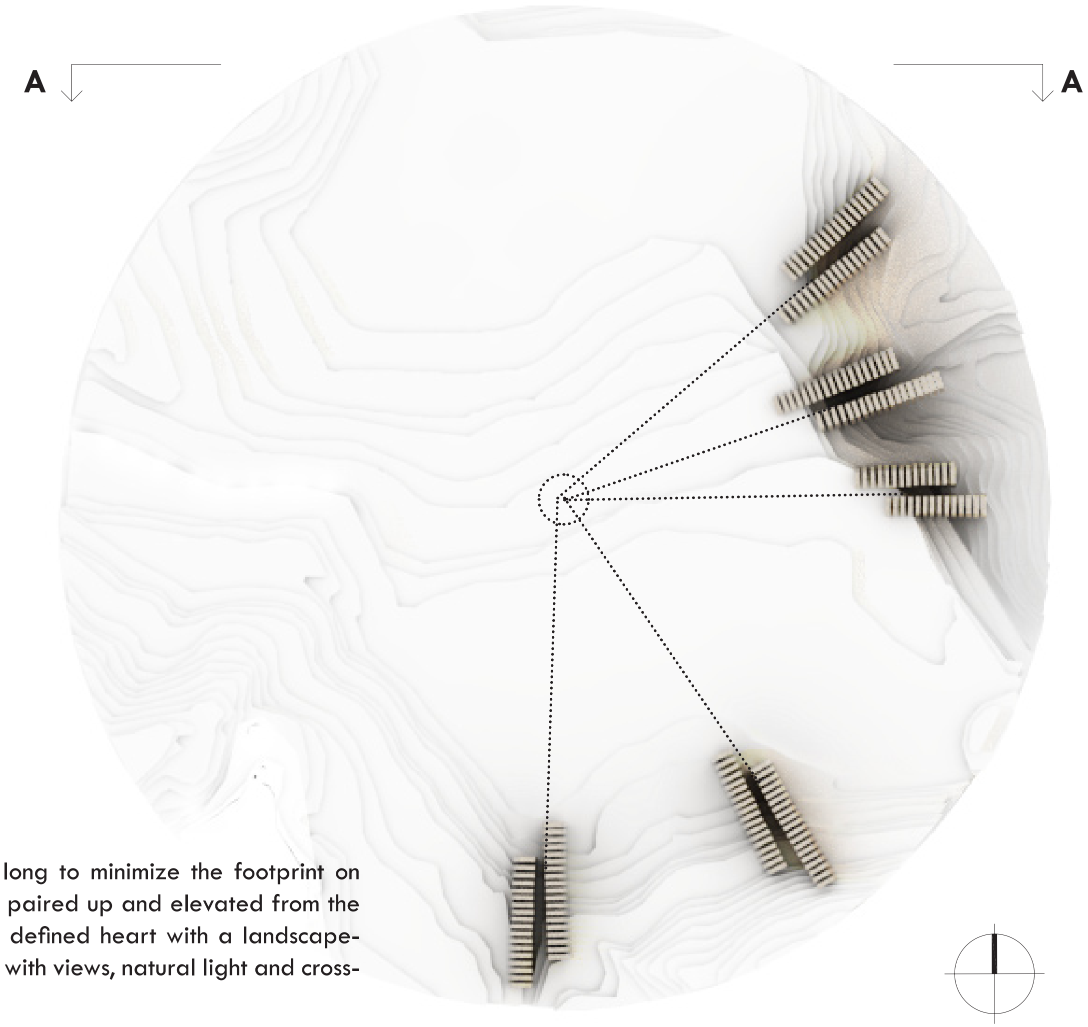
Around summer solstice (June 21st) the days are a little bit shorter and the sun rises at 05.58 the 1st of April and 06.09 the 1st of July, with the sun setting at 05.50 in April and 05.49 in July.

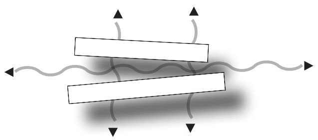
In tropical environments, the east and west aspects receive the strongest sun at the lowest angle. During daytime the site is exposed to the sun and has little shadow space.



The design method arranges the position of the buildings.







The pattern:

The buildings are meeting the slopes of Mount Salak and the National park, following the landscape and leaving the agricultural land almost untouched. The buildings are growing out of the hills and from above the view is free. Formed on circles adapted to the shape of the site with the buildings angled to meet the center. The pattern is adapted to the local climate conditions allowing prevailing wind crossing through and optimal sun flow over and through the buildings and the agricultural land.

The buildings are high and long to minimize the footprint on the site. The long bodies are paired up and elevated from the ground creating an opened, defined heart with a landscape-like inner structure, providing with views, natural light and cross-ventilation.

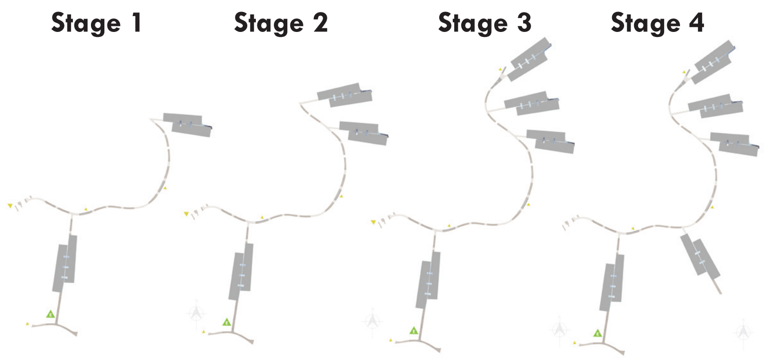
Gunung Halimun Salak
National park entrance

Parallel activities:

The road to the entrance of the resort is passing through the gates of the park area. From the parking an elevated bamboo pedestrian bridge brings the guests to the entrance building and trough-out the resort, connection to the terraces below and the natural paths within.

Increasing the site density (agriculture and tourism) ensures that there is plenty of extra room for the community, including space for recreation, agriculture and water treatment. Green principles have been used throughout to minimize the environmental impact. Solar water heating, natural A/C and water collection facilities are incorporated into the architecture and later re-used in the landscape. Food and agricultural waste is converted into compost. Biogas technologies will be used to utilize waste from humans.

The planted terraces and no paving reduce the ground temperatures of the site and a bamboo nursery and plantation are growing on the site as natural warning system and reinforces the terraces.



The resort will be built in stages and by adopting a modular system, the houses becomes widely flexible, making it possible for the resort to add on or subtract units depending on the amount of space needed or in case of disaster or need of restoration.

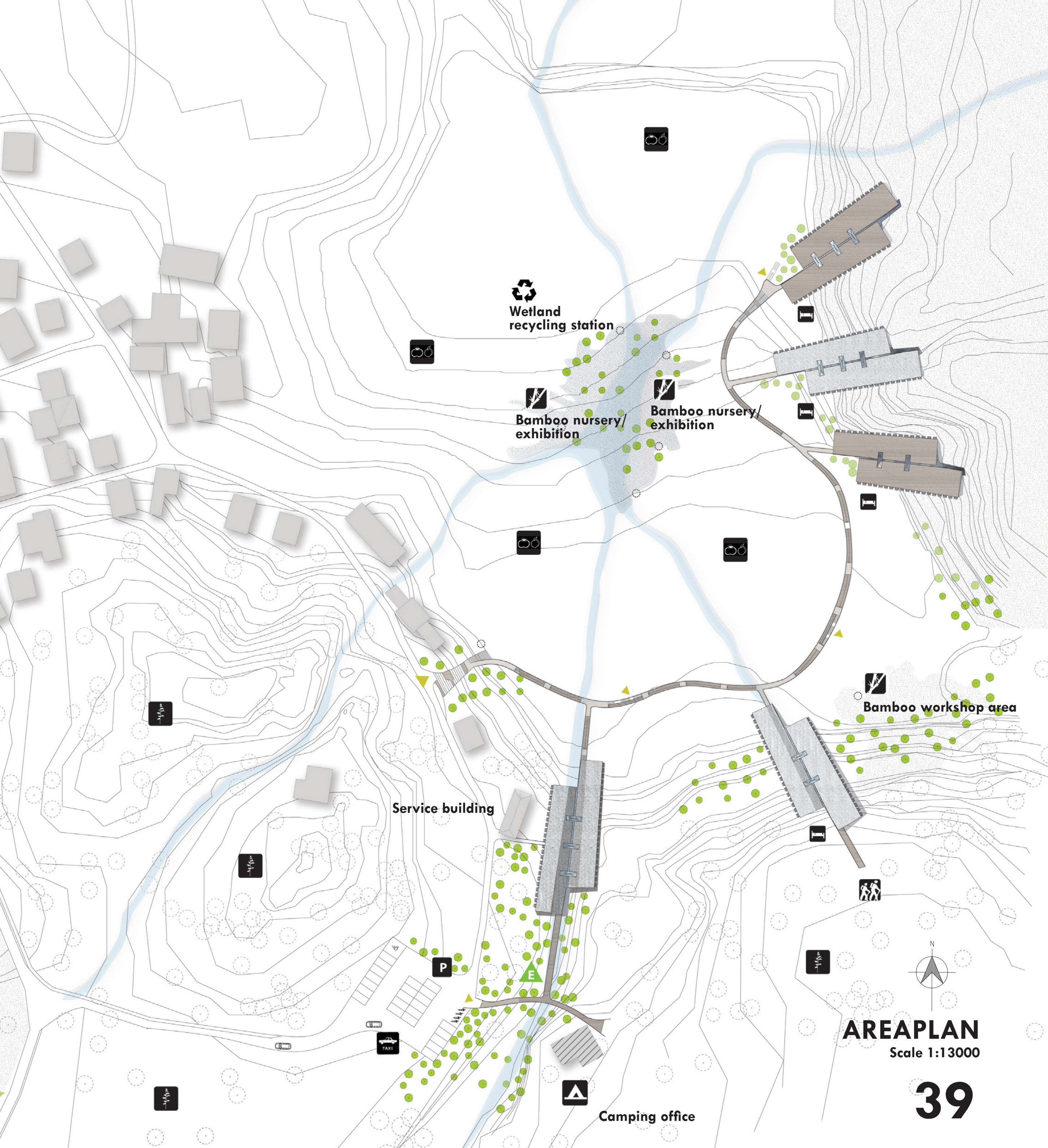
The layout

Five buildings are carefully positioned on the site connected from the National Park area with a pedestrian bridge. A new road-link is created connecting the community and the park area together and to enter the site and entrance from the community side is possible.

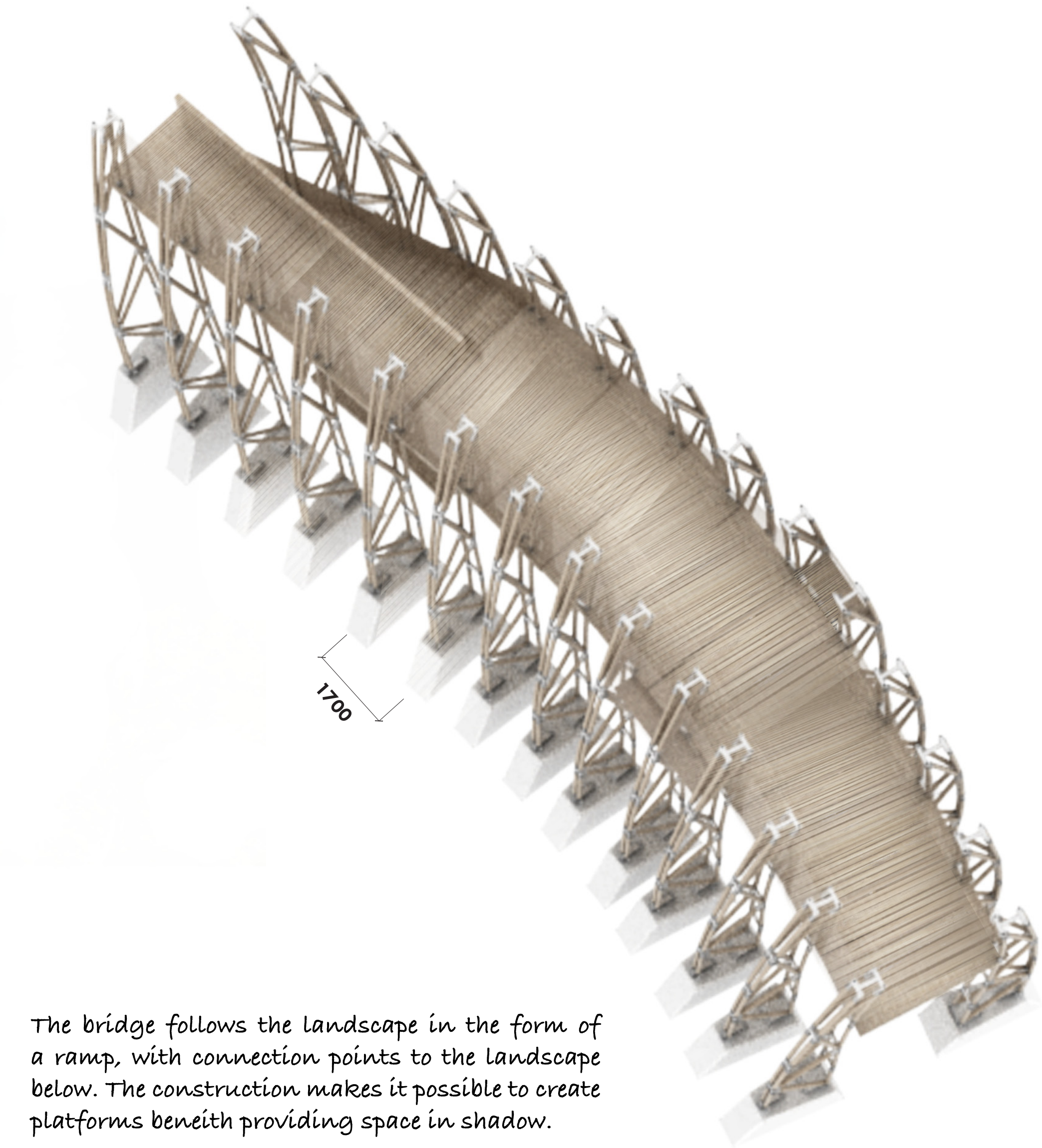
The entrance building contains an organic market, provided with supplies from the site, a reception area and administration, a restaurant and café, spa facilities, overlooking the resort area, and conference facilities including multifunctional exhibition space, meeting rooms and workshop areas. The exhibition space has different bamboo exhibitions on display and the resort will arrange workshops building with bamboo.

The resort offers different kind of accommodation, including single bedroons, units with living room and terrace and 1-3 bedrooms. A total of 60 rooms where the average is 15 rooms/building, with the possibility to extend within the buildings. Communication is placed public and central to ensure flexibility and rooms can be pared up together or rented out separately. The buildings contain natural bath facilities and a kitchen unit.

There are storage spaces for the resort and for the cultivation in the bottom of the buildings. A service building is placed and connected to the entrance building (clearing the entrance from closed volumes). Including entrance and facilities for the staff (kitchen, showers, bathrooms), delivery, storages and kitchen space, waste facilities for the restaurant and the café and a laundry and sanitary station (220 sqm, 3 levels).

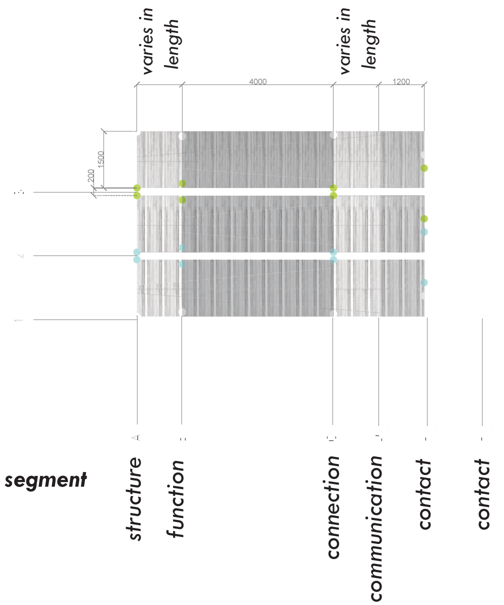


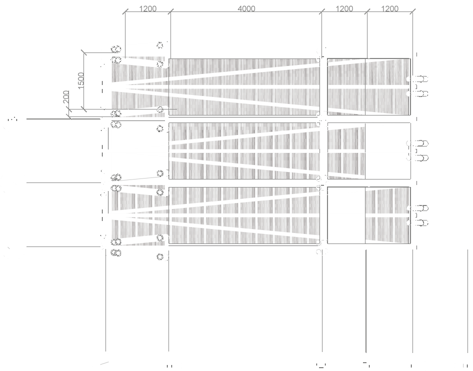
View of the elevated pedestrian bridge connecting the buildings together.



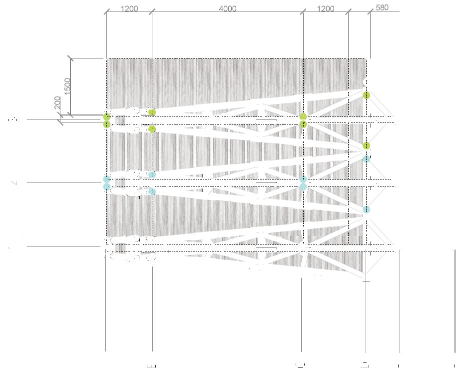
The bridge follows the landscape in the form of a ramp, with connection points to the landscape below. The construction makes it possible to create platforms beneith providing space in shadow.

Ground segment



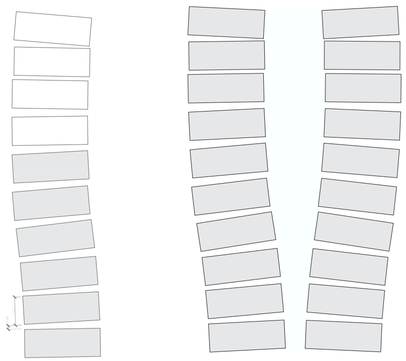


Structure
Example of tree segments, showing the beam-structure and the flexibility within each segment

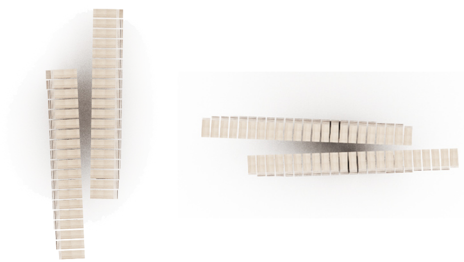


Roof trusses
Connecting the segments together.

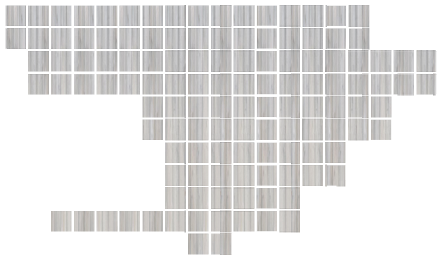
Scale 1:200

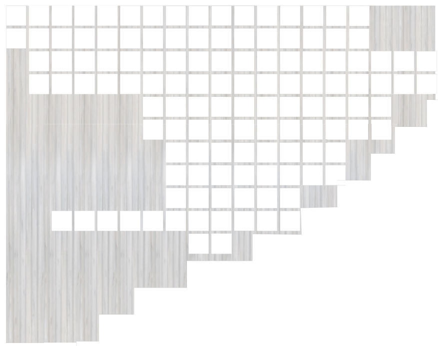


Sections of the functional space angled to create an inner room and the base for the form of the structure.

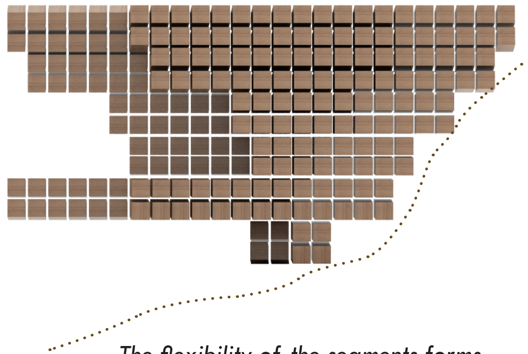


The composition





Different combinations of the segments shapes positive and negative forms. Creating smaller and bigger spaces within the structure.



The flexibility of the segments forms and follows the terrain.

The composition:

The buildings are created by segments and angled to meet the centre of the site.

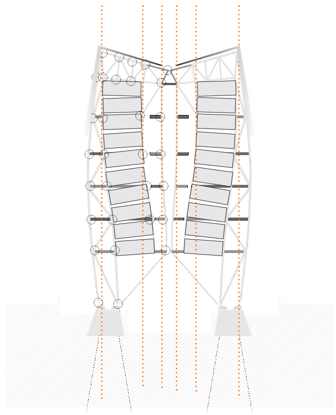
The segments:

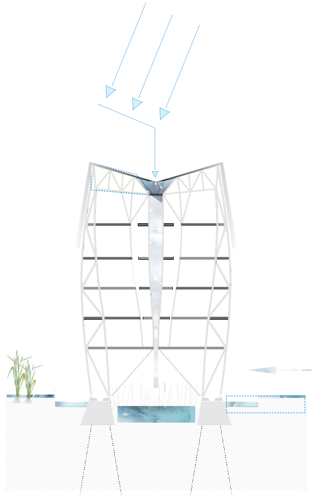
The segments are made in order to minimize the construction costs and reduce the recovery period, esp. in cases of severe destruction. The segments and units within are movable and constructed with flexible joints. This way the structures are flexible and can grow or increase after time.

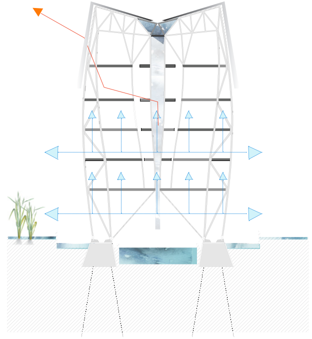
The structure:

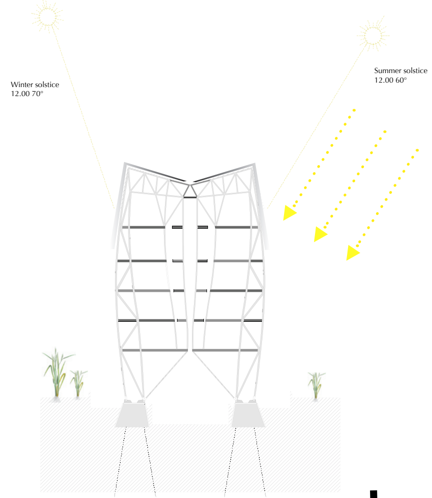
The segments build up the structure in plan, and in section the functional spaces (1,5 x 4 meters) are angled, to create a rounded structure, intensifying the heart of the building. This assures the construction with protection from sun and rain and an opened structure is created.

Components will be mass-produced with local materials, to supply replacement, possibility to deconstruct and for expansion. Flexible and light building materials are used through out the resort, mainly bamboo.









Structure

The functional units are creating the form for the structure. The buildings are built off the ground to avoid flooding and narrow functional spaces to allow natural lighting.

Rainwater

Rainwater is harvested from the roof and stored in a tank at the bottom of the structure and a smaller on at the top. The water creates an opened waterfall and natural A/C. Grey water is collected and cleaned in the recycling wetland and spring and rainwater passes through natural cleaning stations.

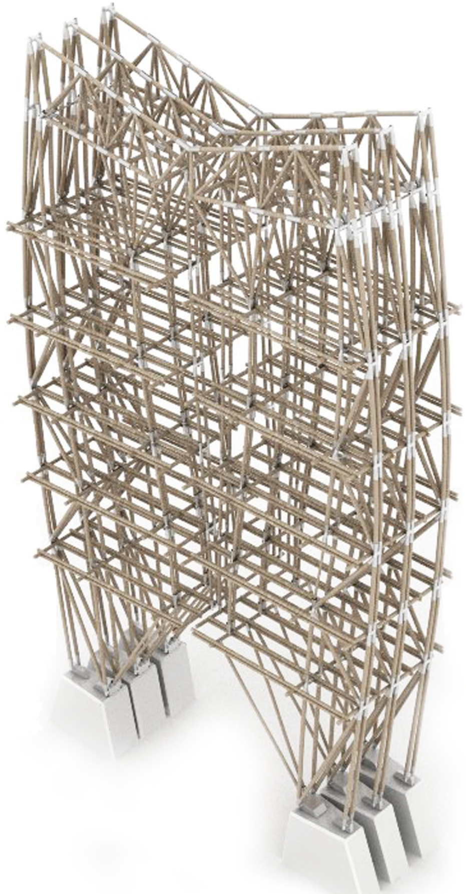
The vegetated landscape and bamboo cultivations are naturally designed to absorb a lot of the storm water and also direct it away from the living areas towards lower elevations. The root network of the bamboo plant forms a supremely effective protection against erosion and it acts as a sewage filter for waste and polluted surface water.

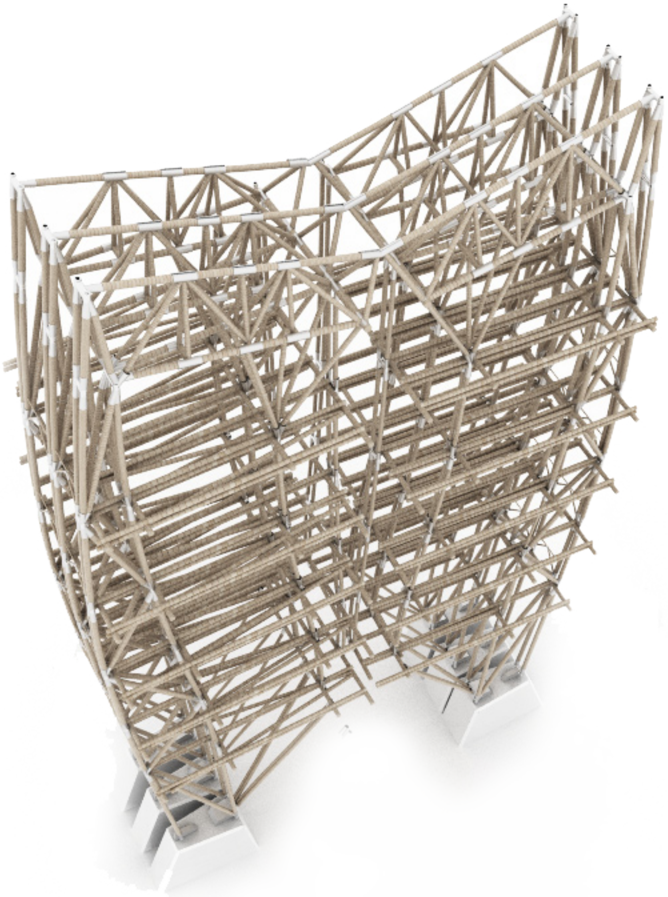
Ventilation

The buildings orientations are balanced to the prevailing winds of dry and wet seasons. The stilted structures are transparent to allow wind through the spaces with light walls and flexible doors. Water features cools the air and vegetation around the buildings reduces the reflection of heat from solar radiation and works as a filter or barrier to the wind flow.

Shading

Facade- and roof shape together with the structural galleries of buildings protects the spaces from direct sunlight on the walls. Vertical sliding screens are found in the functional spaces to avoid sun and heat penetration into internal spaces. Color and materials are natural, which reflect or absorb solar heat.





The structure

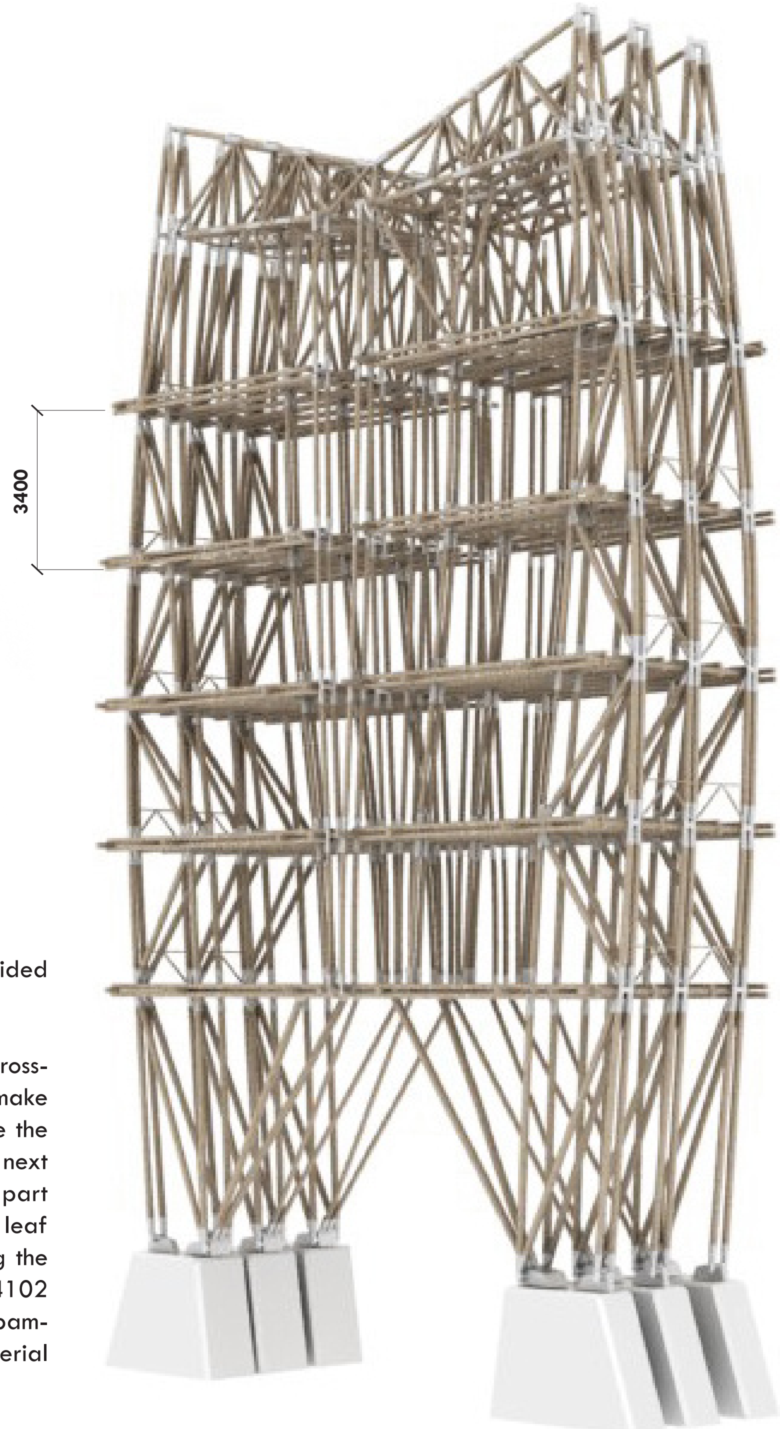
Bamboo structures are very elastic and have a low dead weight. They deform under the force acting upon them and are dynamic, therefore particularly suitable for Indonesia, and the resort development in Kebon Kopi, with a large number of earthquakes. For higher buildings framework structures are suited (Dunkelberg, 1985, p. 256).

A three dimensional structure is created and connected together in the segments and connecting the opposite side with beams and in the roof trusses. The trusses are supported continuously at the edges, to create an efficient structure. Diagonal bracing is used throughout the building, vertical and horizontal and in both directions and with internal bracing in the walls. The lower columns are reinforced for the greater load. Fixtures of the columns are over the ground, to protect from rot and termites. The framework structure consists of shorter rods lengths to minimize the deformations under load.

Fire

The resort buildings have an internal sprinkle system , provided from the water collection cisterns.

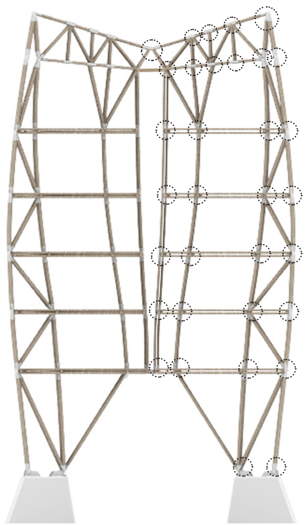
Bamboo canes burn slower than wood with an equal cross-section. The greater density and the silicon acid content make the material flame-retardant. When flames reach a node the diaphragm acts as a firebreak. The fire proceeds to the next segment only on the outside and will soon extinguish. The part of the structure, which is most easily ignited, we find in the leaf or grass roofs, but it can burn completely without igniting the bamboo rafters and structure. In accordance with DIN 4102 (behaviour of building materials and components in fire) bamboo would be classified as a flame retarding building material (Dunkelberg, 1985, p. 77-82).

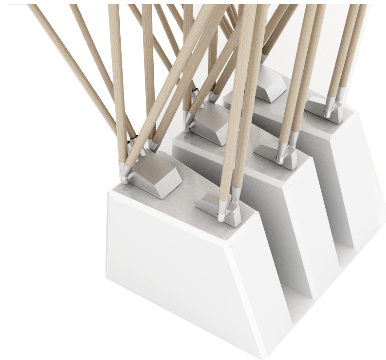


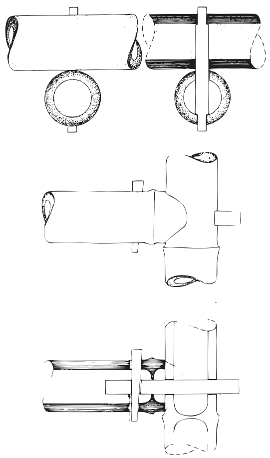
The highest segments.

Cut, above the node.

Bamboo pin







Connections

Traditionally, bamboo joints were most of the time made with pins and open ends, kept together with a rope, with the result of that the strength of the bamboo is lost in the joint and deformation is considerable. But with new kind of joints the strength of the bamboo is kept and deformation is little and it is possible to prefabricate and apply a modular system.

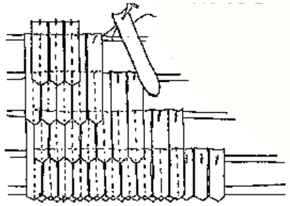
Joints are used throughout the structure and hardwood or bamboo pins. No nails, screws or bolts are used in the structure, which can weaken the bamboo and splitting can occur. The opened end of the bamboo is filled with a piece of wood internally to the culm (Janssen, 2000, p.26), or cut directly after the node.

Foundation

Bamboo in contact with soil has a very short lifetime. The lower parts of the structure are therefore traditionally placed on a stone (Janssen, 2000, p. 21). Here the bamboo poles are connected to the joint system and further on to a concrete foundation /plinth above surface and piled into the ground. The system makes it possible for the structure to vary in height and follow the landscape. The joint system of the structure make the lower parts exchangeable in case of rot or termite attacks.

Common foundation

Grass or palm leafs



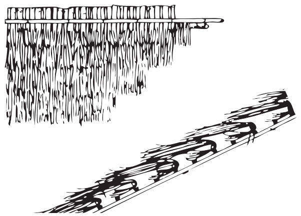
Shingles are cut from mature green culms, of a diameter as great as possible. A split is cut into each shingle, which it is hooked to the batten. Up to three layers can be necessary to reach a waterproof roof (Janssen, 2000, p. 31).

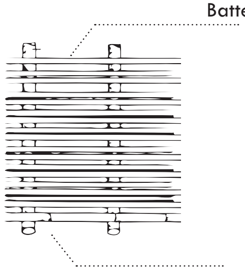
Shingles

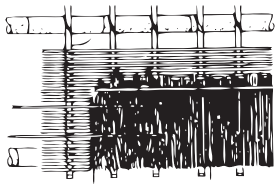
Injuk

Grass or palm leaves are bent around the batten and lashed and placed in three layers (Dunkelberg, 1985, p. 220).

Ijuk fibers are plaited into ropes a laid in two layers lashing them to the battens (Dunkelberg, 1985, p. 222).





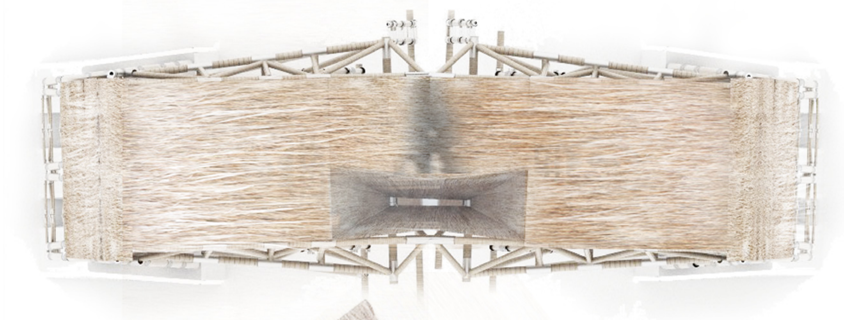


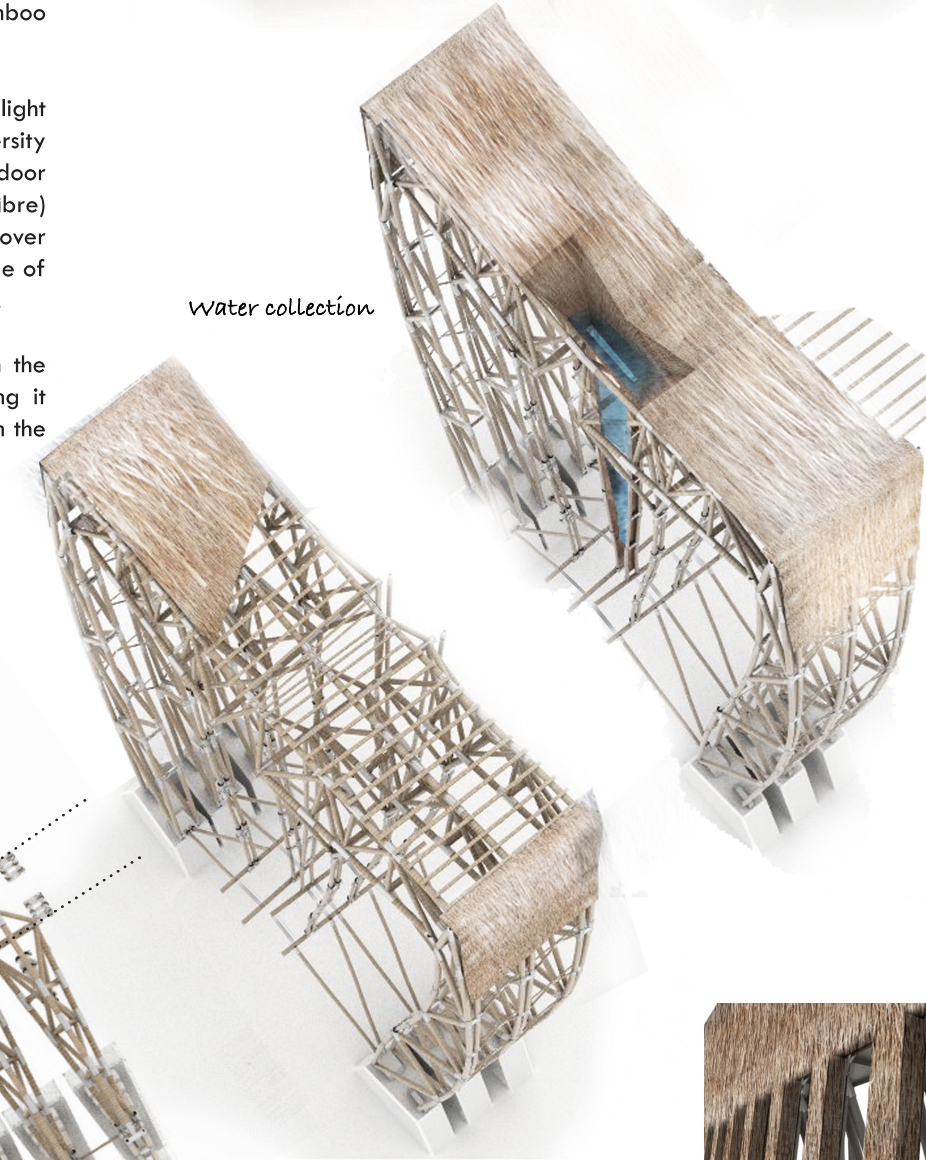
Roof/ facade

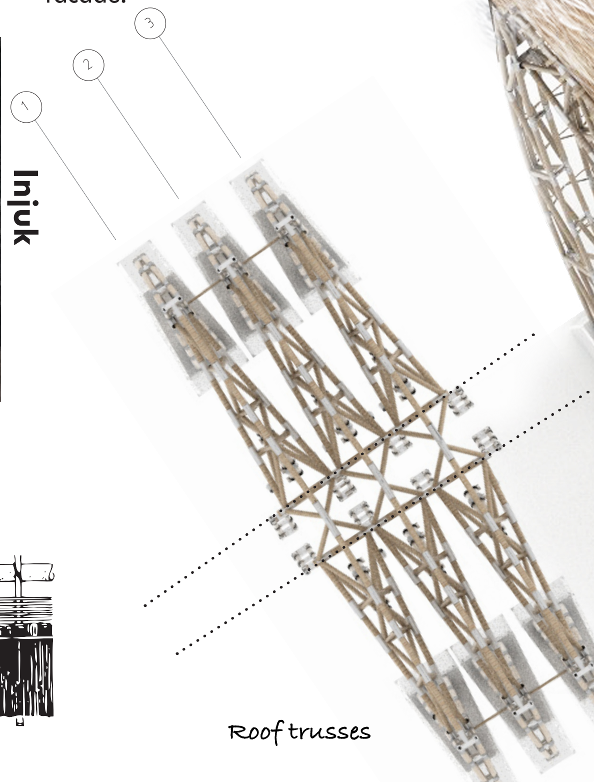
The roof functions as a shelter and also as a gutter for rain. The rainwater is directly distributed to the tank through the middle of the structure, which is covered with bamboo on two sides. The roof is reinforced closer to the middle to handle the water transportation. The roof leans inwards towards the openings, and outwars towards the ends, collecting the water into bamboo pipes leading to the ground.

The roof cover consists of different light natural materials giving the resort diversity and making sure of a comfortable indoor climate. Grass, palm leaf, injuk (palm fibre) and bamboo shingles are used. The cover is lashed to the bamboo battens (made of spitted bamboo, lashed to the trusses).

The roof material continues down on the upper part of the structure protecting it from rain and sun, leaving openings in the facade.







Roof trusses

Roof and facade

Bamboo board

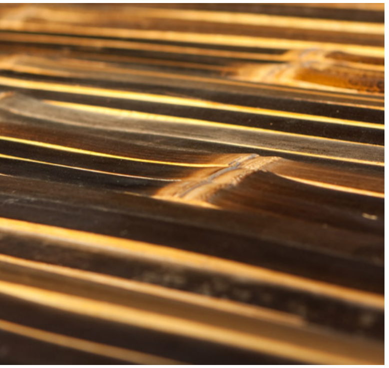
Bamboo floor

Floor

The beams are connected to the structure and stabilizing beams are added diagonally.

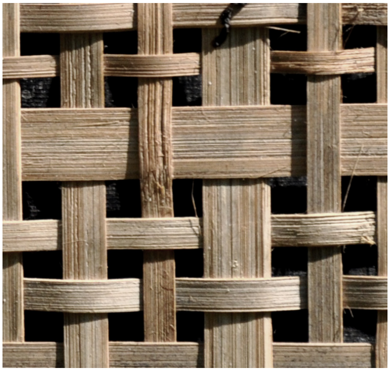
Floor cover: All the floors are made of flattened bamboo, laid on top of the joists.

Flattened bamboo strips: the culms are cut open with a knife and made into stripes placed in different variations, and sometimes glued together.



Flattened bamboo

Bamboo weaves

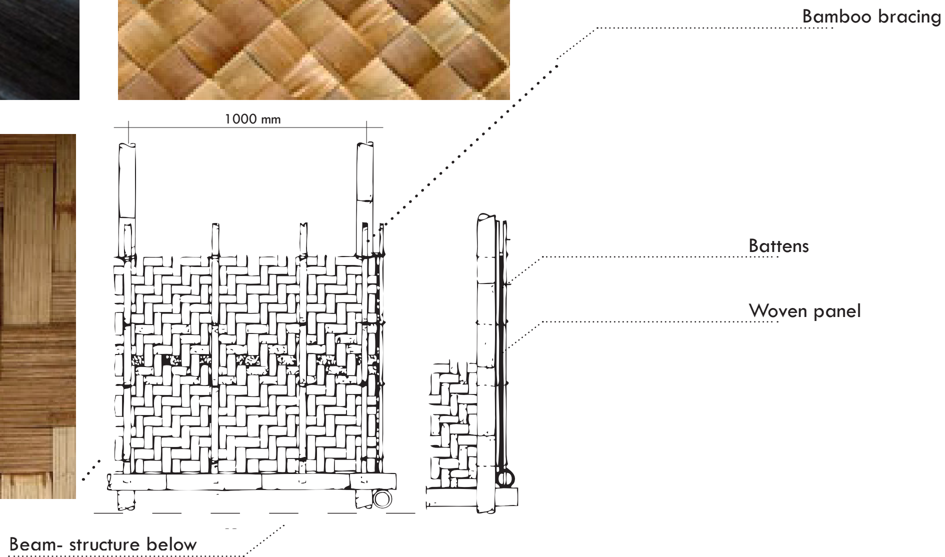


Walls and ceilings

The inner walls contain bracing to resist (typhoons) and earthquakes and the framework is filled with woven bamboo or bamboo boards.

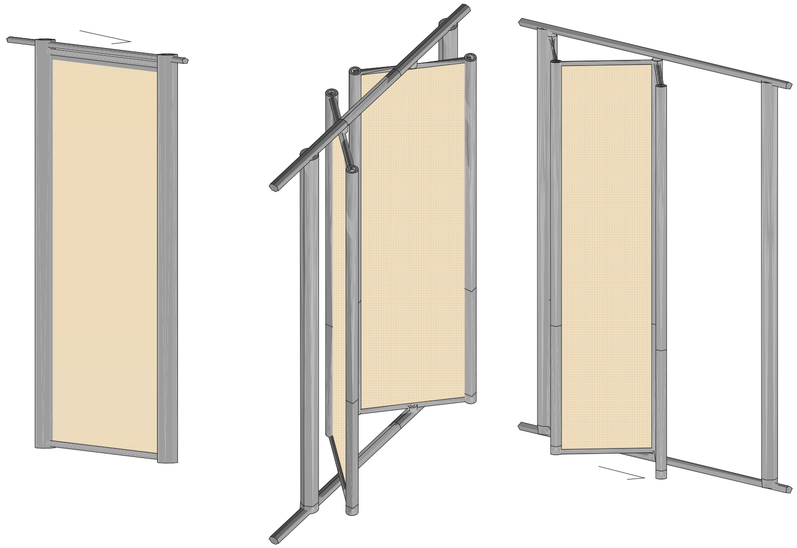
The kitchen and other areas with a higher risk of fire have laminated boards that are more resistant to fire.

The roof structure is higher than the bamboo walls to create space for ventilation.



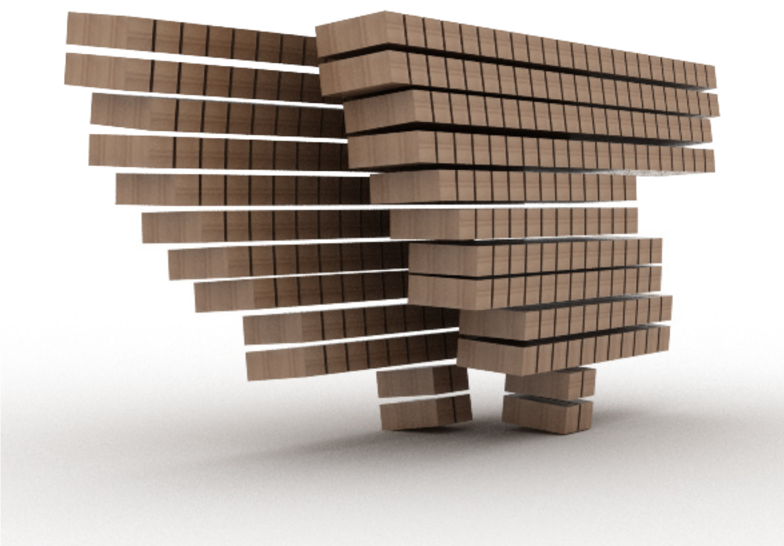
Doors and windows

All doors, sliding or hinged, are framed with a panel of woven bamboo matt.



View of the entrance bridge

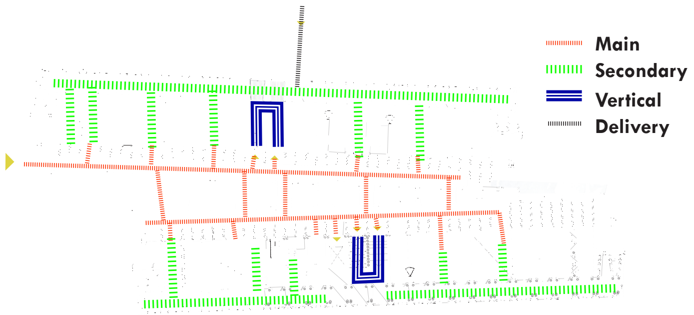
View of the entrance building



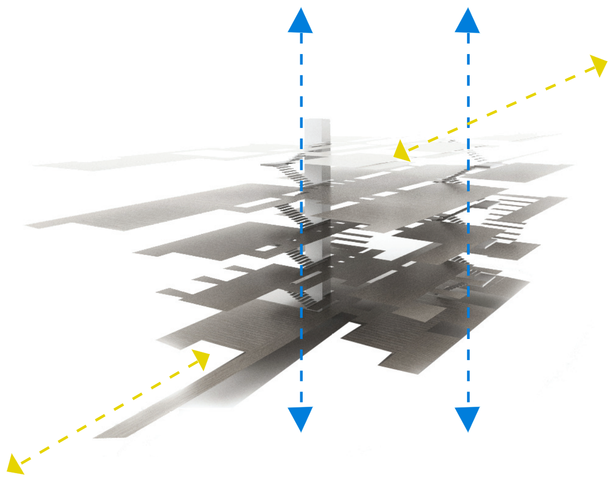
View of functional space of the entrance building.

The entrance building

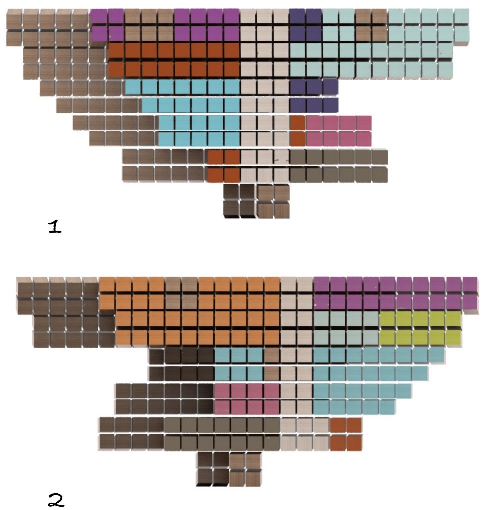
The layout is planned so the guests are passing through the reception area before entering the area with accommodation. From the entrance the stairs or elevator brings the guests to public spaces within the building or to the elevated bridge and to their rooms.

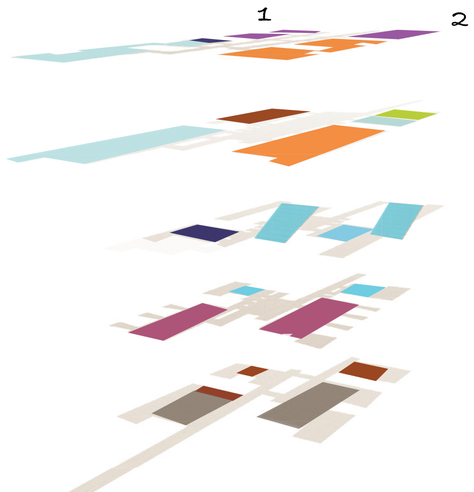


Typical circulation



Circulation:
Two central blocks serves the building with communication, leading down to the landscape below or to the pedestrian bridge.





Organic market
34 sqm
Café
143 sqm
Restaurant
122,5 sqm
Administration
94,8 sqm
Spa facilities
115 sqm
Meeting rooms
242,8 sqm
Exhibition space
54,4 sqm
Workshop area
85,5 sqm
Bathrooms
33,9 sqm

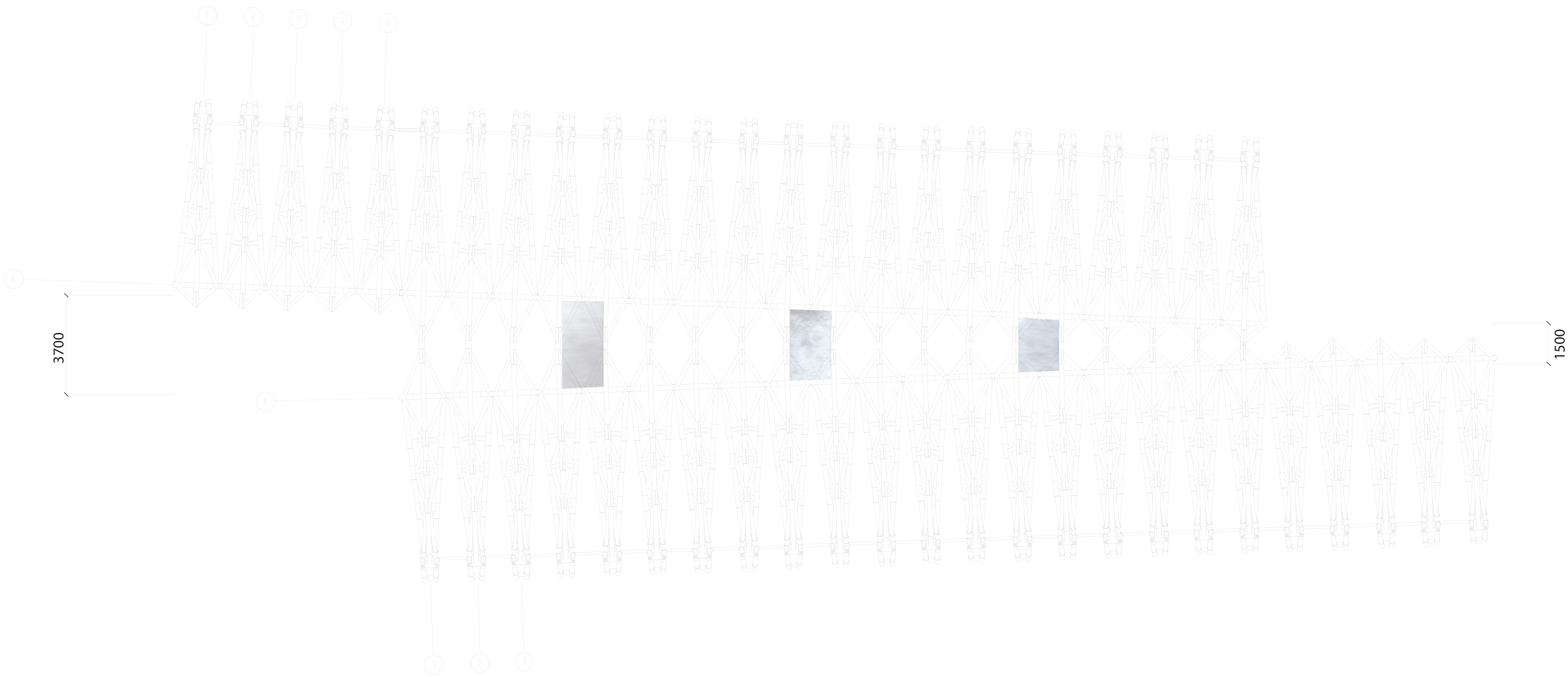
Level +1:
spa: 115 sqm
café/bar: 48 sqm
restaurant: 54,5 sqm
bathrooms: 13,5 sqm
Total: 231sqm

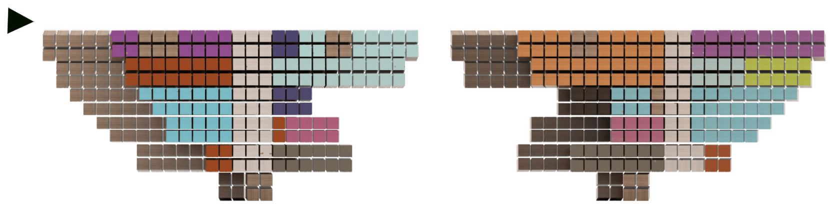
Entrance level:
reception/administration: 54,5 sqm
organic market: 34 sqm
restaurant/kitchen (incl. day storage, dish washing): 68 sqm
café (incl. day storage, dish washing) :95 sqm
Total: 251,5 sqm

Level -1:
bathroom (incl. hwc): 20,4 sqm
meeting room: 122,4 sqm
Total: 144,4 sqm

Level -2:
meeting room: 120,4 sqm
exhibition space: 54,4 sqm
Total: 174,8 sqm
Level -3:
administration: 34 sqm
workshop space: 85,5 sqm
Total : 119,5 sgm
Total: 921 sqm

Service building: a total of 220 sqm
storages and cold room: 25 sqm
wet kitchen: 20 sqm
preparation (kitchen): 50 sqm
personnel (incl. bathrooms, showers, kitchen): 40 sqm
laundry service (incl. storage): 40 sqm
sanitary station: 10 sqm
waste facilities: 10 sqm





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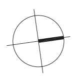
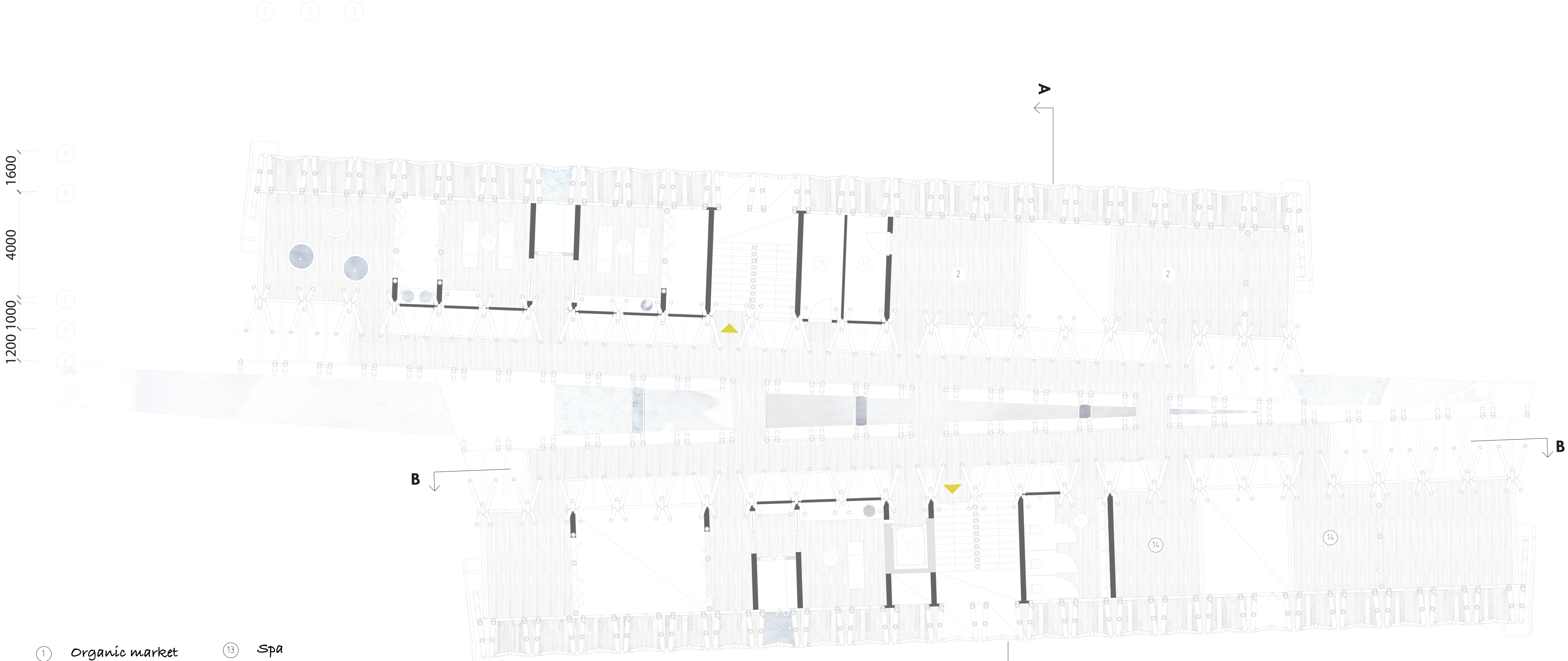
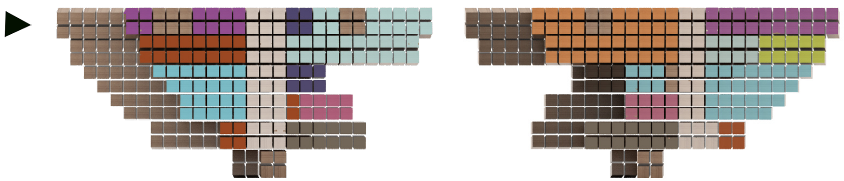


0 1 2 3 4 5 6 7 8 9 10 Meter

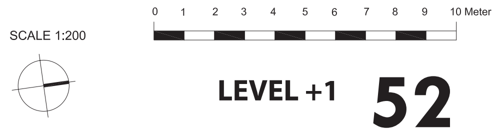
ROOF PLAN



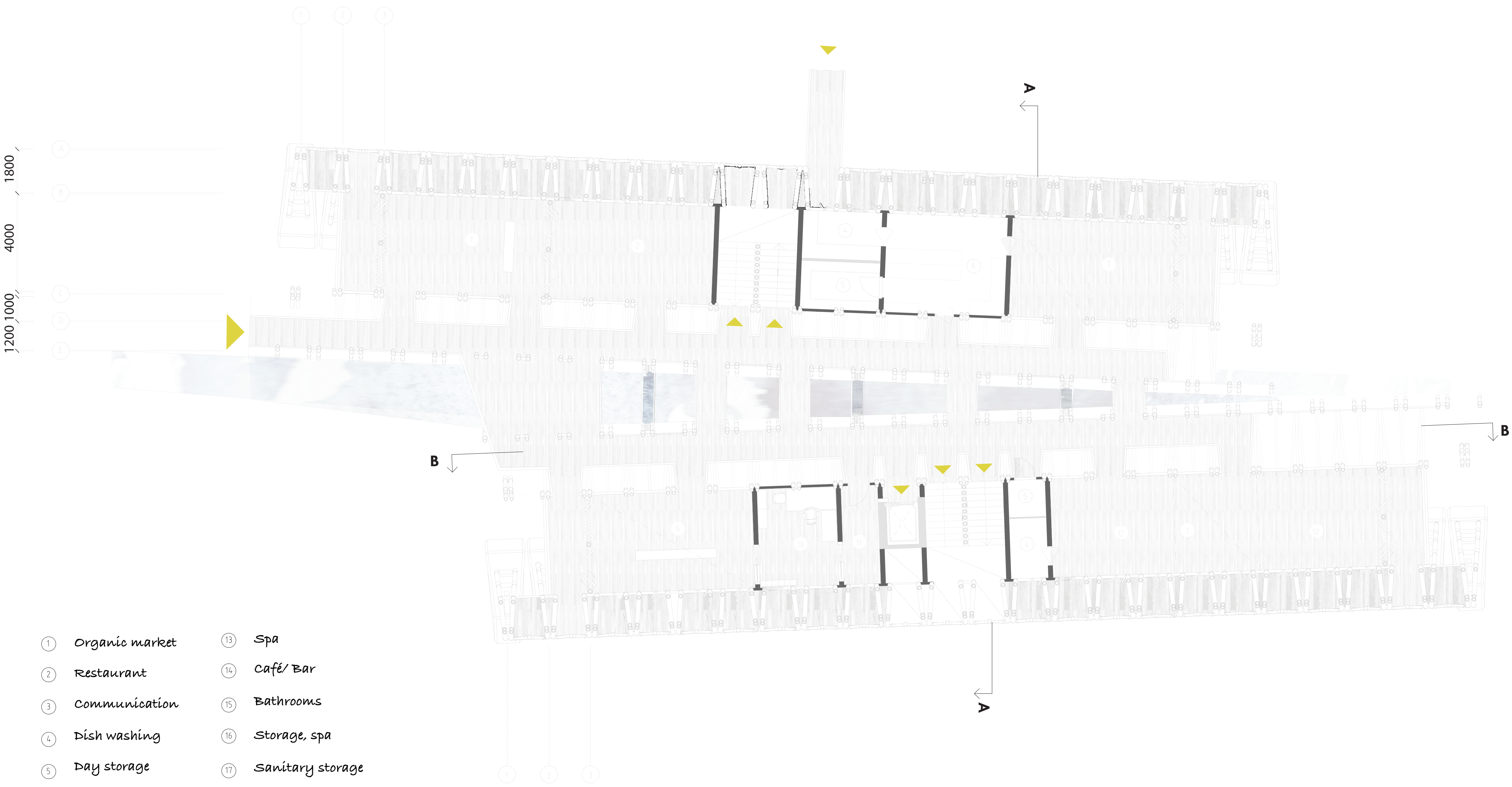
1. Organic market
2. Restaurant
3. Communication
4. Dish washing
5. Day storage
6. Kitchen
7. Servery
8. Entrance hall
9. Reception
10. Reception office
11. Storage, luggage
12. Café
13. Spa
14. Café/ Bar
15. Bathrooms
16. Storage, spa
17. Sanitary storage
18. HWC
19. Meeting rooms
20. Administration
21. Workshop
22. Exhibition space
23. Connecting bridge



1 2



LEVEL +1



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14. Café/ Bar
15. Bathrooms
16. Storage, spa
17. Sanitary storage
18. HWC
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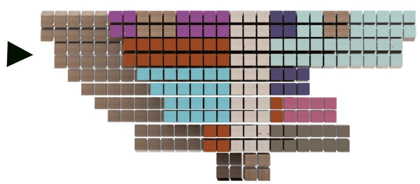
20. Administration
21. Workshop
22. Exhibition space
23. Connecting bridge



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2

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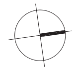
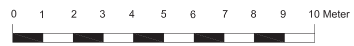
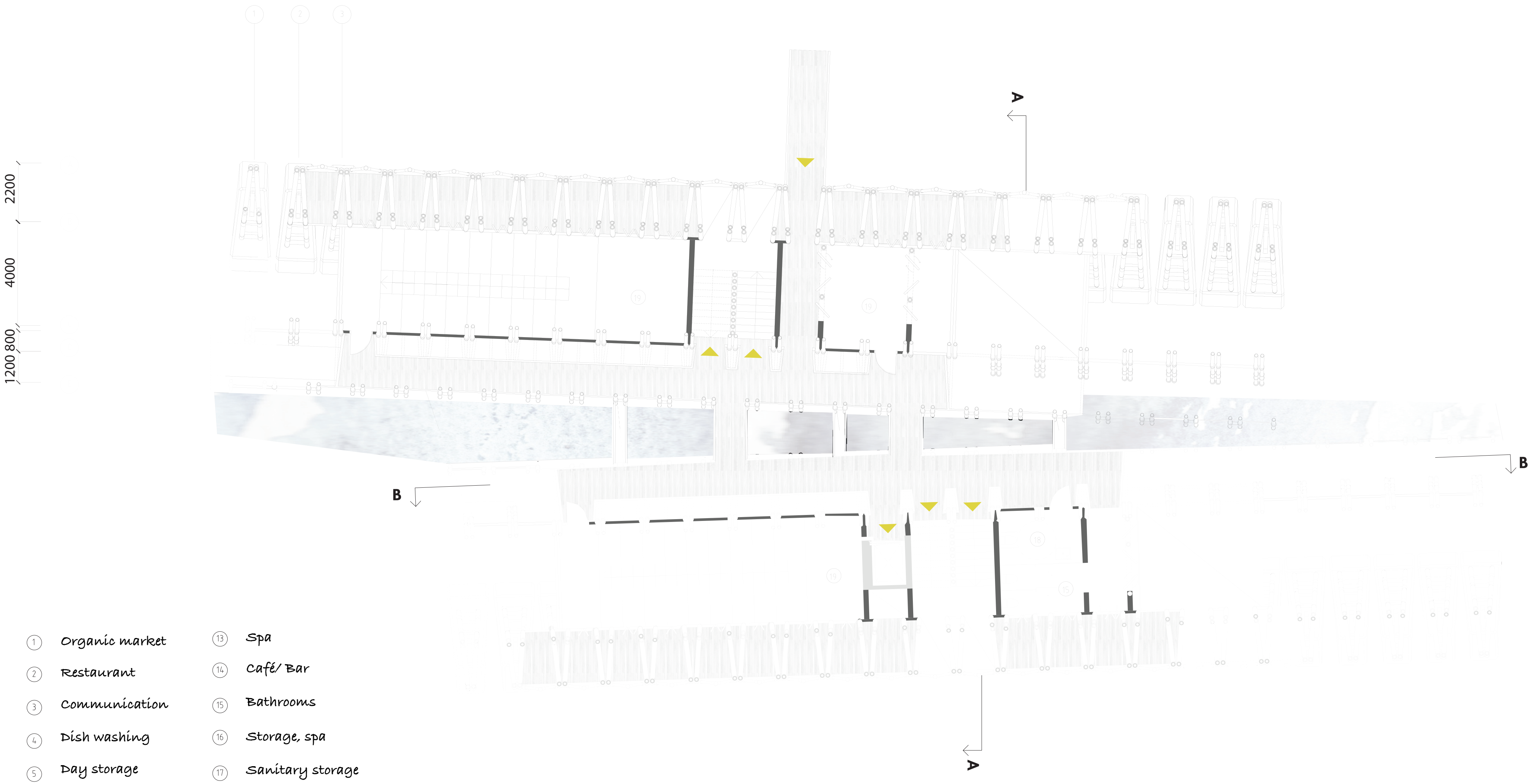
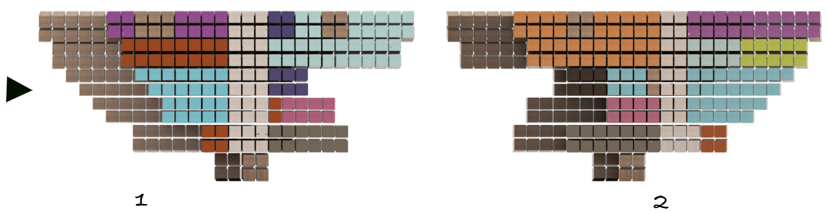




ENTRANCE LEVEL 53



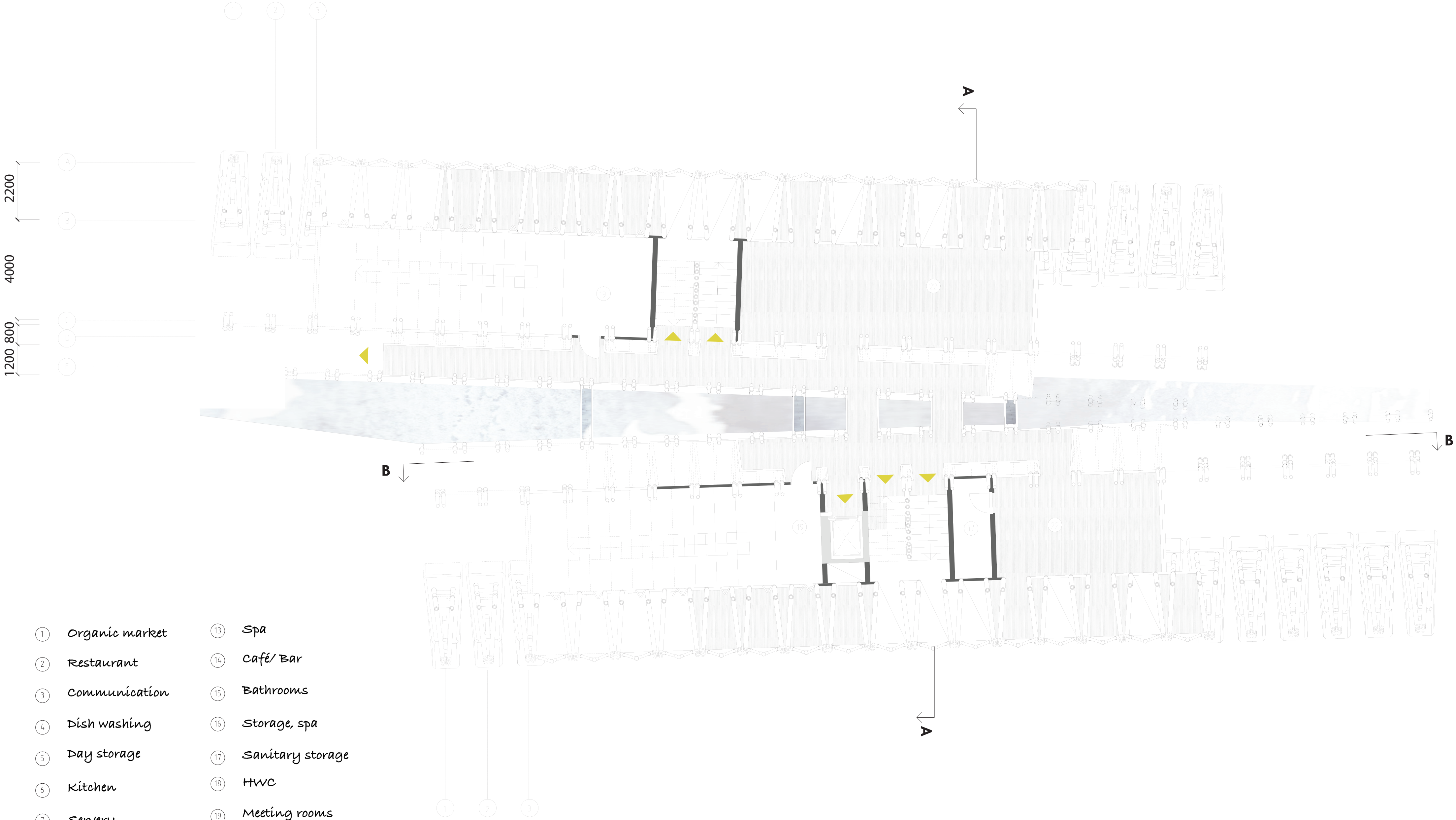
1. Organic market
2. Restaurant
3. Communication
4. Dish washing
5. Day storage
6. Kitchen
7. Servery
8. Entrance hall
9. Reception
10. Reception office
11. Storage, luggage
12. Café
13. Spa
14. Café/ Bar
15. Bathrooms
16. Storage, spa
17. Sanitary storage
18. HWC
19. Meeting rooms
20. Administration
21. Workshop
22. Exhibition space
23. Connecting bridge



SCALE 1:200

0 1 2 3 4 5 6 7 8 9 10 Meter

LEVEL -1



1. Organic market
2. Restaurant
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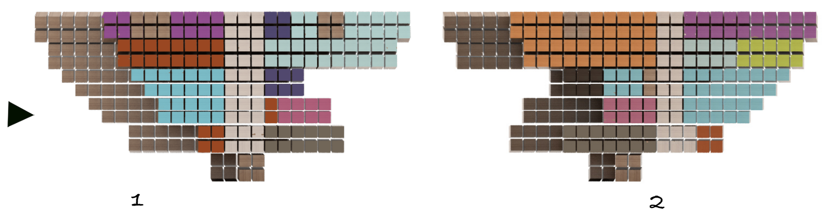
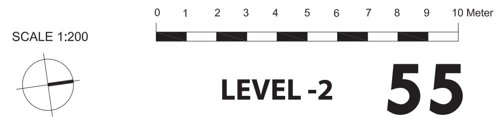
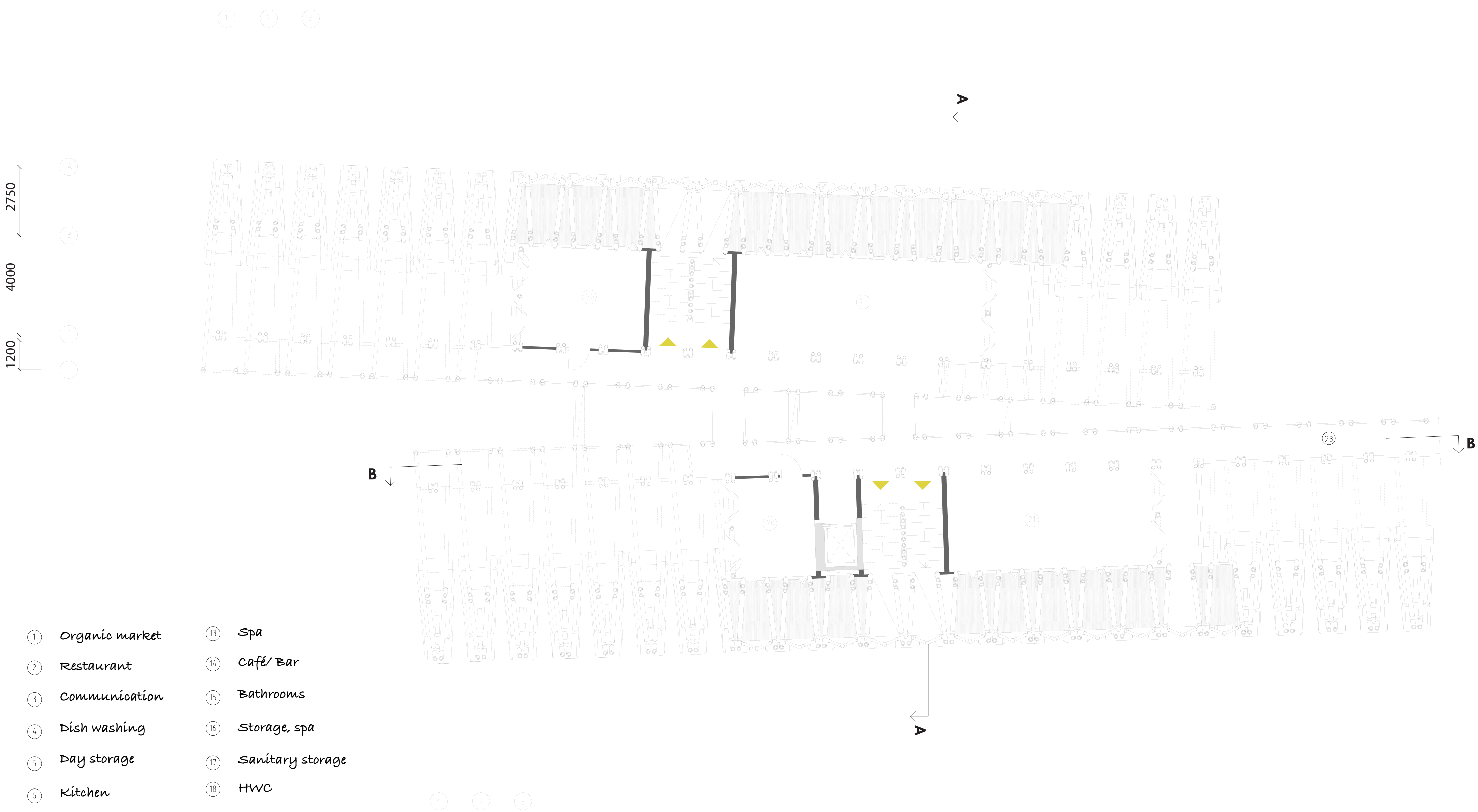
10. Reception office
11. Storage, luggage
12. Café
13. Spa
14. Café/ Bar
15. Bathrooms
16. Storage, spa
17. Sanitary storage
18. HWC
19. Meeting rooms
20. Administration
21. Workshop
22. Exhibition space
23. Connecting bridge





LEVEL -2



1 Organic market
2 Restaurant
3 Communication
4 Dish washing
5 Day storage
6 Kitchen
7 Servery
8 Entrance hall
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10 Reception office
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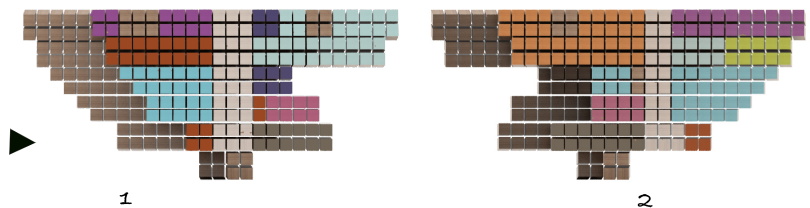

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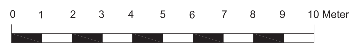
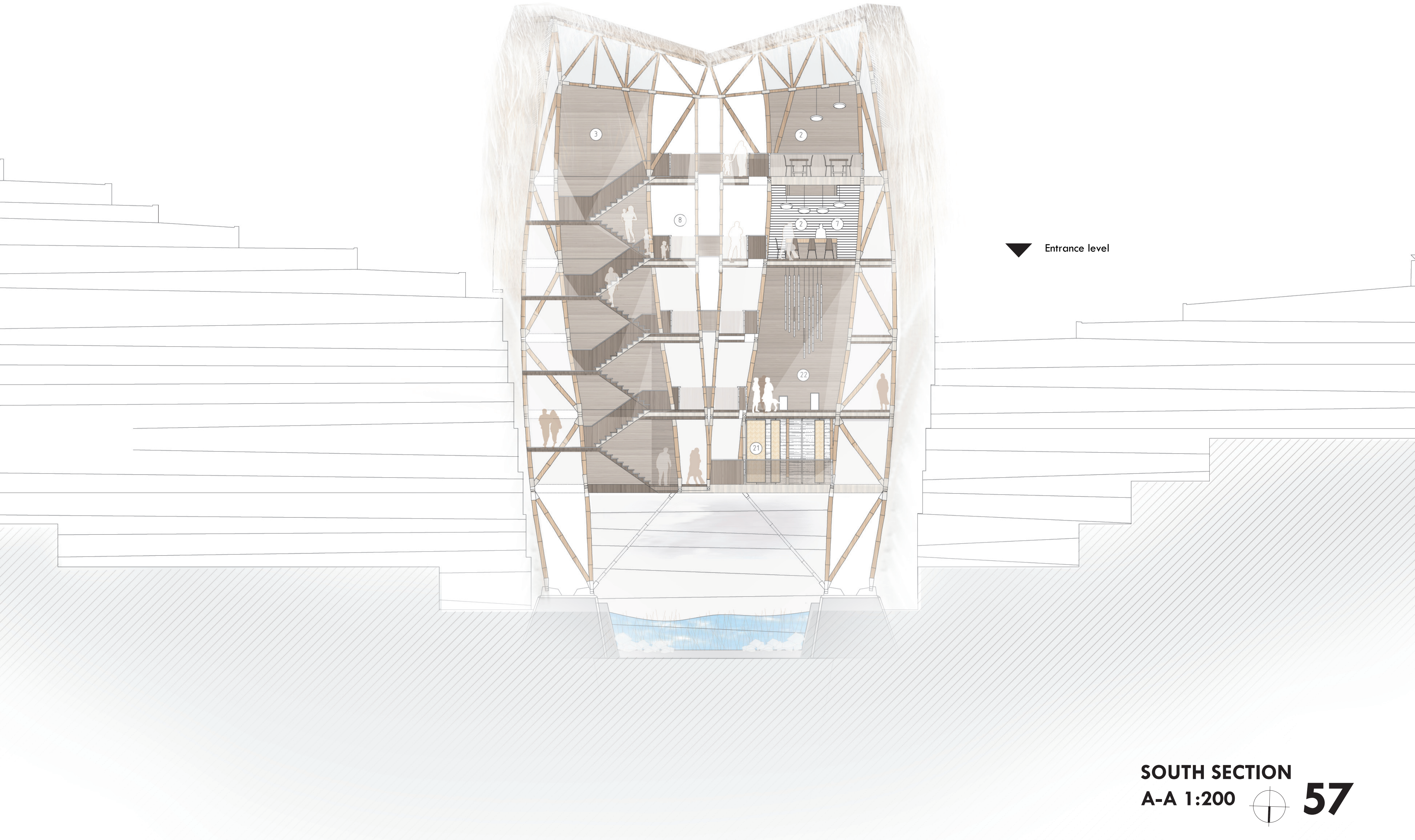
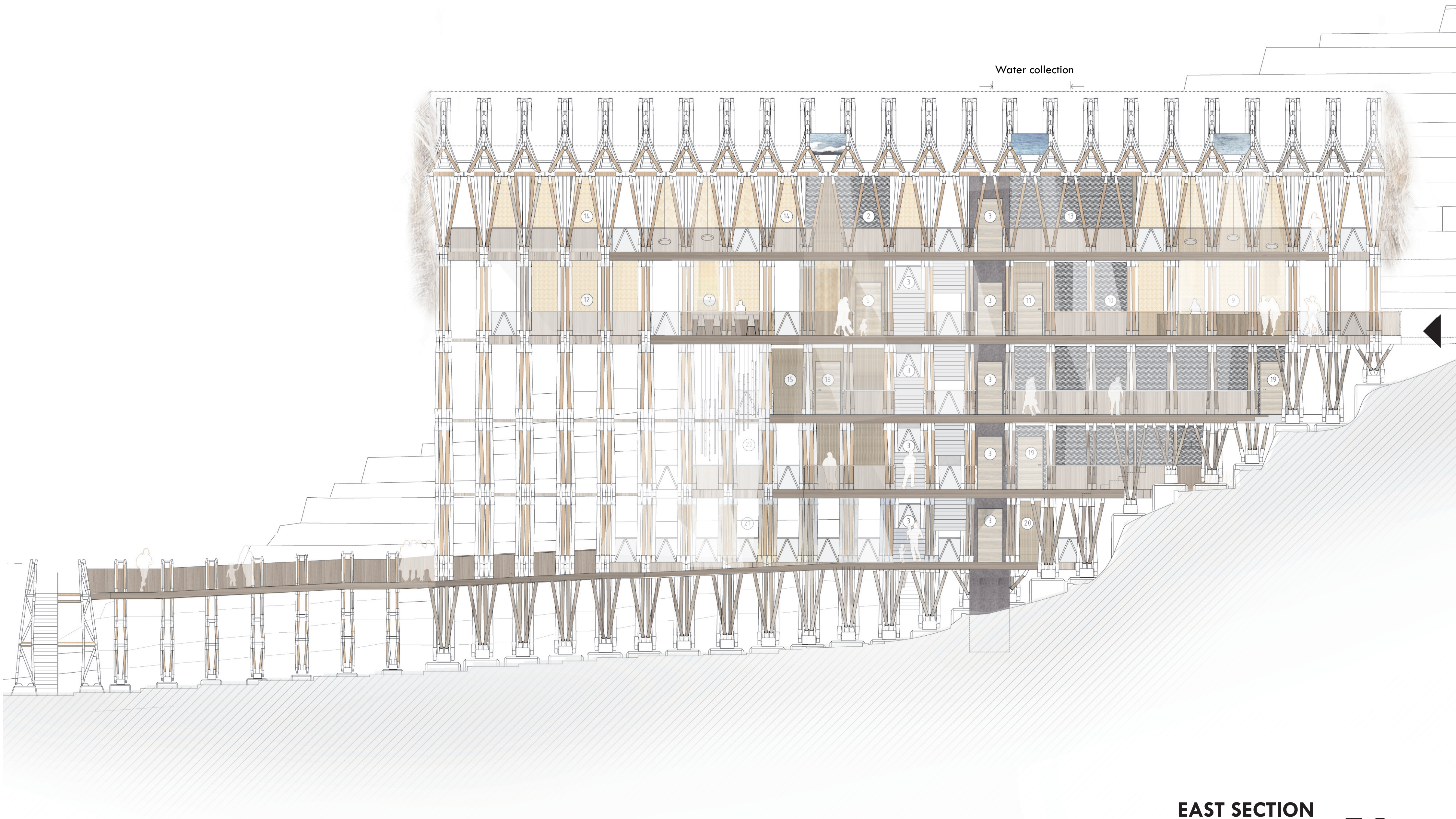


LEVEL -3



SOUTH SECTION
A-A 1:200

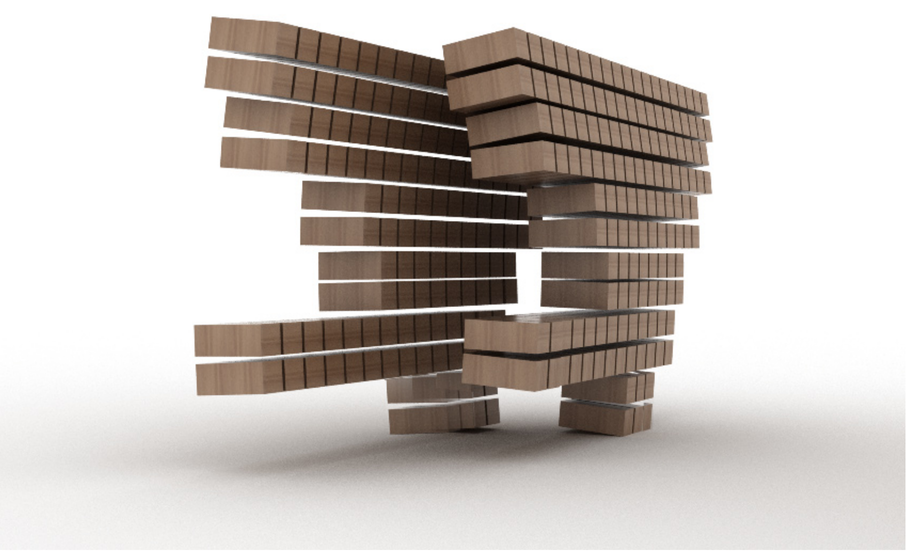


EAST SECTION
B-B 1:200

View of the entrance hall

The café

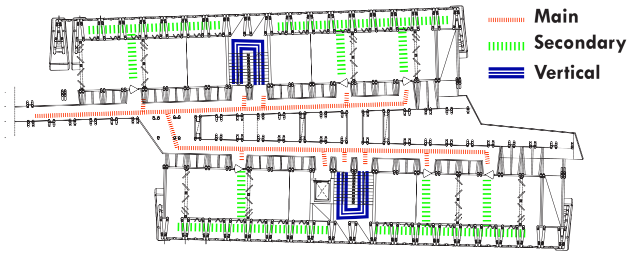
View of one meeting room



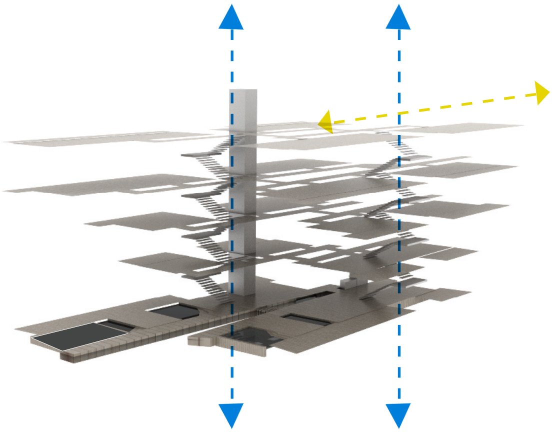
View of functional space.

Accommodation:

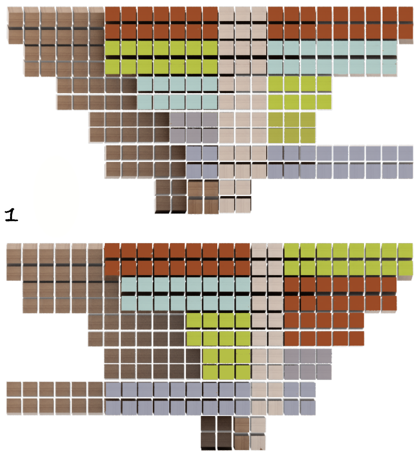
The building contains 14 different variations of rooms, single bedrooms, units with living room and terrace and the possibility of 1-3 bedrooms. The layout is planned with communication placed public and central to ensure flexibility and rooms can be pared up together or rented out separately. From the entrance floor the stairs or elevator brings the guests to the rooms or to the natural pool area or kitchen unit.

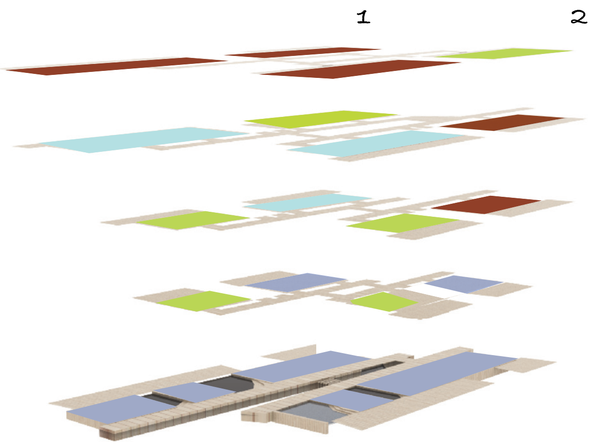


Typical circulation



Circulation:
Two central blocks serves the building with communication, leading down to the common natural pool facilities or the landscape below.





A **Type A**
Total: 251,6 sqm

B **Type B**
Total: 142,8 sqm

C **Type C**
Total: 197,2 sqm

Public space
Total: 177,2 sqm

Level +1:
Type A: 61,2 sqm
Type A: 47,6 sqm
Type A: 61,2 sqm
Type C: 54,4 sqm
Total: 224,4 sqm
(+ communication)

Entrance level:
Type A: 47,6 sqm
Type B: 54,4 sqm
Type B: 54,4 sqm
Type C: 47,6 sqm
Total: 231sqm
(+ communication)

Level -1:
Type A: 34 sqm
Type B: 34 sqm
Type C: 27,2 sqm
Type C: 27,2 sqm
Total: 122,4 sqm
(+ communication)

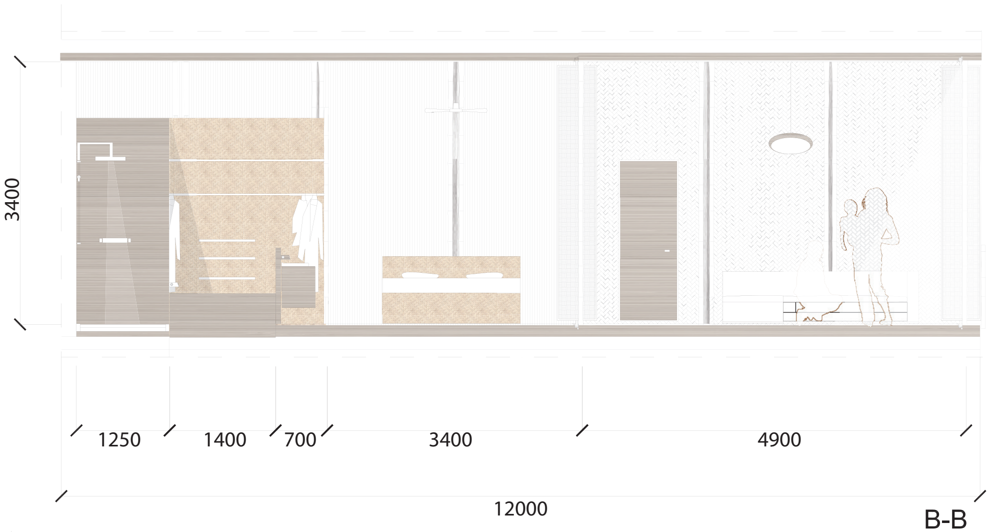
Level -2:
Type C: 20,4 sqm
Type C: 20,4 sqm
Kitchen unit: 20,4 sqm
Storage: 6,8 sqm
Total: 68 sqm
(+ communication)

Level -3:
Natural bath facilities: 150 sqm
Total: 150 sqm
(+ communication)

level - 4:
Storage:27,5 sqm

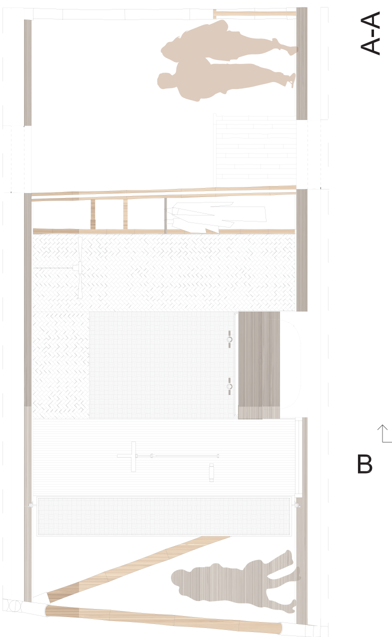
The typologies:

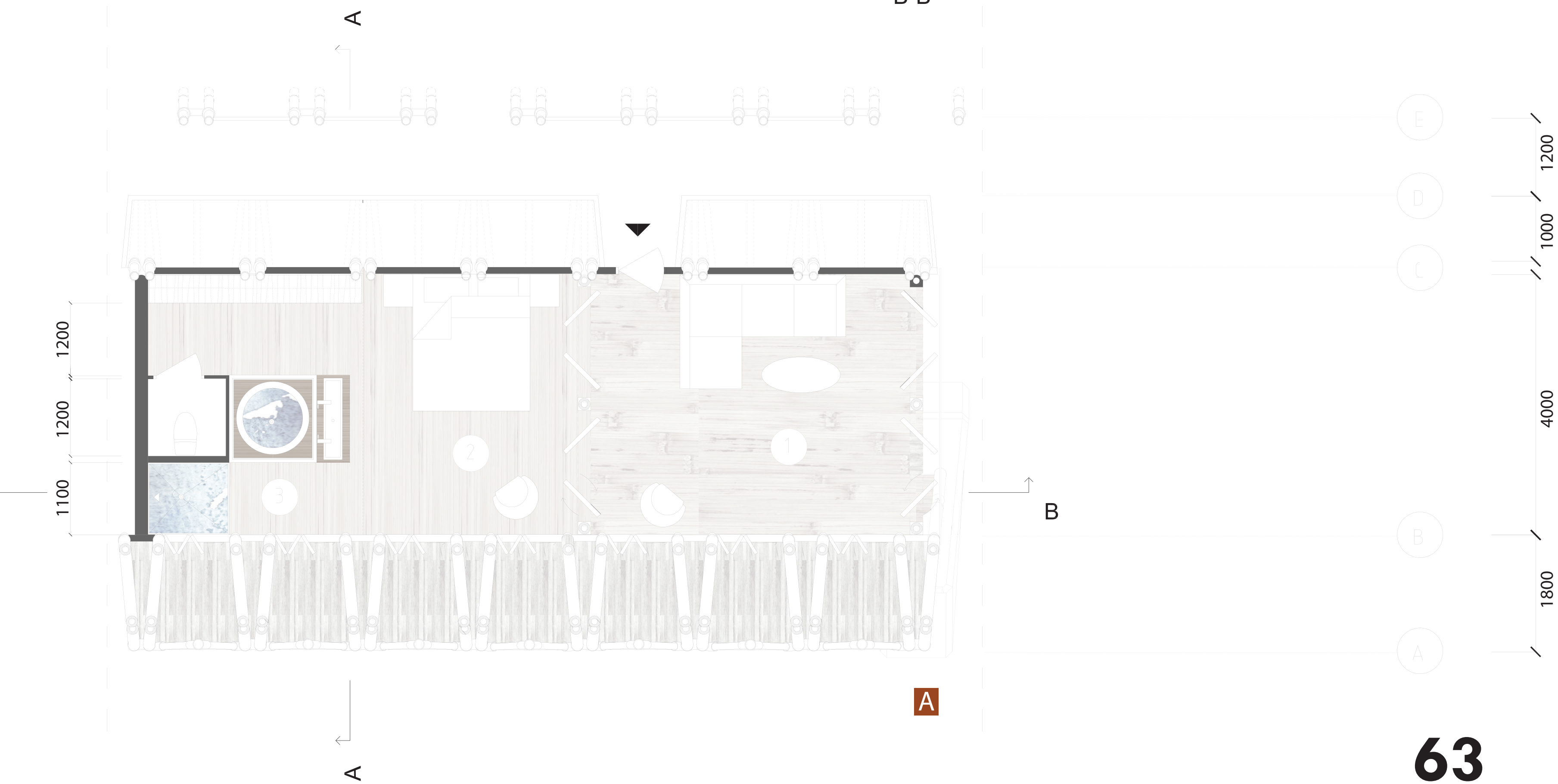
The typologies consist of a bathroom and bedroom unit with the possibility to be combined with a living room and terrace space. Following plans are examples of combinations.



Typology **A**

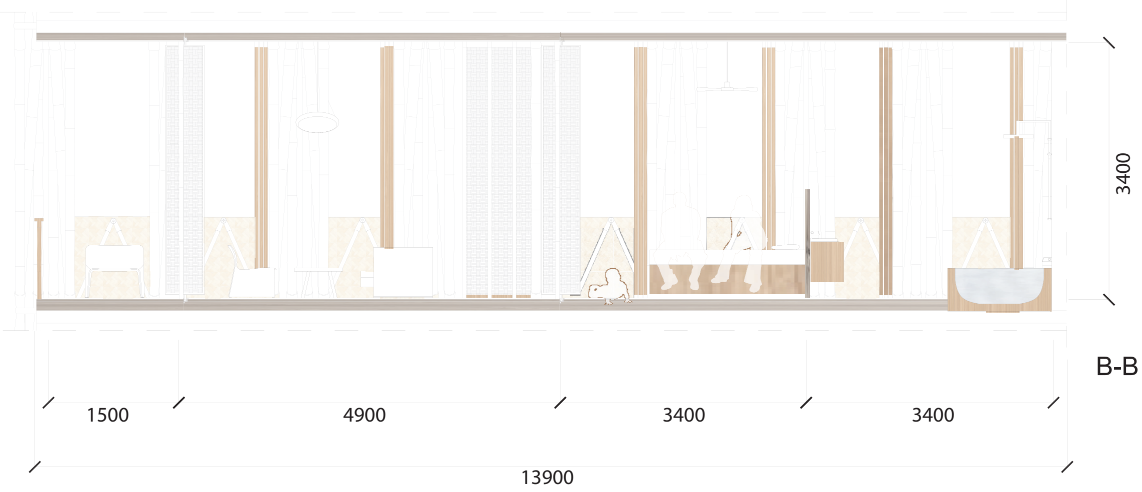
1. Living room 20,4 sqm
2. Bed room 13,6 sqm
3. Bathroom 13,6 sqm

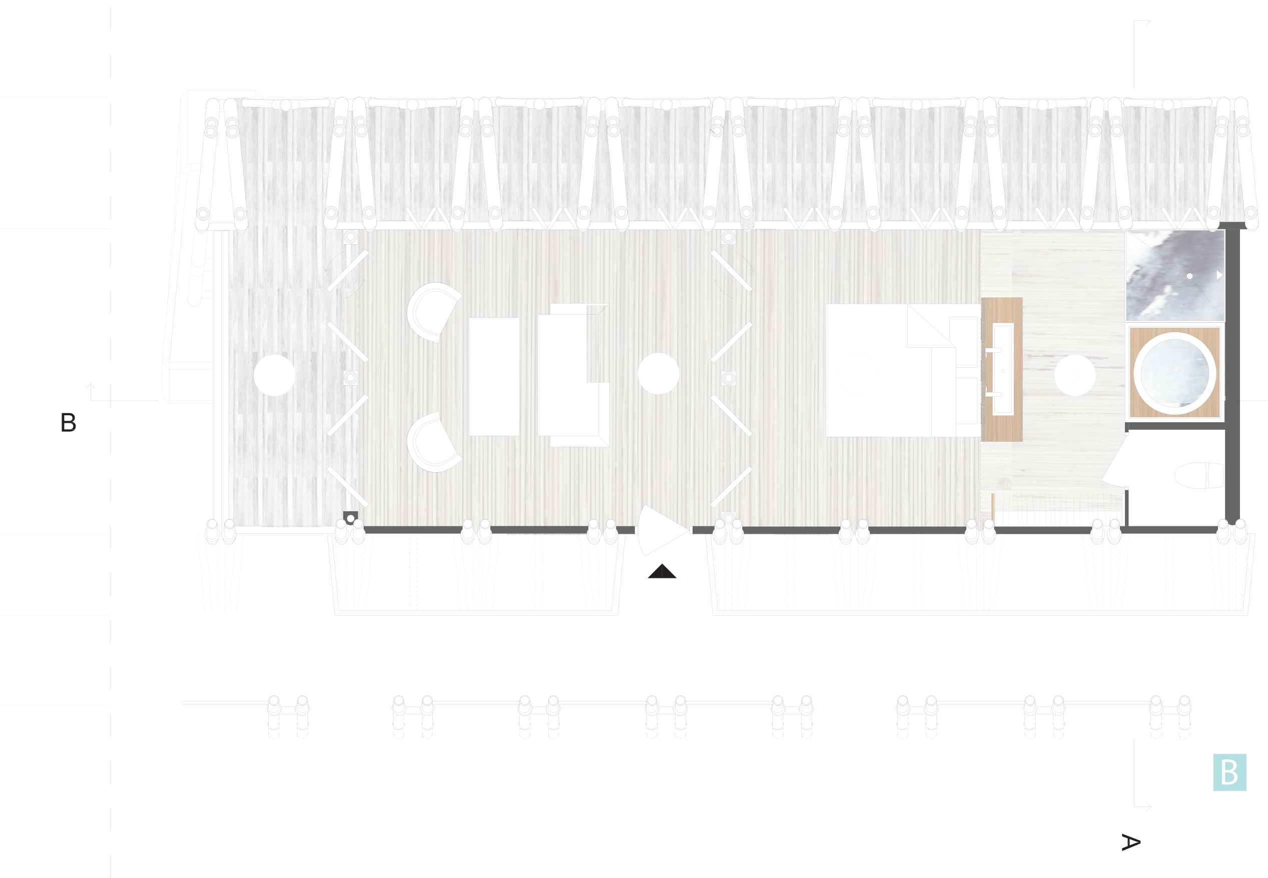


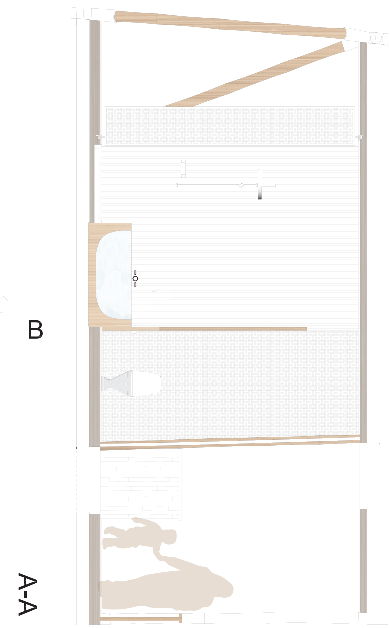


Typology B

1. Living room 20,4 sqm
2. Bed room 13,6 sqm
3. Bathroom 13,6 sqm
4. Terrace 6,8 sqm





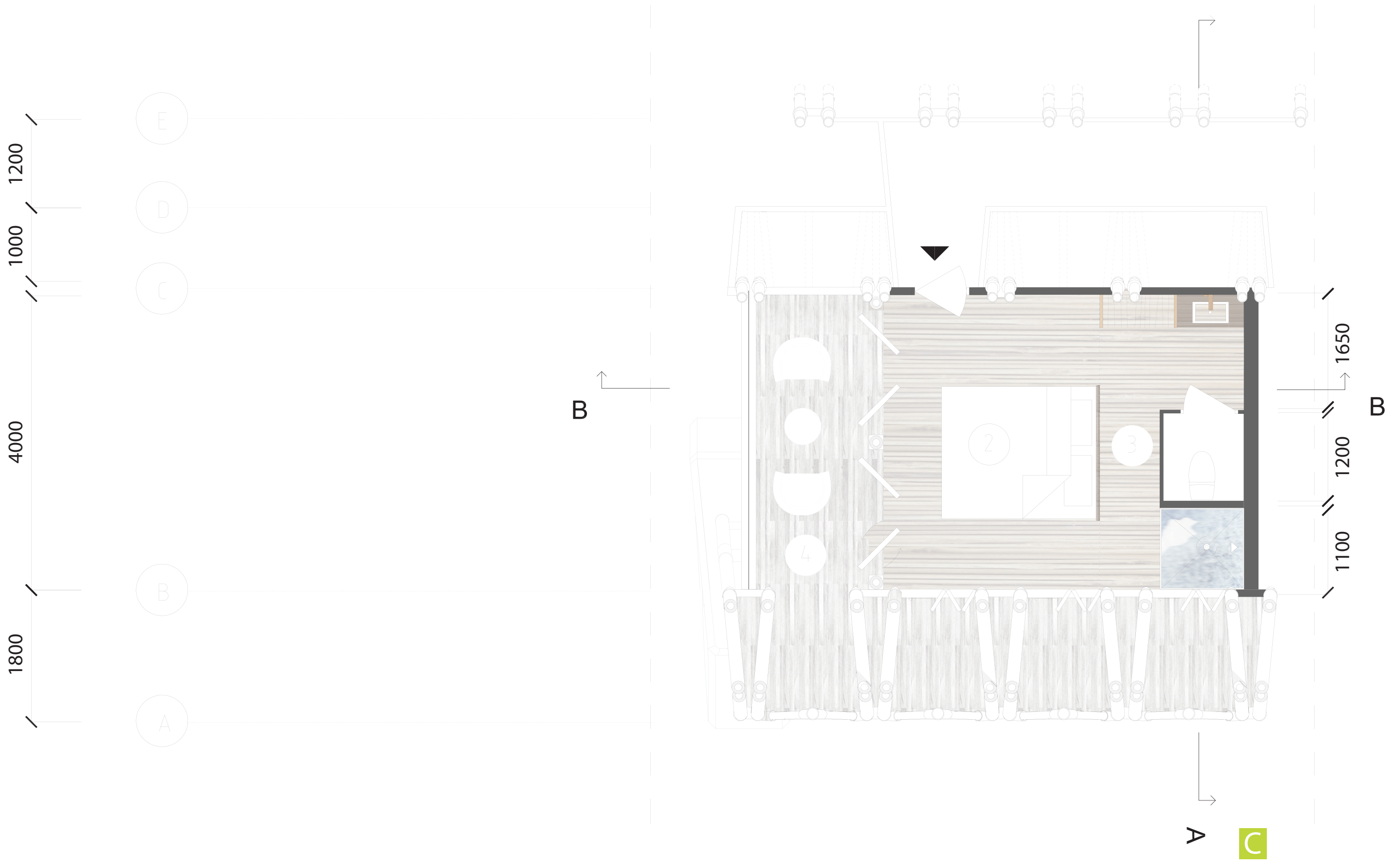


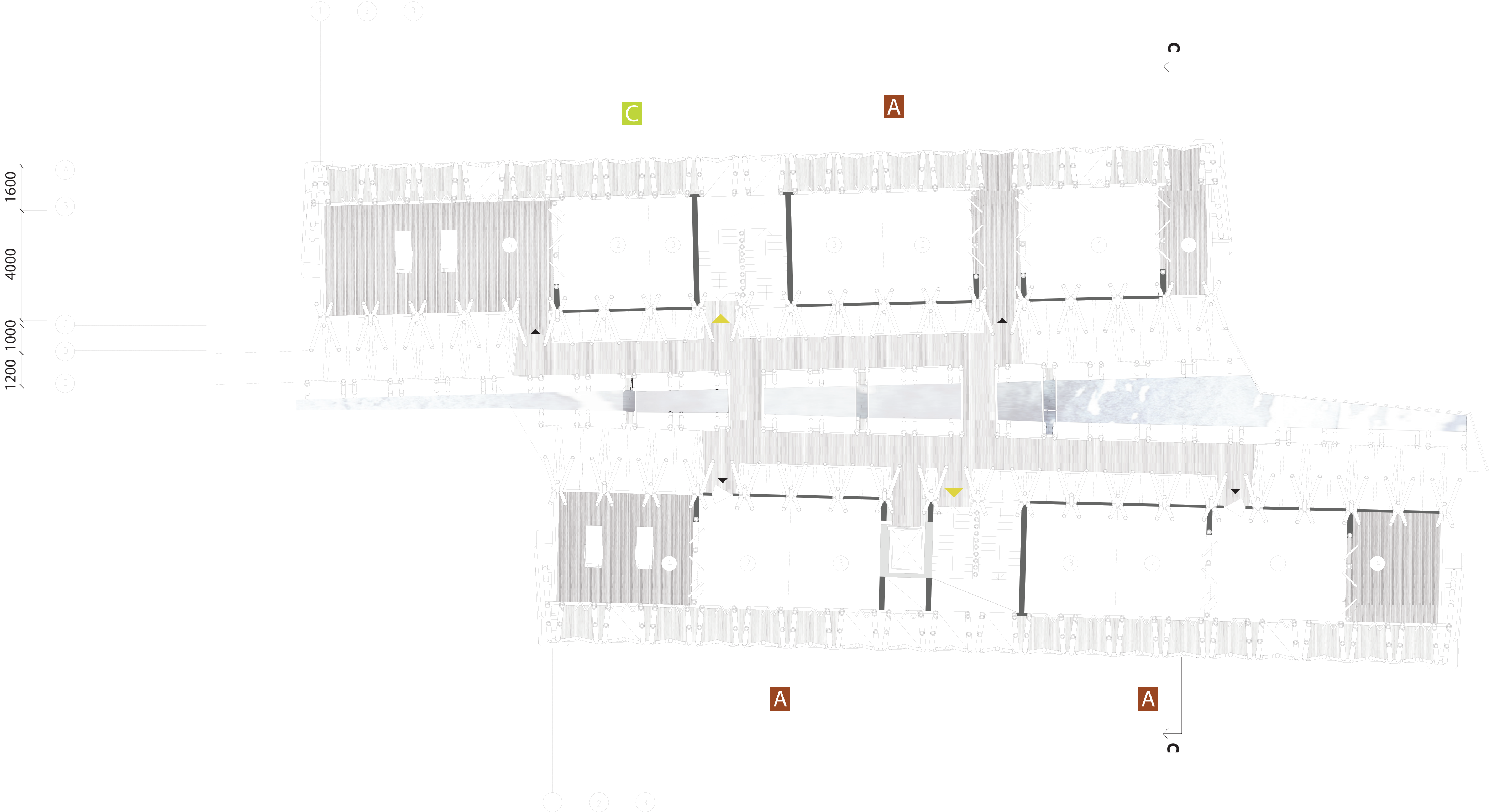
Typology C

(2) Bed room 12,4 sqm

(3) Bathroom 8 sqm

(4) Terrace 6,8 sqm



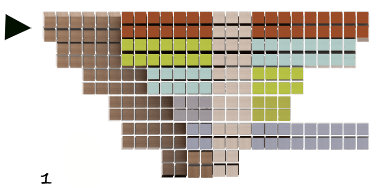


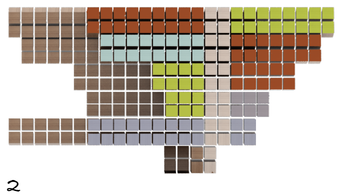
1 Living room

2 Bed room

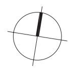
3 Bathroom

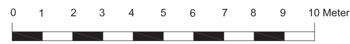
4 Terrace



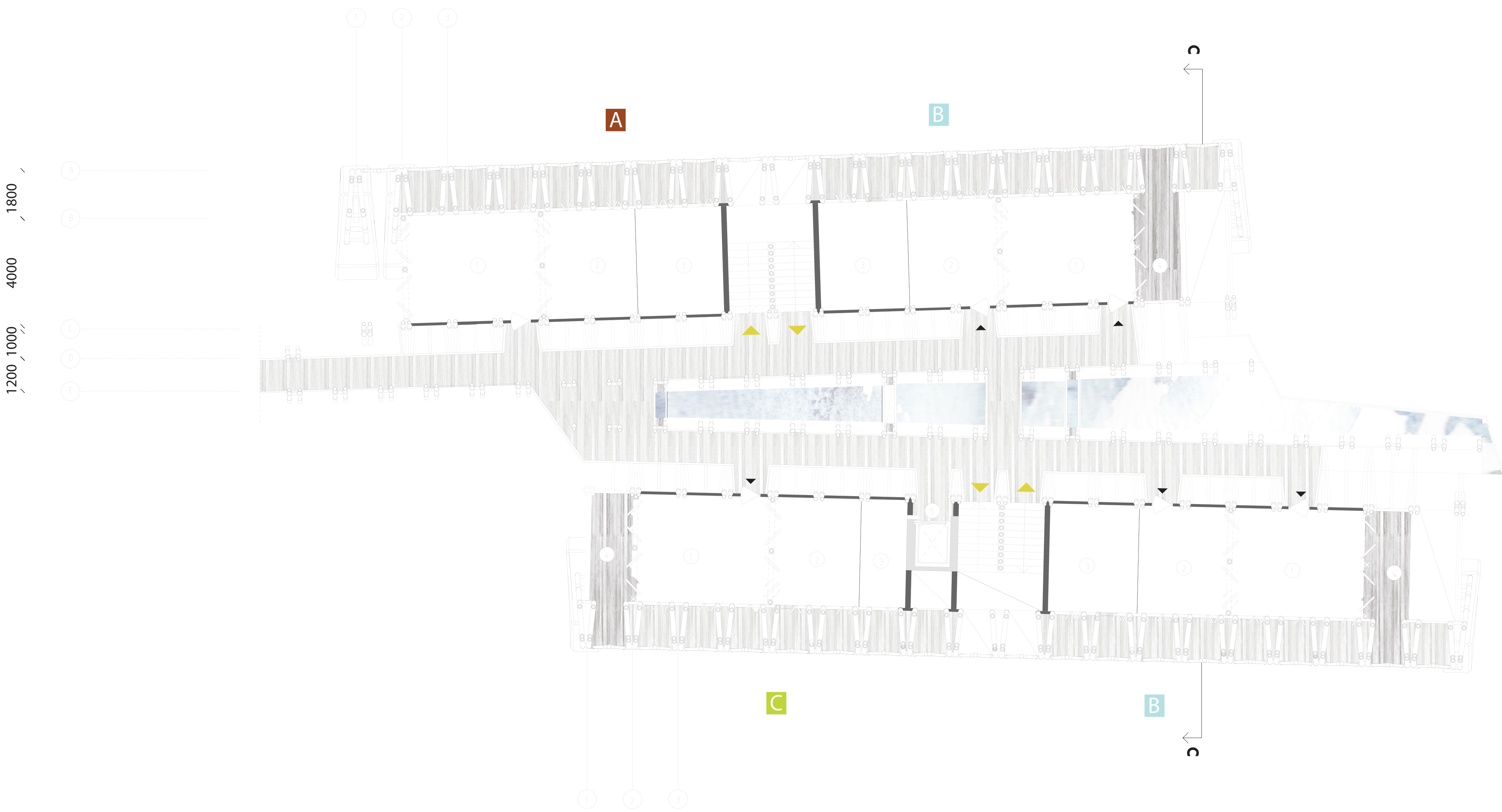


SCALE 1:200





LEVEL +1

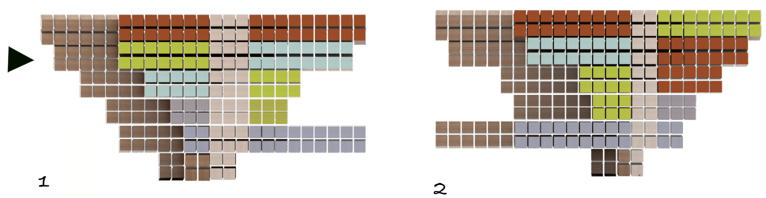


1 Living room

2 Bed room

3 Bathroom

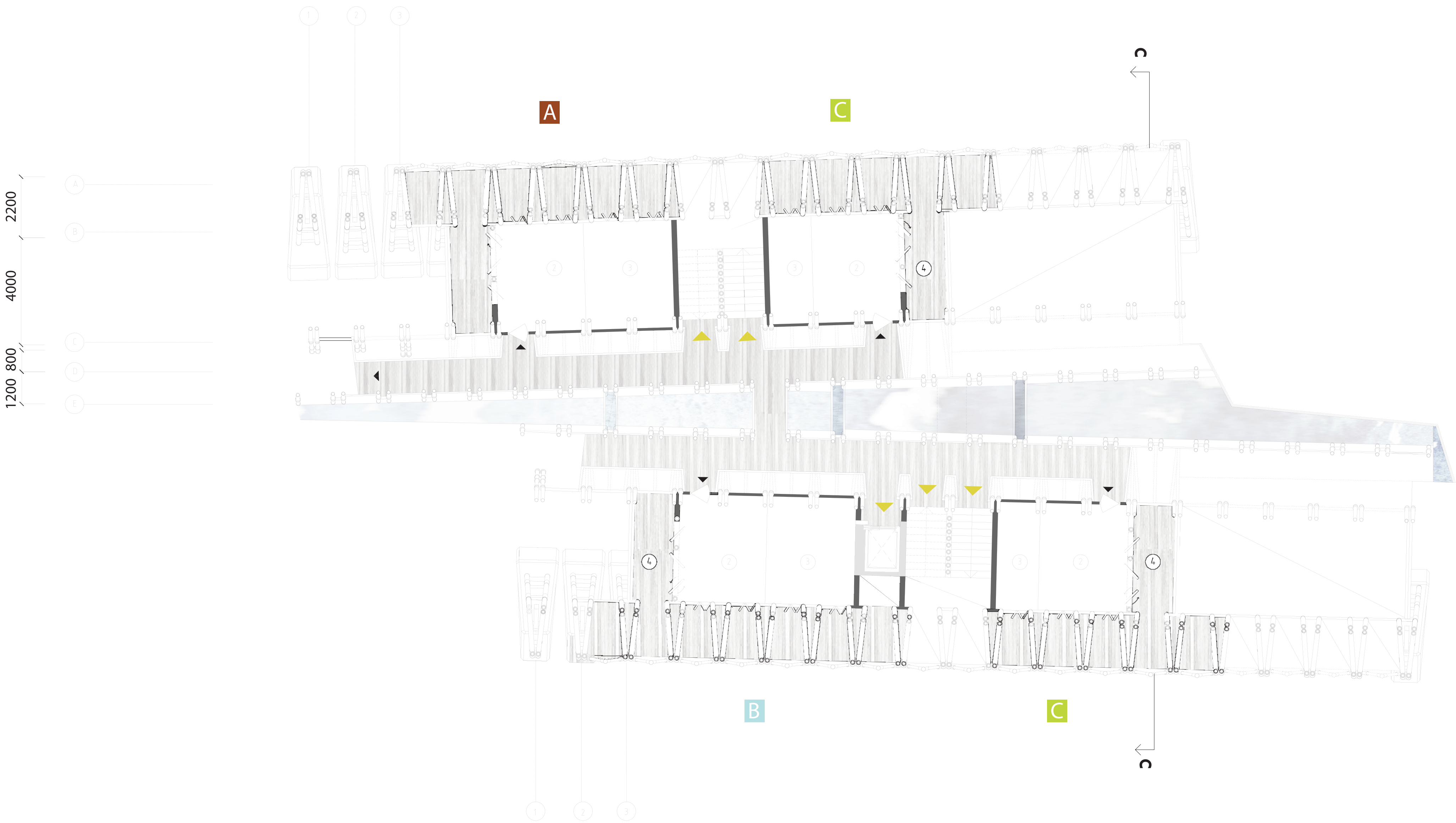
4 Terrace



SCALE 1:200

0 1 2 3 4 5 6 7 8 9 10 Meter

ENTRANCE LEVEL

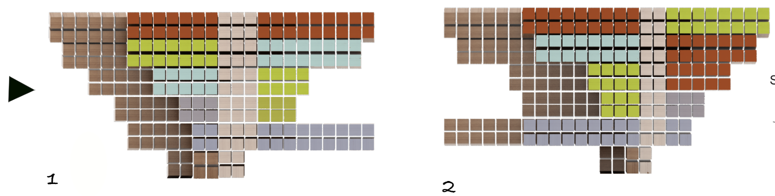


1 Living room

2 Bed room

3 Bathroom

4 Terrace



SCALE 1:200

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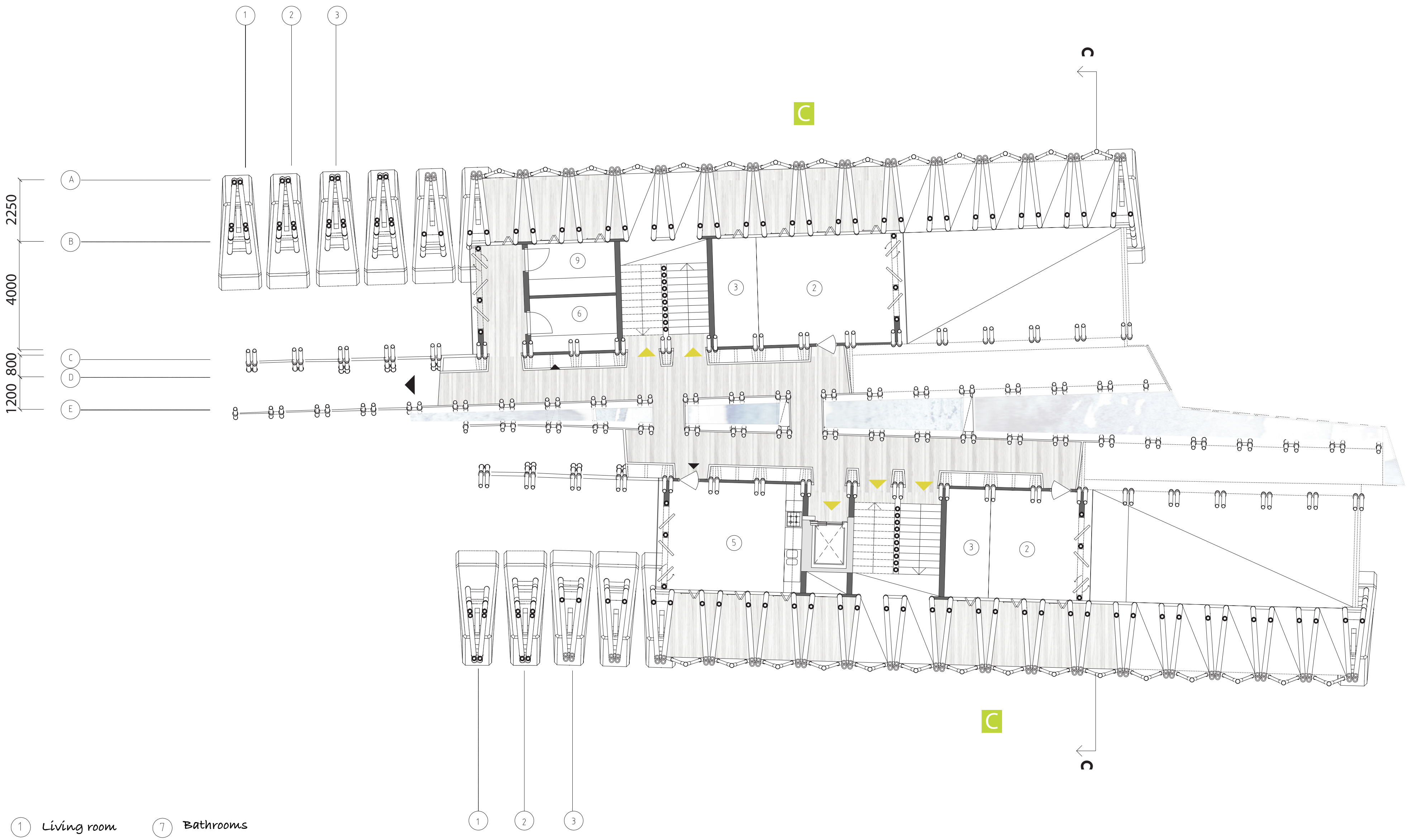
LEVEL -1



1 Living room

2 Bed room

3 Bathroom

4 Terrace

5 Kitchen

6 Storage space

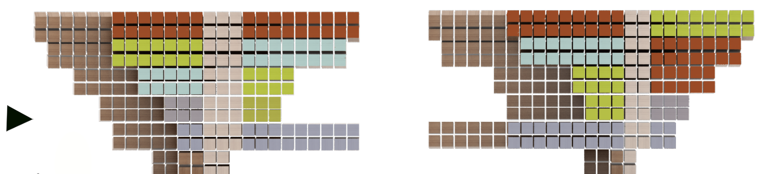
7 Bathrooms

8 Showers

9 Sanitary storage

10 Natural pool area

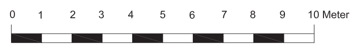
11 Bath/ showers



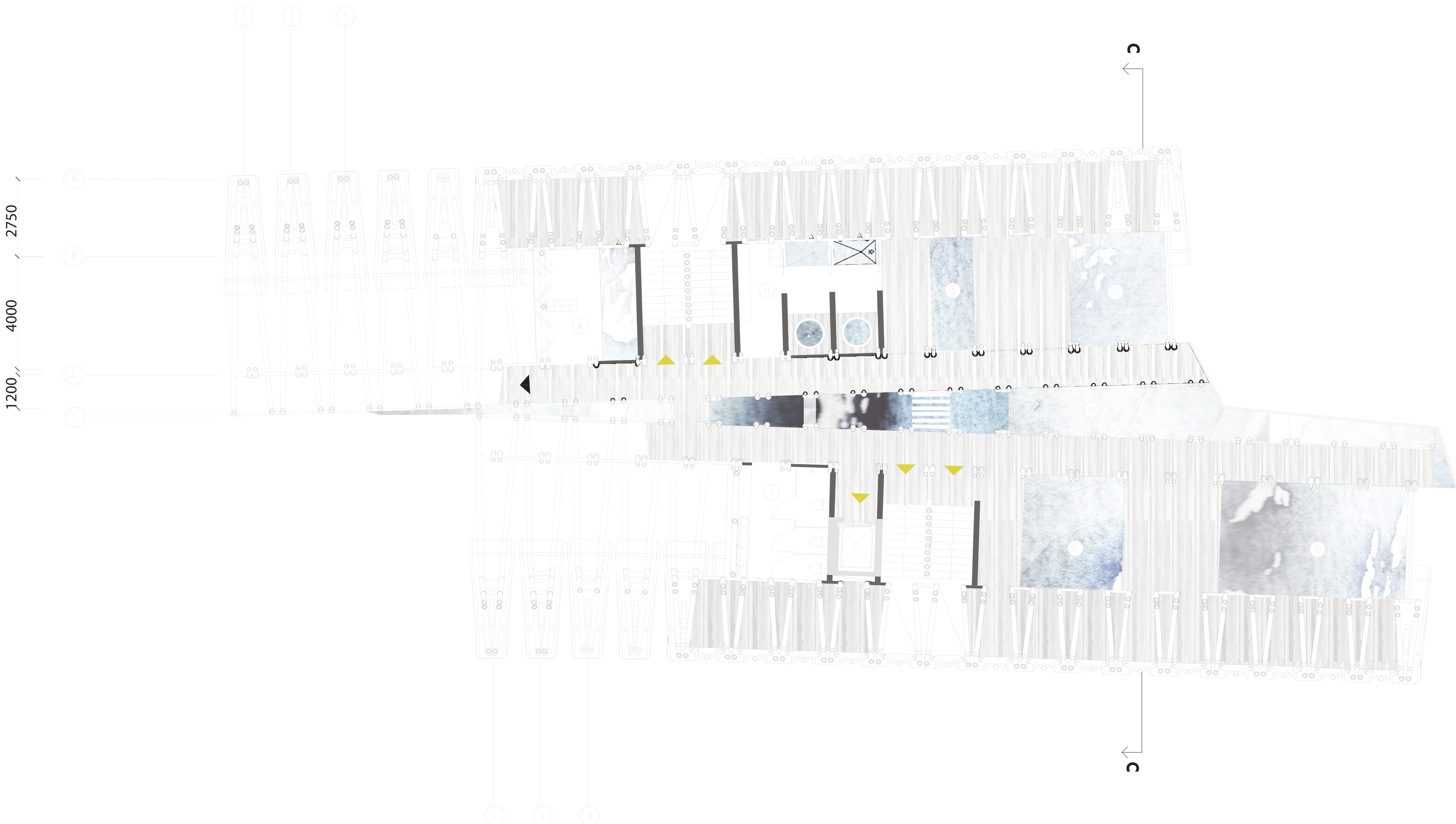
1

2

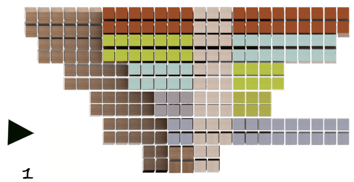
SCALE 1:200



LEVEL -2



1. Living room
2. Bed room
3. Bathroom
4. Terrace
5. Kitchen
6. Storage space
7. Bathrooms
8. Showers
9. Sanitary storage
10. Natural pool area
11. Bath/ showers



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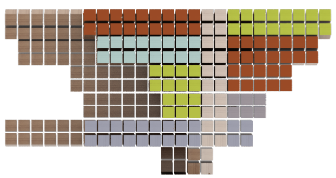
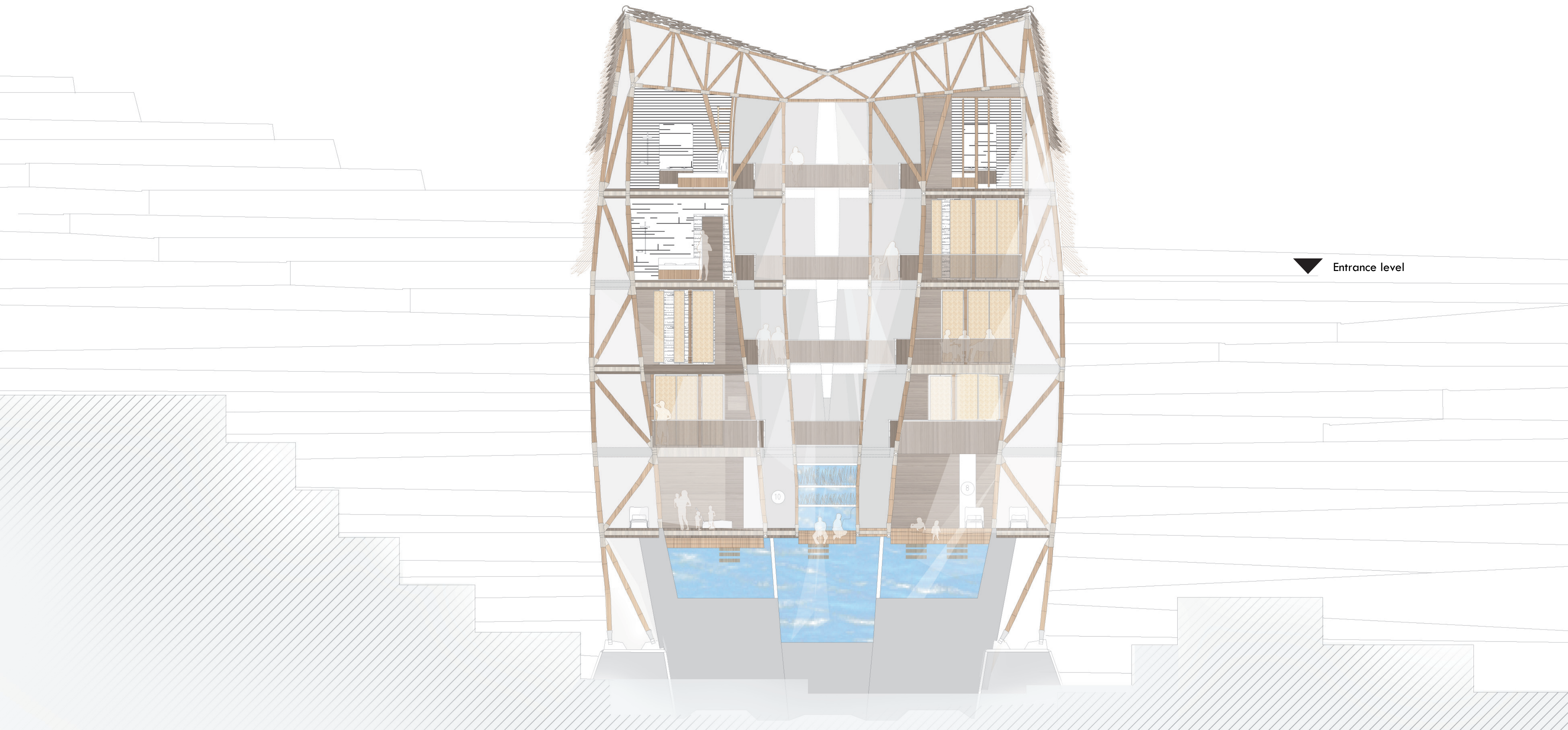


2

SCALE 1:200

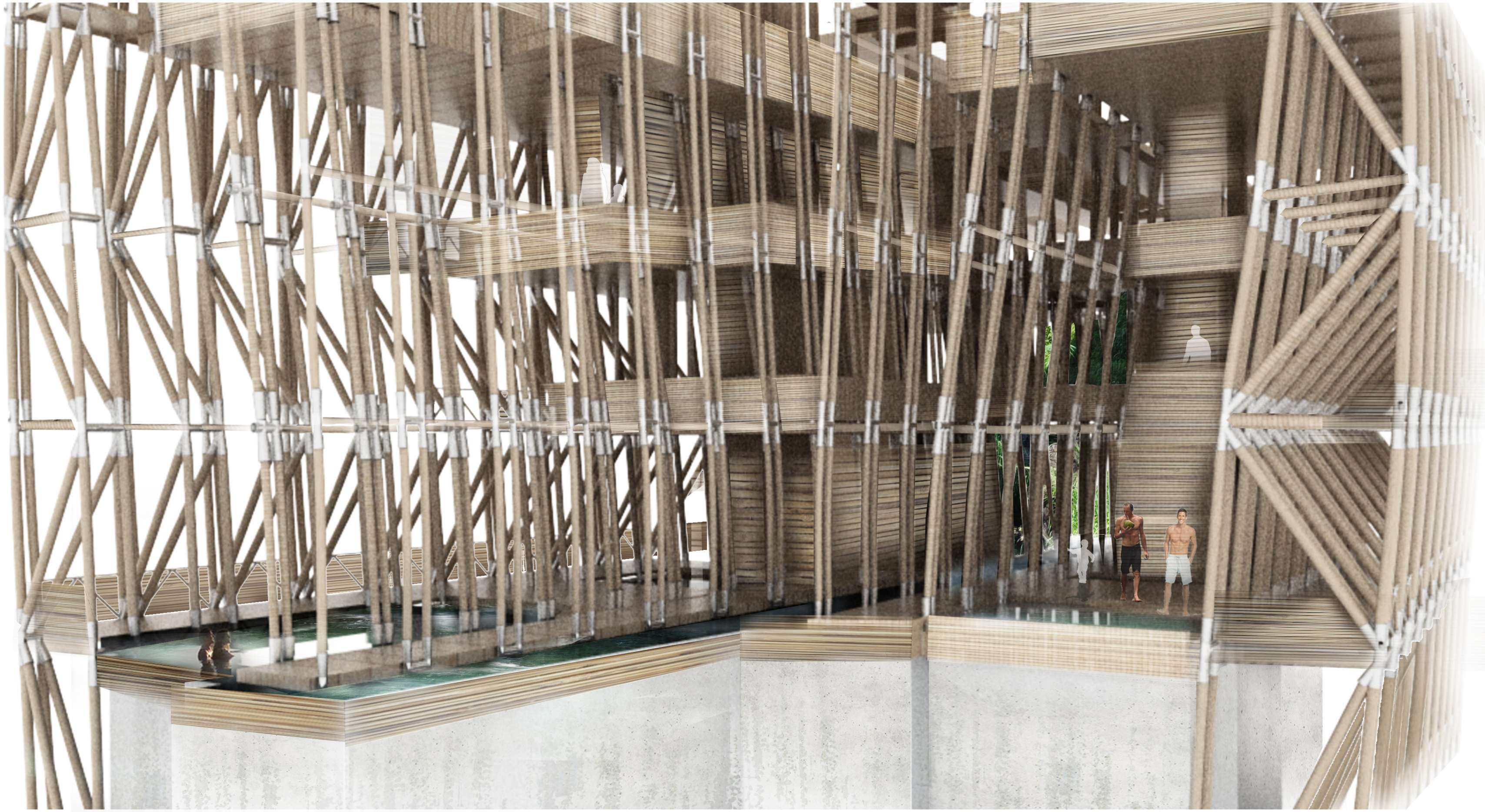
0 1 2 3 4 5 6 7 8 9 10 Meter

LEVEL -3



WEST SECTION
C-C 1:200

View of the natural bath



View of the natural bath

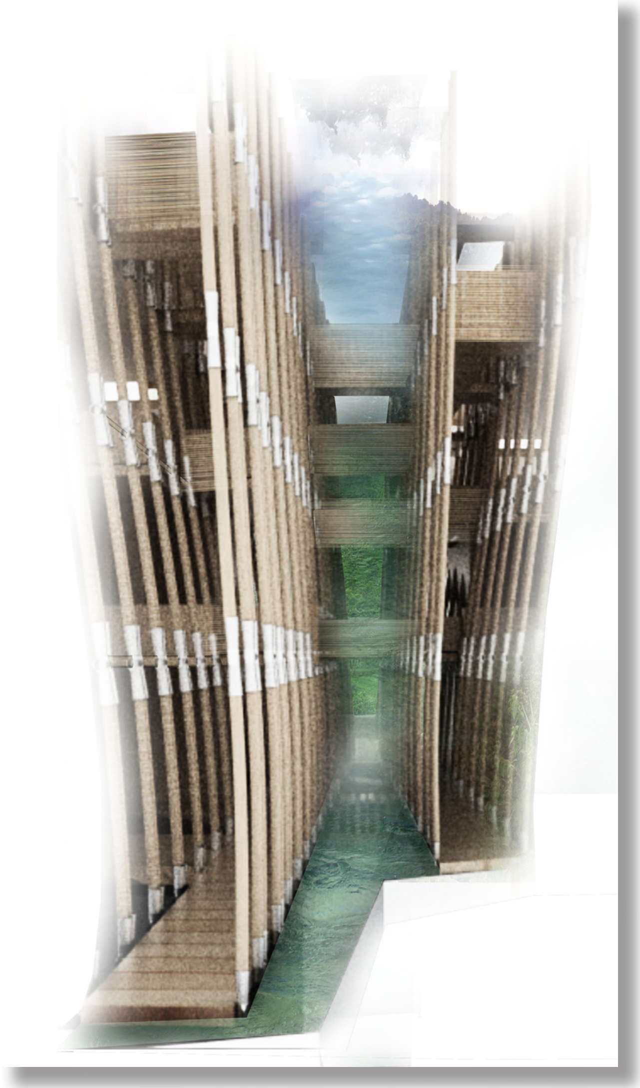


Diagram of the hearth of the building

6. CONCLUSION

Thoughts and insights

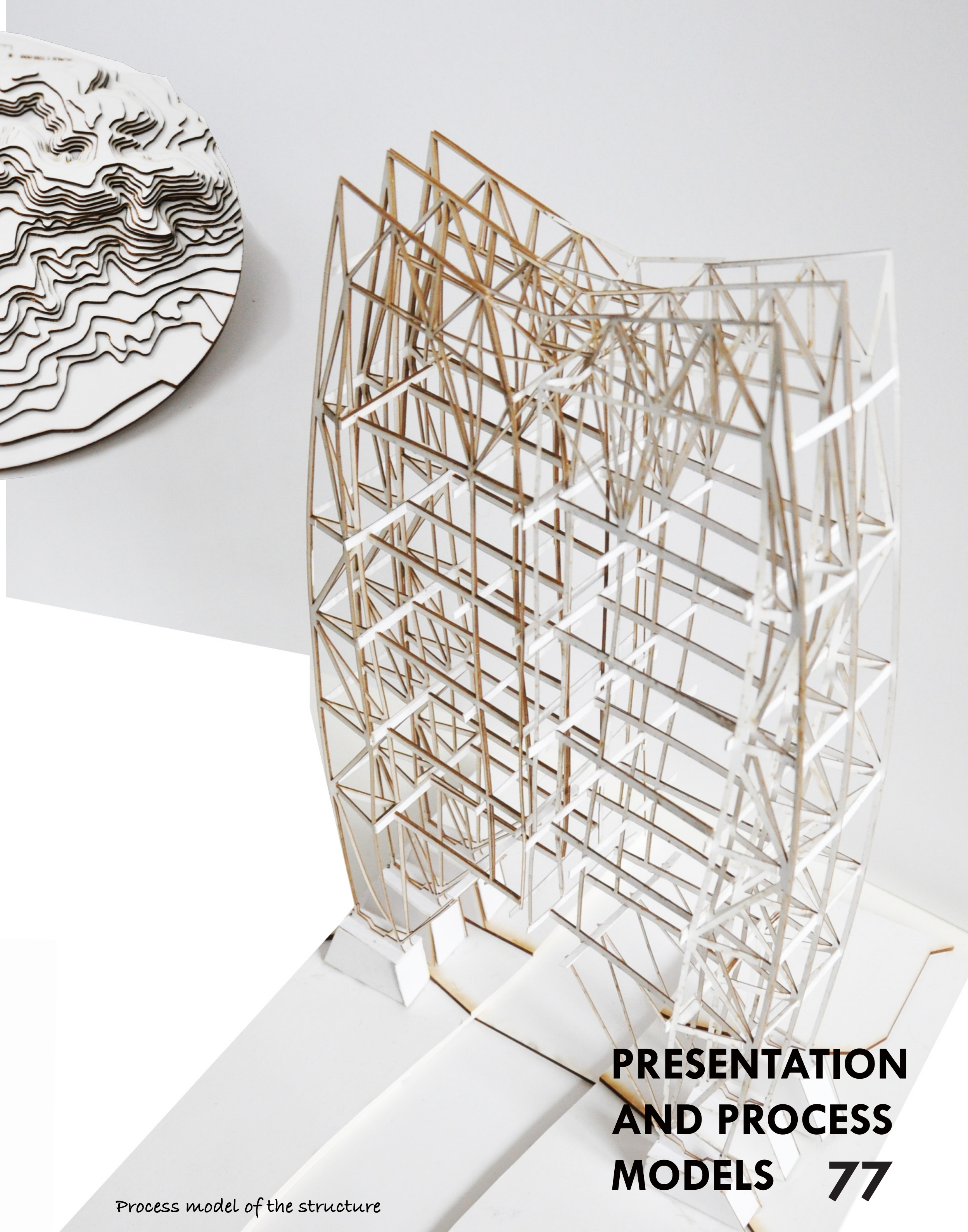
The loss of traditions and local knowledge expose people for disasters, especially in poor and rural communities. I believe to be able to create a better response and to become less vulnerable the understanding and acceptance of disasters as natural phenomena, that is part of a natural cycle is an important factor for future planning. Where we don't believe in man over nature.

A high demand for materials bamboo, being the quickest growing plant in the world, extremely renewable and easy to process in large quantities, without big machinery, can be a solution in the areas where it grows in abundant. Especially in rural communities, with the possibility to adapt the building techniques to the surroundings they are set in. Where a different view of life span of buildings is important with flexibility and reversibility and where accessible and adapted materials are key points.

But to change the trend and to reintroduce the material we have to continue to encourage contemporary architecture and design and demonstrate the potential of bamboo and natural materials as building materials. Also guidance in farming, treatment and building techniques of bamboo are of importance, so the material can remain local and still be an economical choice.

View of Mount Salak

Top view of the site



Process model of the structure

PRESENTATION AND PROCESS MODELS

Green School, Ibuku

The school opened its doors in September 2008 with around 100 pupils and a tailor made campus that had only recently emerged from the jungle and rice fields. Since then it has grown physically and in student numbers. John Hardy, a Canadian art student who was as creative as he was intuitive, made his way to Bali in 1975. Intrigued by the Balinese craft traditions, he settled there and began producing jewellery with local artisans. Together with his wife, Cynthia, they started the architectural firm Ibuku, and created this bamboo school, learning and experimenting with bamboo.

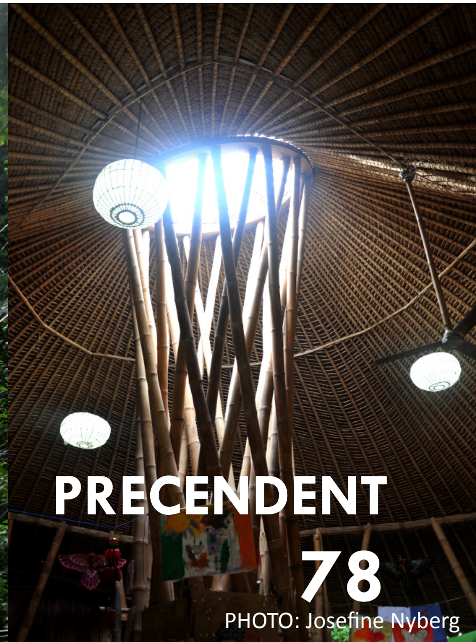


PHOTO: Josefine Nyberg

Green Village, Ibuku

Elora Hardy is the architect behind the team of Ibuku today, and their recent project is the Green village set within a rural landscape along Bali's Ayung river, Green Village is a planned community based on design concepts and sustainable principles established by the artisans and craftsmen that built Green School. Here we find spacious private bamboo villas up to five floors.

PHOTO: IBUKU

Outward Bound Indonesia,

OBI Eco Campus, training and teambuilding, located in Jatiluhur, West Java. Designed by Andry Widyowijatnoko

Bamboo restaurant buildings, Bali
Ptgreenhome, Oliver Toquet

Bamboo chocolate factory, Ibuku, Bali.

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