MAUNA KEA VIS

REDESIGN

DIPLOMARBEIT

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TECHNISCHE UNIVERSITÄT WIEN
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DIPLOMARBEIT

MAUNA KEA VIS
REDESIGN

zur Erlangung des akademischen Grades einer Diplom-Ingenieurin
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Abstract EN

Mauna Kea is a mountain attracting mainly three kinds of user groups in conflict with each other: Culture, Science and Tourism all have various ways of interacting with the area, resulting in different demands concerning the structures and behaviors on site.
The search for common values is the first step for a successful synergy between those parties. By creating a structure that offers a stage for every one of them, meeting their expectations and needs, a constructive, cooperative and respectful behavior is promoted, leading to the advantage of interdisciplinary collaboration that benefits all groups.

The proposed design considers requirements and assets of the three involved viewpoints, combining them under one single roof. It offers space for an open dialogue and enhances appropriate behaviors, mindful of the expectations and needs of the respective other user groups. Additionally, it provides functions, mechanisms and a room schedule that incorporates the demands of all participants.
The project defines itself as a Visitor Information Station, focusing on the main desire of all its users: providing and gaining information.

Abstract DE

Mauna Kea zieht drei große Benutzergruppen an, die jeweils verschiedene Ansprüche an den Berg stellen. Kultur, Wissenschaft und Tourismus haben teilweise sehr unterschiedliche Vorstellungen von angebrachten oder notwendigen Verhaltensweisen und Strukturen vor Ort, und stehen deshalb seit einiger Zeit in Konflikt miteinander.
Um der angespannten Situation zu einem konstruktiven Umfeld zu verhelfen, ist in einem ersten Schritt vor allem die Suche nach gemeinsamen Werten zu fördern.
Ein Ort, der Erwartungen und Bedürfnisse aller Parteien erfüllt, begünstigt eine produktive Zusammenarbeit und ein respektvolles Verhalten in einem interdisziplinären Zusammenschluss, von dem alle Lager profitieren.

Der ausgearbeitete Entwurf berücksichtigt Anforderungen und Wertvorstellungen der involvierten Benutzergruppen und vereint dieselben an einem gemeinsamen Standort. Hier eröffnet sich Raum für einen offenen Dialog während Erwartungen gegenüber Verhaltensweisen zwischen den Konfliktparteien klar kommuniziert werden können. Zusätzlich bilden erarbeitete Funktionen, Mechanismen und ein entsprechendes Raumprogramm eine Struktur, die Ansprüche der verschiedenen Erwartungshaltungen miteinander verbinden und eine Zusammenarbeit fördern.
Das Projekt versteht sich als ein Besucher-Informations-Zentrum und konzentriert sich auf das Bestreben, dass alle Benutzergruppen teilen: Wissen vermitteln und sammeln.

CONTENT

PART III
DESIGN

01 INSPIRATION

I grew up between the sheer cliffs of the Dolomites in Eastern Tyrol. Alpine surroundings have a very special atmosphere, as the environment changes rapidly and intense with increasing altitude.
When I moved to Vienna as a young adult, the first thing I recognized was the lack of a starry sky during the nights. By the time I began to think about the topic of my master thesis, I knew very quickly it would concern itself with the night sky and visited the Astronomical Institute of the University of Vienna for inspiration. People there were eager to tell me all about their work as astronomers and fascination with the stars, as well as what I needed to know about star observatories in general. They also told me about their worries because of the struggles concerning the construction of the TMT (Thirty Meter Telescope) in Hawai'i. With the intention of designing a public stargazing facility at the top of Mauna Kea on the Big Island of Hawai'i I travelled there to talk to natives, astronomers, tourists and visit the construction site. During many talks with people from different origins, intentions and relations to the site it turned out that a design at the summit area would not be a satisfying project. With help of professional astronomers, staff members of the Mauna Kea Observatory Management, Natives, the Bishop Museum and many more I could find a new approach serving different parties at the same time. A redesign of the Mauna Kea Visitor Center and associated dormitories is a request many people share, even if they hold opposing positions.

PART I
CONTEXT

02 LOCATION

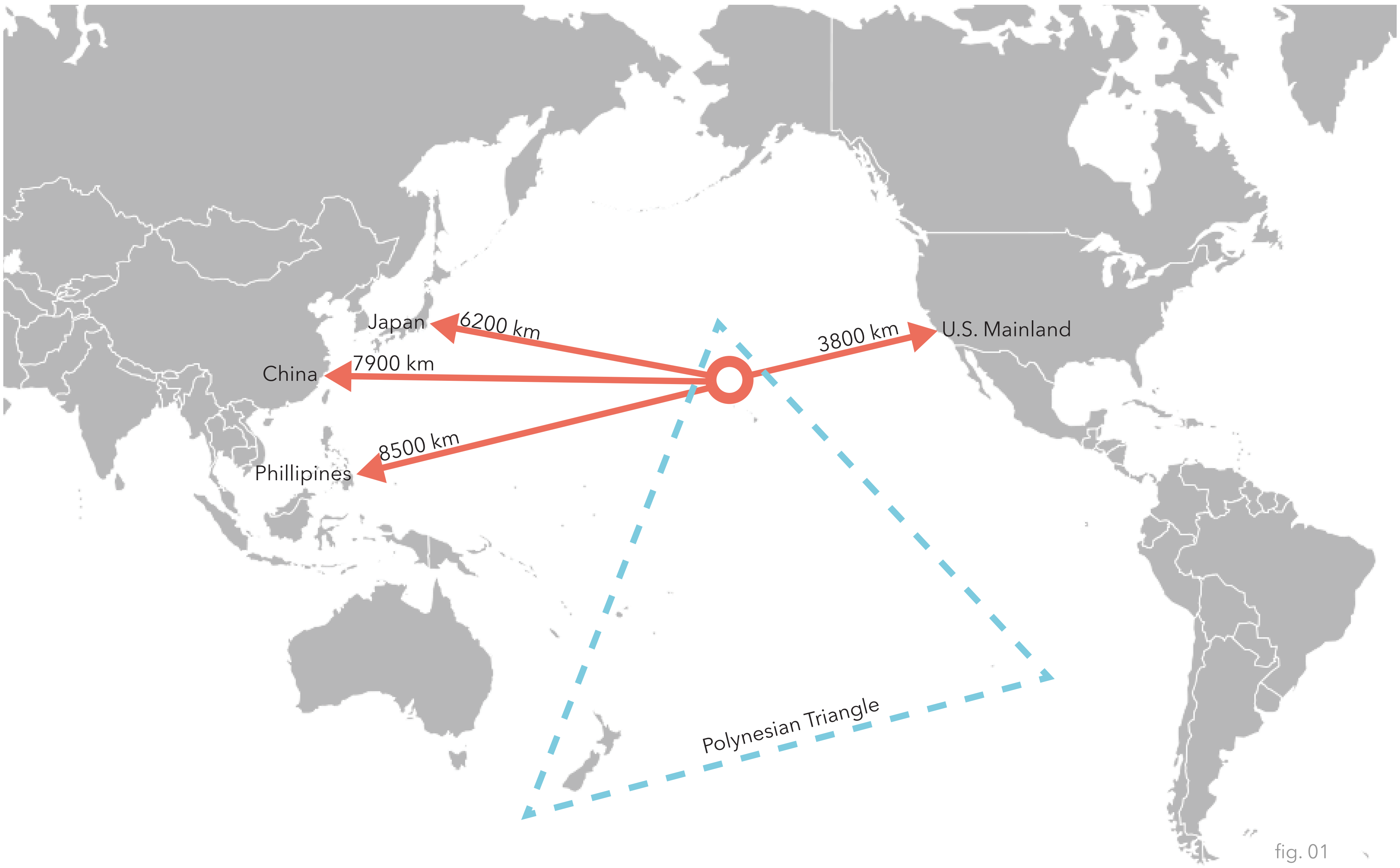


fig. 01

02.01 HAWAI'I

Hawai'i is a string of islands of volcanic origin, which are separated by more than 3200km from their nearest continental neighbor. Currently only three of the many volcanoes remain active. In total Hawai'i consists of 137 islands, islets and atolls.
Despite being part of the United States of America, its firmly rooted in Polynesian culture, representing the most northern tip of the Polynesian triangle and the most southern point of the U.S.A.
Because of its isolated location and tropical climate, Hawai'i still holds an exclusive ecosystem including many endemic plants and animals.
The deepest point of the islands is situated directly at sea level, while the highest point marks the summit of Mauna Kea at 4205m above sea level on The Big Island of Hawai'i. Located in the middle of the Pacific , the eight main islands of Hawai'i, despite their relatively small overall area, house an astonishing diversity of landscapes as well as most of the existing vegetation zones.
The country's most important industrial sectors are tourism, military and agriculture. Only about 5% of the total population of about 1.3 million is original Hawai'ian. Most inhabitants are of mixed race and backgrounds, causing the multicultural population it is famous for.

02.02 ISLANDS

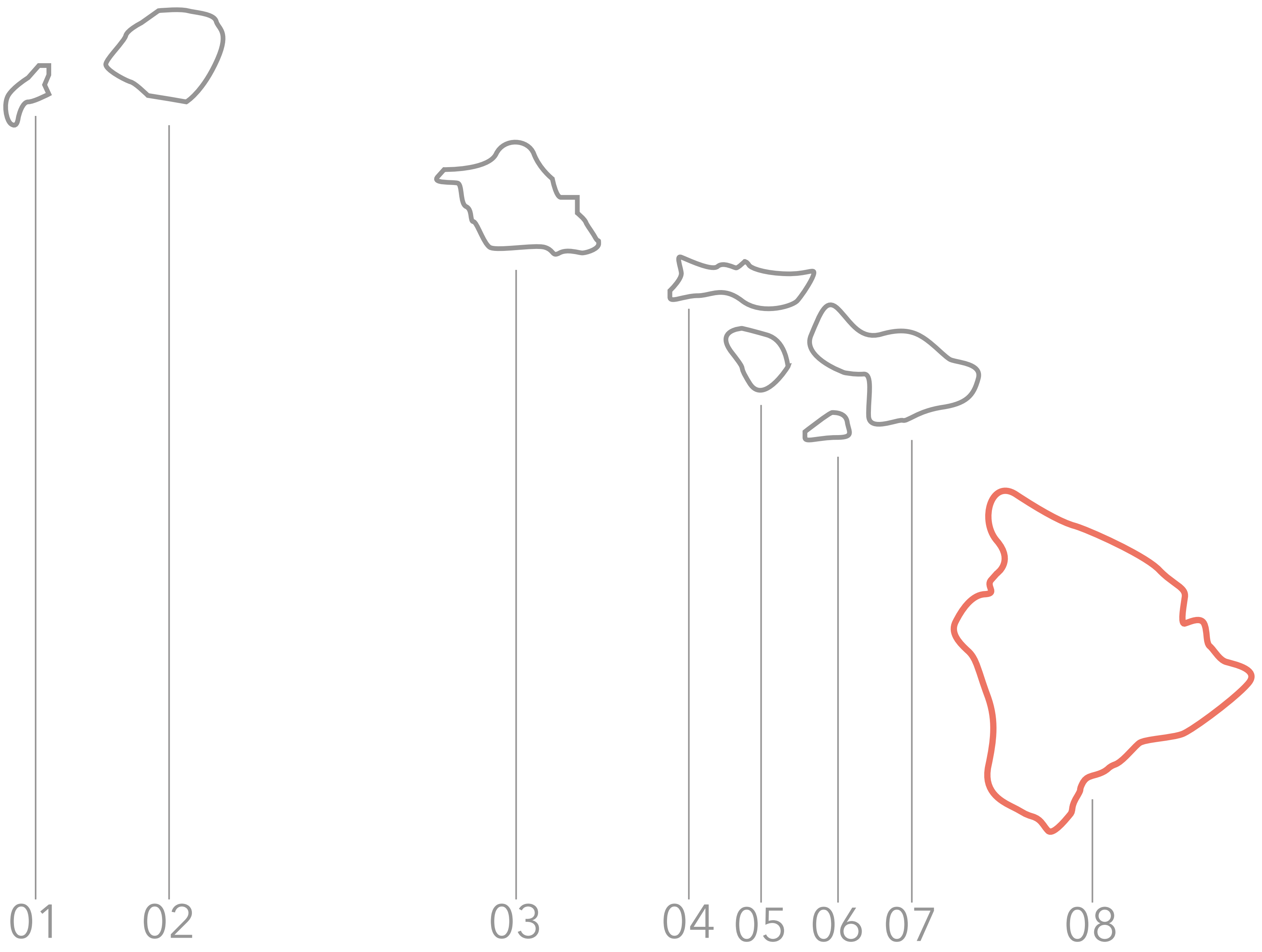


fig. 02

01 Ni'ihau

02 Kaua'i

03 O'ahu

04 Moloka'i

05 Lana'i

06 Kaho'olawe

07 Maui

08 Island of Hawai'i

The eight main islands of Hawai'i all result from one main volcanic hotspot. Over time, new islands pushed away the older ones to grow larger. As a result, the representative string formation of Hawai'i was generated. All islands have distinct features and were characterized individually by locals.

01 Ni'ihau, also called the forbidden island, is inhabited only by local Hawai'ians, as tourists are not allowed to enter. Here, neither cash, alcohol, cigarettes or electricity are available.
02 Kaua'i, also called "Garden Island", is the oldest of the eight islands, it's main geographical feature being the impressive Waimea Canyon. It is the place with the second highest amount of precipitation per year on earth, and therefore one of the less travelled islands, attracting fewer tourists as the others. About 4 million years old, it is home to approximately 64.000 inhabitants in a total area of about 1.435km².
03 O'ahu, also called "Gathering Island", is home to the capital of Hawai'i, Honolulu. It is about 3 million years old and home to approximately 950.000 residents, on a total area of about 1.557km². The famous Waikiki Beach and the military port Pearl Harbor are the main tourist attractions of the island.
04 Moloka'i, also called the friendly or forgotten island, saw a significant rise in tourism in the last decade. Being very sparsely populated, the natural features of that island have been kept mostly untouched, and the local population is actively working on keeping tourism contained to hot spots on the west coast of the island, sparing the rest of its natural wildlife and flora.
05 Lana'i used to be the biggest pineapple cultivation area in the world, and still boasts a large number of plantations to this day. Approximately a fifth of the whole area is used for pineapple cultivation. The rest of the island is left to nature.
06 Kaho'olawe, with a total area of only 115,5 km² is the smallest of the Hawai'ian islands. Just like Ni'ihau it is privately owned and can only be entered with official authorization. There are no permanent residents living on the island.
07 Maui, also called "Valley Island", is about 1.3 million years old. On a total area of 1.883km² it is home to approximately 144.500 residents. Named after the famous demi-god Maui, this island is the most popular with tourists. Travel guides usually call it "Paradise Island" as it is home to many endangered species of giant sea turtles and offers a large variety of landscapes.

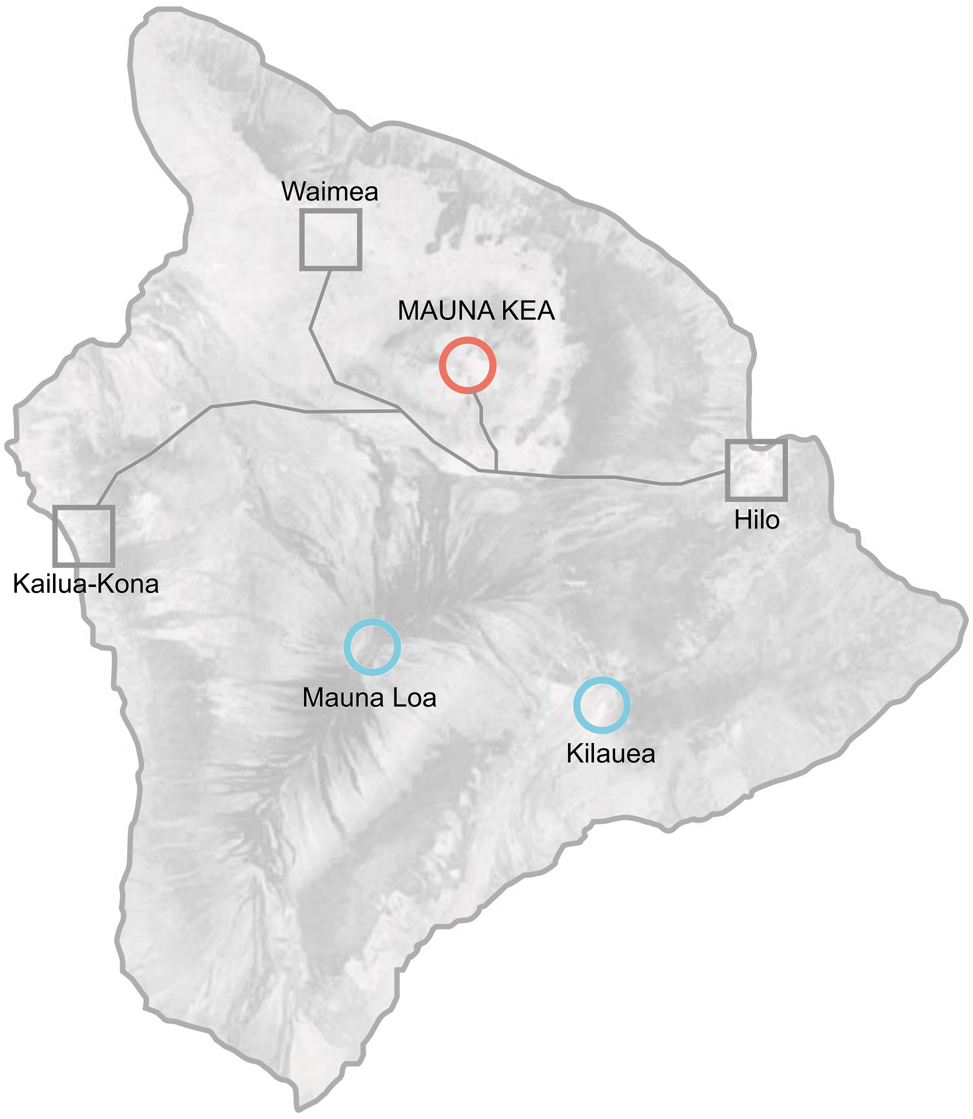


fig. 03

08 The Big Island of Hawai'i is the youngest of the archipelago, only about 300.000 years old, and at an area of 10.433km² by far the largest one too. It is home to three very special volcanos. Kilauea is the most active volcano in the world. Mauna Loa is the most massive, active one, and lastly Mauna Kea, albeit dormant, is the tallest volcano on earth. It is also marking the highest point of Hawai'i at 4.205m above sea level. Mauna Loa and Mauna Kea form a barrier, which divides the weather of the island into two sections. On the East Side, also called Kona-Side, it is very dry and mostly sunny. In the western part of the island, called Hilo-Side, a lot of rain is coming down on a regular basis.
In general, this is the location of extreme differences not only in climate, but also in its variety of landscapes. In only one day it is possible to snorkel with turtles and sharks in the sea, watch lava flow into the ocean creating new land, and to play in the snow on the tallest mountain in Polynesia.
The Big Island, compared to the others, is only sparsely populated counting 173.000 inhabitants and still seems provincial in many ways.
Tourists visiting this island usually seek the calmer and more authentic live style of Hawai'i when coming here, with tourism also being the main source of income for native residents.

03 MAUNA KEA

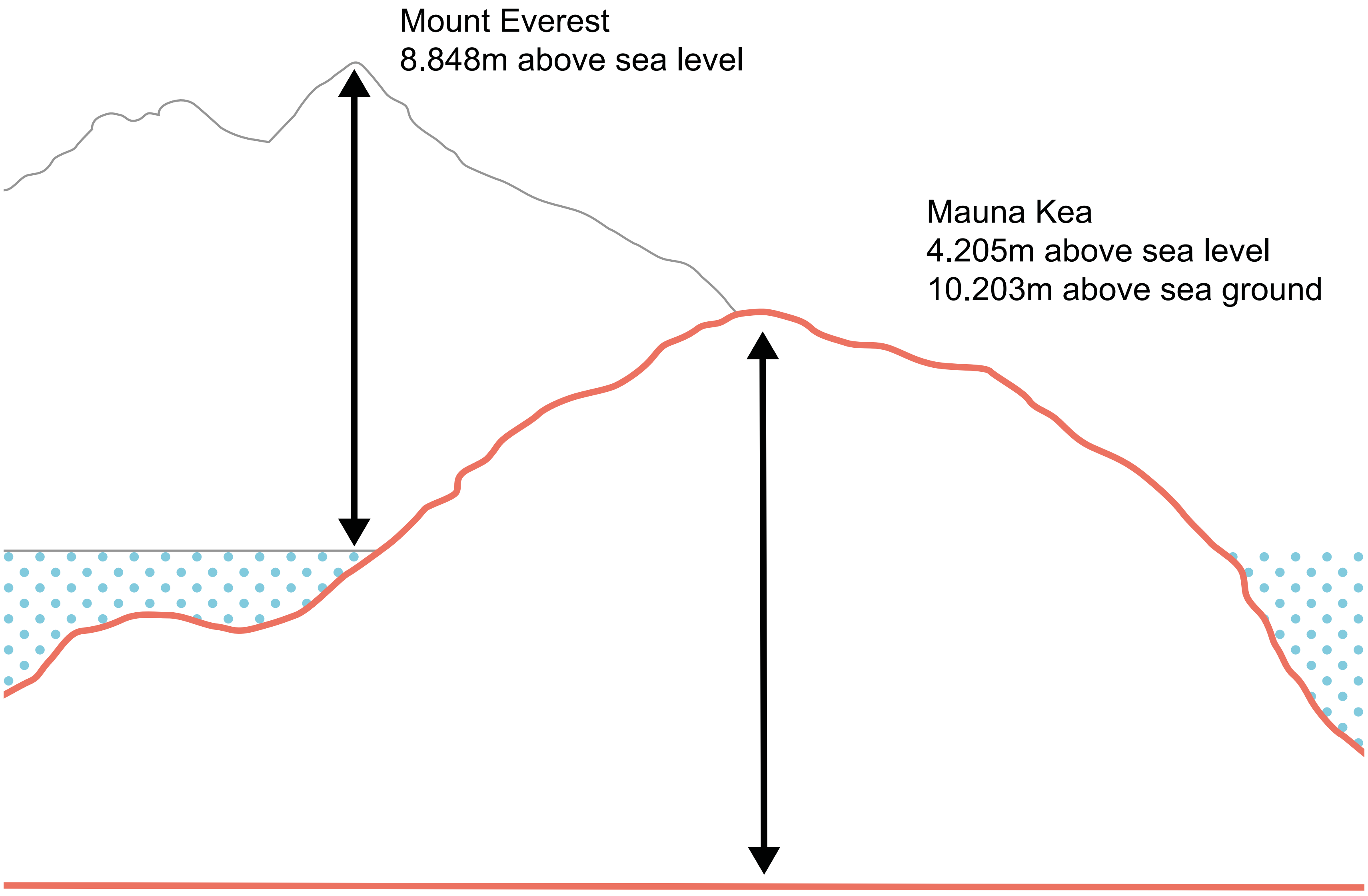


fig. 04

03.01 INTRODUCTION

Mauna Kea meaning “White Mountain” is an exceptional appearance among the other pacific islands. Measuring 4.205m above sea level and 10.203m from base to summit, measured from sea ground level up, it represents the tallest mountain in the world challenging visitors in many different ways. In winter, the top of the dormant volcano is often covered in snow and ice, making it impossible for visitors or even scientists to reach the Mauna Kea Observatory Facilities on the summit, one of the most important institutions of astronomy worldwide. The landscape differs significantly from the rest of the island. The sparse vegetation and the red colored rock and gravel, are more reminiscent of earths deserts, the Moon or the barren surface of Mars, than what one usually associates with a pacific island. This unique geography even prompted NASA to let the astronauts of the Apollo missions train there, to get used to the extraterrestrial scenery. The climate is very dry and with increasing altitude temperatures drops down to -4°C and lower. For ancient Hawaiians, the peak was a major landmark, guiding sailors towards the island and helping them to navigate on fishing trips. There are many Hawai’ian legends concerning the mountain. Fantastic stories of different deities dwelling on it, playing by or even fighting for control over it. Mauna Kea is also, to this day, a place of worship for Hawai’ians as it is said to be the birth place of the islands of Hawai’i.

Today it hosts both scientific and cultural activities, but also many tourists who come here to watch the stars, visit the observatory facilities, and hear the stories of the ancient Hawaiians and their amazing journeys.

03.02 LANDSCAPE AND ECO-SYSTEM

fig. 05

GEOLOGY

The long dormant volcano is about 1 Million years old, spending a majority of its lifetime beneath the water surface, while the last eruption happened about 4500 years ago. The estimated total volume of the mountain amounts to 30.000km³ and the slope averages 4-5° resulting in a 7-9% gradient.
Almost 100 cinder cones can be found on the upper slopes. One of them is located only a few hundred meters next to the Visitor Station.
The reddish surface of Mauna Keas upper part is the result of eruptions of major volcano activity. The material consists of andesite, a volcanic rock, richer in silica than basalt. The layers below this lighter colored surface are composed of typical gray to black shaded basalt formations.
The Visitor Center itself sits on a smooth layer of ash and cinder covered with gravel. Basalt is a shapeable material, suitable for various construction projects and purposes.
The landscape of Mauna Kea went through drastic changes in the past. From intense lava flows, to mild climates, it also used to feature a glacial area reaching its peak about 20.000 years ago, that melted away 10.000 years later. On the volcano, the highest lake in the Pacific Ocean basin can be found. Lake Waiau is a nearly round alpine lake, rich with algae causing its water to be colored in a rich green. The ground consists of clay formed from ash thousands of years ago and provides from water of melted snow and precipitation.

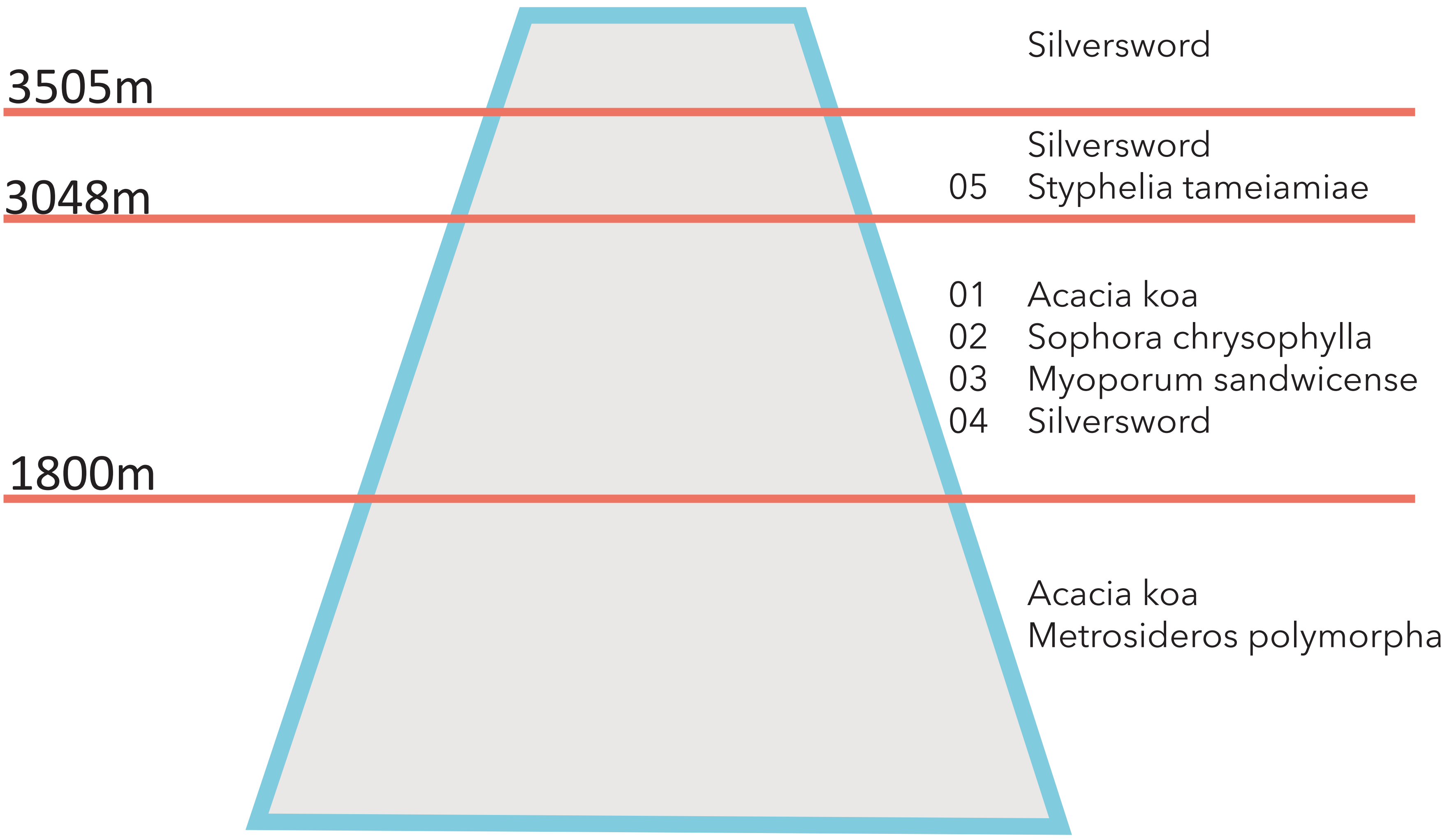
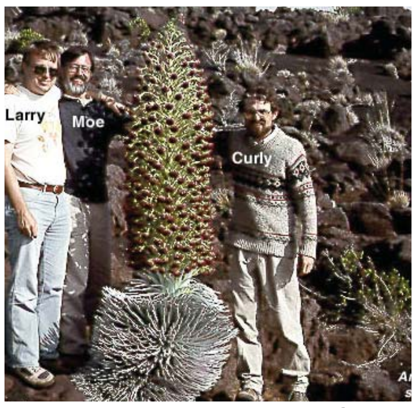

Silversword
3505m
Silversword
05 Styphelia tameiamiae
3048m
01 Acacia koa
02 Sophora chrysophylla
03 Myoporum sandwicense
04 Silversword
1800m
Acacia koa
Metrosideros polymorpha

fig. 06

FLORA


01 fig. 07



04 fig. 10

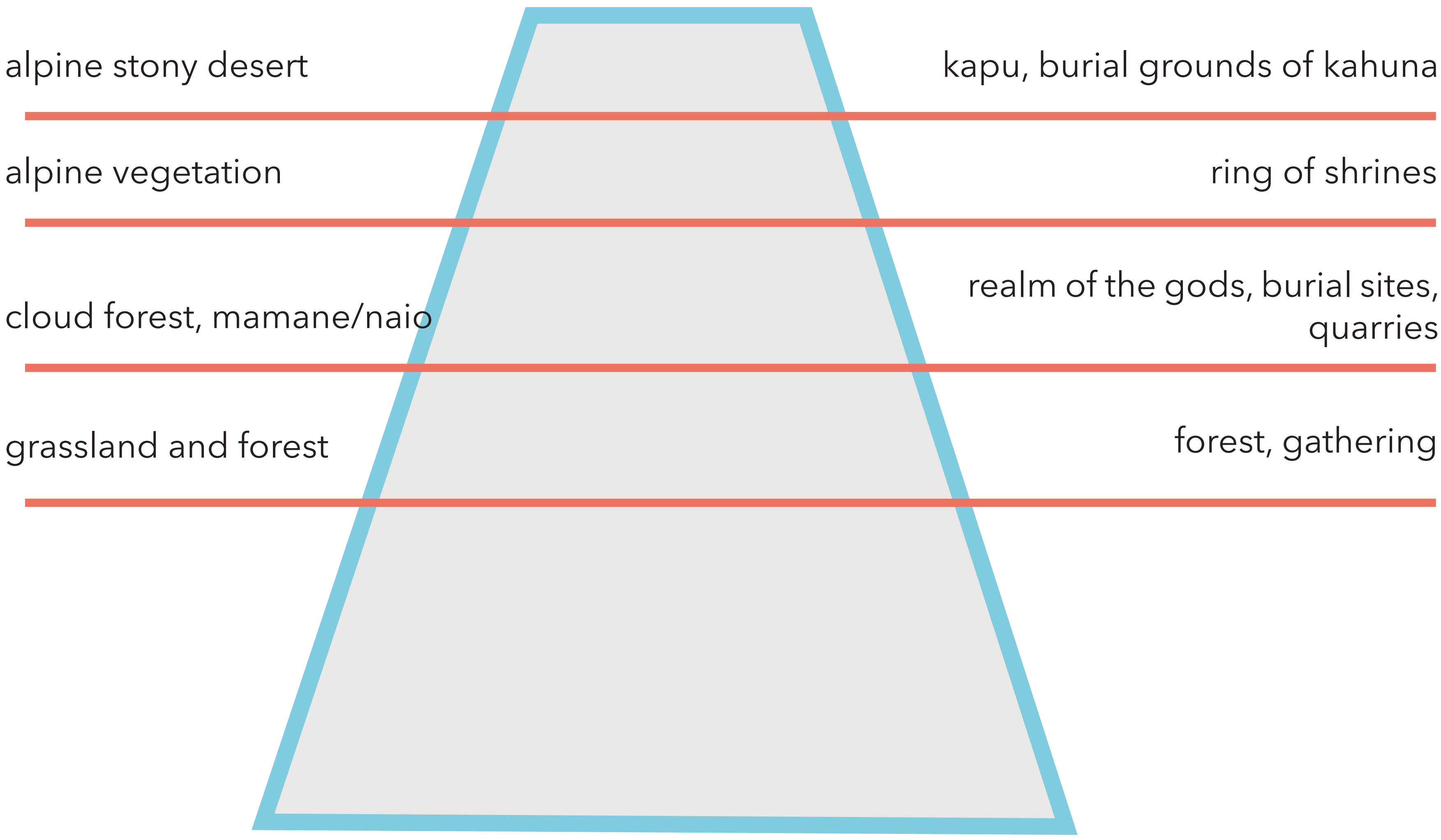

02 fig. 08


04 fig. 11


03 fig. 09


05 fig. 12

In different heights of Mauna Kea sundry types of plants endemic to Hawai'i are to be found. At the level of the Visitor Station, Acacia Koa Trees do not grow up to their usual height of up to 33 feet but, because of the altitude, remain small. Koa is one of the most expensive woods in the world, used for furniture, veneer and crafts.
Sophora chrysophylla, called Mamani by Hawai'ian people, grows in the form of shrubs about 6-10 feet high.
Also as shrubs of 2-10 feet, Myoporum Sandwicense is a common plant growing around the Visitor Station. In Hawaiian, it is called Naio. This fast-growing tree is very robust and well-adjusted to dry, hot areas. In early Hawai'i, this tree or shrub was used for the posts, rafters or frames of huts and buildings.
One of the most exceptional plants on Mauna Kea is the silversword or 'Ahinahina. This plant can live up to 90 years, blooms only once and then dies shortly afterwards. The silversword is highly endangered and endemic to Hawai'i. On a trail, next to the Visitor Center, several of them have been planted to secure a continued existence of this unique and impressive Hawai'ian native.


alpine stony desert
kapu, burial grounds of kahuna
alpine vegetation
ring of shrines
cloud forest, mamane/naio
realm of the gods, burial sites, quarries
grassland and forest
forest, gathering
fig. 13

03.03 CULTURE ON MAUNA KEA

People settled on these islands 300-600AD. The close relationship between Hawai'ian and Tahitian culture and believes, suggests that only about 800 years ago there was a heavy immigration wave coming in from Tahiti to Hawai'i. During the following centuries, the immigrated population of the volcanic islands developed its own culture including hula, surfing, chanting and storytelling. The old Hawai'ian culture was a peaceful one, based on tolerance and universal harmony: among living and decease generations of people, among the spiritual, physical, and physiological worlds.
After missionary works in the 18th century a lot of the ancient knowledge and way of living got lost. Nowadays, especially young people are actively seeking their cultural roots again. While kids get taught the Hawaiian native tongue in school, today's young adults at least try to reintroduce phrases into their daily life to identify again with the way of living of their ancestors. At the same time, a deeper cultural connection to Hawaiian history and folklore, legends and gods, as well as a newfound appreciation of the natural uniqueness of their islands is seeing a renaissance with today's Hawaiians.

On the Big Island of Hawai'i, Mauna Kea is a very special place of worship and historic significance. On many parts of the mountain, there are indications of ancient religious ritual sites and places of craft and labor.
The "Mauna Kea Adze Quarry" is listed as a national historic landmark. A material formed when molten lava erupted under glacial ice cups, adze is a material harder than any other available to ancient Hawaiians, and was mined directly on the mountain. The site includes quarries, caves for sleeping, workshops and shrines. It was in use from at least the mid-1200s. Most of the shrines found on Mauna Kea are located beneath the summit, as the peak was believed to be the birth place of the Hawaiian Islands and therefore "kapu", forbidden to people except the highest chiefs.

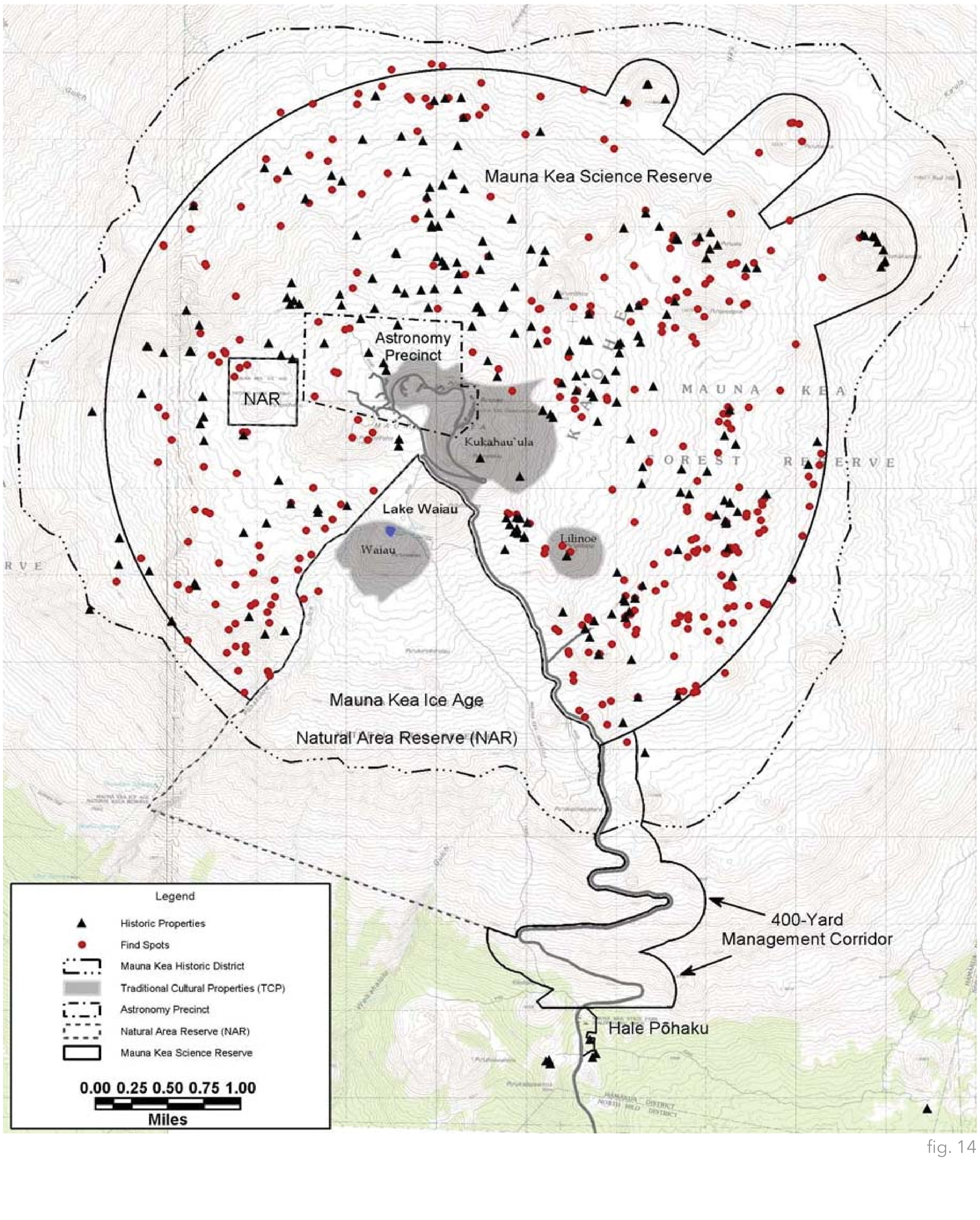

Mauna Kea Science Reserve
Astronomy Precinct
NAR
Kukahau`ula
Lake Waiau
Waiau
Lilinoe
MAUNA KEA
FOREST RESERVE
Mauna Kea Ice Age
Natural Area Reserve (NAR)
400-Yard
Management Corridor
Hale Pōhaku
Legend
Historic Properties
Find Spots
Mauna Kea Historic District
Traditional Cultural Properties (TCP)
Astronomy Precinct
Natural Area Reserve (NAR)
Mauna Kea Science Reserve
0.00 0.25 0.50 0.75 1.00
Miles

fig. 14

Some of the holy sites are made from wooden structures, called "heiau" (temples) but most of them are very subtle stone formations and not readily noticed by casual visitors. Those "kuahu", simple altars without a prepared court, were built by individuals or small family groups who conducted a short ritual that required no priest. The age of those structures is hardly known but estimates range from 700 to 900 years old. Shrines on Mauna Kea always contain one or more upright stones, arranged in different patterns on different types of foundations. The upright stones were probably representations of deities. The shape of them indicates which particular god was worshipped. Besides some adze material no ancient offerings have been found at the shrines of Mauna Kea, suggesting that mostly food and other organic sacrifices and presents were brought here.

Besides shrines many burial sites are located on the dormant volcano. In ancient times, it was common to bury the dead in remote areas, hidden under stones, so the bones remained untouched and undamaged. Some Hawaiian families even nowadays bury the remains of their beloved up on the mountain.
The lake Waiau is also a special place of worship to this day. Some Hawaiians carry the "piko", the umbilical cord of newborns up to the holy water.
In lower altitudes people respectfully come to Mauna Kea to reinforce "mana", spiritual energy, pray and seek council from the mountain and their ancestors.

Therefore, it is very important for every visitor of Mauna Kea to be respectful towards its history and cultural significance and reflect before entering, as it raises awareness for the surrounding.

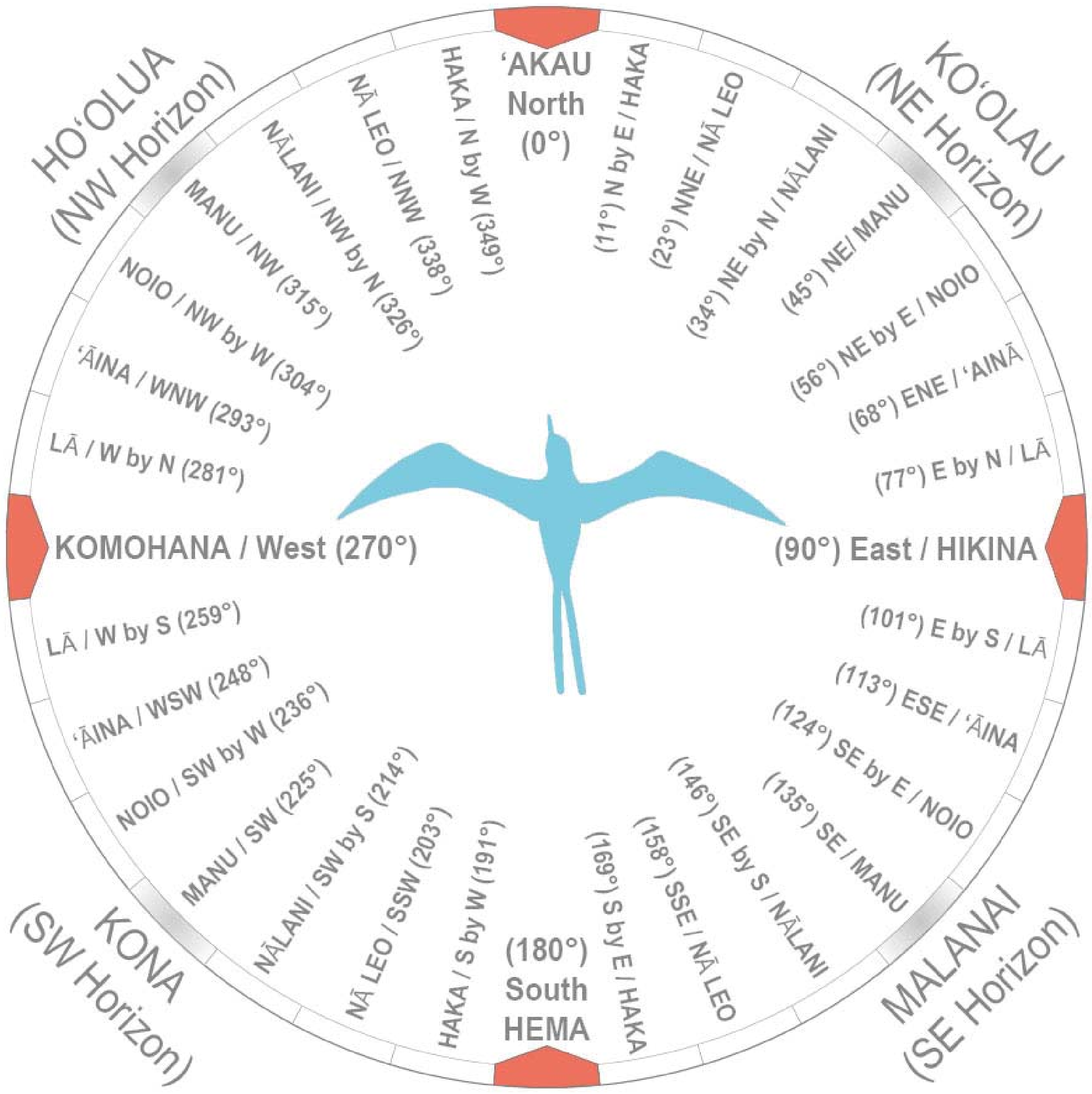

‘AKAU
North
(0°)
(11°) N by E / HAKA
(23°) NNE / NĀ LEO
(34°) NE by N / NĀLANI
(45°) NE/ MANU
(56°) NE by E / NOIO
(68°) ENE / ‘AINĀ
(77°) E by N / LĀ
(90°) East / HIKINA
(101°) E by S / LĀ
(113°) ESE / ‘ĀINA
(124°) SE by E / NOIO
(135°) SE / MANU
(146°) SE by S / NĀLANI
(158°) SSE / NĀ LEO
(169°) S by E / HAKA
(180°)
South
HEMA
HAKA / S by W (191°)
NĀ LEO / SSW (203°)
NĀLANI / SW by S (214°)
MANU / SW (225°)
NOIO / SW by W (236°)
‘ĀINA / WSW (248°)
LĀ / W by S (259°)
KOMOHANA / West (270°)
LĀ / W by N (281°)
‘ĀINA / WNW (293°)
NOIO / NW by W (304°)
MANU / NW (315°)
NĀLANI / NW by N (326°)
NĀ LEO / NNW (338°)
HAKA / N by W (349°)
HOʻOLUA
(NW Horizon)
KOʻOLAU
(NE Horizon)
MALANAI
(SE Horizon)
KONA
(SW Horizon)

fig. 15

03.04 ASTRONOMY ON MAUNA KEA

Polynesian navigators travelled the vast ocean proving their exceptional knowledge of the stars and their behavior, as a means of navigation and orientation at sea. Ancient Hawai'ians could distinguish between planets and fixed stars. More than 100 Hawai'ian names for stars and their formations are known until today, suggesting that there have been many more which got lost in time.
Stories tell of Mauna Kea as a place where the ancestors watched the stars from and of its important role as a point of orientation when at sea.

In 1960 a tsunami hit The Big Island of Hawai'i causing great damage especially in the area around Hilo. To revitalize the economy, The Hawai'i Island Chamber of Commerce confronted the U.S. and Japanese University with the idea of developing Mauna Kea as an astronomic observation area. After expert examinations, Mauna Kea was declared to be the best place on earth for visual research of the starry night sky, retaining that status to this day.

In 1962 the construction of the NASA-funded University of Hawai'i-Telescope, marked the beginning of the Mauna Kea Observatory. In 1968 the Hawaiian University received a 65 years lease for the summit area of Mauna Kea. Since then, altogether thirteen observatories have been constructed in the defined Science Area. Those include nine reflector telescopes, three submillimeter telescopes and one radio telescope. The most famous one beeing the Keck Observatory which is responsible for important discoveries such as black holes, dark energy and the new category of the dwarf planet for Pluto.
There are plans for a fourteenth observatory, called the TMT (thirty-meter telescope) in the summit area. It would be the biggest mirror telescope in the world with estimated costs of about 1.4 billion U.S. $.
The observatories are independent astronomical research facilities and therefore not subject to any national control but solely dedicated to scientific matters.


fig. 16

Different factors come into play, concerning Mauna Kea’s status as the best place in the world to research the night sky.
First, at a height of 4205m only 60% of the earth atmosphere is left, causing less degradation of starlight.
The dry air on the mountain is also especially important for infrared and submillimeter telescopes as water vapor affects the wave length in their spectrum.
Additionally, Mauna Kea is an almost cloud free zone. Its amount of clear nights a year is the highest in the world. The symmetrical shape of the volcano causes a smooth airflow which is important for the atmospheric and metrological stability at the summit.
Also, situated in the middle of the Pacific, the sky turns out to be very dark. The location of the observatories is far from any city lights, with very little interfering light pollution. Hawaiian lighting ordinance on the island, even has clear regulations concerning the types of illuminants used in public.

Another major asset is Mauna Kea’s location in relative proximity of the equator. Situated at about 20 degrees northern latitude it is possible to observe both the northern hemisphere and most of the southern sky.

The political stability of Hawai’i and the access to modern infrastructure and technology including access to harbors, airports and modern communication systems, are also essential to the success of the Mauna Kea’s astronomical research facilities.

03.05 TOURISM ON MAUNA KEA

The road to the observatories on the summit is public and therefore open to everybody except when weather conditions get too dangerous and the road is closed. Since the renovation of Saddle Road, more tourists are coming every year, to visit the mountain and stay for a stargazing tour at the Visitor Information Station after sunset.

The number of tourists who come by car has been increasing permanently. While in 2003 about 100.000 visitors were counted at the VIS, in 2010 the number had increased to 200.000 people per year. In 2015 more than 300.000 attended the nightly stargazing tour free of charge. A survey done in 2012 suggests that about 20% of them are locals, 54% come from mainland U.S. and the rest are international travelers.

Most of the tourists visit Mauna Kea because of the famous observatories and are not educated in the cultural meaning and importance of the area they are entering. As a result, many of them take short trips at the summit and often unknowingly destroy shrines and altars, which are subtle structures and not easy to recognize if one doesn't know what to look for.

In general Hawai'ian people do not have a problem with tourism on Mauna Kea, but what is being criticized is the general lack of education, care and respect for the cultural significance of the site.

For the observatories, tourists also mean only a little disturbance as most of them leave the summit area shortly after sunset and only few come up to watch the sunrise. The main concern regarding the telescopes, being the headlights of cars hitting into the domes, causing problems in research nights.

While the Visitor Station provides basic infrastructure like water supplies, sanitary facilities and shelter, the summit does not. Visitors are strongly advised to stay at the VIS for at least an hour before going up to the summit to acclimatize.

03.06 DANGERS VISITING MAUNA KEA

People visiting the Mauna Kea Observatories travel from 0m to 4205m sea level within two hours or less. To avoid accidents, it is clearly recommended to stay at the Visitor Center at an altitude of 2800m for at least 30 minutes to an hour, to get used to the change in altitude. During that time, the body usually is not able to fully adjust, but at least is not in immediate danger and tourists are given enough time for self-assessing their own state concerning dizziness, shortness of breath etc.
The drop in atmospheric pressure and oxygen with the increasing altitude can cause altitude sickness. This can lead to life-threatening conditions such as High Altitude Pulmonary Edema and High Altitude Cerebral Edema.
People are not supposed to travel further than the VIS if they are under 16 years old, pregnant, intoxicated or having high blood pressure, diabetes, heart or respiratory condition. Additionally, the summit air is very dry and hydration is a very serious matter to keep in mind while visiting.

Most people coming to Mauna Kea do not expect cold temperatures of 0°C and below. Combined with strong winds, the danger of Hypothermia is given if exposure to the cold is not limited to short periods of time.
The intense solar radiation on the summit is another factor that is often underestimated. Only 15 minutes of direct, unprotected exposure can cause first to second-degree burns on the summit.
Also, as in most alpine regions, the weather is unpredictable and can change in a matter of minutes. Cloudless skies can turn into white fog within a short period of time causing possible white-outs and zero-visibility.
To drive up to the summit area, 4-WD vehicles are required. Most accidents by car happen because of brake overheating when driving down the mountain. Road hazards include atmospheric and solar glare, blind curves, rock debris and poor traction.

PART II
THE SITE

04 HALE POHAKU

fig. 17

04.01 LOCATION

Hale Pohaku is the midlevel facility area of the observatories on top of Mauna Kea being located about 2800m above sea level and therefore above the forest line. Vegetation at this altitude consists of small trees, shrubs and different grasses. Altitude-sickness at those heights is very uncommon but visitors often complain about getting light-headed.
The site is accessible from all main cities of The Big Island of Hawai'i. The drive from Kona to Hale Pohaku is the longest one and takes about two hours. From Hilo and Waimea, one can reach the area within an hour. All roads leading there, including Saddle Road and the Mauna Kea Access Road, are paved and well manageable by private and rental cars.
From the midlevel facilities, an eight miles long road leads to the summit. Getting there requires a 4-WD with low gear, and most rental companies do not allow leased cars to drive on that road. In case of any accidents, the driver must take full responsibility for all damages and resulting costs.

Hale Pohaku is also a popular starting point for hikers to reach the summit. The round trip takes about ten hours. Sometimes athletes come here to undergo high-altitude training by biking up to the peak.
Slopes around Hale Pohaku vary but average at 6.4° steepness.


DORMITORY
VISITOR INFORMATION CENTER
CONSTRUCTION CAMP
N

fig. 18

04.02 HISTORY

Hale Pohaku describes a complex of mid-level facilities that supports observatories on the summit of Mauna Kea. Stone cabins served as temporary lodges for hunters since the 1930s.
In the 1960s, the construction of five temporary buildings for construction workers began, including facilities for sleeping, eating and acclimating to the climate and altitude.
In 1983 a dormitory for astronomers and scientists was completed, including areas for dining, lounges, offices, a library and small laboratories. The dorm provides 72 beds with blackout shades for daytime sleepers.
Along with the new midlevel facilities, a Visitor Information Station was constructed below the main dormitory. The 90m² building serves as a learning center, control point for visitors to the mountain and provider of transition points for visitors to acclimate.
Below the Visitor Information Center, a construction camp was developed. Two of the temporary buildings from the original site were moved to the area below the VIS (Visitor Information Station) when the W.M. Keck Observatory was built. When more Observatories followed, the camp was extended with three smaller buildings.
After the tragic space shuttle explosion of the Challenger Mission in 1986, Hale Pohaku was named after one of the deceased Astronauts who was born and raised on The Big Island of Hawai'i, Ellison Onizuka. The area was renamed to Onizuka Center for International Astronomy.


fig. 19


fig. 20

04.03 PHOTO DOCUMENTATION DORMATORY

fig. 21

fig. 22

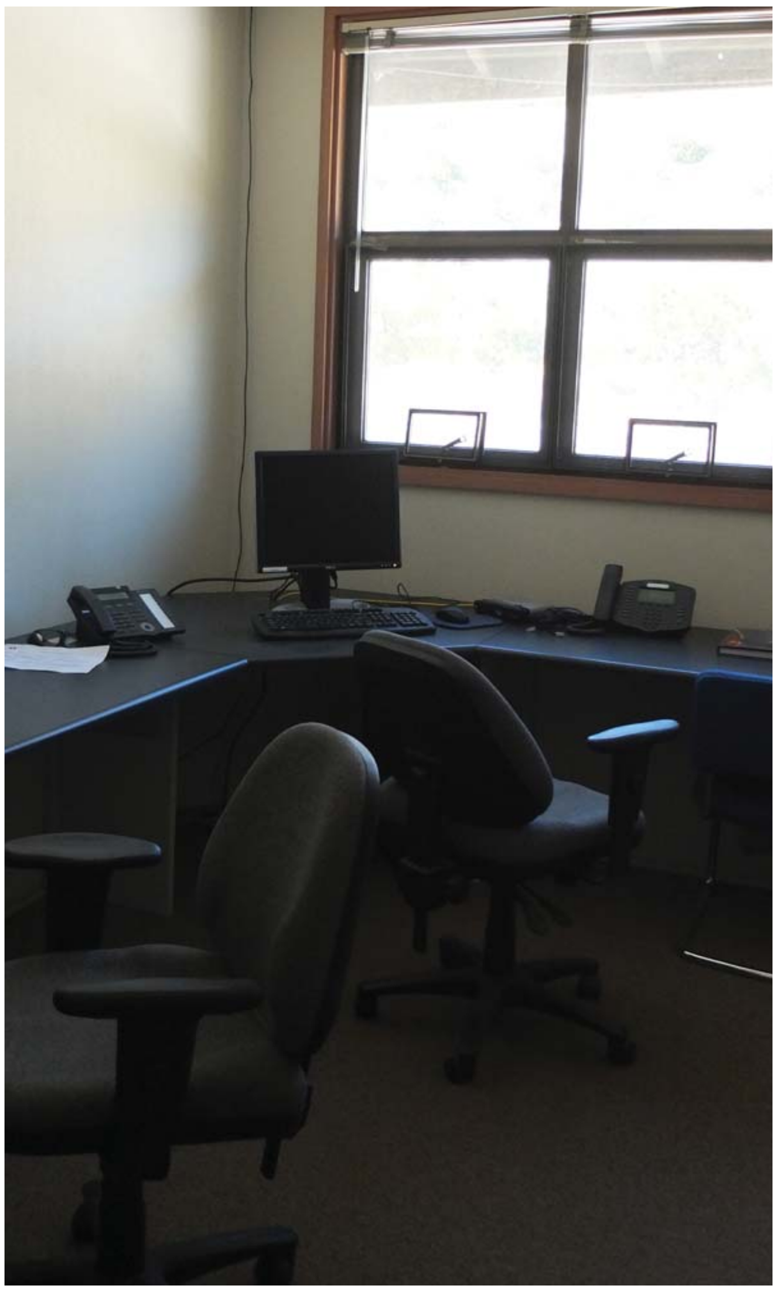


fig. 23

fig. 24


fig. 25

04.04 PHOTO DOCUMENTATION VIS

fig. 26

fig. 27

fig. 28

04.05 DEVELOPMENT

Technological advances changed the usage of the midlevel support facilities. The ability of digital viewing makes it often unnecessary for astronomers to spend time at the dormitories on Mauna Kea. Most of the observatories moved their headquarters from the Ellison Onizuka Center to Waimea or Hilo, near housing and education facilities. As a result, less astronomers and scientists require a dorm room at the mountain. Also, because of Saddle Road quality improving measures, it nowadays is very easy to drive up and back Mauna Kea within a short time. In average, less than 30 beds of the astronomer's dorm are reserved.

Most of the people sleeping on site are volunteers of the Visitor Center, staff of the dormitory such as chefs and astronomers who work inside the observatories at night.

The Construction Camp below the VIS was not used at all during the last years and remains empty.

At the same time the VIS, which is designed to fit 58 people inside is excessively overcrowded. In 2015 more than 300.000 visitors were counted on site, which means an average of 821 people on site per day. This number is supposed to increase even more in the coming years.

04.06 PROGRAM AND ACTIVITIES

Currently the residence buildings are restricted to astronomers, scientists, and staff members only. There is no public access except for Native Hawai'ians who join a special tour taking place several times a month. This tour includes an information seminar about Mauna Kea, the observatories, cultural matters and the cooperation of both parties. The presentation is taking place in one of the seminar rooms in the dormitory. Afterwards, the participants are taken up to the telescopes where they may enter the observatories. These are usually also restricted for the public. For tourists and locals who are not part of such a special tour, the VIS offers a stargazing event and a glance through their ten portable telescopes free of charge. Until fall 2017 this tour took place on a daily basis, until they were reduced to four times a week caused by a lack of volunteers and money.

The VIS also provides information on safety and hazards, astronomy and observatories, natural and cultural resources, restrooms and a gift shop.

Its main task is to increase visitor knowledge about all matters of Mauna Kea.

Most of the space inside the building is used as a gift-shop. Next to the entrance, an information screen is showing different, educational programs.

Once a month it also hosts the University Astrophysics Club, which gives the general public the chance to interact directly with astronomy students and promotes relations between different parties.

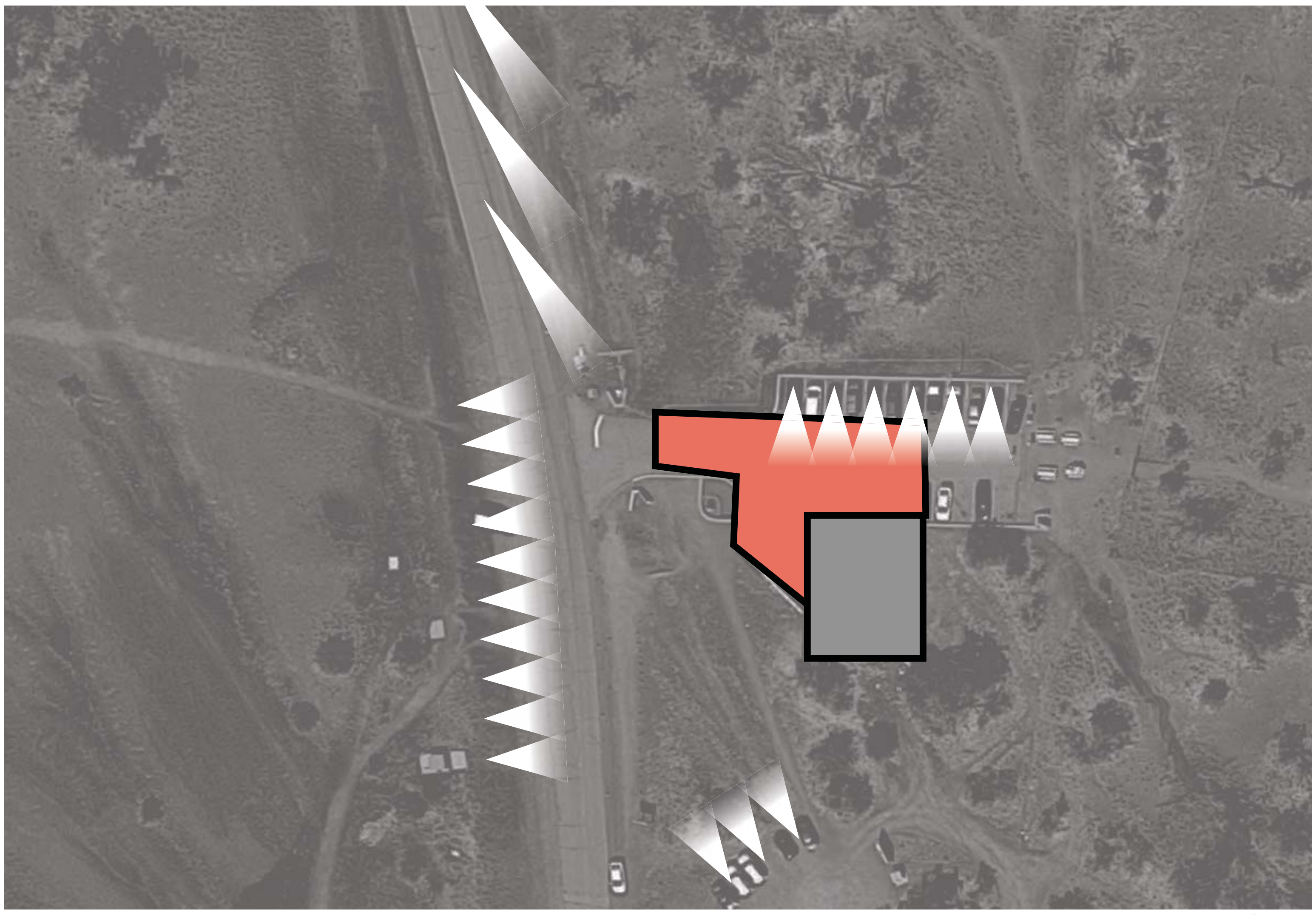


fig. 29

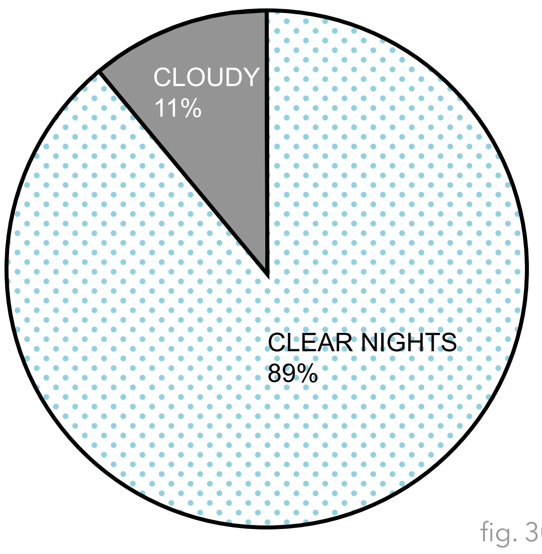


fig. 30

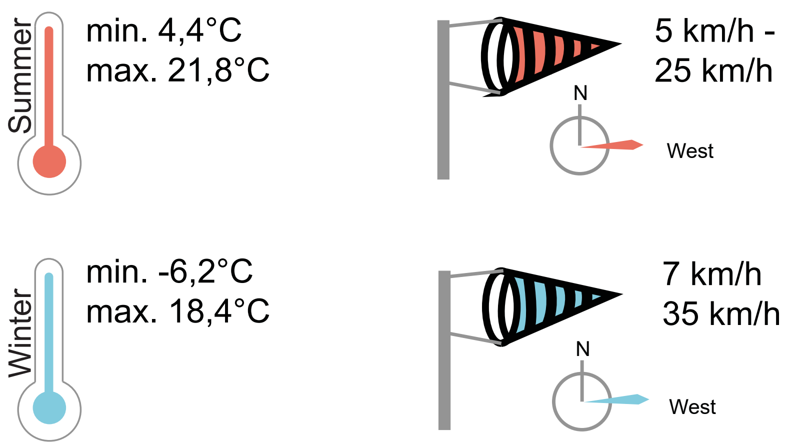


fig. 31

04.07 CLIMATE AND LIGHT POLLUTION

Hawai'i's year consists of two seasons: Summer from May until September, and Winter from October until April.
The region around Hale Pohaku is defined as summer-dry cool. The average temperature is between -1°C at night and 21°C during the day. Trade winds are blowing 50% of the time in winter and even 80% in summer. These winds make the felt air temperature lower than it actually is. 80% of the time, the wind is coming from west to northwest.
During the day fog often wanders up the mountain but mostly the sky clears after sunset, when the surface cools off.
The annual average rainfall of 64cm is very low. Most of the precipitation comes down between November and March in the form of light rain while snow is rare but possible.
An annual 325 nights are cloud free, promoting Mauna Kea as the best stargazing spot on earth. Another reason for that status is the low light pollution on the island. Strict rules help regulate street lanterns and lights in public spaces. Light Bulbs gleam at a special light wave, that does not interfere with the observatories' vision.
Headlamps of cars at the summit on the other hand might cause disturbances. The dimensions of that problem are also experienced at the VIS. The building itself is equipped with red light during night hours which does not influence night vision of human beings. Passing or parking cars use white light and therefore blind stargazing people who already adjusted to the darkness. Getting readapted to good vision in the dark then starts from the beginning and takes around 30 minutes.

VISITING PEAK HOURS

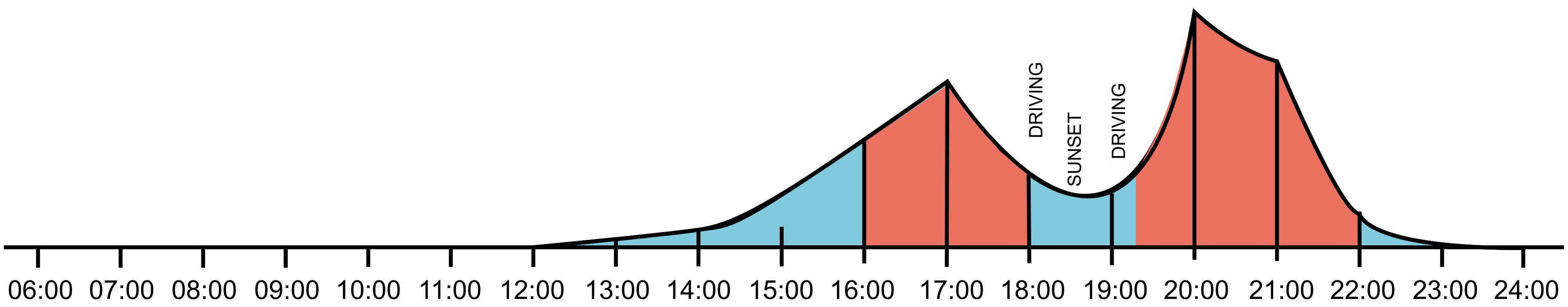
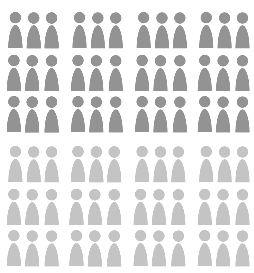


fig. 32

VIS OPENING HOURS

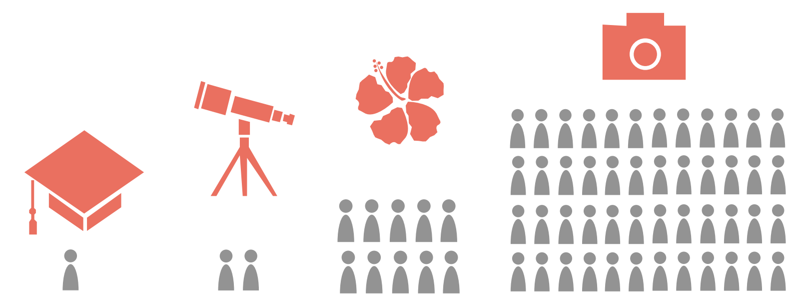
VISITOR CENTER		STARGAZING	
MON	12:00-22:00	MON	
TUE	12:00-22:00	TUE	19:00-22:00
WED	12:00-22:00	WED	19:00-22:00
THU	12:00-22:00	THU	
FRI	12:00-22:00	FRI	19:00-22:00
SAT	12:00-22:00	SAT	19:00-22:00
SUN	12:00-22:00	SUN	

VISITOR NUMBERS



Depending on weather conditions

average: 700 people
busy days: 1000
poor days: 200



0.5% Scientists
0.1% Educators
20% Lokals
80% Tourists

fig. 33

VIS PARKING LOTS

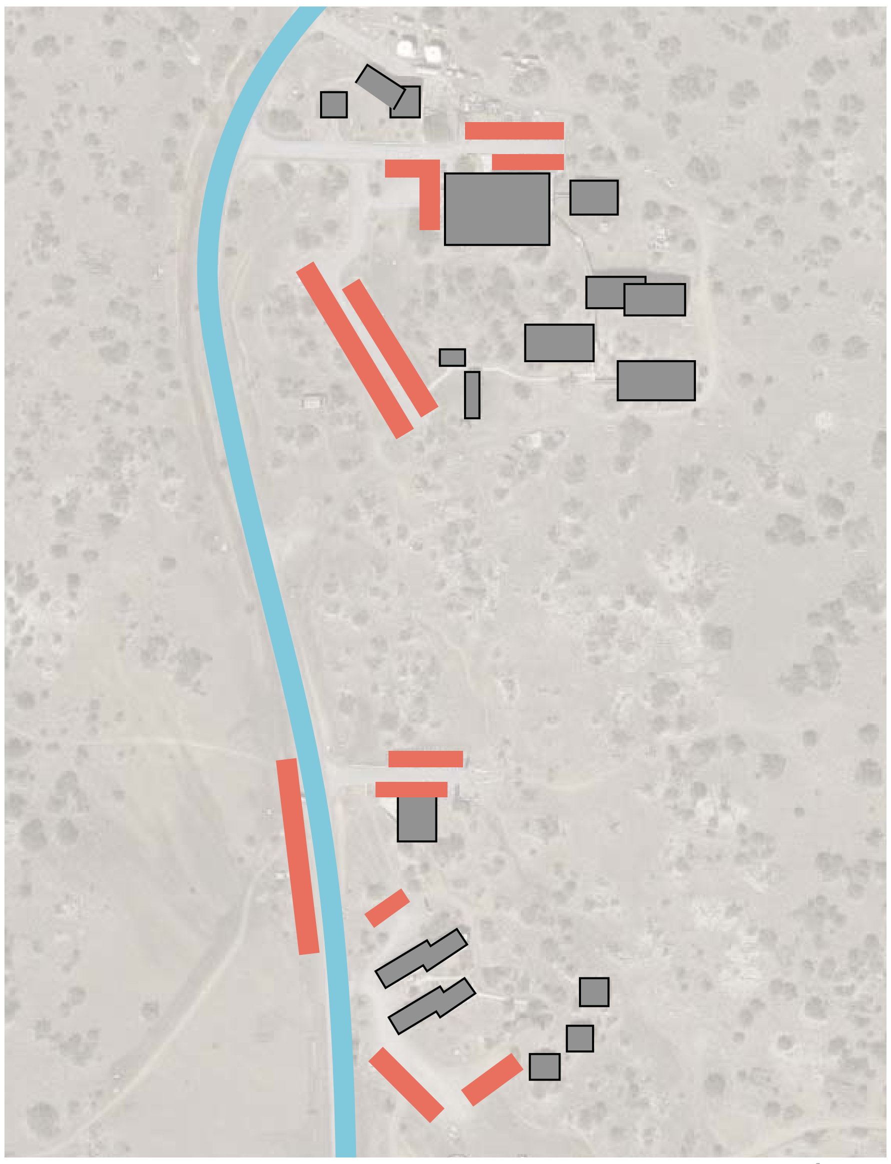


fig. 34

04.08 VISITOR ANALYSES

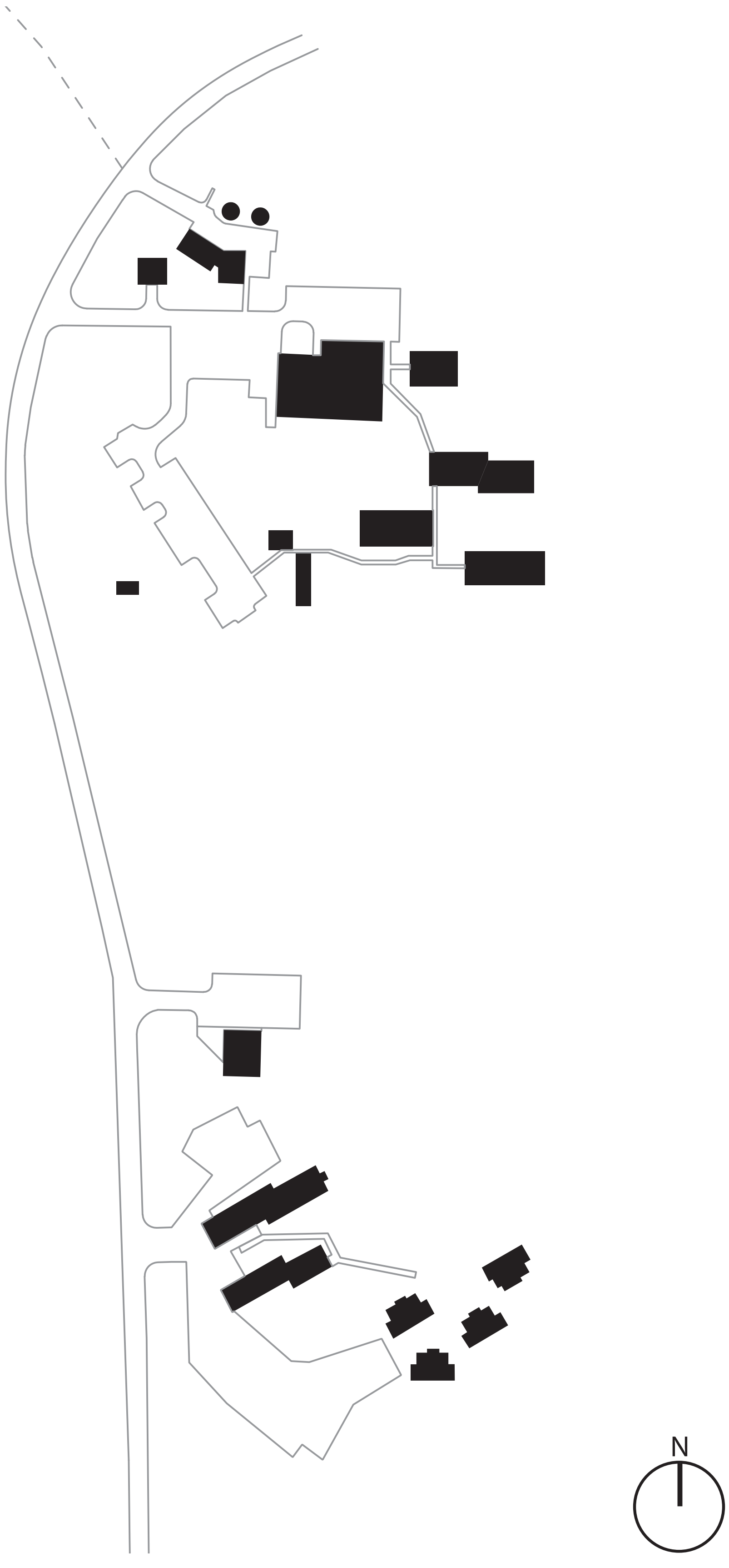
Visitors come to Mauna Kea for different reasons. Locals drive up the mountain to reconnect to their ancestors, pray or meditate. They also visit Lake Waiau or simply get some snow for the kids at home.
Tourists mostly come to see the observatories and the sunset from the summit and afterwards return to the VIS to attend the stargazing tour. Some of them also visit the silversword-flower garden, hike on different trails or visit Lake Waiau.
Currently the VIS gets very crowded, especially one to two hours before sunset and the hours afterwards.
Usually tourists come here to acclimate for an hour, which is highly recommended, around 5pm and then drive up to the summit within 20-30 minutes. In general, they stay there for not much longer than 30 minutes as it gets very cold on top and there is no shelter. Also, the feeling of dizziness and light-headedness is often a reason why tourists stay on the peak for only a very short period of time.
As restrictions forbid children under 16 years, pregnant women and people with special needs and diseases on the summit, many of them take the chance of joining the stargazing tour at the VIS though.
Approximately 16 organized commercial tours, with about 14 participants each, drive up the summit every night before stopping at the VIS for some more hours after sunset.
Many tourists drive up the mountain with private or rental cars. Around the VIS about 110 parking lots are available, which are no longer sufficient to handle the visitor increase in recent years. As a result, people started to park wherever they can find a spot, off-road, directly on the mountain, resulting in conflict with the Hawai'ian community and raised environmental issues.

04.09 REASONS TO REDESIGN

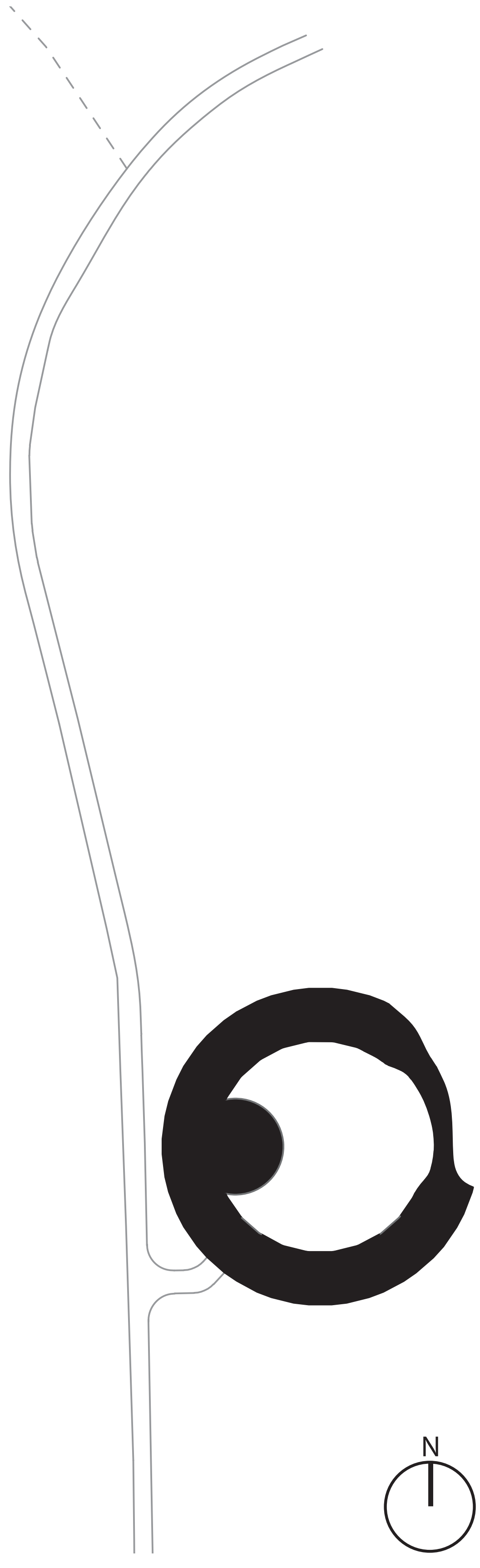
The midlevel facilities on Mauna Kea were planned in the 1960s and updated in the 1980s. Almost 30 years later, the requirements for that area have changed drastically.
Recent technological advances and infrastructure expansion at the observatories, result in new circumstances the area has not adapted to yet.
The construction camp has not been in use for several years and due to the reconstruction of Saddle Road, they have become obsolete for future construction projects on site.
Because of advanced technology observatories nowadays can be monitored and controlled by the headquarters in Waimea and Hilo. As a result, the dormitory for astronomers and scientists provides more accommodation units than necessary. Only two of the buildings are maintained, the rest of the facilities remain empty. Overall, only a fraction of the originally required structures are currently in use. This applies to sleeping units as well as kitchen, dining, office and community space. Since most of the monitoring installations of several observatories were relocated to Hilo and Waimea, offices are oversized. Usually researches do not spend more

than three days in a row at the dormitory.
On the other hand, the Visitor Information Station was originally planned for only a small number of visitors. The building fits 58 people, while nowadays between 200 to at peak days 1000 visitors gather there every night.
The main purpose of the building, is to enhance tourists' knowledge in different subjects, including life-protecting measures and cultural education. Because of the disproportionate capacity of staff members, significant information cannot be communicated effectively. This results in undesirable, unintended and dangerous behavior of tourists on Mauna Kea.
Also, the stargazing tours at the VIS suffer from the subpar setting of the plot, because of light disturbances from passing cars and lack of staff.
With the increasing number of tourists and therefore private cars, a serious lack of parking lots is another problem the mid-level facility faces. It provides space for 110 cars while at least 300 more would be necessary when taking into account that no public transportation system goes up the mountain.

PART III
DESIGN



Old Site Plan



New Site Plan 1:2500

fig. 35

06.01 SIZE BALANCE

As mentioned before, the sizes of the three different plots of the site, are severely out of balance. To reestablish an equitable ratio between user numbers and building sizes, every structure must be rethought.
The construction camp is not used at all. With the improved infrastructure of Saddle Road connecting the VIS to the base of the mountain, rendering the camp obsolete, they will be deconstructed.
The dormitory buildings are only partially working to capacity. Therefore, the structures will be demolished completely, while necessary facilities are merged with the new Visitor Information Station which is undergoing a significant extension process.
This means that the whole plot of Hale Pohaku will be concentrated to one single building generating a compact center.

fig. 36

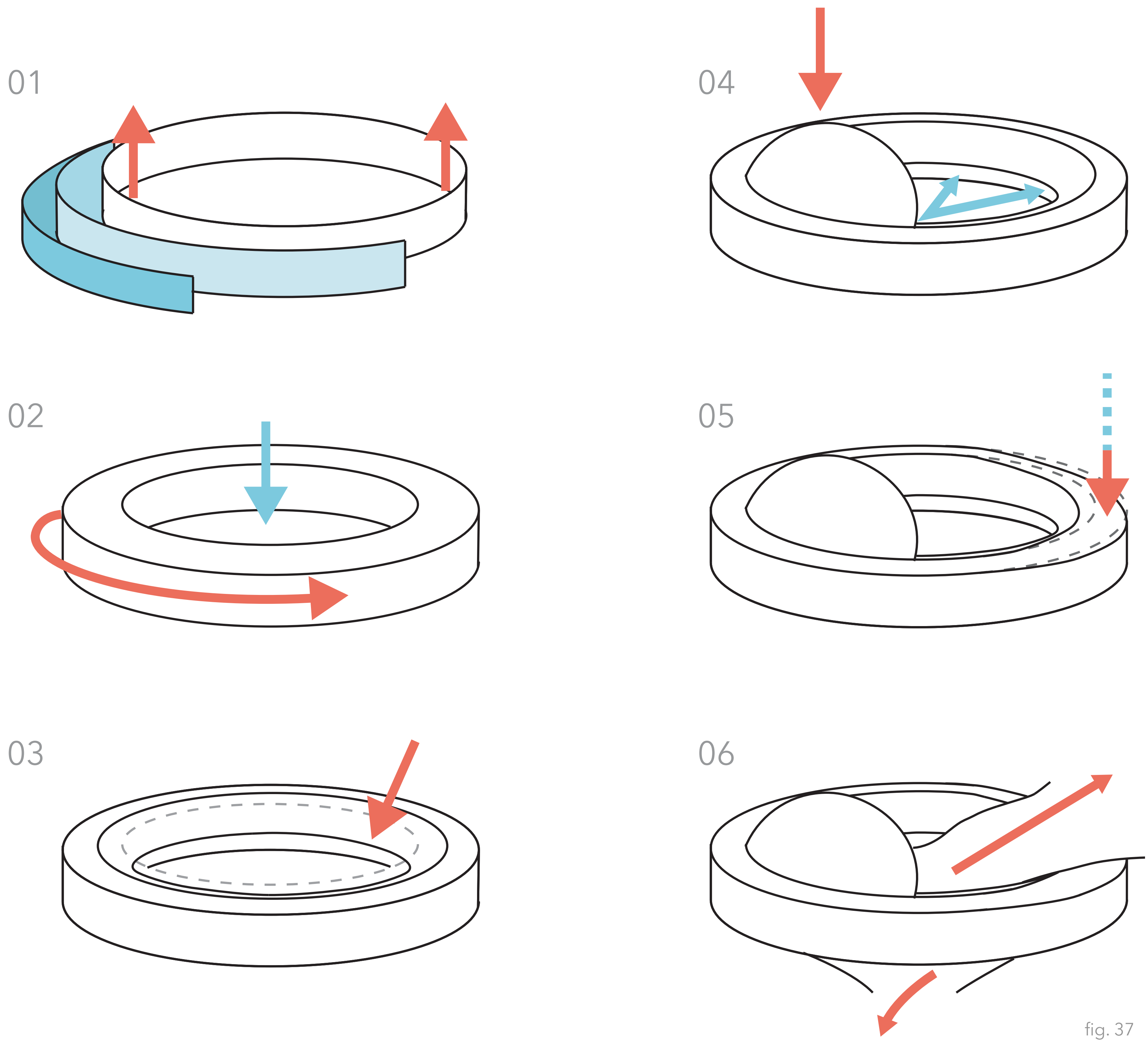
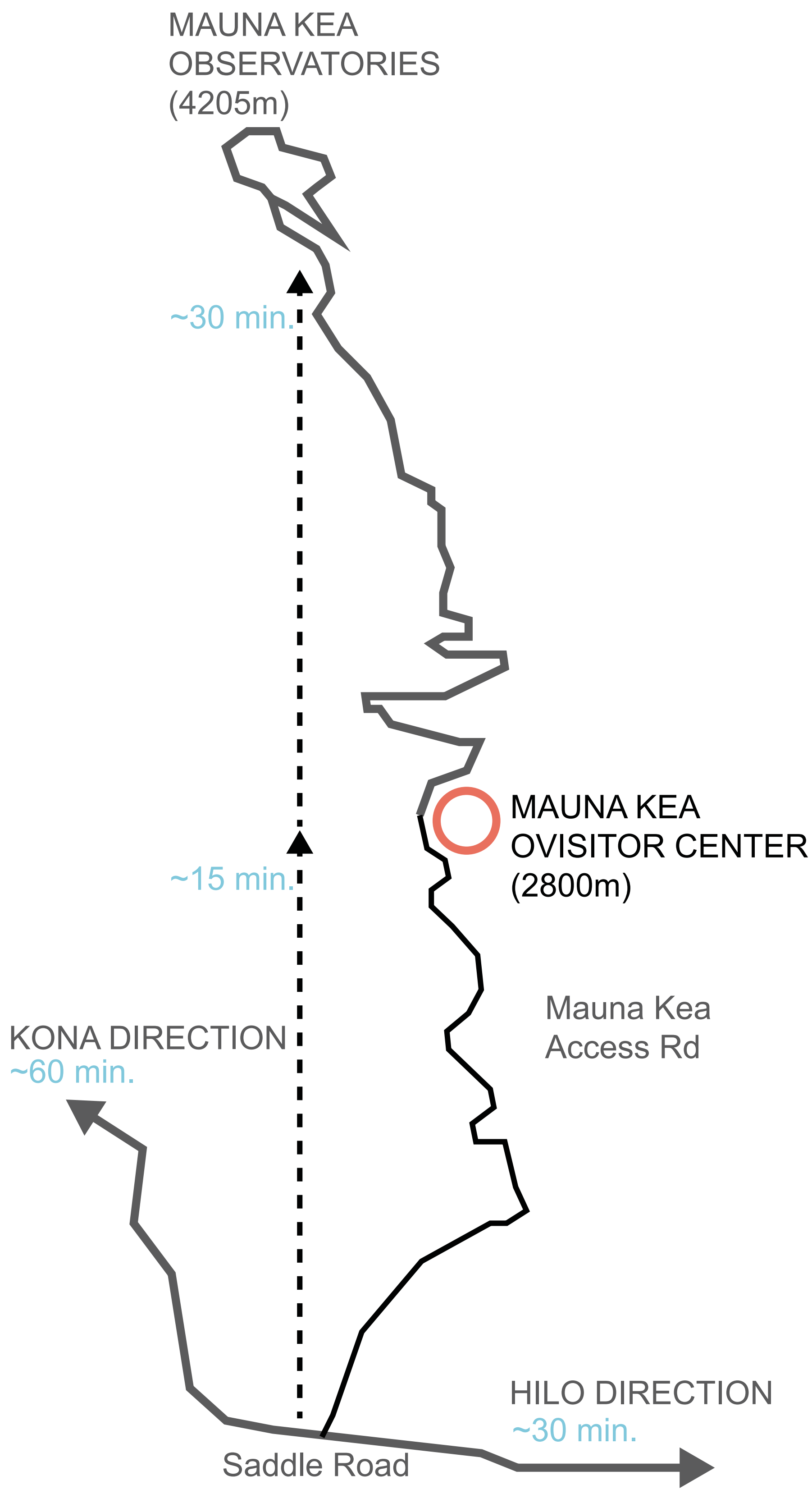


fig. 37

06.02 GENERAL CONCEPT

The main structure is formed like a circle, blocking out wind from the main directions and light from passing cars and other light sources (01).
The room schedule is woven around this circle, generating a defined path for visitors. Inside, a shielded courtyard offers open space for different plots and activities (02).
To reduce sight barriers the inner facade of the structure is chamfered (03), resulting in a vast open space experience and better views for stargazers at night. It also causes an exciting sense of space in the indoor areas.
An added spherical structure containing a planetarium (04), completes the room program. The landscape design connects to the main structures where required (04).
Accounting varying ceiling heights, the roof adjusts by partially falling away and then ascending again (05).
The natural slope of the mountain site is continued in the inner courtyard, burying the building in the north-west and under diving it in the south, connecting the whole structure to its natural surrounding (06).



VIS-SUMMIT

DEP.	ARR.
12:00	12:30
15:00	15:30
17:30	18:00
17:40	18:10
17:50	18:20

SUMMIT-VIS

DEP.	ARR.
15:45	16:15
17:15	17:45
19:10	19:40
19:20	19:50
19:30	20:00

VIS-KONA

DEP.	ARR.
11:45	13:00
14:30	15:45
15:45	16:00
18:00	19:15
19:45	21:00
20:15	21:30
21:45	23:00
22:00	23:15

VIS-HILO

DEP.	ARR.
12:30	13:00
12:45	13:15
15:30	16:00
15:45	16:15
19:00	19:30
20:30	21:00
21:00	21:30
21:40	22:10

KONA - VIS

DEP.	ARR.
10:00	11:15
13:00	14:15
14:15	15:30
16:00	17:15
16:15	17:30

HILO- VIS

DEP.	ARR.
10:15	10:45
13:15	13:45
13:30	14:00
16:15	16:45
16:30	17:00

fig. 38

06.03 TRANSPORTATION CONCEPT

The project includes a proposal to increase the level of public transportation not only up and down Mauna Kea, but also regarding the connection between the two main cities of the Island.
Offering parking space for five buses bringing in and getting people out from Kona and Hilo via Saddle Road, results in a new transportation route much faster than the current one directed along the coastline.
A new bus schedule facilitates five new connections between the cities and Mauna Kea itself, including the Visitor Information Station and the summit area.
Each bus is able to transport up to 50 passengers per ride, excluding the driver, during different times of the day and with increased frequency during peak times in the evening.

In total, approximately 500-700 people can be brought up Mauna Kea and back to the cities again on a daily basis.
The measurement of generating an efficient public transportation system reduces the amount of necessary parking lots at the VIS and allows more control over the visiting hours of tourists.
Car parking lots are reserved for staff members, scientists and people with special needs. Every car going up must check in online beforehand, to enhance the public transportation system. Additionally, this process enables full oversight of available parking space.
It is still possible to book one of the private tours going up Mauna Kea in groups of 15 people per session, offering a flexible time schedule and more time at the summit area.

50 ppl/BUS
Parking Space VIS: 5
fixed schedule per season

15 ppl/Shuttle
Parking Space VIS: 19
scheduled as required

cars only with reservation
Parking Space VIS: 54
privately organized

fig. 39

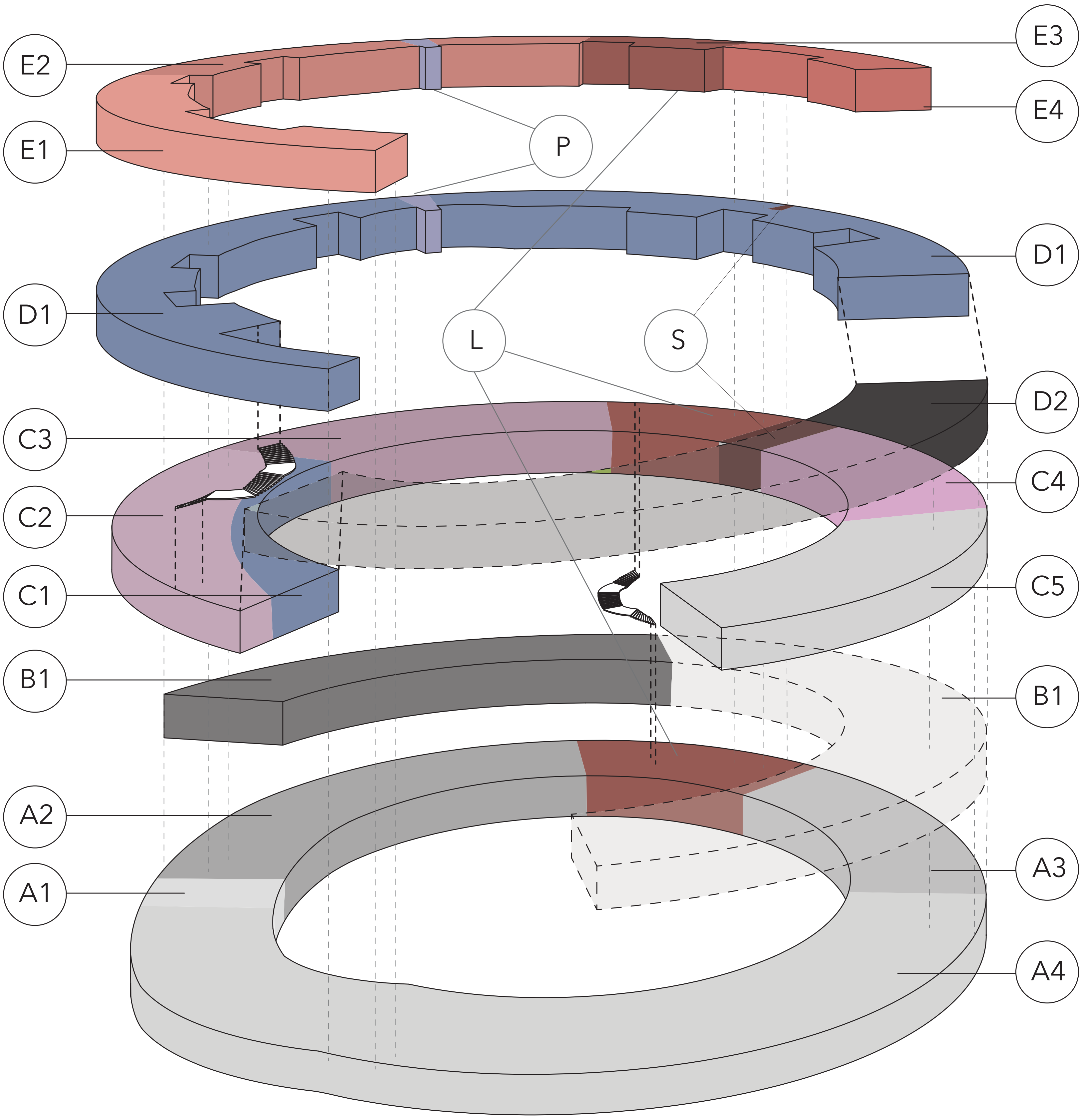


fig. 40

06.05 ROOM SCHEDULE

A	PARKING GARAGE	4.875	m²
A1	GARAGE ENTRY	150	m²
A2	PARKING BUSES	5	parking lots
A3	PARKING SHUTTLES	19	parking lots
A4	PARKING CARS	54	parking lots
B	TECHNICAL AND STORAGE	3.070	m²
B1	TECHNICAL		
C	LEVEL 00	4.650	m²
C1	EXPO	700	m²
C2	CAFETERIA	490	m²
C3	SHOP & VISITOR LIBRARY	440	m²
C4	CULTURE PRACTICE HALL	1.200	m²
C5	STORAGE	590	m²
D	LEVEL 01	3.820	m²
D1	EXPO	2.270	m²
D2	DARKNESS TO LIGHT AREA	1.500	m²
E	LEVEL 02	2.110	m²
E1	DORMS AND BATHROOMS	870	m²
E2	COMMUNITY AREA	460	m²
E3	READING AREA	180	m²
E4	OFFICE AND LABORS	530	m²
L	LOBBY AND INFO DESKS	635	m²
S	VISITOR SANITARY	210	m²
P	PLANETARIUM ENTRY	30	m²

NET AREA	19.220m²
OUTDOOR AREA	3.860m²

max. OCCUPANCY	
COURTYARD	800 ppl
CAFETERIA	300 ppl
CULTURE HALL	120 ppl
EXHIBITION	800 ppl
DORMATORY	46 ppl

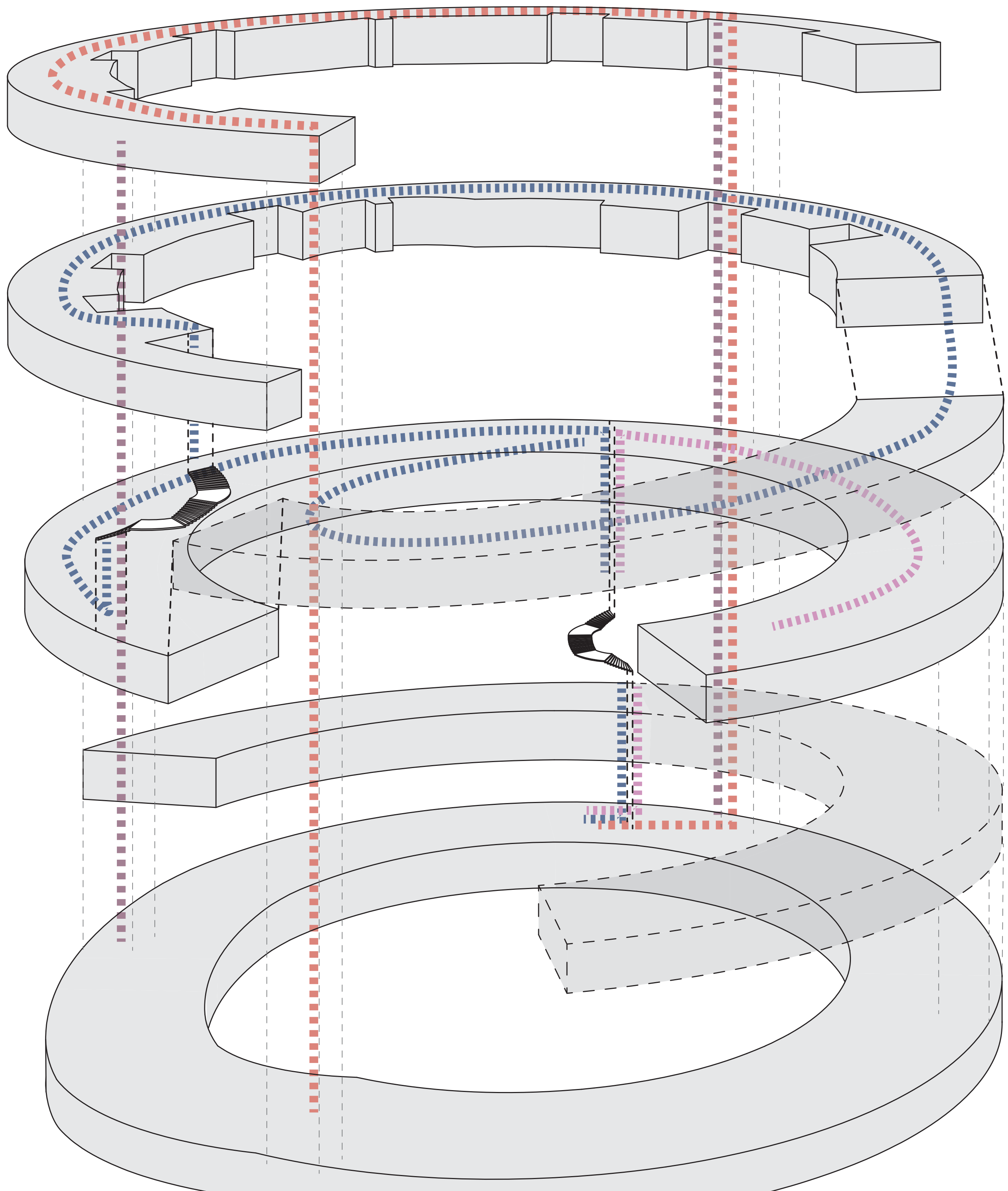


fig. 41

06.06 USER SCENARIO AND ROUTES

The building offers different pathways for several user groups. General visitors represent the biggest group and therefore have the easiest access to the main entrance stair and elevators, leading from the parking garage to the lobby, info desk and sanitary facilities. From there, their journey begins by passing the shop, library, the news room and cafeteria for basic provision and information. Having passed those areas, the exhibition begins on the ground floor and leads to another broad stair bringing them up to the first level where the main exhibition is installed. Here, they are introduced to Mauna Kea and all its special features, covering environmental, cultural and scientific topics. Another sanitary facility and a lounge invite them to rest for a bit, before going on by learning about legends of several deities living on the mountain and the sacred structures to worship them.
Then the visitors enter the tunnel of the "Darkness to Light" installation, to reflect on the gained knowledge and themselves, while walking down the slope into more illuminated space. When daylight has come back to the structures, they are led into the inner courtyard where they can explore the nature of Mauna Kea, gather, rest or stargaze if it is already dark enough. Afterwards they come back to the lobby and can leave the mountain via bus leaving from the parking garage or their private shuttle.
Visitors who want to participate in one of the courses offered by the Culture Practice Hall, go up to the lobby and info desk, pass the sanitary facilities and branch out to the according class areas.
Scientists and staff members can use the main elevators or the delivery elevator to get to the second floor, where they enter a lobby before spreading into different areas of the non-public level.
Delivery usually happens during early hours when visitors are still rare and use any of the elevators to get to the according levels.

Visitors
Class Participants
Scientists and Staff
Delivery

fig. 42

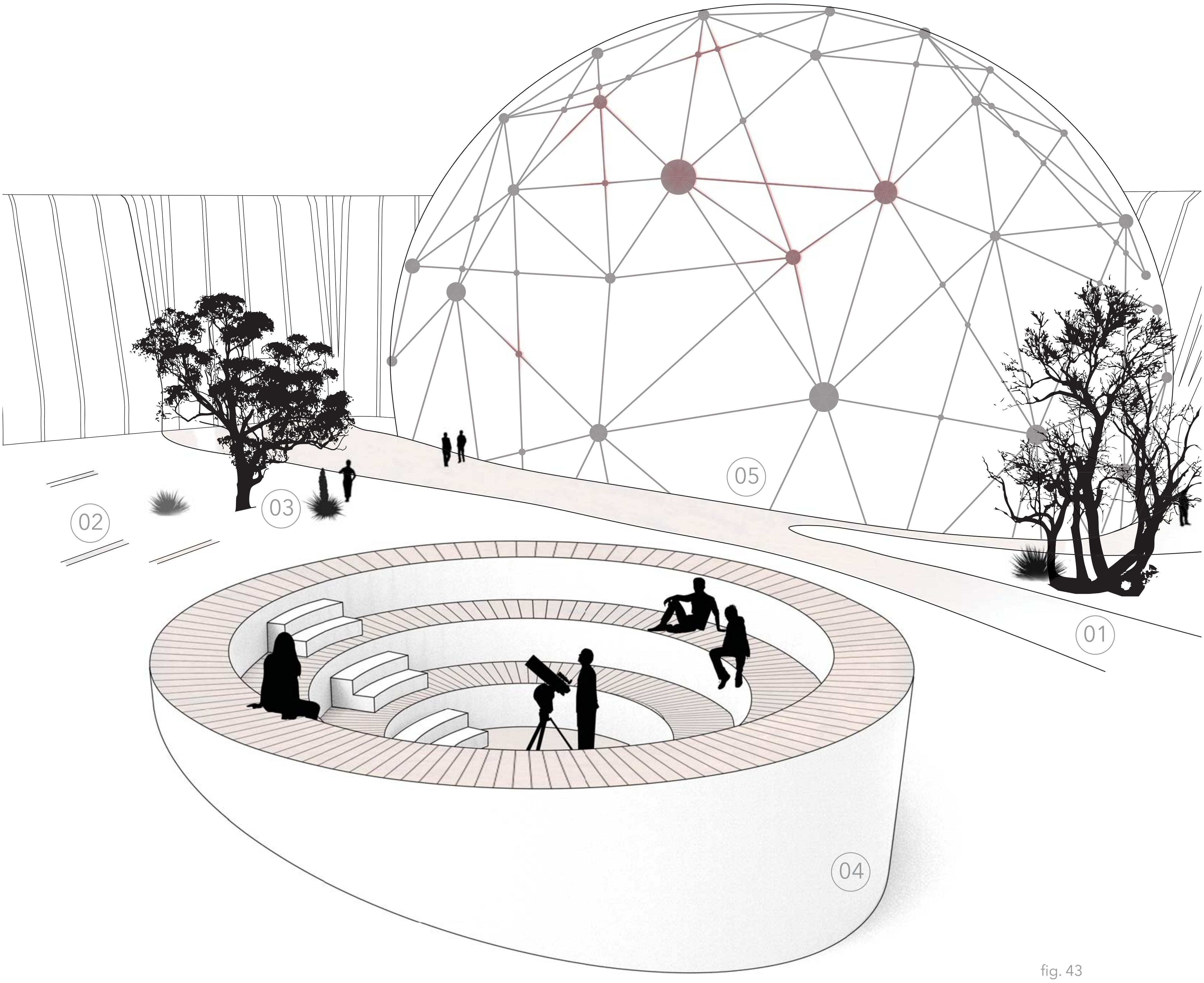
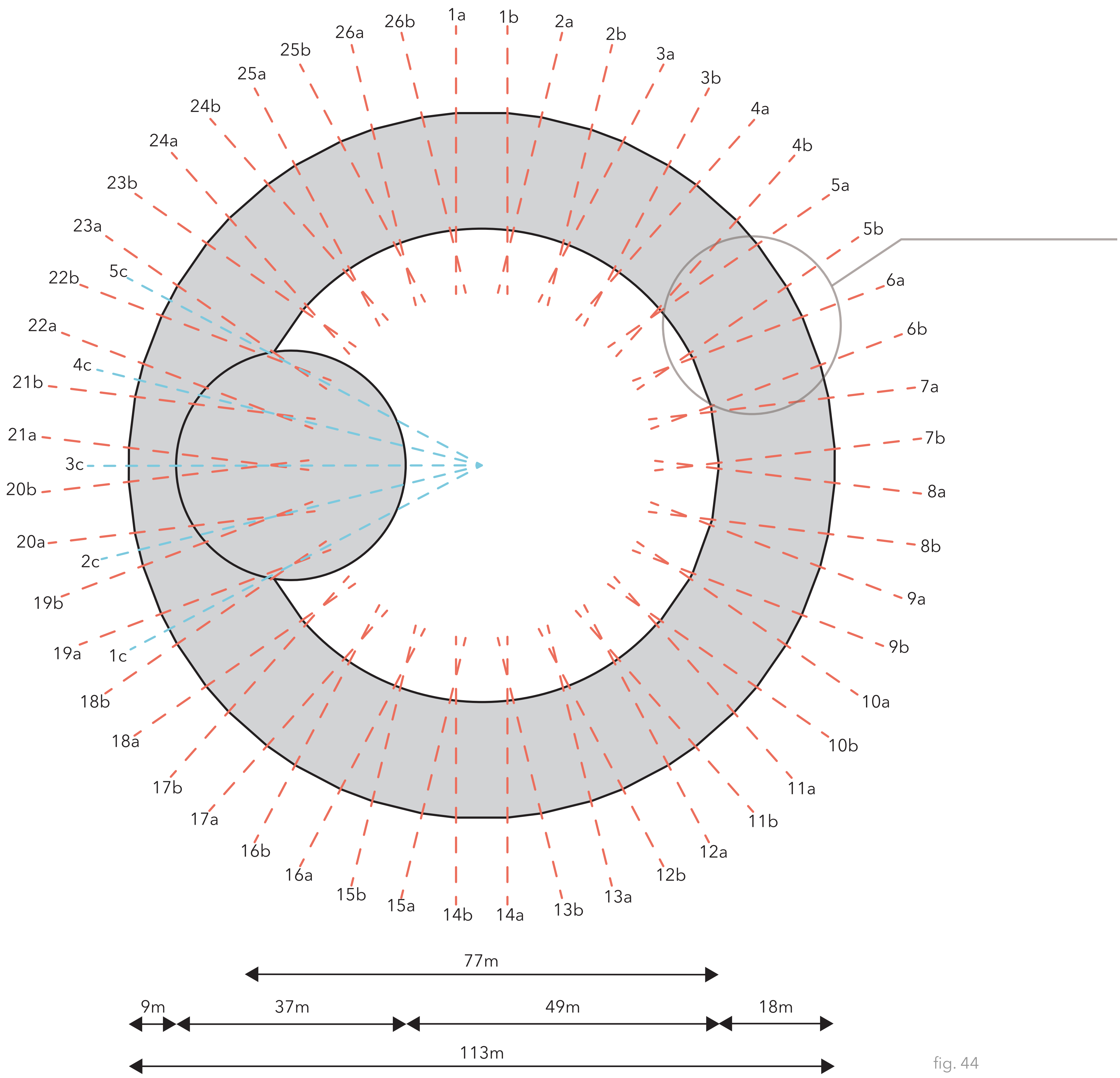


fig. 43

06.07 LANDSCAPE CONCEPT

Inside the circular building a large inner courtyard introduces visitors to the mountain and its special features.
The fixed and well defined wooden terrace (01) generates a shortcut between the lobby and the beginning of the exhibition. It also functions as an outside area for three of the five classrooms for Hawai'ian Culture Practice, inviting visitors to spectate or participate.
After visitors complete the exhibition and the "Darkness to Light" reflection area they are lead to an exit to the courtyard, where beams of naio wood (02) are embedded into the ground. Those bars are densely placed in the beginning and then start to disperse into the open area. This measure encourages guests to explore the landscape by themselves with respect and caution. Sparsely located naio trees, endemic to Hawai'i and naturally growing on Mauna Kea, and planted silversword plants (03) help organize the large area into recognizable sections for a better sense of orientation.
The building itself is partially buried under a natural slope of Mauna Kea. This slope coming from the north-east continues in the patio connecting it with the mountain and falls away directing south. There, a section of the building is free floating, giving the landscape a chance to dive under the construction, rejoining the landscape outside the circle.
On the upper part of the slope, inside the courtyard, 10 gathering circles (04) are located. During the day, visitors can rest and gather. During the night, the circled structures function as gathering spaces for stargazing groups, protecting them from wind, the main building might not block.
Five of the circles with a diameter of 7m hold up to 90 people at a time. In the middle, there is enough space for a telescope. The other circles with a diameter of 5m offer space for up to 36 people and can be used for private tours or bigger groups.
For a comfortable stargazing experience, the seating surfaces are made from wood while the solid structure consists of stone walls. Visitors can recognize the semblance to the sacred heiaus they got introduced to in the exhibition before.
During stargazing tours at night, the outer shell of the planetarium (05) helps to navigate and illustrate the starry sky. Currently discussed star formations during the lectures, are projected through the perforated structure with red light to not disturb night sight abilities.


1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6b
7a
7b
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9a
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22a
22b
23a
23b
24a
24b
25a
25b
26a
26b
1c
2c
3c
4c
5c
77m
9m
37m
49m
18m
113m

fig. 44

06.04 CONSTRUCTION CONCEPT

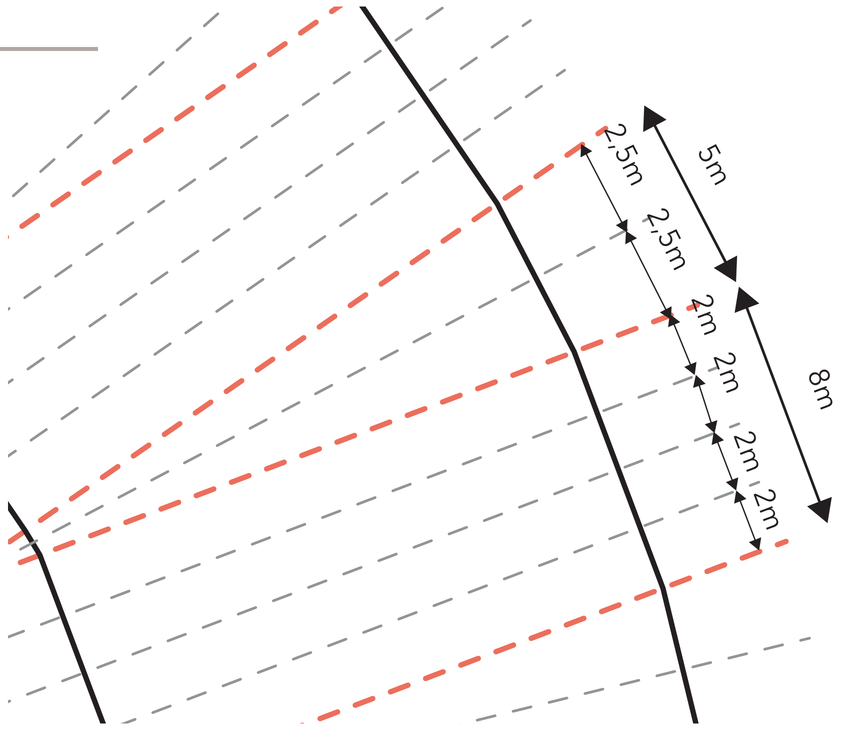


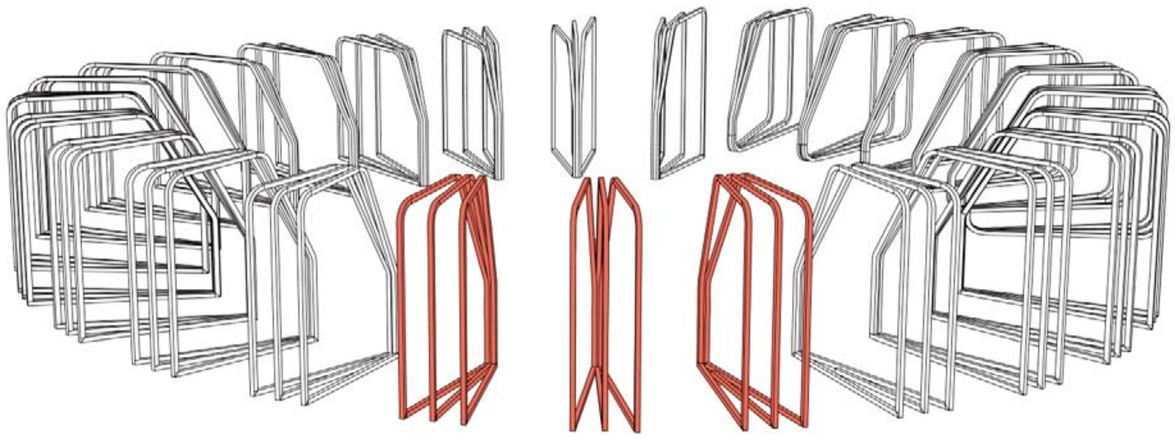
fig. 45

The construction consists of 26 sections. Each of them is supported by two steel frame beams situated to the left and right side of the eight-meter-long parallel segment (01). The circular arrangement forms a triangular rest-surface in-between those sectors with an outer longitude of five meters. On the inner point of intersection, the main beams of two adjacent parallel segments are welded together to a singular support beam of 80cm in thickness.

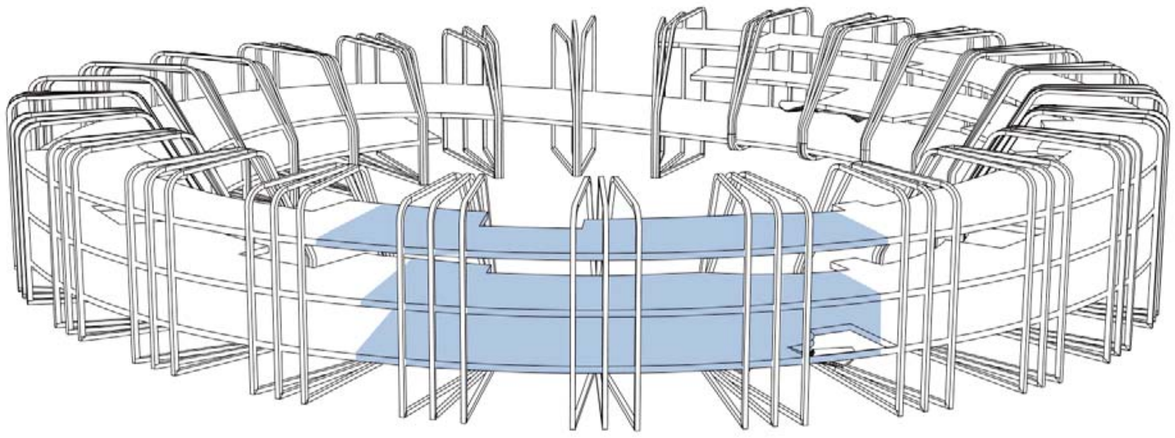
The bracing of the building is achieved by the circular configuration of the frame structure and the horizontal beams made from reinforced concrete. Those support the ceilings on each particular level (02). Because of the large span of up to 18m in the parking garage and the ground level, the ceilings are composed of prestressed concrete to keep the floors unsupported and therefore guarantee a highly flexible entity.

To enable an organized and uncomplicated technical infrastructure within the project, the facades of the rest-surfaces mentioned before are completely closed (03). Within this 26 five-meter wall section, all electricals, water pipes, aeration systems, heating systems and other kinds of supplying infrastructure are installed. Hence no windows or other openings are located within those sectors.

01



02



03

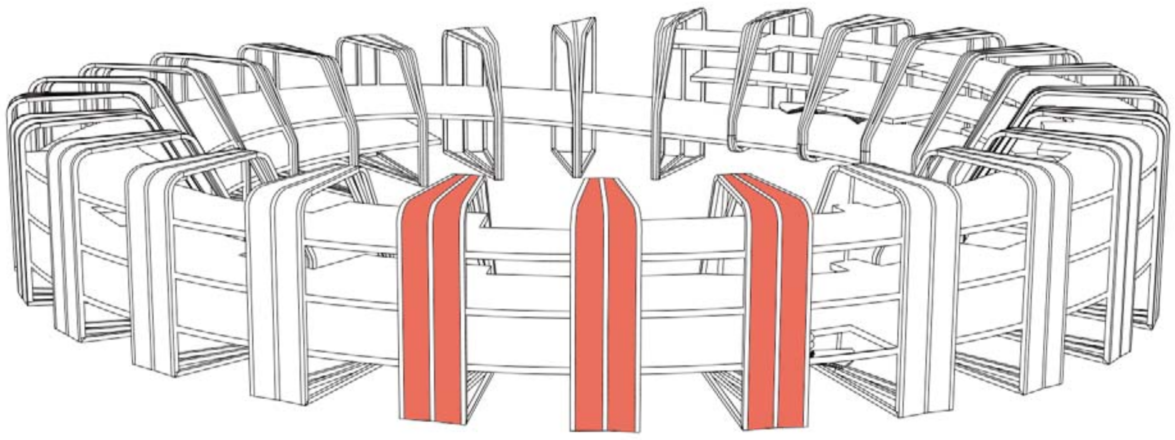
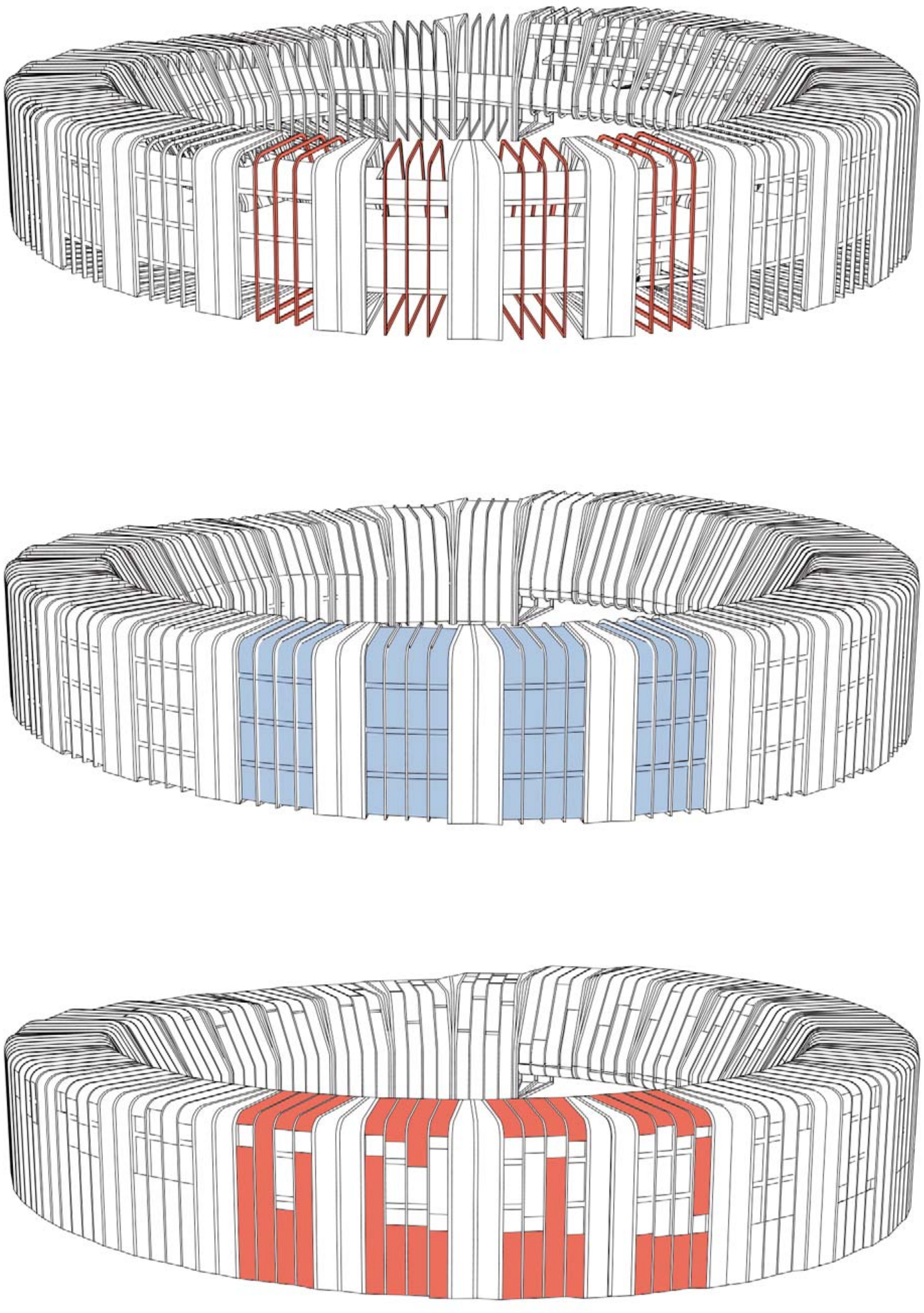


fig. 46



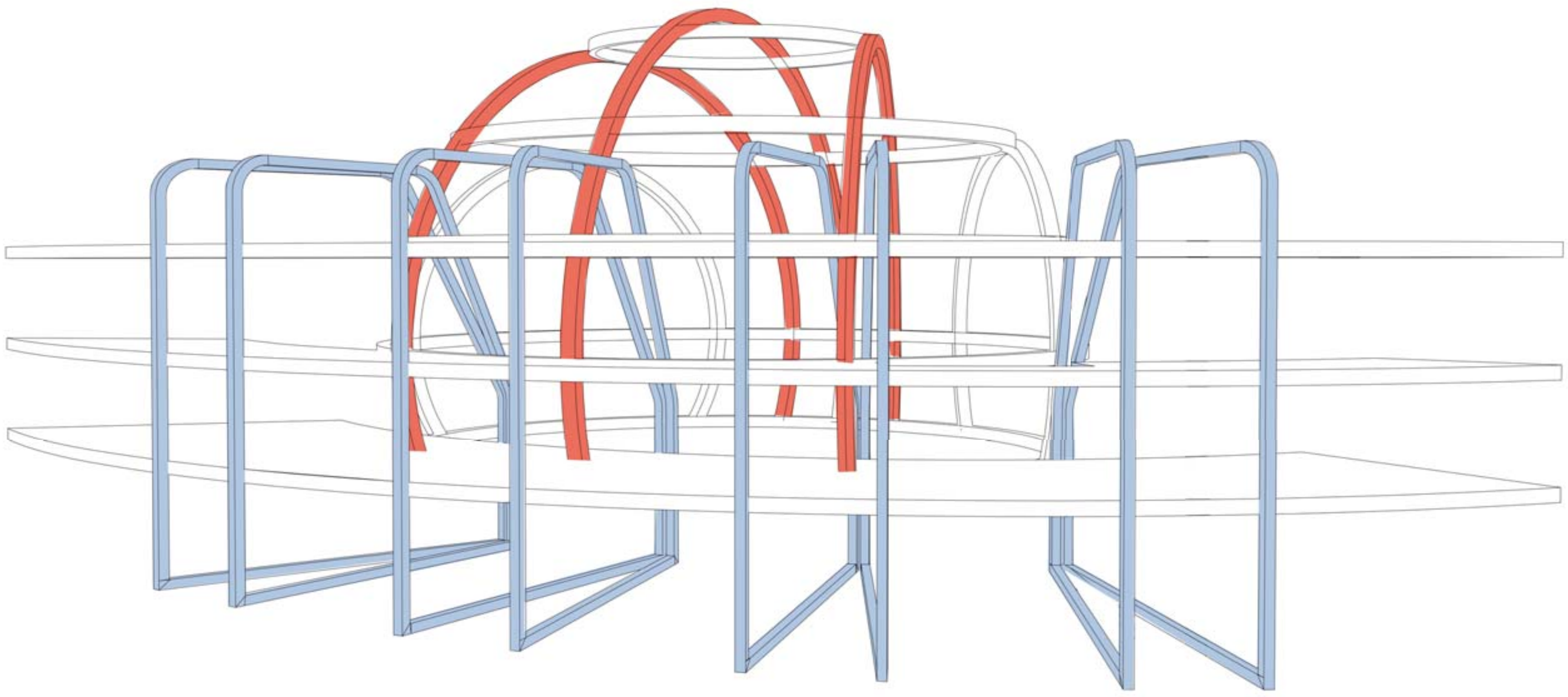
04

05

06

fig. 47

07



08

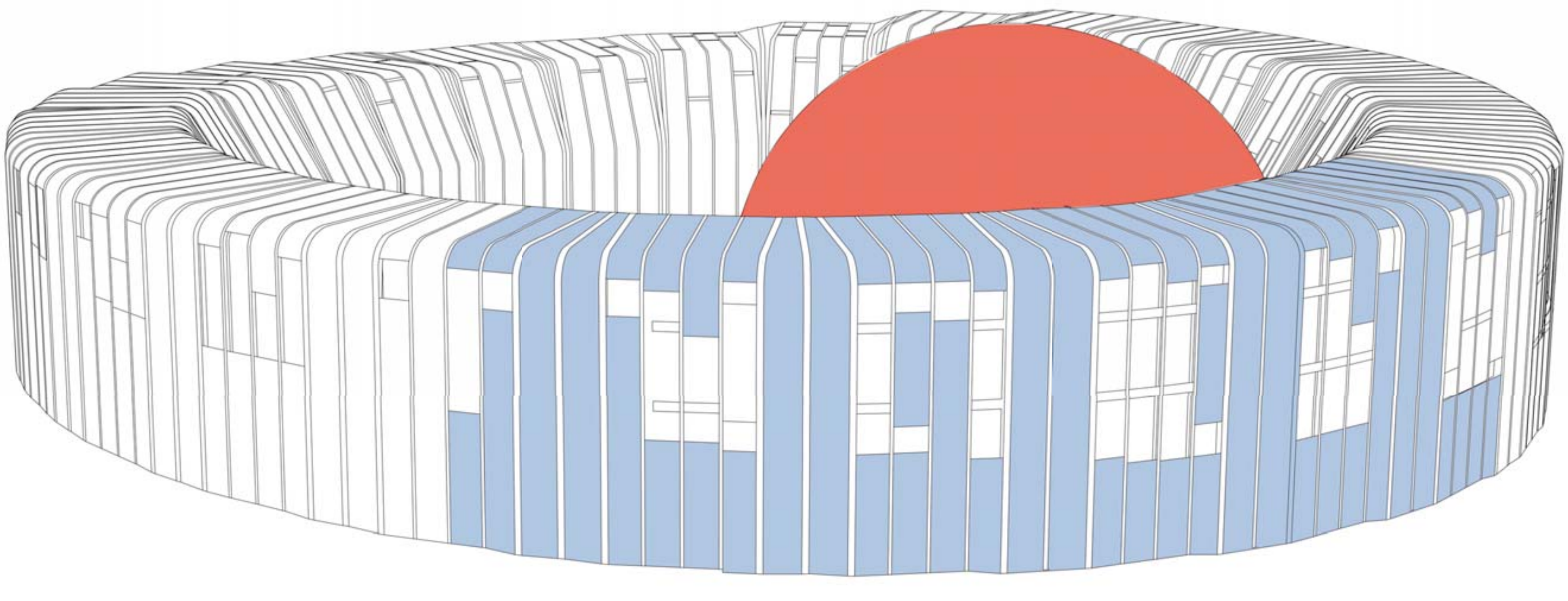
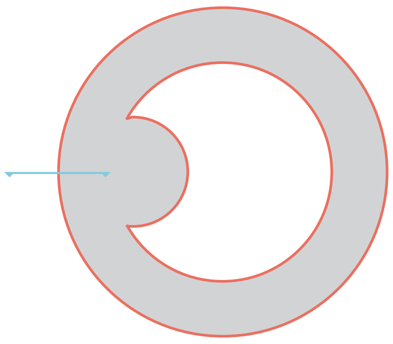
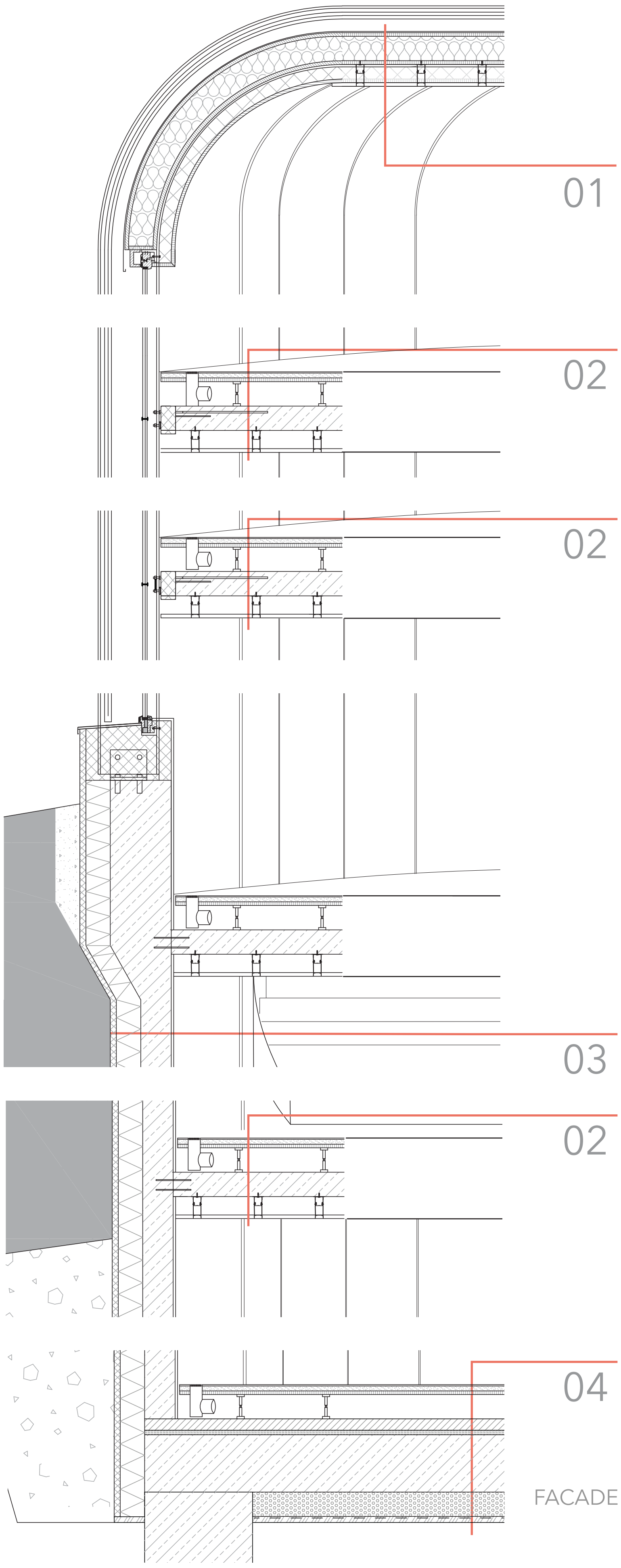


fig. 48

The secondary frame structure (04) is connected to the concrete ceiling. It consists of three pieces in each parallel segment and differs in size depending on its particular location and the roof development.
On the inside of the frame structure the glass facade (05) is fixed to the steel beams allowing a smooth and seamless look of the glazing.
On the outside, the kinetic hatches (06) are installed. They move along in the same plain as the outer closure of the frame structure, giving the building a calm surface without any disturbing tilts along the outer shell generating a consistent and strong image. This is especially important for the buildings appearance as the high-level flexibility needs a minimalistic contrast and steady background for its exciting movements and transformations.
The construction of the planetarium (07) consists of several horizontal and vertical beams. To keep the structures of the sphere and the one of the building independent they do not interfere with another. The beams of the planetarium are positioned in-between the main frames of the circular part of the building. Hence two separate constructions can visually merge together without touching each other (08).





FACADE SECTION1:50

fig. 49

01 CEILING
Cover plate
3cm three-layer panel
20cm thermal insulation
3cm three-layer panel
10cm thermal insulation (around beams)
3cm panel
15cm installation level
3cm perforated plate

02 INTERMEDIATE CEILING
3cm perforated plate
15cm installation level
20cm prestressed concrete
20cm installation plate (aeration)
3cm sound insulating boards
5cm floor screed
3cm floor tiles (polished lava rock)

03 BASEMENT WALL
10cm XPS boards
20cm thermal insulation (hard)
20cm waterproof concrete
2cm interior plaster

04 BASEMENT FLOOR
20 cm granular subbase
47 cm waterproof concrete (basement)
5cm PKV 5 and protective concrete
20 cm insulating fills with installations
3cm insulation panel
5 cm screed
10cm asphalt layer

Scheme Connection Detail

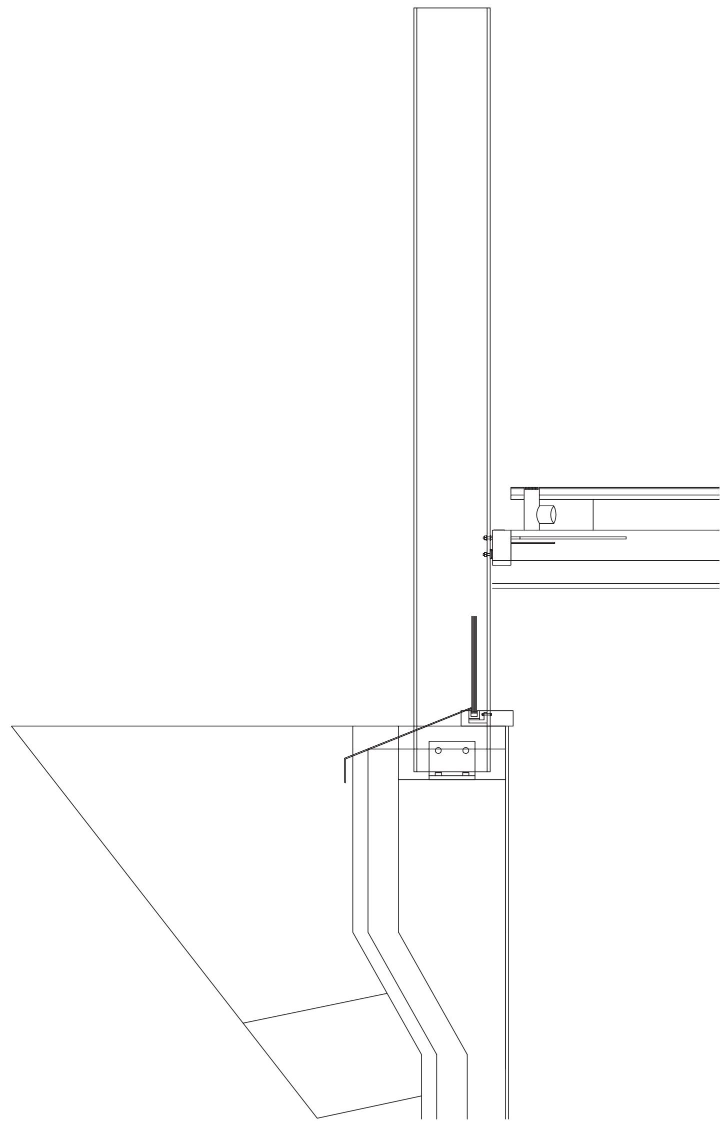


fig. 49

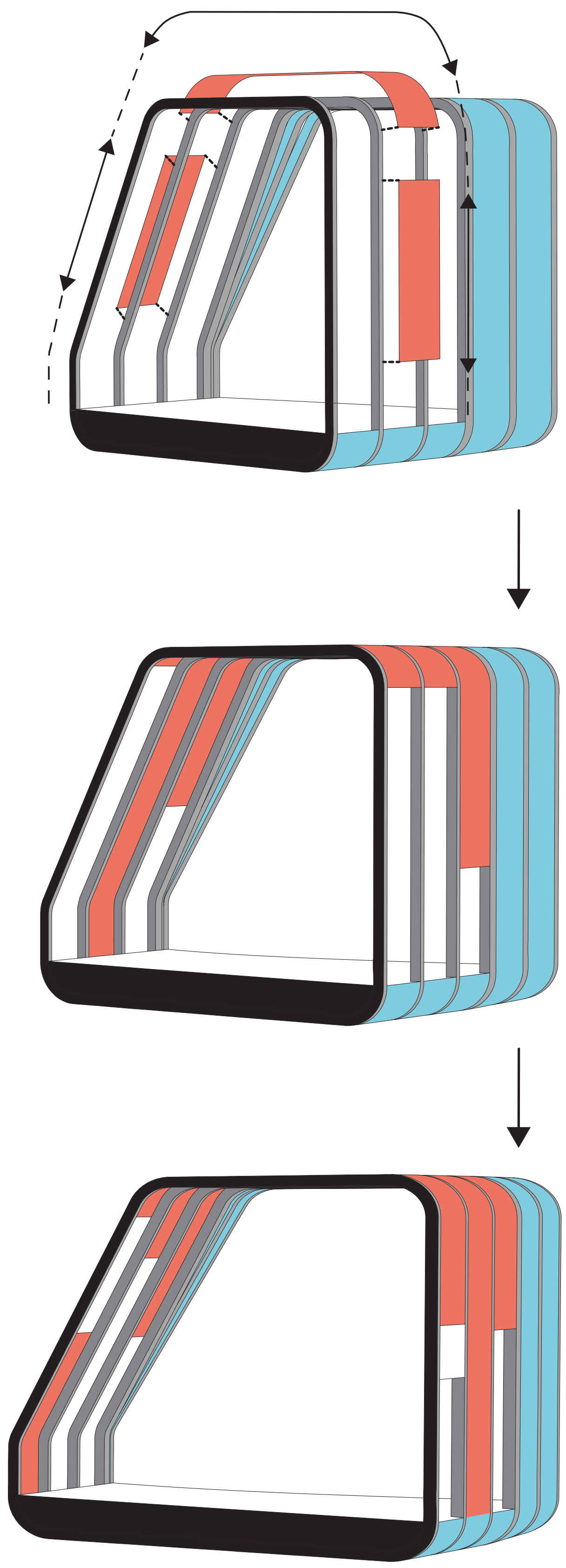


fig. 50

06.08 FACADE AND LIGHTING CONCEPT

The Visitor Information Station has very special requirements regarding the light situation. It calls for vastly different solutions during day and night, requiring a highly flexible facade.
During daytime, visitors are walking through the exhibition, classes in different subjects are taking place and office work must be done. Natural light is vital for a comfortable and inviting atmosphere for all the mentioned activities.
During nighttime on the other hand, the building must block out any white light so stargazers' night visibility is not disturbed at any time. Once blinded, half an hour passes before the human eye readjusts to the darkness again.

Therefore, the facade consists of 26 sections, with four flexible and two fixed divisions each.
Every one of the flexible divisions has three hatches attached. The one in the middle measures 14m while those found left and right to it have a length of 7m. This formation allows a huge variety of facade constellations depending on the current weather and light situation, or special requirements for events, and can close one site of the building completely.
During daytime, the location of the panels varies a lot, generating different sources of natural light in every section and at every level. This results in a sufficient and pleasant lighting situation, supported by white light spots inside the building.
At night on the other hand, all hatches are moved to the inner side of the structure so it blocks out every white light source of the outside area. Exceptions are made only at entry and exit situations which are reduced to a minimum. During stargazing hours, the inside of the building is illuminated by red light sources only. Red light does not disturb the night sight visibility of the human eye or the observatories at the summit area. This is of great importance, because if the inner facade is closed, the outer shell remains open and well visible for visitors coming down the mountain.

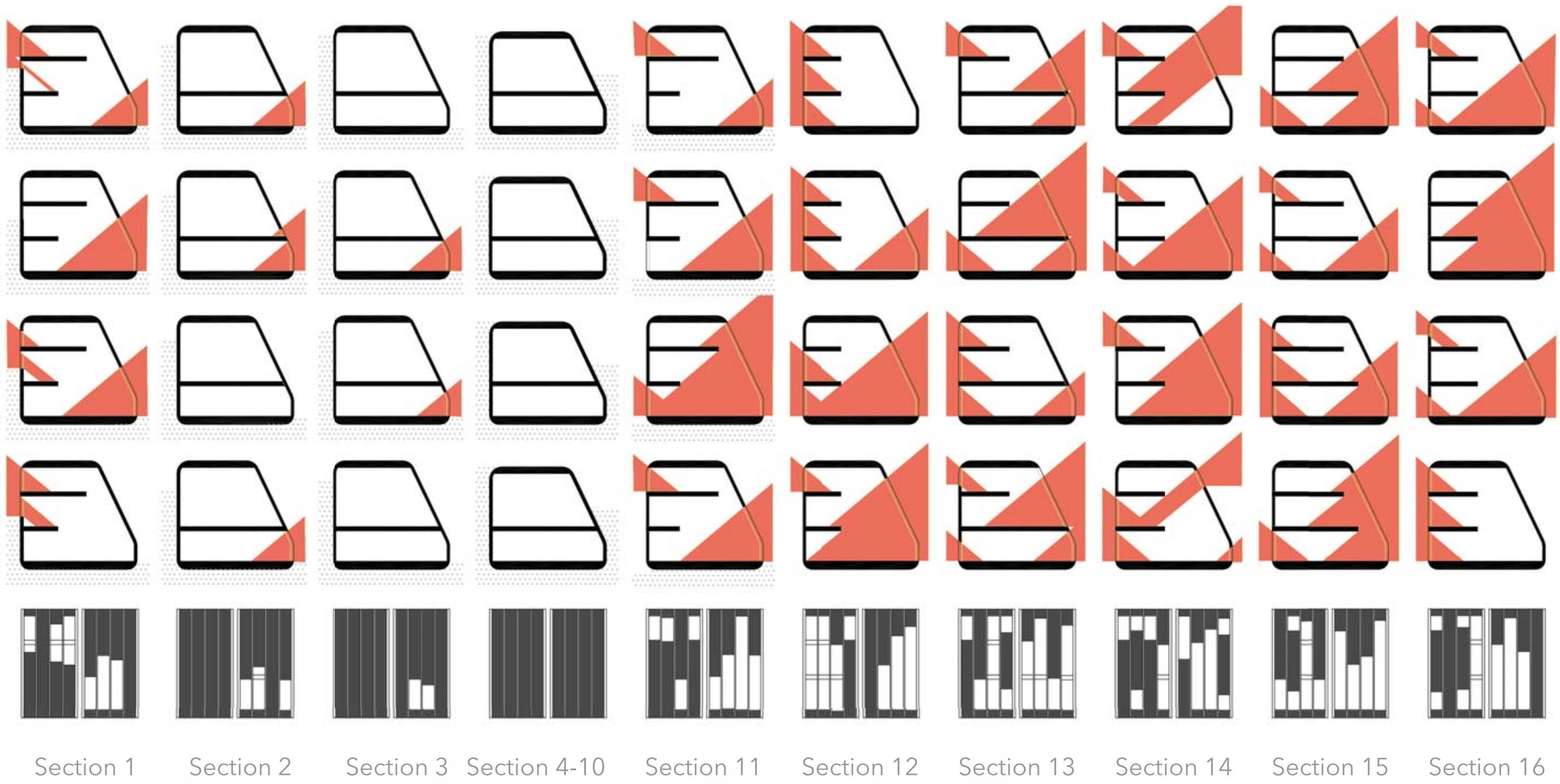
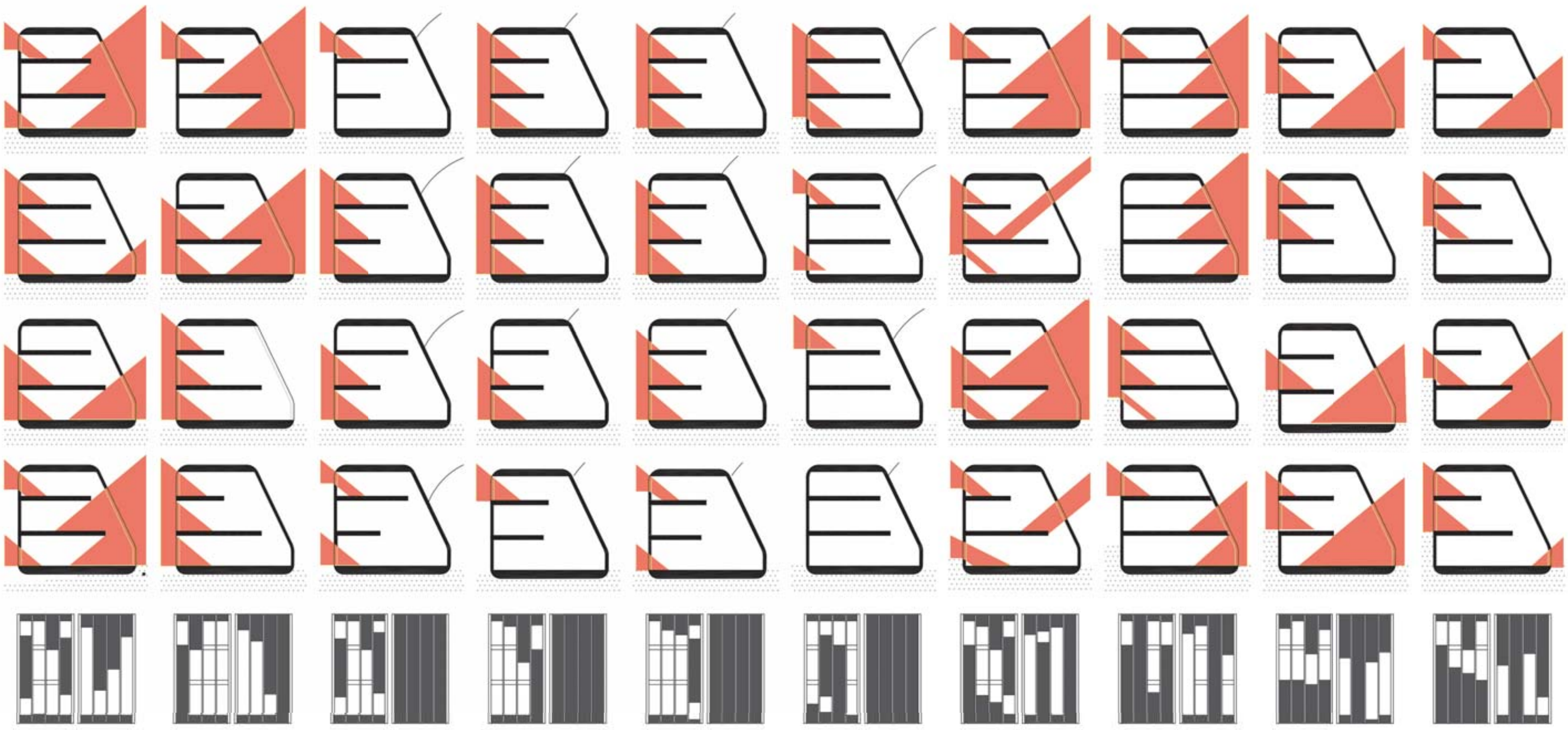
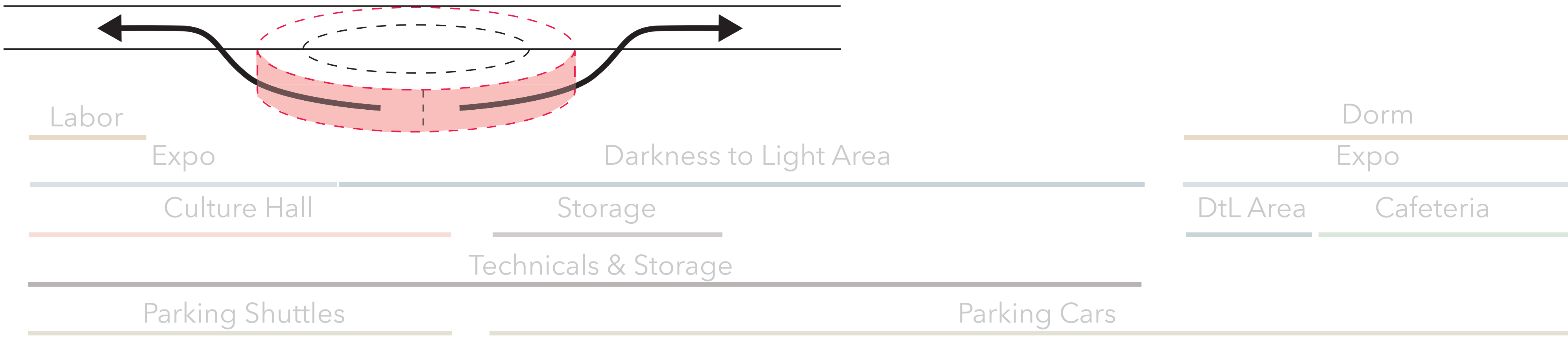

Section 1
Section 2
Section 3
Section 4-10
Section 11
Section 12
Section 13
Section 14
Section 15
Section 16

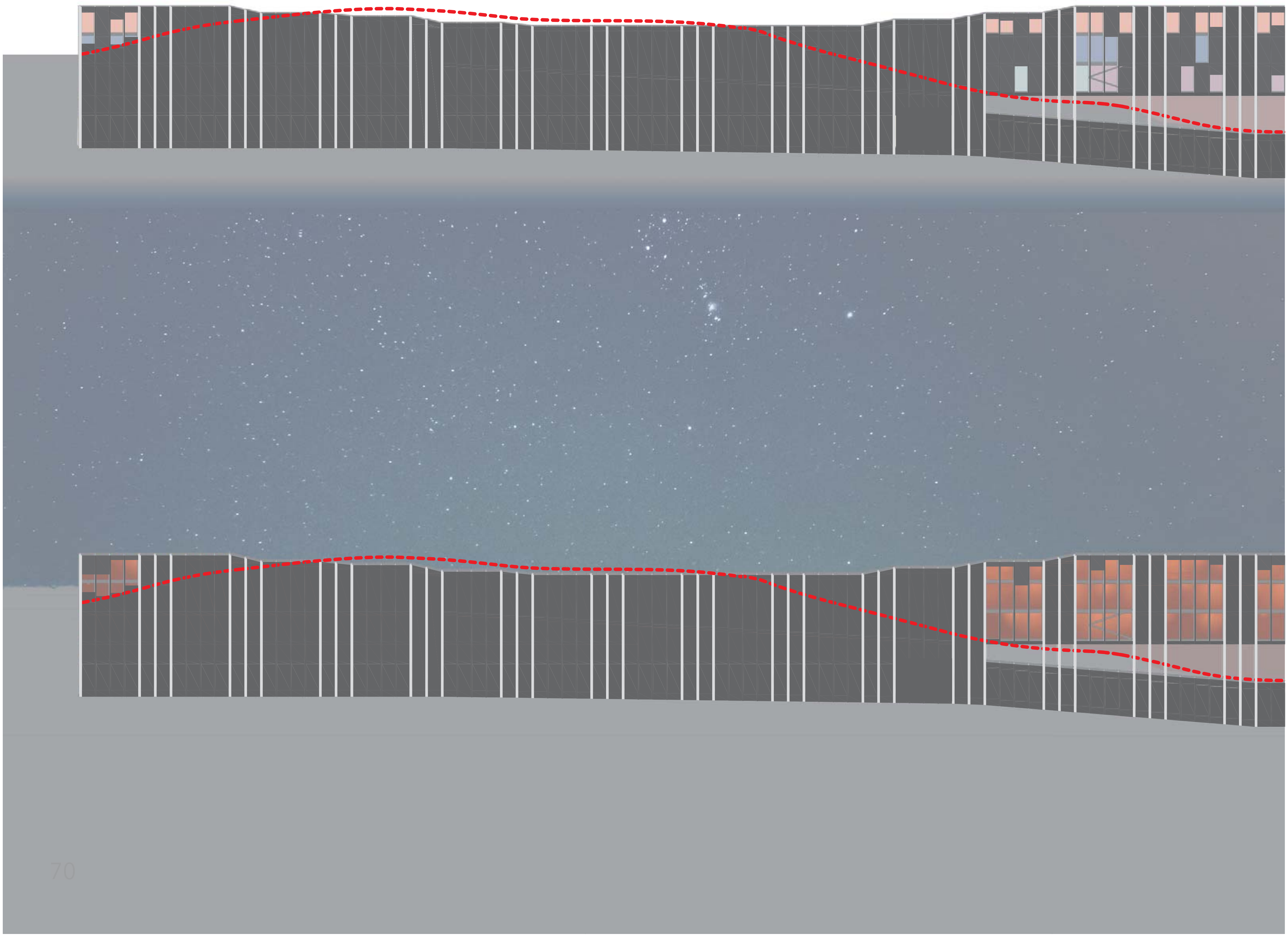
fig. 51

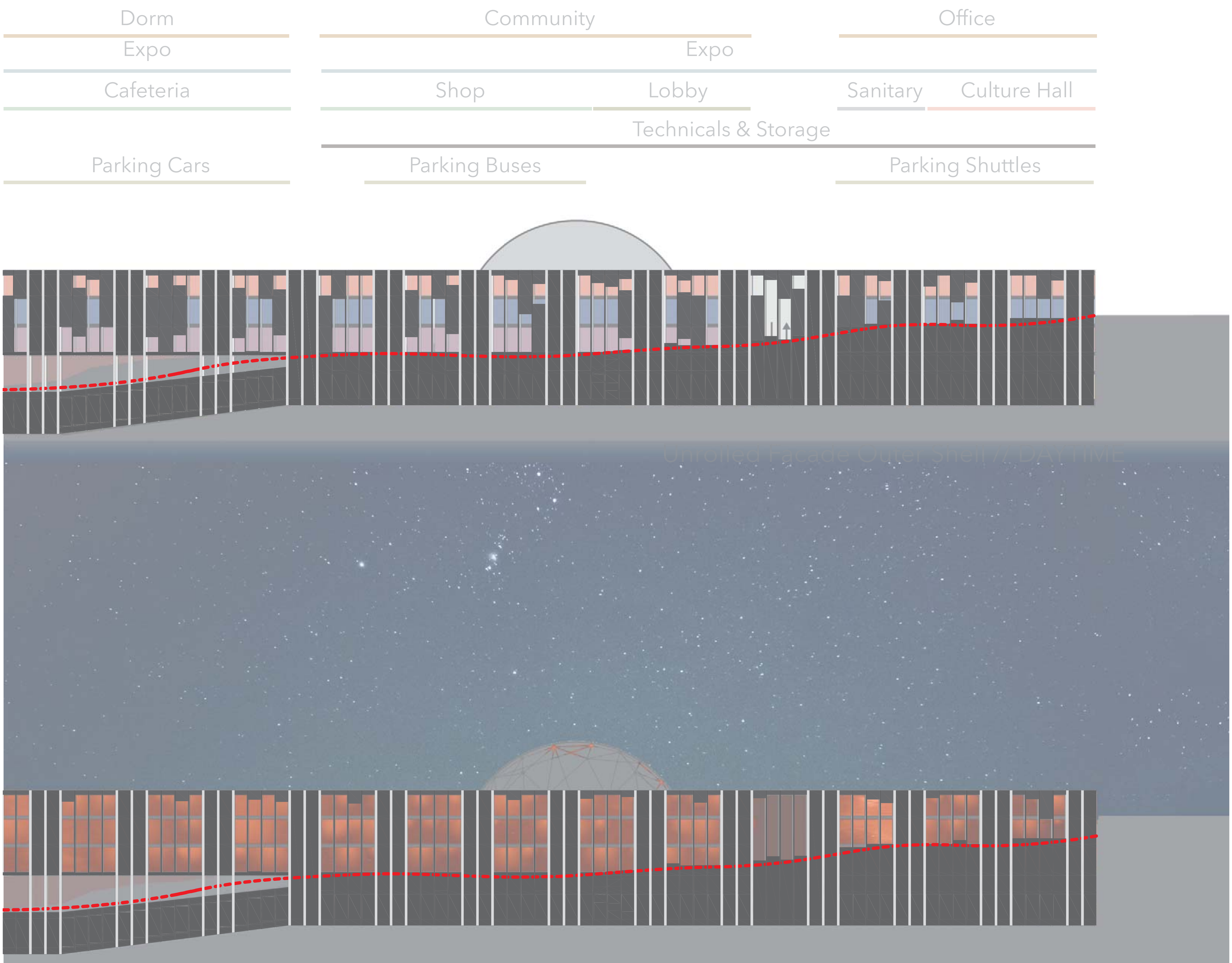


Natural Light Studies

fig. 52


Labor
Expo
Darkness to Light Area
Culture Hall
Storage
Technicals & Storage
Parking Shuttles
Parking Cars
Dorm
Expo
DtL Area
Cafeteria

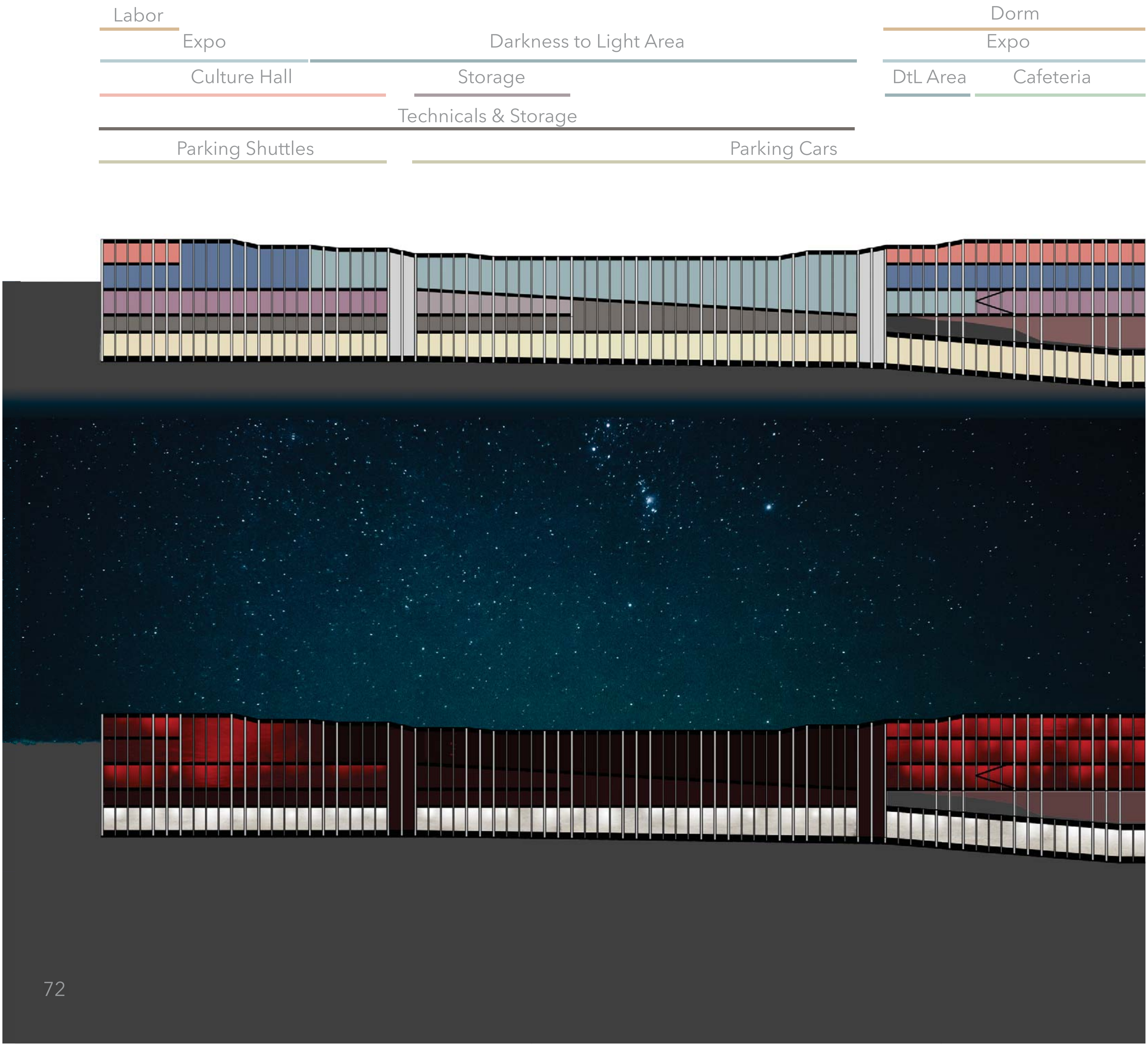


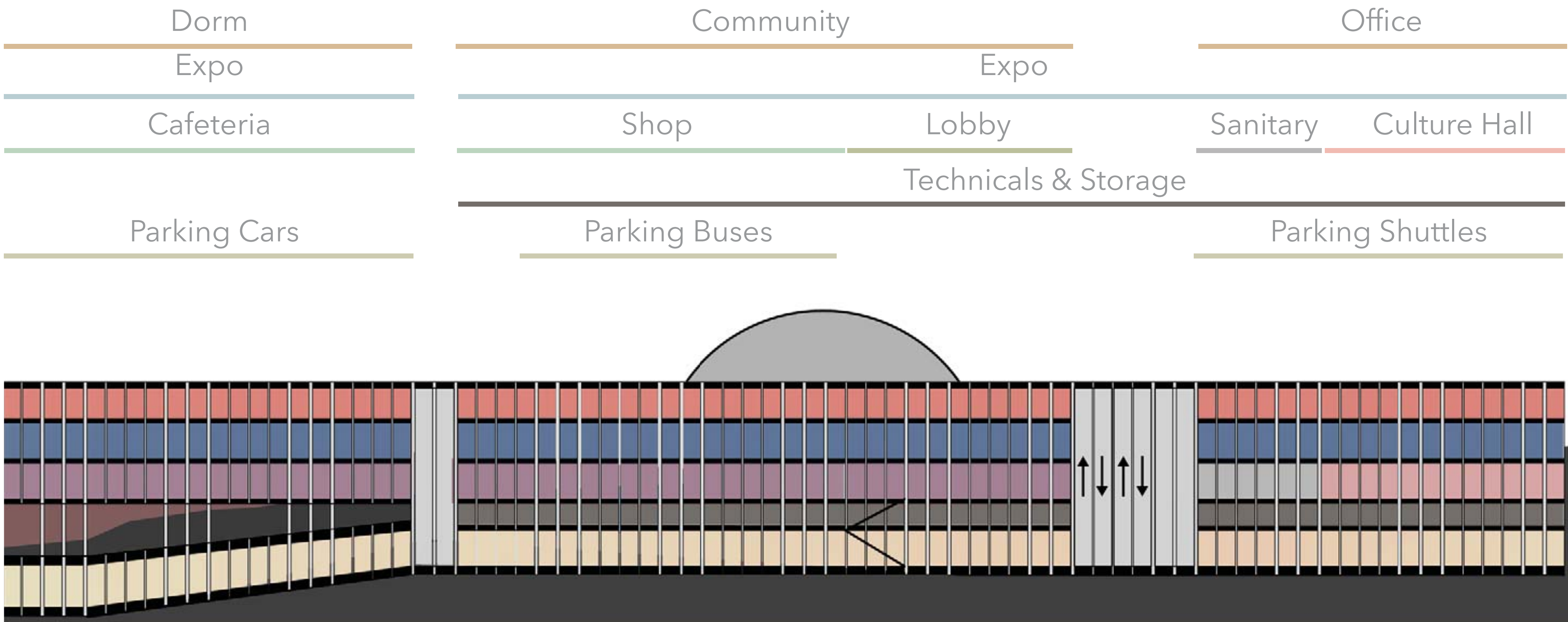


Unrolled Facade Outer Shell // DAYTIME

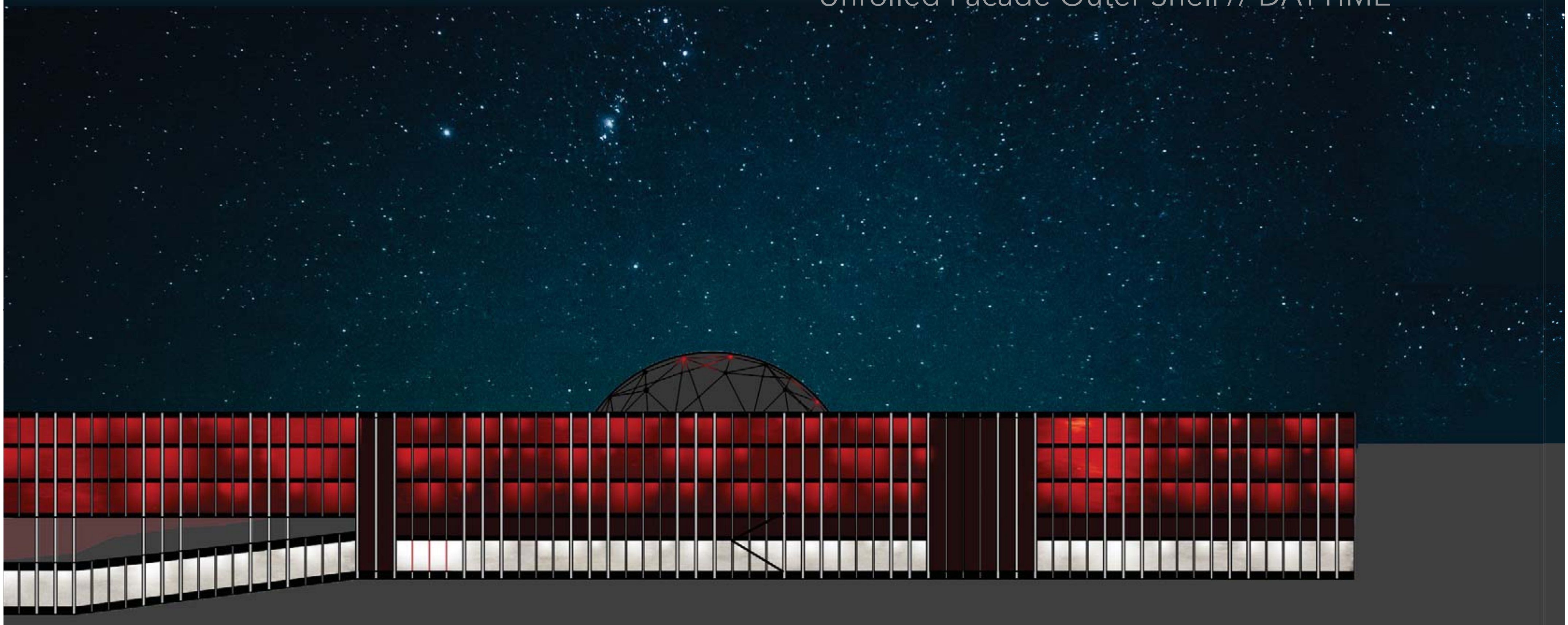
Unrolled Facade Outer Shell // NIGHTTIME

fig. 53


Labor
Expo
Darkness to Light Area
Culture Hall
Storage
Technicals & Storage
Parking Shuttles
Parking Cars
Dorm
Expo
DtL Area
Cafeteria



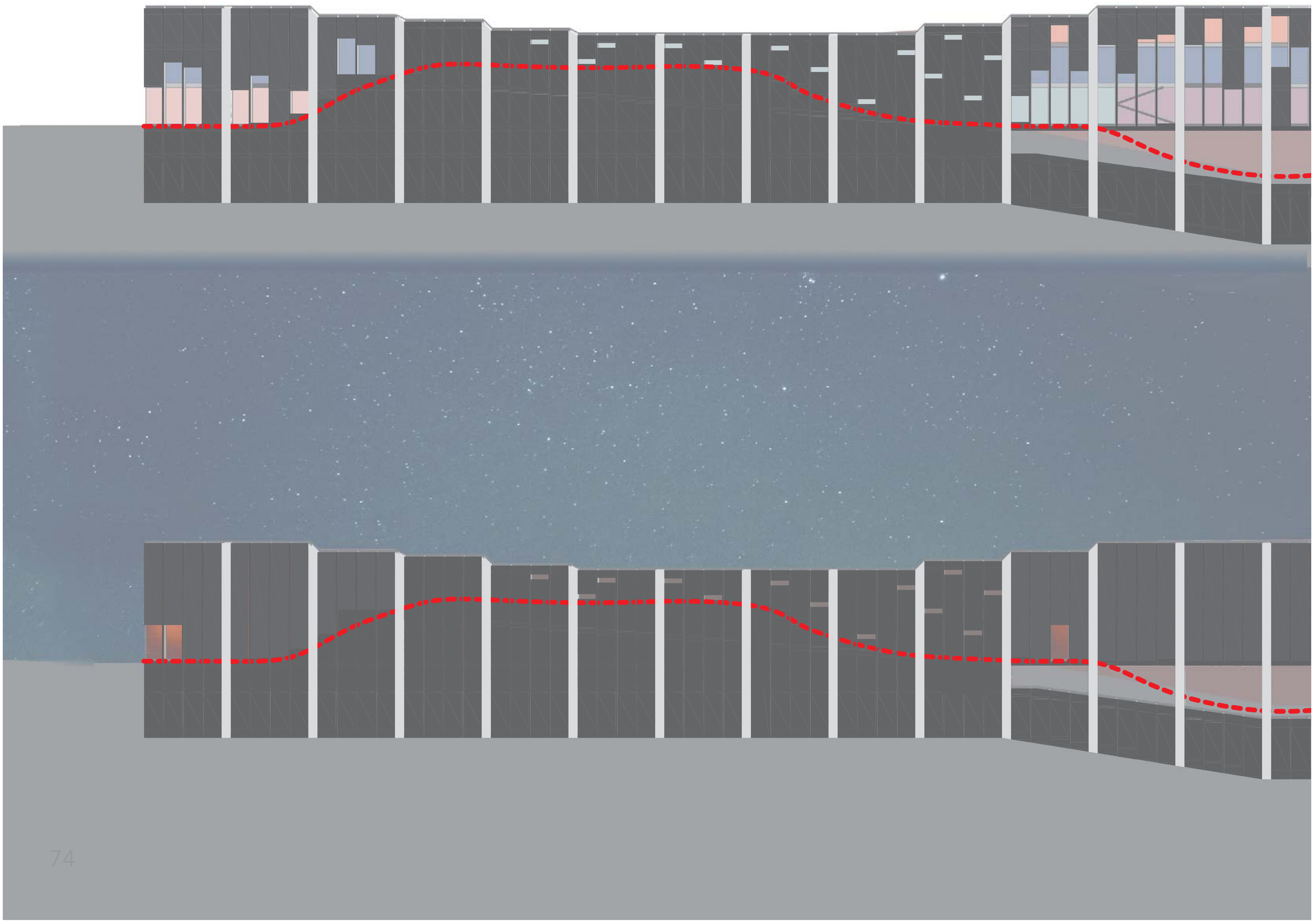
Unrolled Facade Outer Shell // DAYTIME

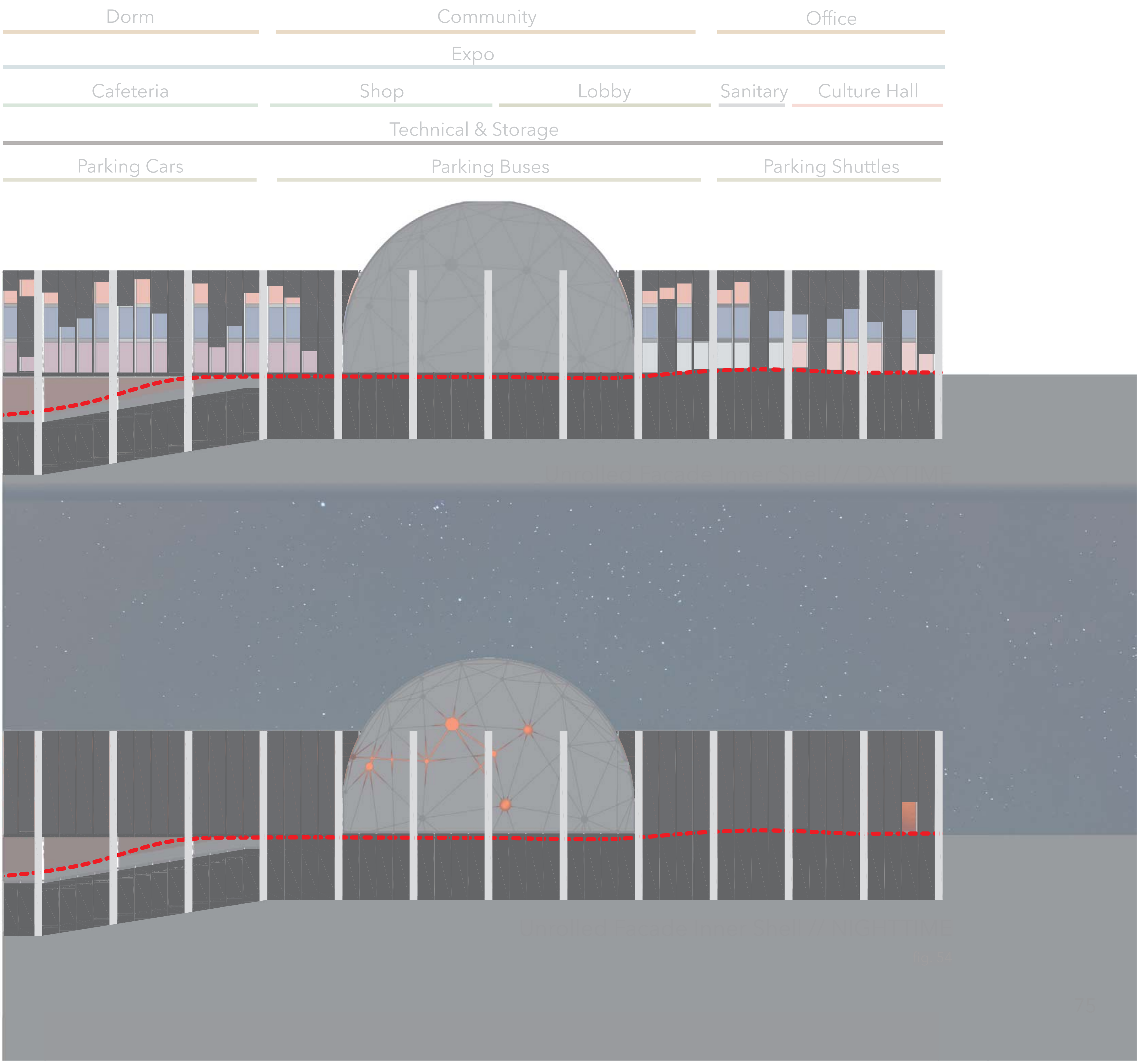


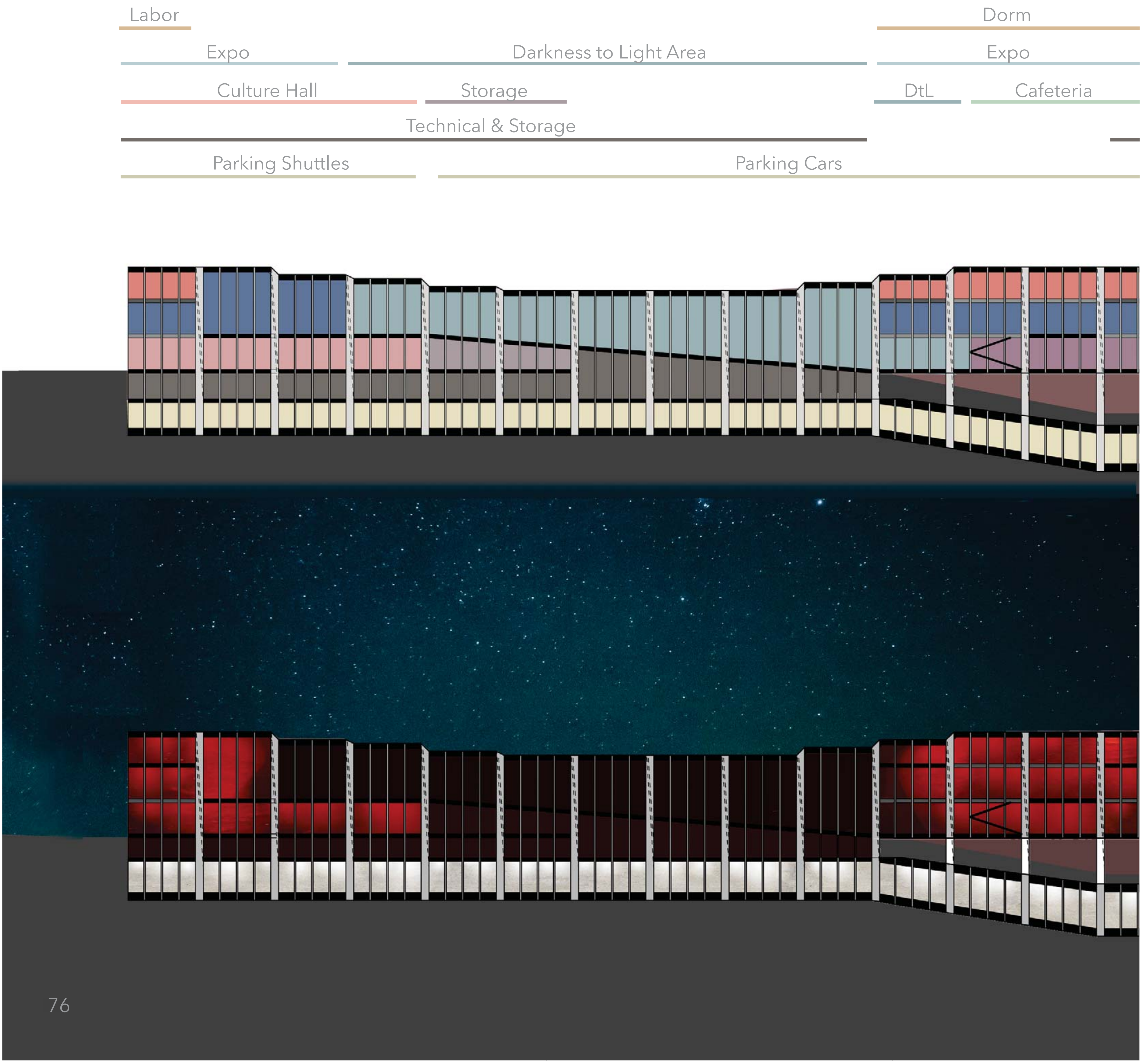
Unrolled Facade Outer Shell // NIGHTTIME

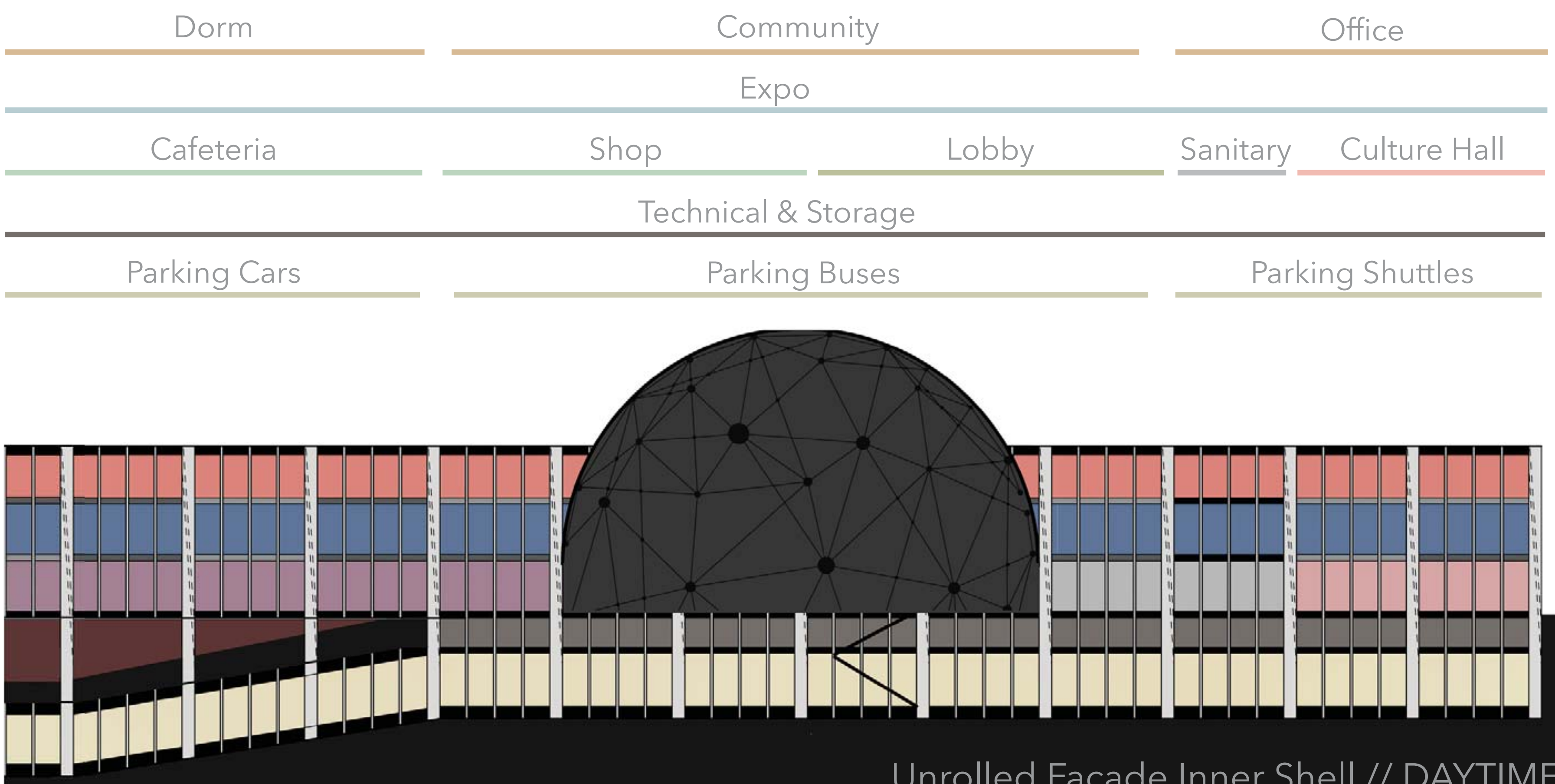
fig. 53


Labor
Dorm
Expo
Darkness to Light Area
Expo
Culture Hall
Storage
DtL
Cafeteria
Technical & Storage
Parking Shuttles
Parking Cars

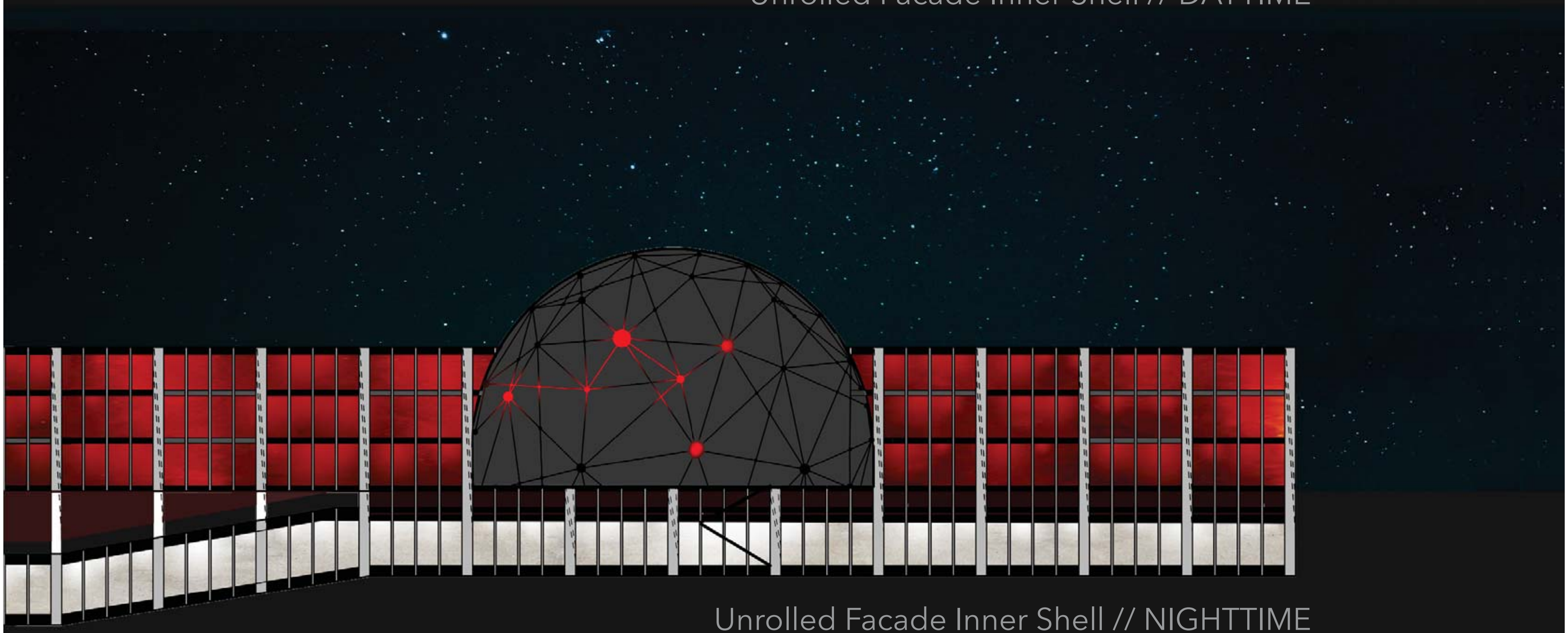



Dorm
Community
Office
Expo
Cafeteria
Shop
Lobby
Sanitary
Culture Hall
Technical & Storage
Parking Cars
Parking Buses
Parking Shuttles
Unrolled Facade Inner Shell // DAYTIME
Unrolled Facade Inner Shell // NIGHTTIME
fig. 54


Labor
Dorm
Expo
Darkness to Light Area
Expo
Culture Hall
Storage
DtL
Cafeteria
Technical & Storage
Parking Shuttles
Parking Cars



Unrolled Facade Inner Shell // DAYTIME



Unrolled Facade Inner Shell // NIGHTTIME

fig. 54


fig. 55 01


fig. 56 02

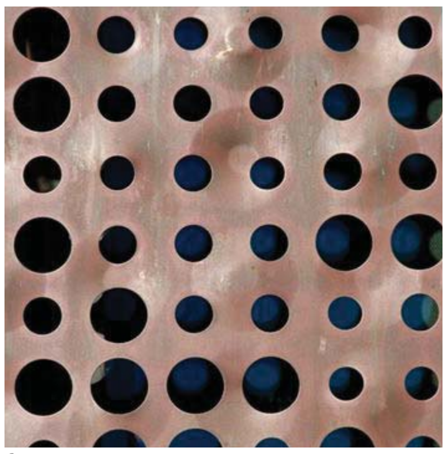


fig. 57 03


fig. 58 04


fig. 59 05


fig. 60 06


fig. 61 07


fig. 62 08

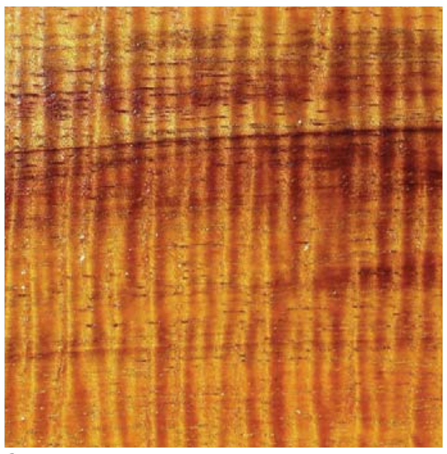


fig. 63 09

06.09 MATERIALS AND COLOURS

The materials have been chosen with regards to aesthetical, regional, sustainability and reparability criteria.
The amount of variety has been limited, to support a clear appearance of the structure and a defined concept.
The color scheme is inspired by the immediate surrounding and consists of mainly earth tones of reddish, brownish and greyish shades.

Naio-wood (01) is a robust material, which was already used by ancient Hawaiians when it came to structures of all kinds, including housing and canoes. This element grows naturally on Mauna Kea and is used mainly in the courtyard, for the terrace and seating surfaces of the gathering circles. Stone walls are made from lava rocks (02) from Mauna Kea and are reminiscent of the bases of sacred stone structures of heiaus all over Hawai'i, as well as on the mountain itself. These kinds of walls in the outdoor area, also offer protection and nesting places for appearing insects and plants.
The landscape materials also include perforated steel panels (03) dyed in a lightly brownish color on the outer shell of the planetarium. In the nighttime, this structure is illuminated from the inside with red light so it reminds visitors of the volcano and at the same time does not disturb the night visibility of stargazers.
The main and secondary beams of the general constructional is made from of steel profiles (04). This metal is allowed to lightly corrode, causing reddish colors which connect the appearance of the sphere to its environment.


fig. 64


fig. 65


fig. 66

While the inner side of the frame construction is mostly glazed, on the outside, hatches made from flexible but light proof PVC (5) in a dark grey are installed. Those elements are easy to maintain, repair or replace if necessary.
The general flooring consists of polished, sealed, and slip-resistant lava stone tiles (6). This material can be produced directly in Hawai'i and proofs itself to be very robust, durable and easy to maintain and clean.
In the interior, most of the walls and ceilings are plastered in a neutral white (07) so it does not distract from functions or exhibition pieces. This also generates a good background contrast for all materials and items that are put in focus.

Bigger structures like the bar in the cafeteria or reception desks on different levels are wrapped in textiles of coconut fiber (08) with different, but geometrically defined patterns. This material is also locally crafted and 100% organic.
For seating furniture in more private and selected areas like libraries or lounges the world famous koa-wood (09) comes to use. Its reddish color radiates the impression of high-quality, which it fulfills. The wood is endemic to Hawai'i, and ecologically more than defensible as most companies get the wood only from dead or carefully cultivated trees but never from wildly grown ones in order to not disturb the natural habitat of the island and its habitants, be it humans, animals or plants.

06.10 FLOOR PLANS

The underground parking level consists of a one-way system and offers space for five buses, 19 shuttles and 54 cars.
The inclined layout of the parking lots and associated road marking, force vehicles to park in reverse. This is supported by a generous street width of 4.5m which makes overtaking easy while another automobile is parking. Extra broad parking lots (3m) enhance an accelerated and uncomplicated parking process.
The forced reverse parking is necessary, because all vehicles have to be able to directly drive off the mountain in case of a possible outburst of Mauna Loa, the active volcano opposite of Mauna Kea.
When driving into the garage, the first section is reserved for car parking only. After that the sections for shuttles and buses are located next to the main stairs leading into the VIS. Visitors exit the buses directly in the pedestrian zone from where they can either use the inviting main stairs or use one of the two elevators located next to it. The elevators stop at every visitor level without access control. Staff members and scientists are able to get to all additional floors. Also, they may use the additional elevator situated next to the escape stairs in the southwest that is usually used by delivery services.

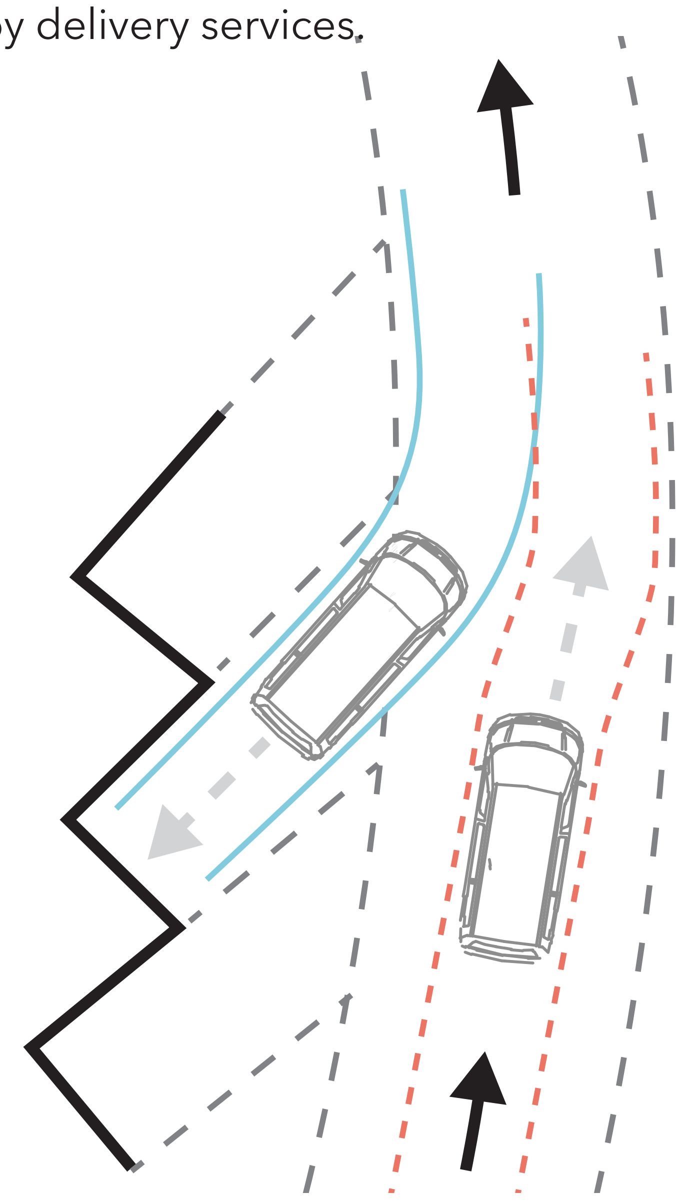
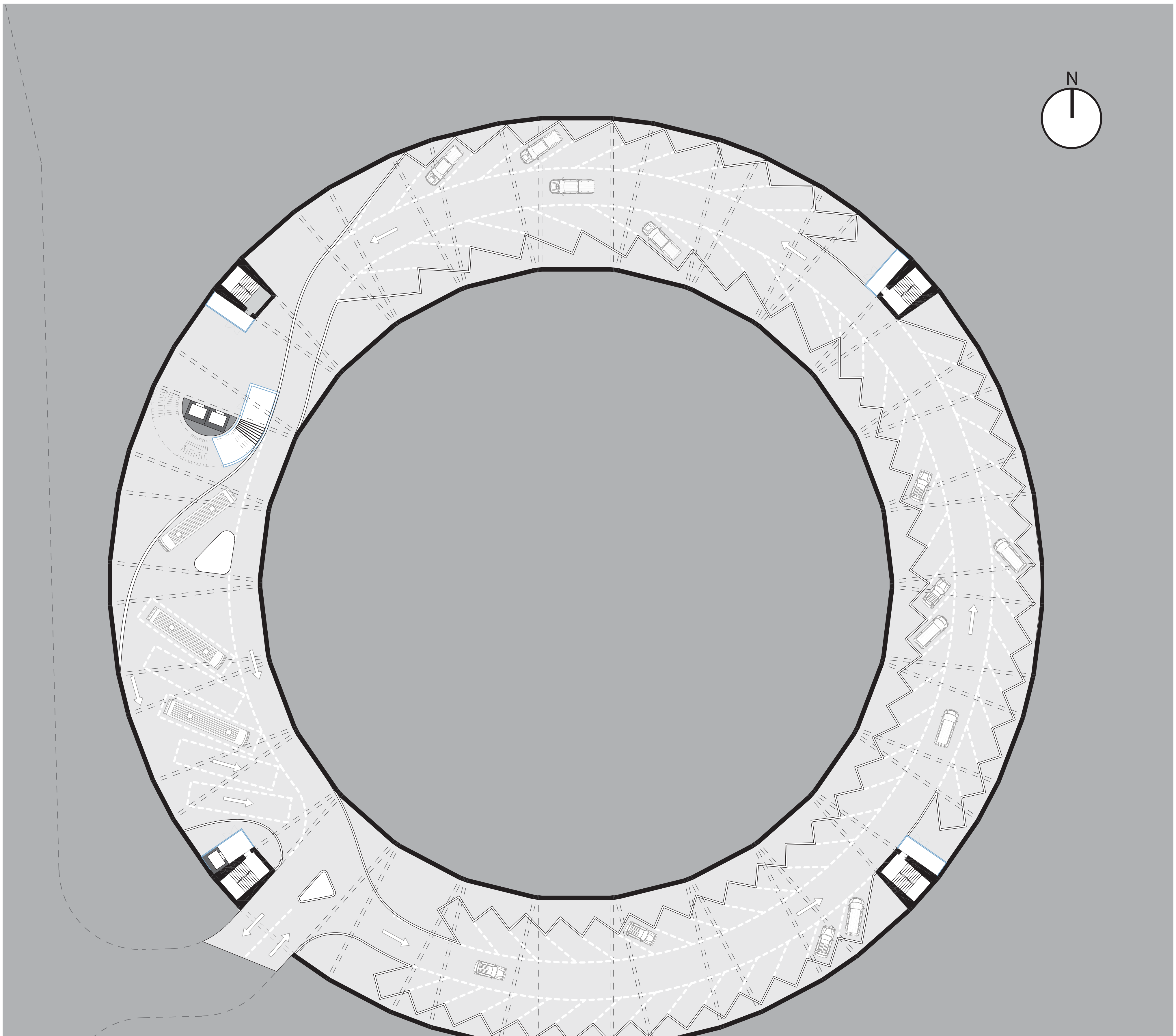


fig. 67



-7,50m

Level -01 1:500

fig. 68

The ground level is a distribution floor where visitors can find supplies and hazard information for their further travel to the summit, a cafeteria for drinks and snacks, a small library and gathering spaces for tours as well as sanitary facilities. This is also where the experience of the VIS starts, leading its users to the according pathway. Tourists follow the main supply areas so they can orientate later and find everything they need to enable a comfortable stay at the Center. After having passed those sectors, they are invited to move onto the next level to start the exhibition tour.
Participants of the Culture Practice Classes are lead to the left side of the lobby, passing sanitary facilities and a social gathering room before being led into one of the five classrooms which are divided by moveable walls attached to the ceiling beams. This opens the possibility to merge several sectors into bigger classroom spaces if needed.
Next to the classes, there is enough space for smaller break rooms or audition space for special happenings and events.
Additionally, each class has an assigned walled room for storage or changing.
The courses can also be watched from the gallery above giving visitors the chance to get an idea of Hawai'ian Culture today and inviting them to subscribe into one if they like, as engaged locals are eager to share their knowledge concerning the Hawaiian Culture. Such galleries are found all over the upper levels to connect them into one unit and evoke the atmosphere of a coherent and impressive structure.

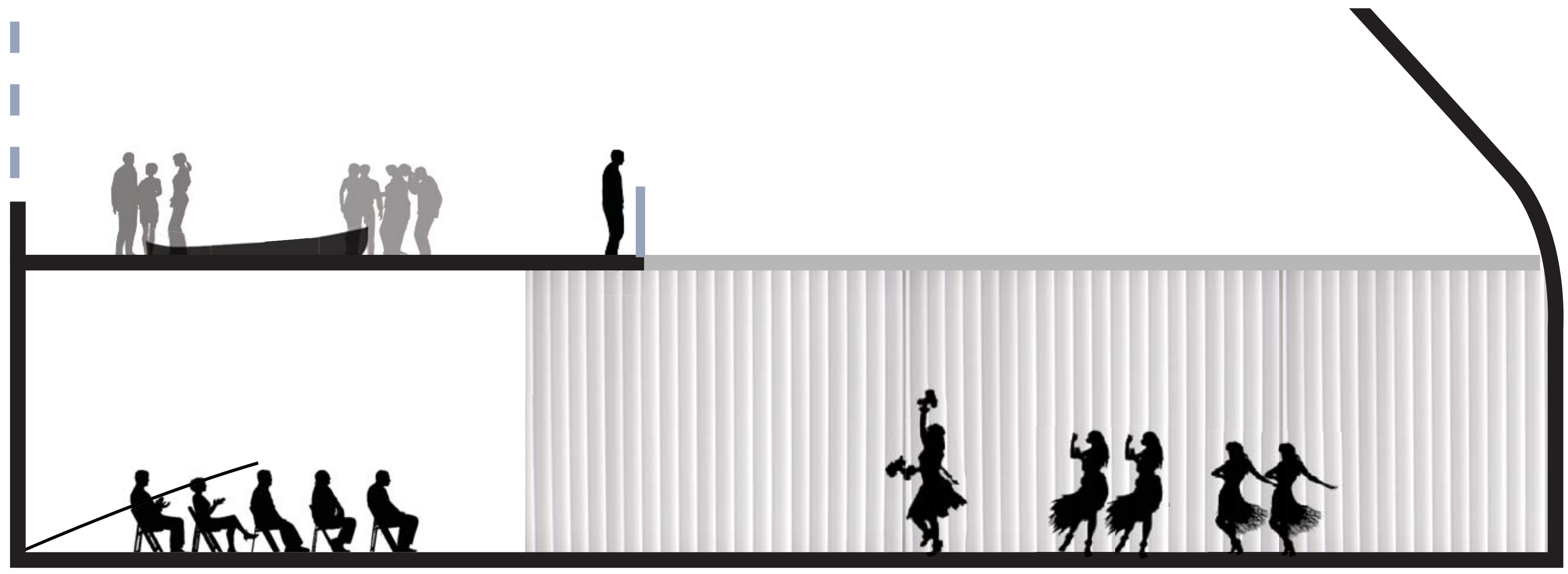
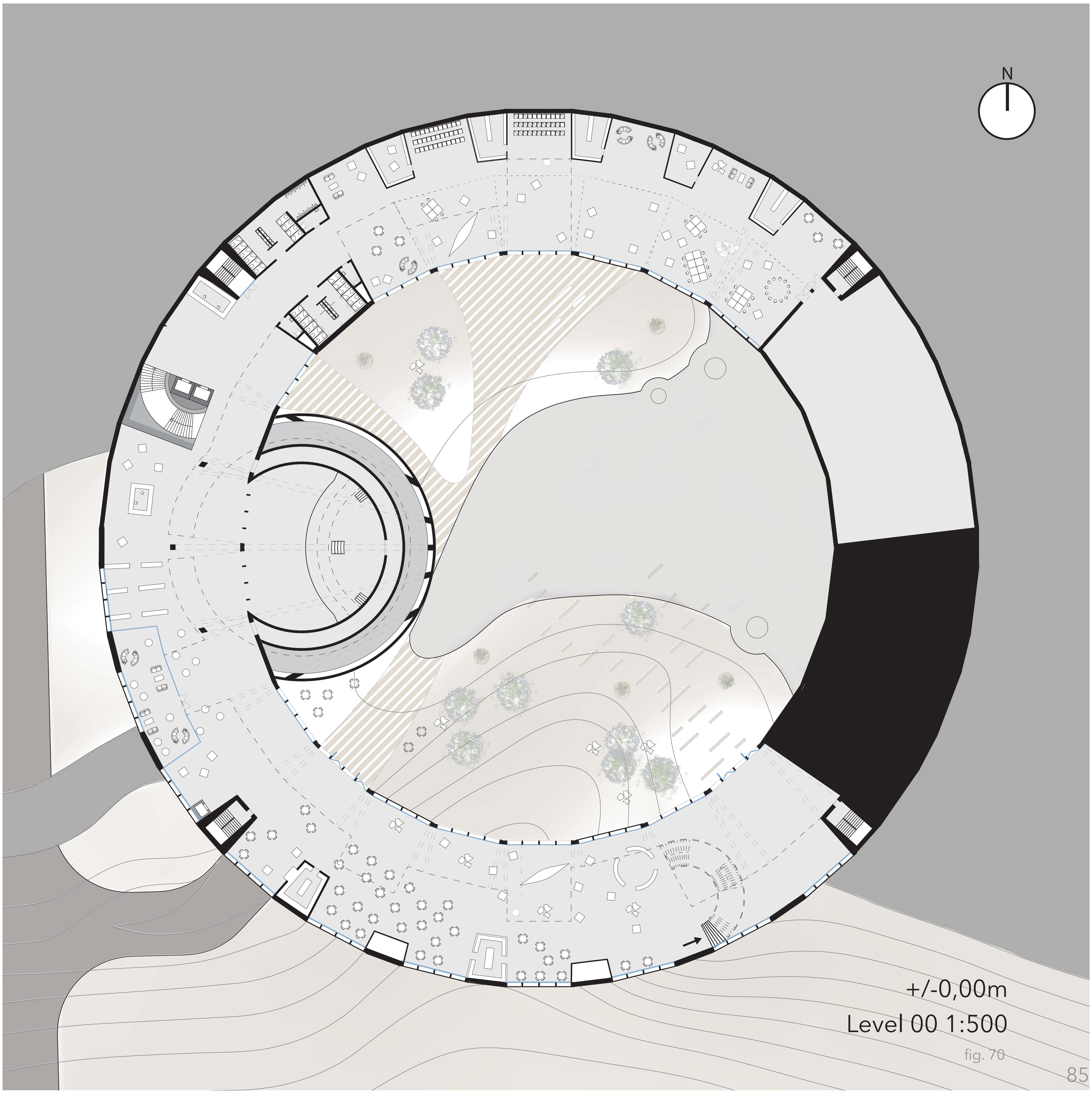


fig. 69



+/-0,00m

Level 00 1:500

fig. 70

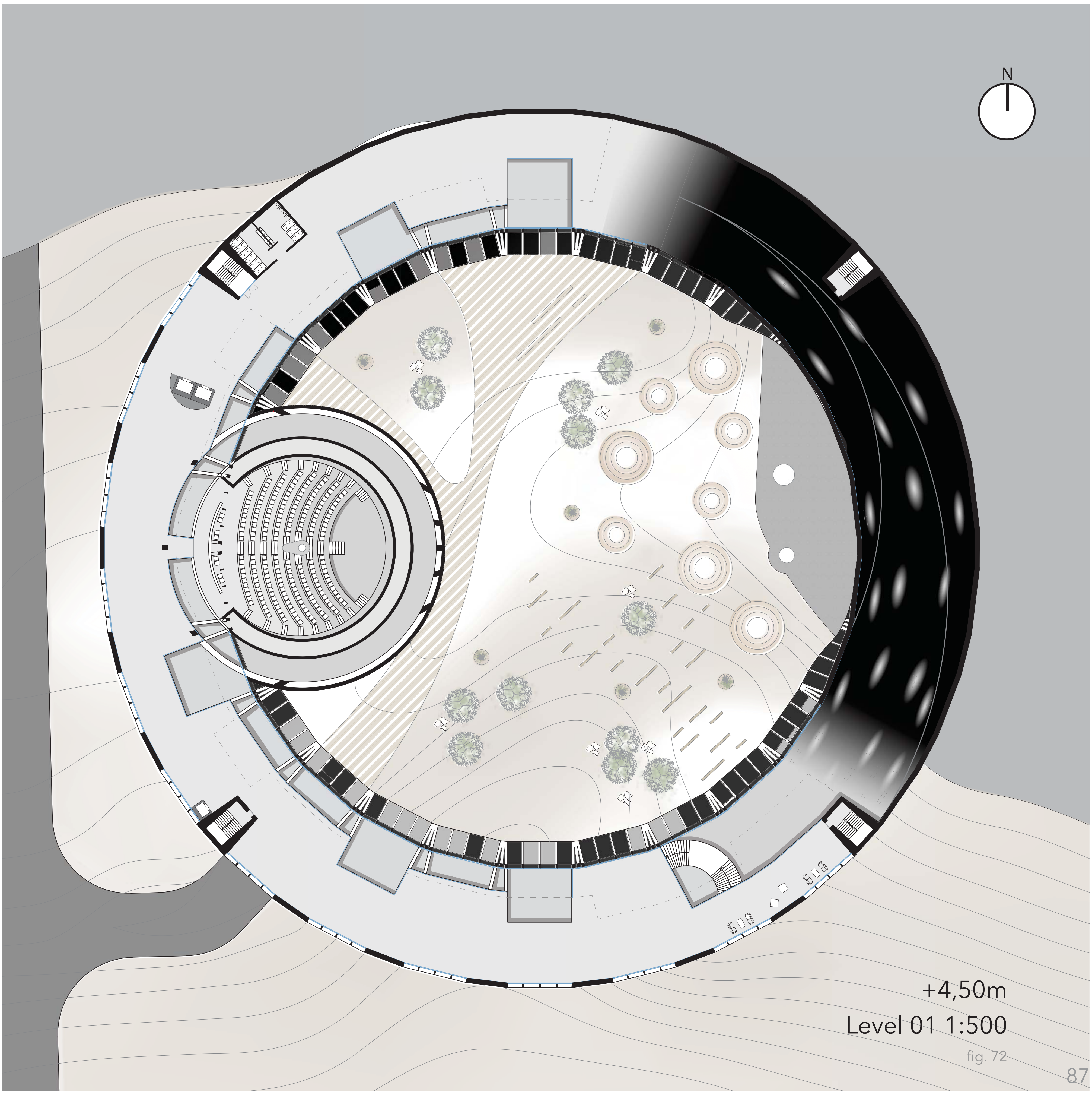
"HE KUMULIPO" (THE CREATION)

"At the time that turned the heat of the earth,
At the time when the heavens turned and changed,
At the time when the light of the sun was subdued
The cause light to break forth."

On the first level, the main exhibition takes place. Its task is to inform visitors about Mauna Kea in general, human activity on the mountain in ancient times, the role of it for modern astronomy and achievements of Polynesian explorers, as well as the meaning of Mauna Kea as a sacred place for Hawai'ians. It teaches people about today's cultural practices on site and how to recognize holy structures on the mountain.

This measure ensures tourists behave accordingly when visiting the mountain and its summit area in particular. To help them understand the significance of the site the exhibition hall merges into a dark tunnel which becomes more and more illuminated until visitors are lead down into the courtyard where they may finally explore Mauna Kea by themselves.
This "Darkness to Light" area regards to the Hawai'ian creation song, that tells the story of the origin of the Hawaiian people and the creation of life, born from a long night, bringing with it the coming of light. It puts the visitors into an unknown, mysterious and calming atmosphere so they start to wonder, reflect what they have just learned and get a moment of silence before they continue moving along onto the sacred mountain.
While the falling slope is an element that supports the disconcerted ambience, no other items are placed within this area because of the darkness and to not disturb the impression of vastness.

fig. 71



+4,50m

Level 01 1:500

fig. 72

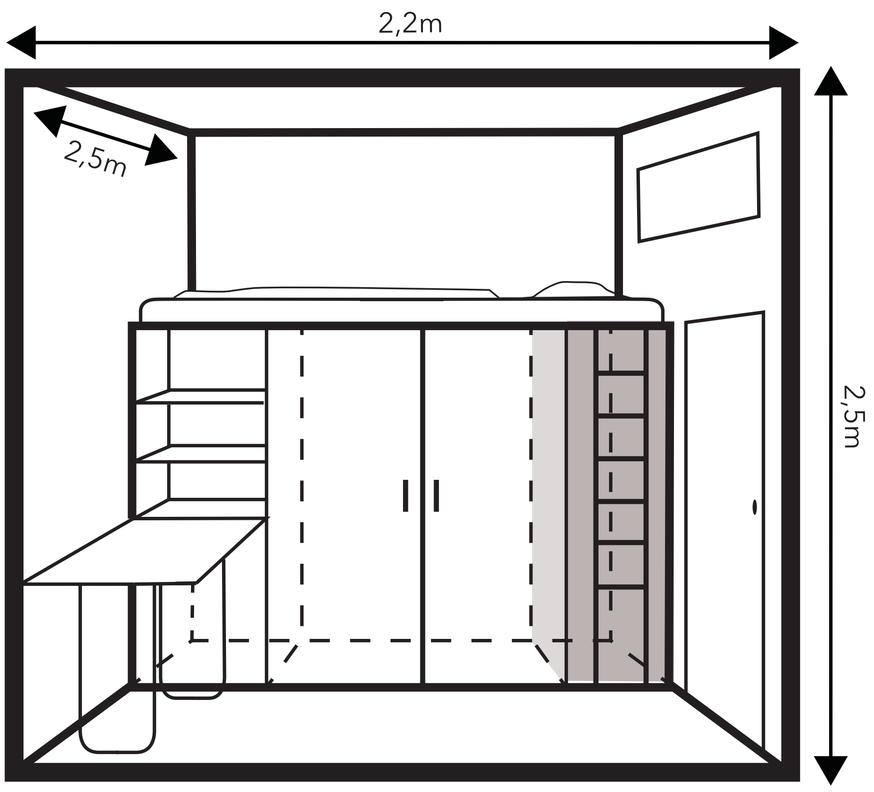
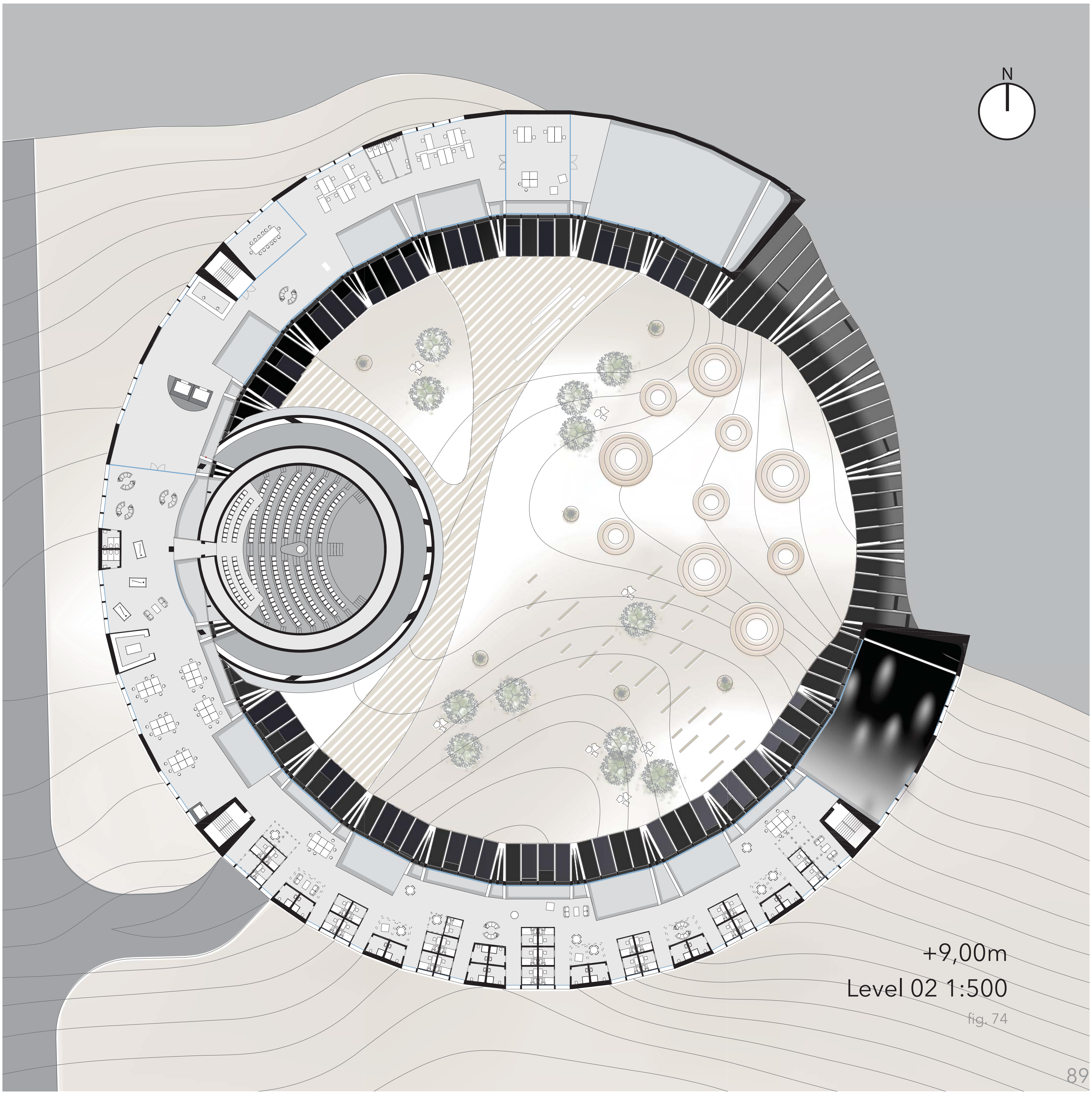


fig. 73

The second level is reserved for scientists, astronomers and staff members, as they need a private area where they can work and rest efficiently. The floor is separated into two main sections. The working space and the living area. In-between a puffer zone for quiet reading or studying next to the lobby and reception desk, the layout allows for a fluent transition. The office holds space for 14 workstations, according to the number of observatories on the summit. It includes a large meeting room, sanitary facilities and a small laboratory.
While the working area is partially visible from lower levels, the private area stays secluded.
This section is divided into an open community area with a small kitchen, dining tables, seating furniture and a games room, as well as the dormitory with small lounges, fixed bathrooms and flexible dorm rooms.
The amount of sleeping boxes is adjustable to current requirements. The dorm offers space for a maximum of 46 of them. They don't have access to direct sunlight as their occupants work during night hours and rest over the day. The size of the boxes is reduced to a minimum to promote communication outside the private zones and to allow a maximum number of guests during peak times over the year.



+9,00m
Level 02 1:500
fig. 74

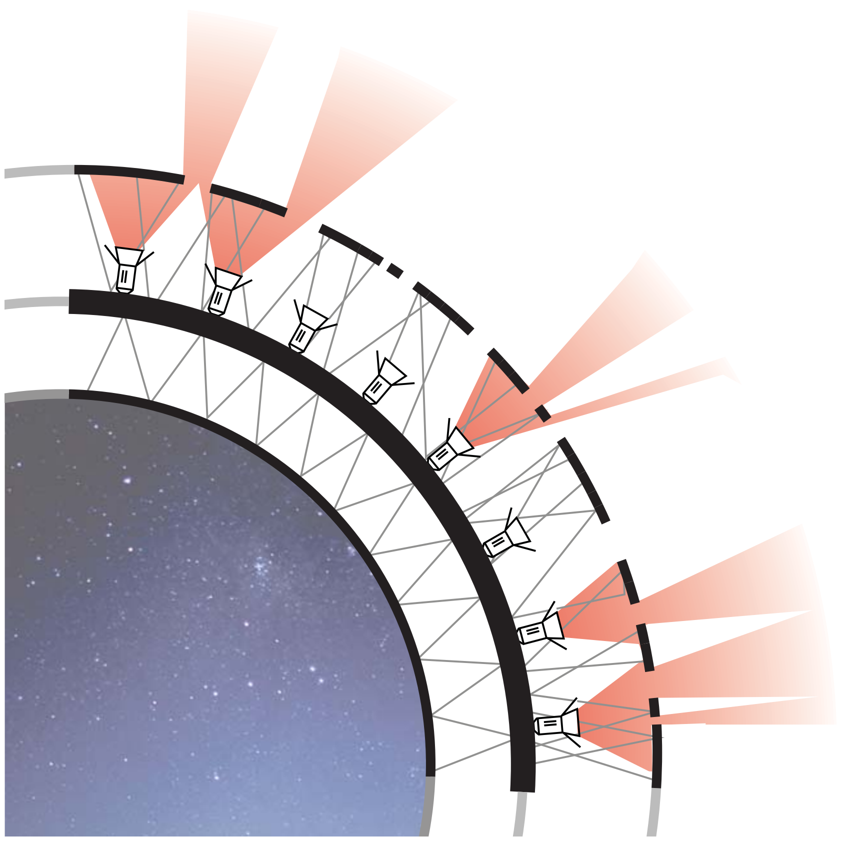
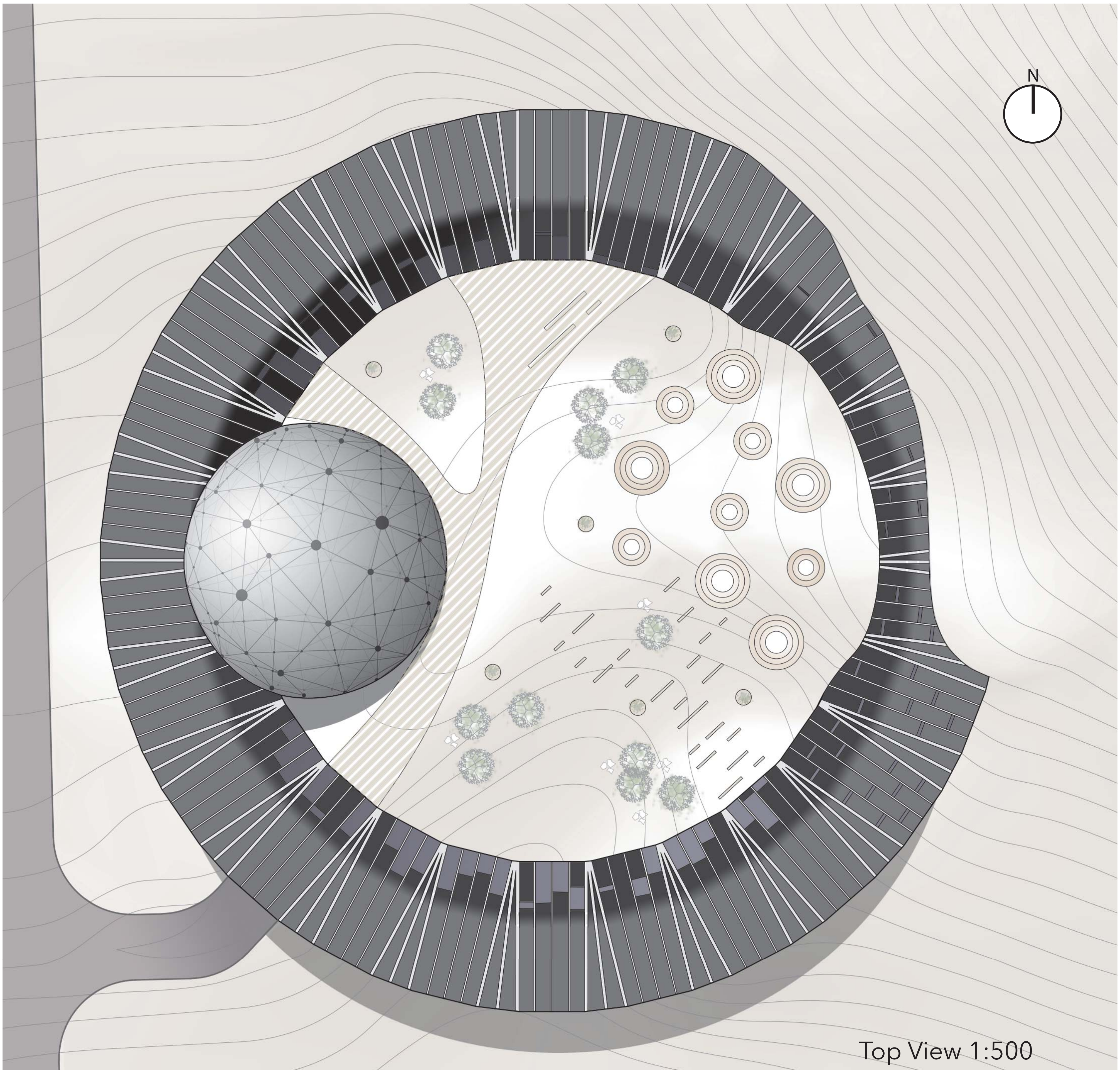


fig. 75

From the top view, it is recognizable how the two main structures, the circle and the sphere, are merged in a very harmonic way. While the main building includes the general room schedule and blocks out winds and white light from the outside, the sphere illuminates the night sky with red light rays, not disturbing the excited stargazers who have come here to watch the starry night from the best spot on earth. The planetarium is a double walled sphere, allowing films and images to be projected onto the inner screen, while a second set of projectors help visitors to find different star formations by projecting them to the outside through the perforated outer shell. During the day, the surface is a decorative element of the courtyard where people start to explore different sites of the sacred mountain.
It is also apparent how the natural slope is continued in the patio and swallows part of the building making it part of Mauna Kea. The gathering circles and the structure itself, looked at from a bird's-eye view, remind of the many craters located in the surrounding environment. Especially at night, when the building glows in red illumination on the outside and visitors of the summit area return to the Visitor Information Station, the structure might be mistaken for a lava filled crater commemorating the sleeping primal force right under their feet.



Top View 1:500

fig. 76

06.11 SECTIONS

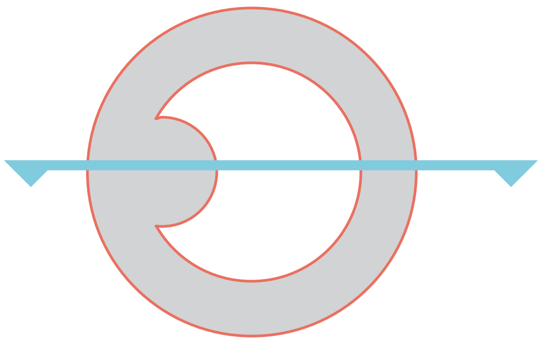


fig. 77

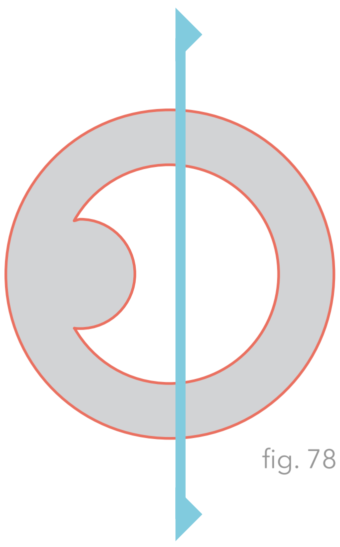
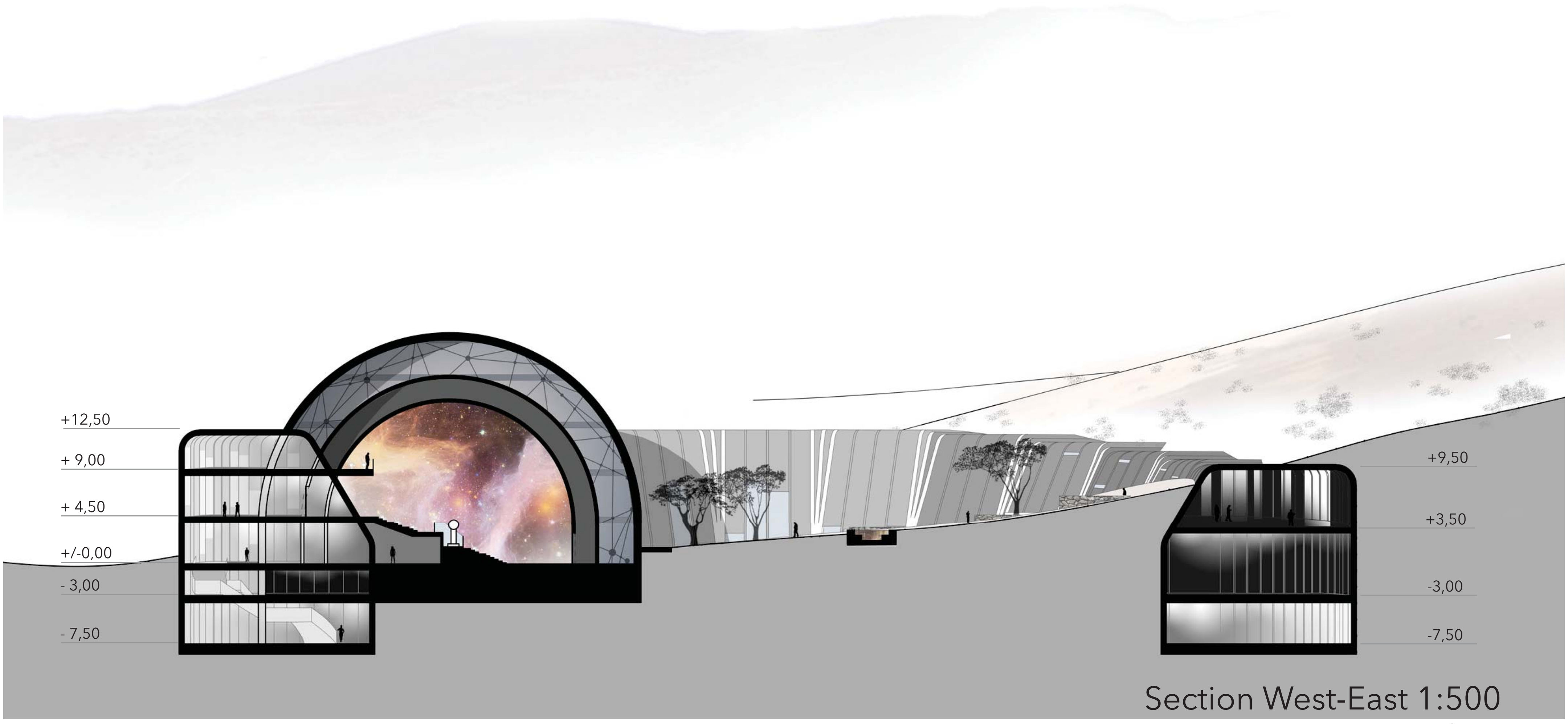
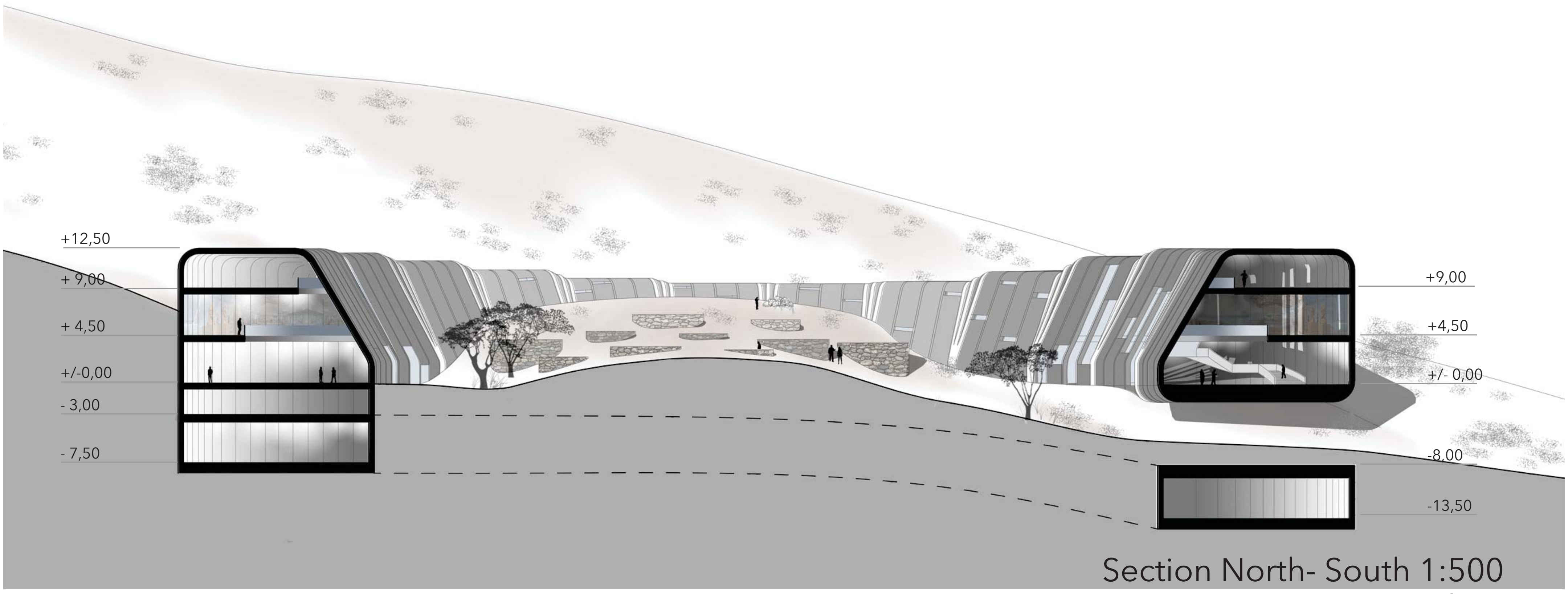


fig. 78



Section West-East 1:500

fig. 79



Section North- South 1:500

fig. 80

06.12 VIEWS

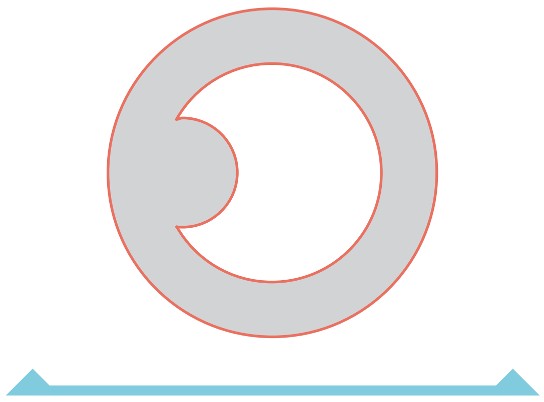


fig.81

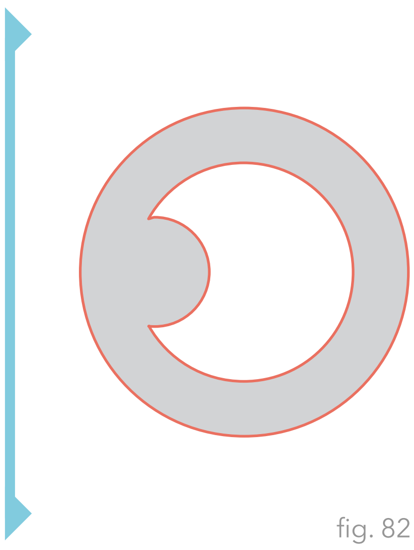
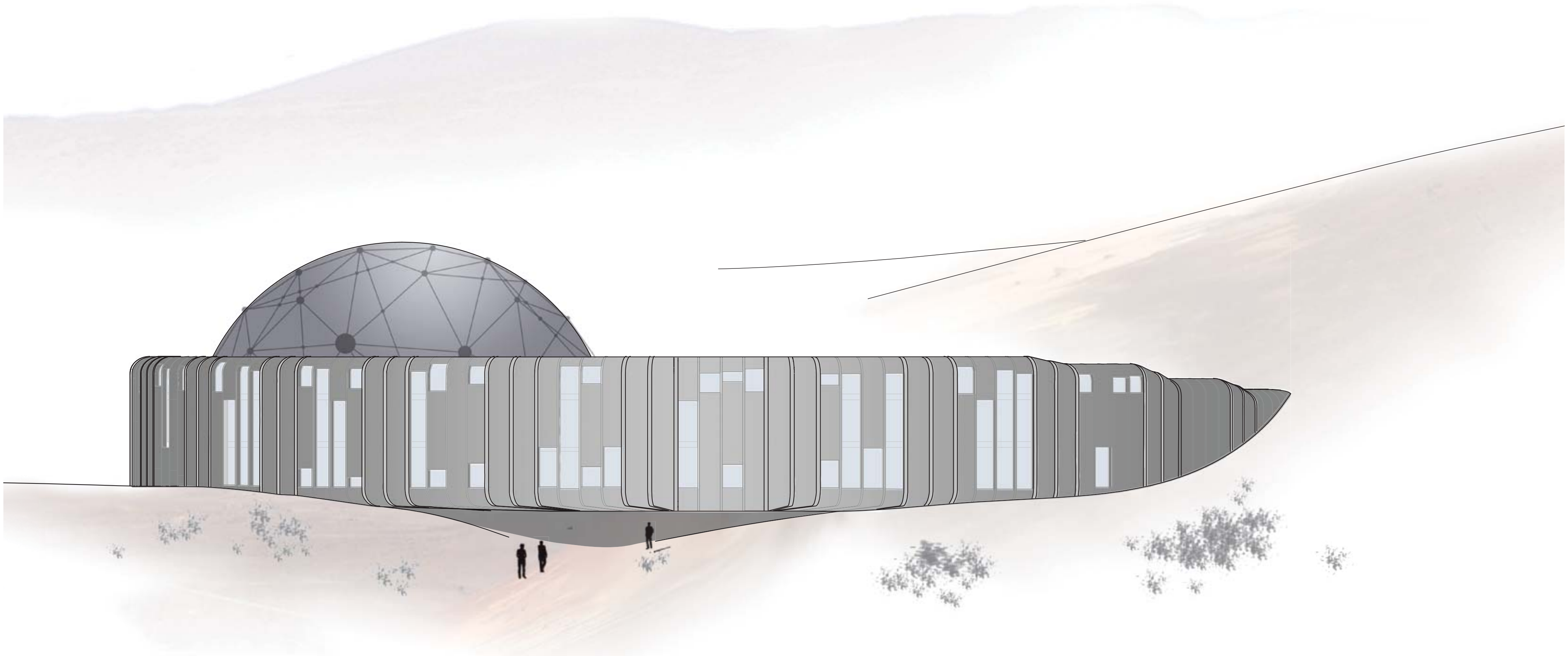
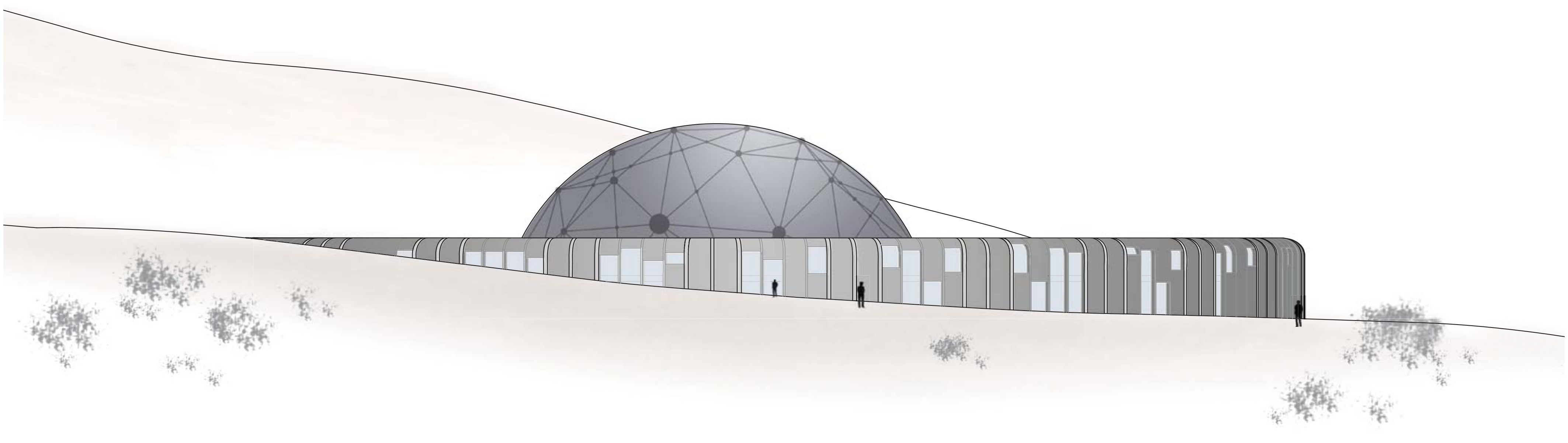


fig. 82



South View 1:500
fig.83



West View 1:500
fig. 84

06.13 VISUALS

VIEW FROM NORTH DURING NIGHTTIME

fig. 85

VIEW FROM SOUTH DURING DAYTIME

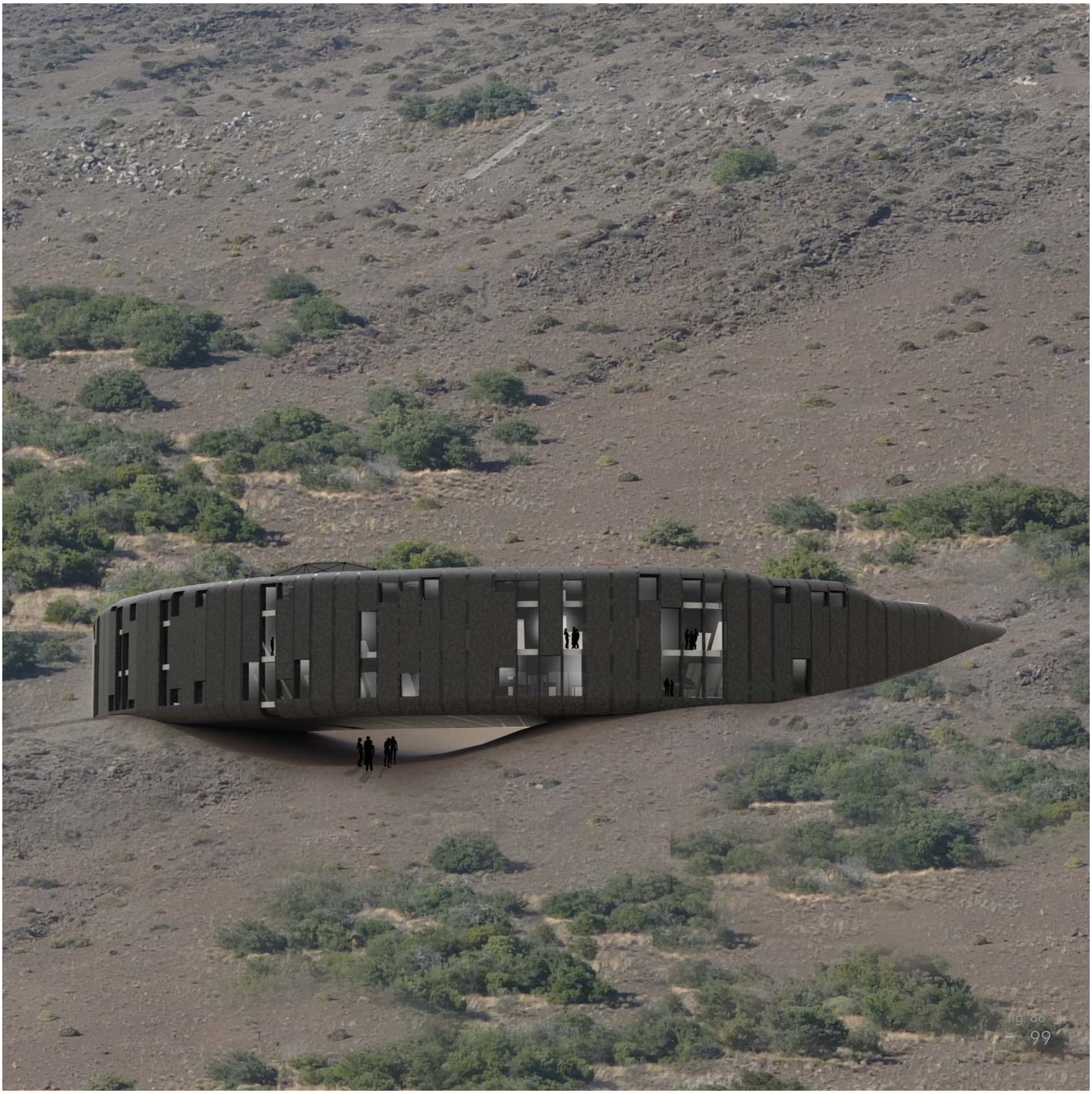


fig. 86

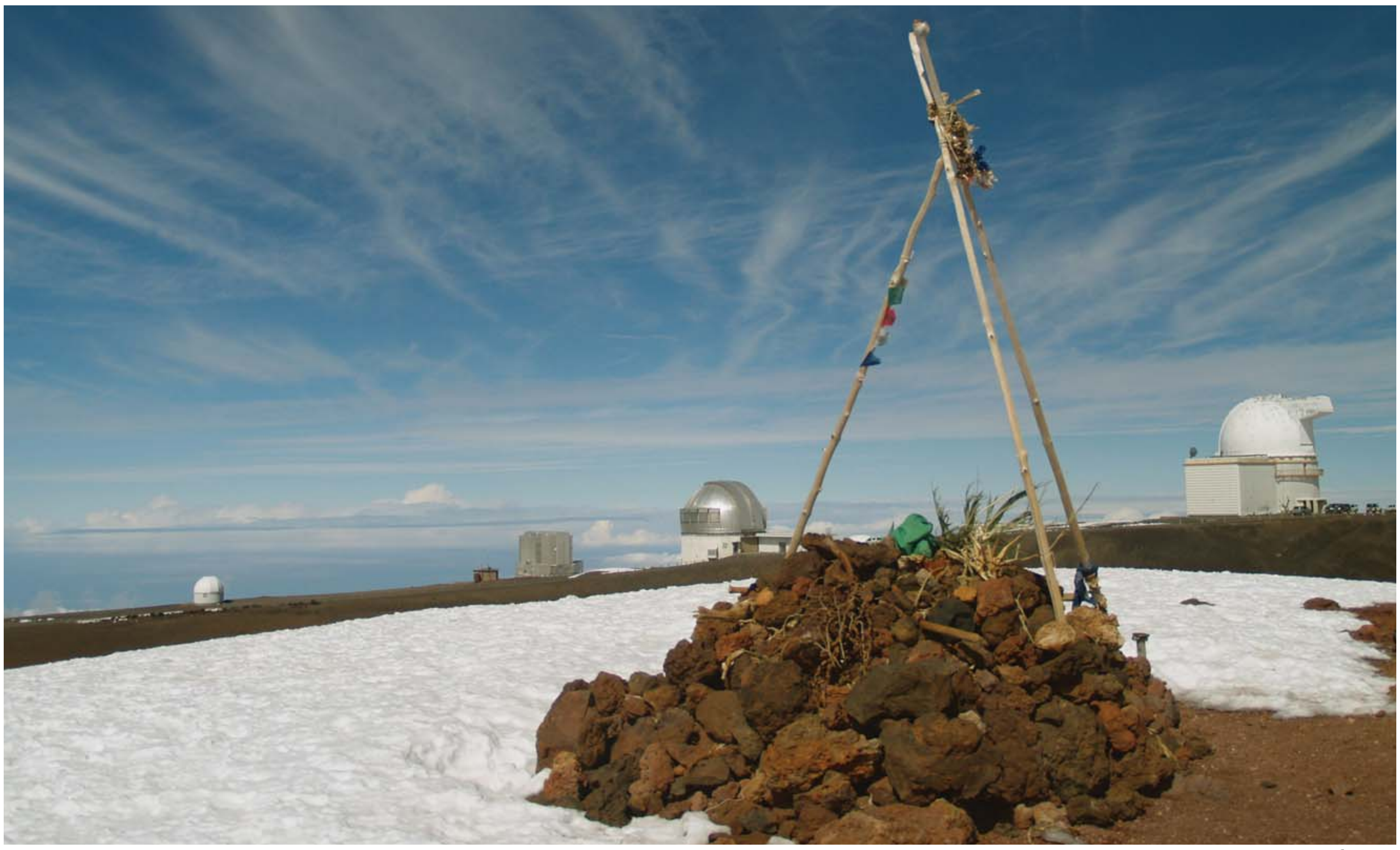


fig. 87

07.01 DISCUSSION

Architecture at sacred spaces is a sensitive topic, that must be handled thoughtfully and with strong consideration of several factors from the environment, to the attached culture, values of the affected community and many more.
There is a difference between architecture hosting sacred space and architecture located on sacred land.
The first kind is usually used by particular user groups, practicing the corresponding habits or ceremonies and often must follow certain rules. This type of architecture can be found all over the world differing strongly in its appearance. Churches, synagogues, mosques and temples are noted examples, but also less familiar structures like the Hawaiian Heiau and Kuahu rank among such forms of man-made sacred structures. The second one is a more open-minded kindof architecture and often represents teaching facilities. Cultural Centers have been a popular form of such facilities, that are very important for preservation of famous as well as almost forgotten ways of living and believes. Engaged community members of different origins can use those structures to share the knowledge their culture can provide and hence keep alive the legacy of the cultural identity.
In modern times, science has become a very important part of the global society. Sometimes, massive conflicts between cultural and scientific ideologies occur and result in a non-profit situation for at least one or at times even both parties.

The Mauna Kea Observatories in Hawai'i is one such current controversial institution. It was installed in the late 1960s to reactivate the economy after a devastating Tsunami hit The Big Island of Hawai'i and destroyed large parts of Hilo's coastline. Since then, 13 telescopes where build on top of Mauna Kea, the sacred mountain of the Hawaiian people. The area was developed to one of the most important facilities for astronomy on the northern hemisphere and enabled a series of spectacular discoveries over the years. But with the proposal of the construction of a

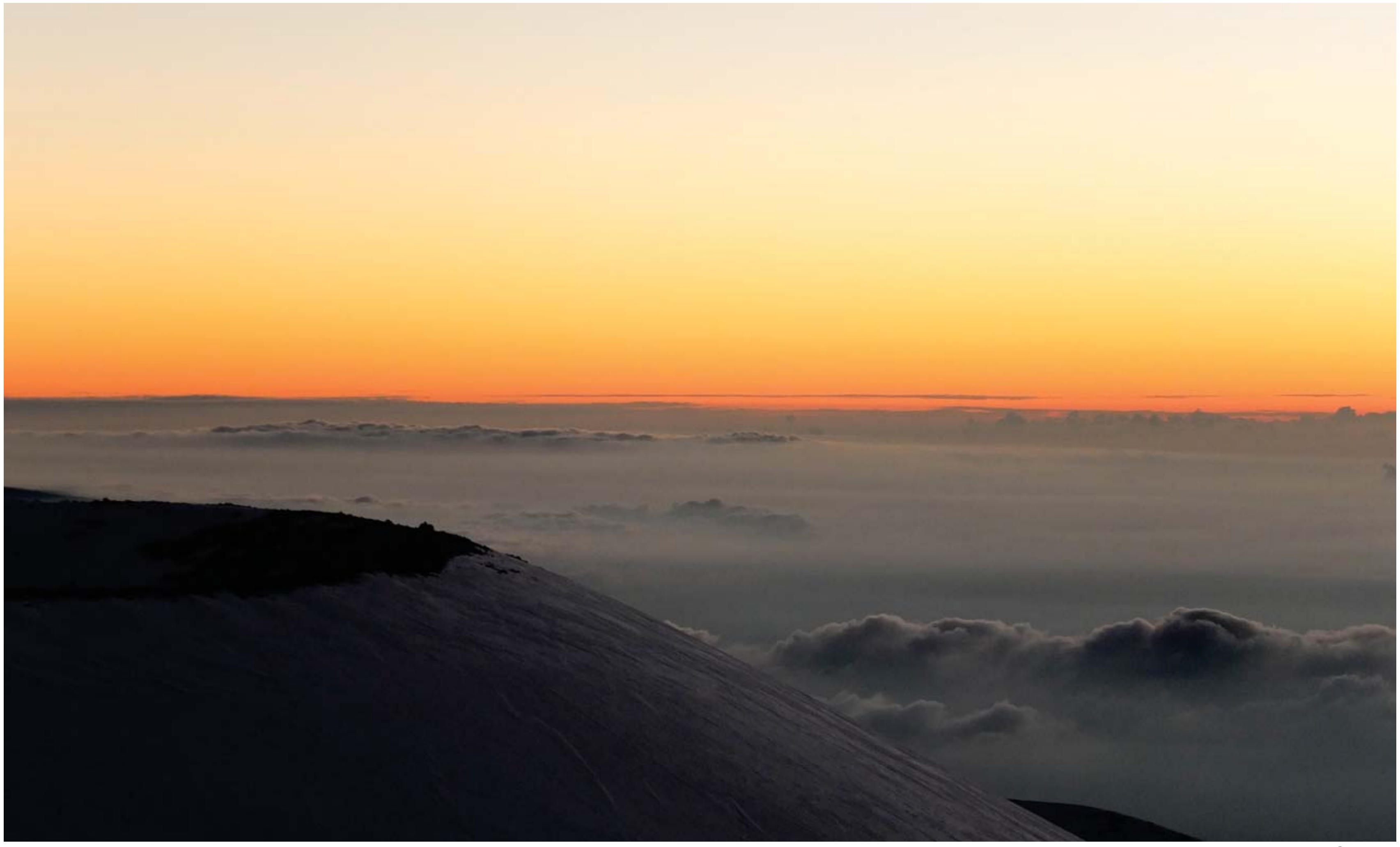


fig. 88

14th telescope, the Hawaiian community was divided into proponents of modern science and protectors of Hawai'i's sacred places and cultural identity.
The severity of this conflict was increased by the uncontrolled increase in tourist activity, visiting the famous observatories and rarely paying their respect to the Hawaiian legacy on the mountain.
Architecture is a tool that can be used to connect these divided parties. It can act as a neutral environment and create space for constructive dialogue, opening up the possibilities of finding cooperative solutions and common ground.

In my proposed design, I want to enhance a major value that the conflicting parties share: the eagerness to gain and share knowledge. This powerful commonality has the potential to bring them together again, to work cooperatively within one facility and exchange ideas as well as values which might not be as different as they appear.

Additionally, a third important party gets involved. Visitors coming to the mountain in large numbers nowadays, have been a disruptive factor for both conflicting parties, but might suddenly turn into a linking element in carrying their experience of a Mauna Kea Visit into the world and re-sharing the knowledge they gained here.

07.02 RESULT

The biggest challenge of this project was to find out who I design for. After doing intensive research in the field of ancient Hawaiian architecture, I turned to gain knowledge about the mountain regarding to scientific approaches. Being on site I got introduced to another party, the many tourists who visit the potential construction site.

It took me a while to recognize that besides all the differences, there are some strong linking elements to all of the involved parties.

I interviewed locals, local scientists, foreign scientists, volunteering staff members and visitors of various international origins. Despite vastly different discussion topics, I found out that there was one issue, that was part of almost every conversation. It was never criticism of the aims of the opposing party in general, but the lack of understanding for the own perspectives. When people told me what those viewpoints where, they all turned out to be very similar: We are curious people, we love to share the knowledge we have gained and we wish to be respected and heard if we have something to say.

This finding pushed me away from my original idea of designing an homage to the Hawaiian Culture in the form of a temporary structure that would be inspired by their ancient ways of building.

Instead, I decided that the building must be large enough to host representatives of all aspects. The architecture must be exciting and generate a link to the observatories at the summit area. At the same time, it must give Hawaiian locals the stage they deserve to take part in the field they opened up to science, and offer space to teach their values to the many tourists that come here, as well as to the foreign astronomers who are guests on Mauna Kea. Lastly, visitors must be trained in respecting the sacred meaning of the mountain, its cultural significance and history.

At the same time, the structure is very much permitted a modern, contemporary appearance from both inside and outside, to be inviting and engaging. Hawaiian People are not stuck in the past, yet they do not forget their roots. The main task of the Visitor Center is to help them preserve the legacy of their ancestors in their very remarkable way of sharing - and I have the honor to propose a shelter for this purpose.

07.03 CONCLUSIO

The amazing task of designing a shelter for cultural inheritance and scientific approaches under one roof, has been a very exciting experience for me. I was often very confused by all the different opinions I got to know and had to watch out to keep my neutral position in the discussions.
While doing this project I often had to ask myself if the modern design of my thesis was appropriate for a site on a sacred mountain. I concluded that the kind of architecture I propose, does not host any sacred space by itself bust must help people understand that they are entering an area they have to pay their respect to.
It represents a preparation and instruction space for further discoveries.

Therefore, I pushed the design to a very high standard of flexibility and planned specific areas for different user groups, while still creating meeting space and not cutting off any of the involved parties. At the same time, I had to adapt the structure to different challenges during day- and nighttime.
The question of how much of a design is needed at all on Mauna Kea is still something that I cannot answer. But I can confidently claim that the kind of architecture I propose, helps the conflicting parties on Mauna Kea to open a dialogue and engage cooperative behaviors, that could be exemplary and applicable in many similar conflict situations across the globe. It allows participants of the whole globe to get introduced to a world they probably were not aware of before.

Architecture as a tool of mediation by highlighting commonalities and promoting congruent values, is a supporting factor that must be invested in, to enhance a constructive atmosphere for cooperation of all kinds and even generating added values for society as a whole.

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IMAGE DIRECTORY

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