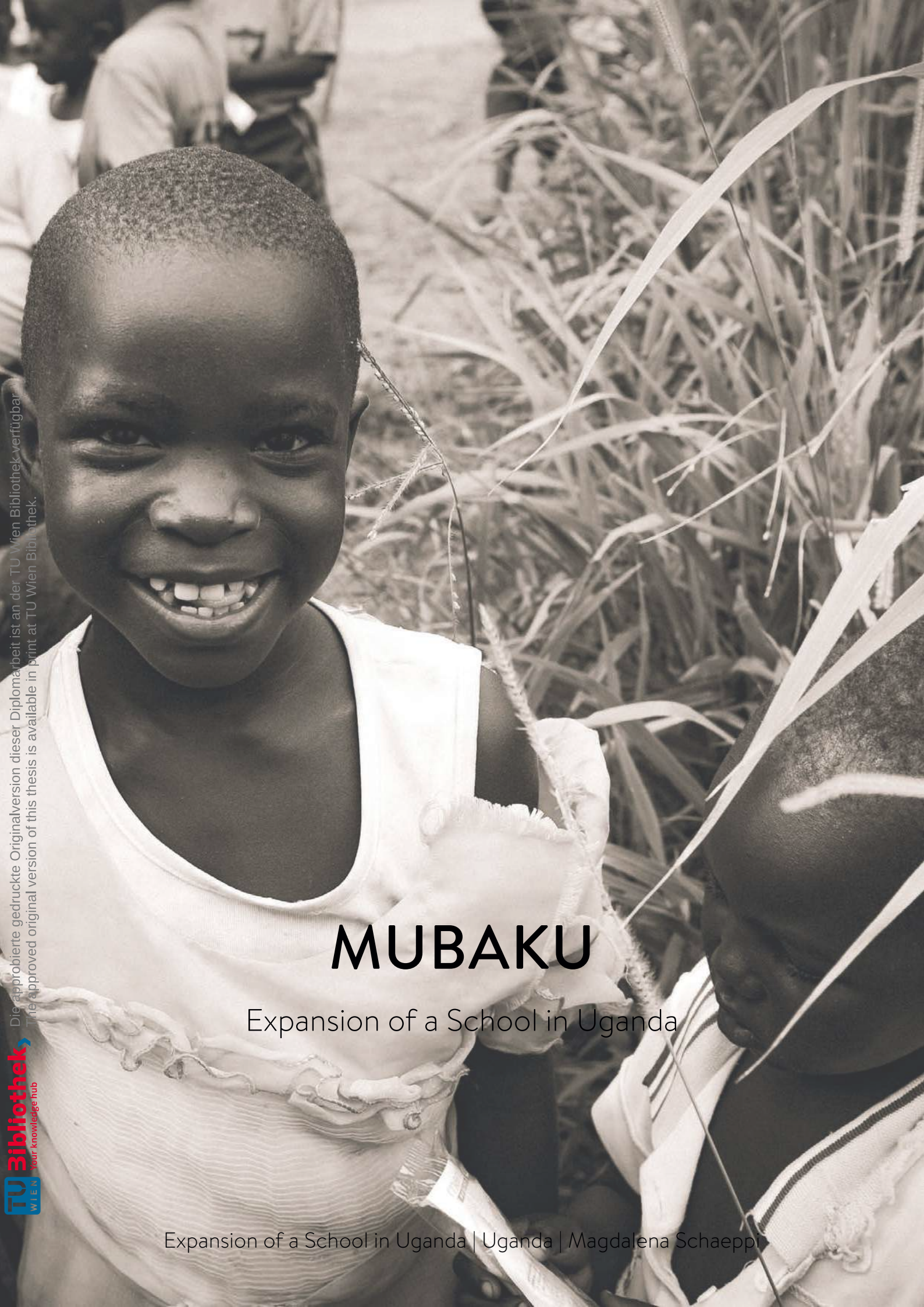

MUBAKU

Expansion of a School in Uganda

TECHNISCHE UNIVERSITÄT WIEN

Diplomarbeit

MUBAKU | EXPANSION OF A SCHOOL IN UGANDA

ausgeführt zum Zwecke der Erlangung des akademischen Grades eines Diplom-Ingenieurs / Diplom-Ingenieurin unter der Leitung

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ABSTRACT

Diese Diplomarbeit befasst sich mit dem Entwurf für eine Schulerweiterung für die Mubaku Community School im Bugungu Wildlife Reserve, Wanseko im Westen Ugandas. Das bereits bestehende Schulgebäude wurde in der zweiten Bauetappe um ein Schlafhaus für die Kinder erweitert. Diese Arbeit widmet sich der dritten Bauetappe. Als Ergänzung zum bestehenden Schul- und Unterrichtsgebäude sollen drei weitere Klassenräume, eine Bibliothek mit Lesesaal, eine Küche mit Essbereich und Wohneinheiten für das Unterrichtspersonal entworfen werden. Ziel ist es, für die Kinder einen Ort zu schaffen, an dem sie neben dem Unterricht auch Platz zum Spielen und zum selbstständigen Arbeiten haben. Die Gebäude sollen dabei möglichst nachhaltig, mit heimischen Materialien und unter Einbezug von traditionellen Bauformen umgesetzt werden, um das Bewusstsein der Menschen vor Ort zu schärfen und die Baukosten so gering wie möglich zu halten.

This diploma thesis is concerned with the design of a school extension for the Mubaku Community School in Bugungu Wildlife Reserve, Wanseko in western Uganda. The already existing school building was extended with a dormitory for the children in the second construction phase. This thesis is dedicated to the third construction phase. In addition to the existing school building, three additional classrooms, a library with a reading area, a kitchen with dining room and living units for the teaching staff are to be designed. The goal is to create a place for the children where they can play and work independently in addition to their lessons. The construction of the buildings is to be as sustainable as possible, using local materials while incorporating traditional forms of construction, in order to raise the local people‘s awareness and keep construction costs as low as possible.

INTRODUCTION

Abb. 1: visit of the Mubaku School

INTRODUCTION

My first extended trip to Africa took place in 2013. Together with my family, I traveled the countries of Namibia and Botswana for a whole month, throughout which the continent aroused great interest in me; further trips to Uganda and Madagascar followed. During our trip to Uganda in 2016, we were able to meet our tour guide Charles Oyer, who inspired me to participate in this project. This visit to Uganda left a lasting impression on me. For the first time we came into contact with the locals and also with Charles' family. We gained insight into people's lives, and especially into the daily school life of the children, by visiting the old Mubaku School, which at that time still consisted of a single tree where the teachers taught the children. This experience was so impressive to me that five years later there could only be one topic for my diploma thesis, one with which I could support the people in Uganda. In December 2021, I contacted Charles via Facebook to discuss the schhol's current projects and their plans for the future. At that time, they were collecting donations for the dormitories, and plans for the rest of the area were still pending, which I was allowed to plan within my diploma thesis.

The foundation of the work was the ongoing exchange with Mr. Oyer in order to respond to the needs of the community and the children. It first started with a conversation in December 2021 and continued throughout the entire duration of the design process until 2023. Contact was maintained via social media platforms, and questions that arose were compiled in a questionnaire; finally, an interview was conducted via Zoom. In order to incorporate the traditional construction methods in the region, literature research was done, partly using the internet but mainly by visiting libraries. The necessary information for the inventory mainly came from Charles, who visited the plot regularly and from analysing the plot, using Google Maps and Google Earth.

Abb. 2: map of Uganda

UGANDA

Uganda is a landlocked country in East Africa, bordering South Sudan to the north, Kenya to the east, Tanzania to the south, Ruanda to the south-west, and the Democratic Republic of Congo to the west.[1] The country is located on a large plateau ranging between 1500 meters in the south and 900 meters in the north[2] and spreads over 241.000 square kilometers.[3] The plateau is bordered by a rim of mountains including the Rwenzori Mountains range in the west and Mount Elgon in the east. Although it has no access to the sea, Uganda is a well-watered and fertile country with a water surface area of 140 square kilometers, consisting of many rivers and lakes, like Lake Albert and Lake Edward. The biggest one is Lake Victoria, which is located in the south, partly creating the border to Kenya and Tanzania. The vegetation differs vastly within Uganda: The south is very rich in vegetation, while the landscape changes from wooded savannah in central Uganda into dry acacias and woodland in the northern region. Because of deforestation, mainly in the south, a large part of the country has been placed under protection, resulting in ten national parks, the biggest one being Murchison Falls National Park, with an area of 3800 square kilometers.[4]
After the country gained independence in 1962 , tourism was a major part of the economy, which, however, ceased under the dictatorial regime of Idi Amin. Since the 1980s tourism has slowly been increasing again. Besides the fertile vegetation, it is also rich in natural resources such as copper, arable land, salt, and even gold.[5] The population of Uganda consists of more than 60 different cultural groups, which not only speak different languages but also have their own traditions and religions. The majority of the population (60%) belong to the Bantu, who are mainly located in the southern areas and west of Lake Kioga. The Baganda are the largest population group of the Bantu people, followed by the Ankole, the Basoga, the Bakiga and the Bagisu. The central north is dominated by the Nilotes, who make up 15% of the population. They include the Langi, the Acholi, the Alur and the Jopodhola. Together with the Hamitonilotes, such as the Iteso and the Karamajong, they represent 24% of the population. In the north, bordering South Sudan, Sudanese-speaking groups are located such as the Lugbara are located, with a share of over 3% populance. As of 2021, a total of 47.9 million people live in Uganda, and this number is increasing annually by 3.2 %.[6] Moreover, Uganda has taken in over 1.5 million refugees and thus is the country with most immigrants on the African continent. Most of them come from South Sudan, the Democratic Republic of Congo, Burundi, and Somalia.[7] The majority of Ugandans live in rural areas, only 24% of the population live in cities, with the Capital Kampala being the most densely-populated area.[8]

[1] Geography of Uganda, in: <https://en.wikipedia.org/wiki/Geography_of_Uganda> (28.11.2022).

[2] Geography of Uganda, in: <https://www.countryreports.org/country/Uganda/geography.htm> (30.11.2022).

[3] The word factbook, Uganda, in: <https://www.cia.gov/the-world-factbook/countries/uganda/> (5.1.2023).

[4] Murchison Falls Nationalpark, in: https://de.wikipedia.org/wiki/Murchison-Falls-Nationalpark (30.11.2022).

[5] Land of Uganda in: <https://www.britannica.com/place/Uganda/Land> (30.11.2022).

[6] Ugandan Population in: <https://worldpopulationreview.com/countries/uganda-population> (4.1.2023).

[7] Flüchtlinge in Uganda in: <https://www.uno-fluechtlingshilfe.de/hilfe-weltweit/uganda> (12.1.2023).

[8] Uganda settlement in: <https://www.britannica.com/place/Uganda/Land> (13.1.2023).

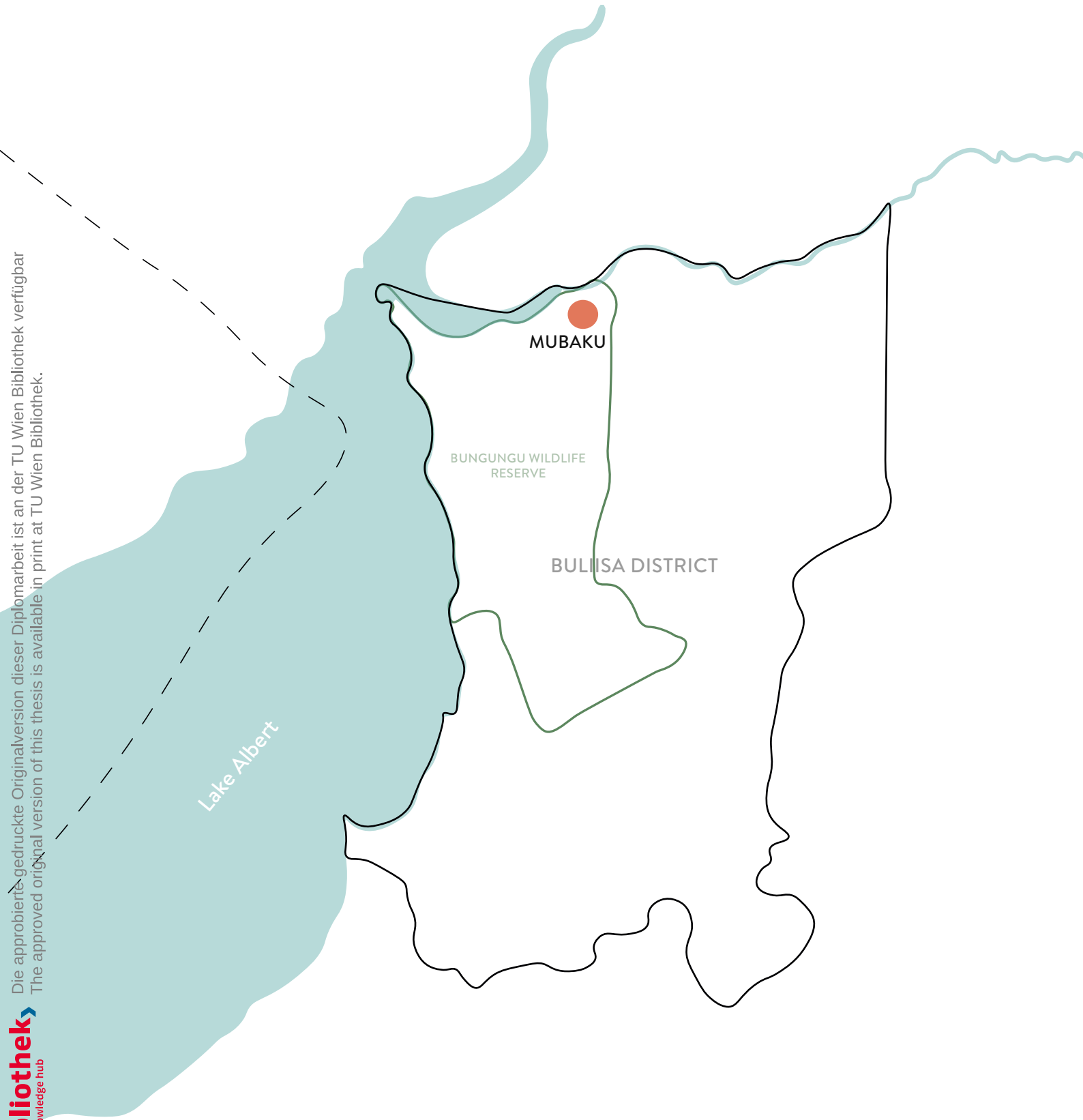


Abb. 3: map of Buliisa district

The official language, besides English, is Swahili, although Swahili is hardly used by the civilian population, but rather mainly by the police and the military. One of the languages spoken by the Ugandans is Luganda, which is the language of the Bantuvolk Baganda and was the official language of the autonomic pre-colonial kingdom Baganda, which was located in Central Uganda.

At 85% of the population, the majority are Christians, including Roman Catholic and Anglican Churches, followed by Muslims at 14%. Only 0.1% of the population officially practice traditional African religions, while most people follow traditional beliefs besides their official confession.[9]

Mubaku

Mubaku is a sub-county within the Bugungu Wildlife Reserve in the Buliisa district, which lies in the Great Rift Valley, bordering Lake Albert in the West and Murchison Falls National Park, in the East.[10] It is Uganda's oldest and biggest National Park. with a landscape consisting of open grassland, scrubby savannahs, hills, and swamps. The park is divided by the Victoria Nile into a northern and a southern part, whereby the northern boasts more wildlife than the south, where Mubaku village is located.[11] Despite the proximity to the National Park, 1000 square kilometers of a total of 1700 square kilometers is a protected area.[12]

[9] Uganda in: <https://de.wikipedia.org/wiki/Uganda> (14.11.2022).

[10] Bugungu in: <https://de.wikipedia.org/wiki/Bugungu> (30.11.2022).

[11] Bugungu Wildlife Reserve in: <https://www.safaris-uganda.com/bugungu-wildlife-reserve/> (30.11.2022).

[12] Questionnaire: Charles Oyer, Executive Director, Chairman of MUCCO (facebook chat history, 12.2021-1.2023).

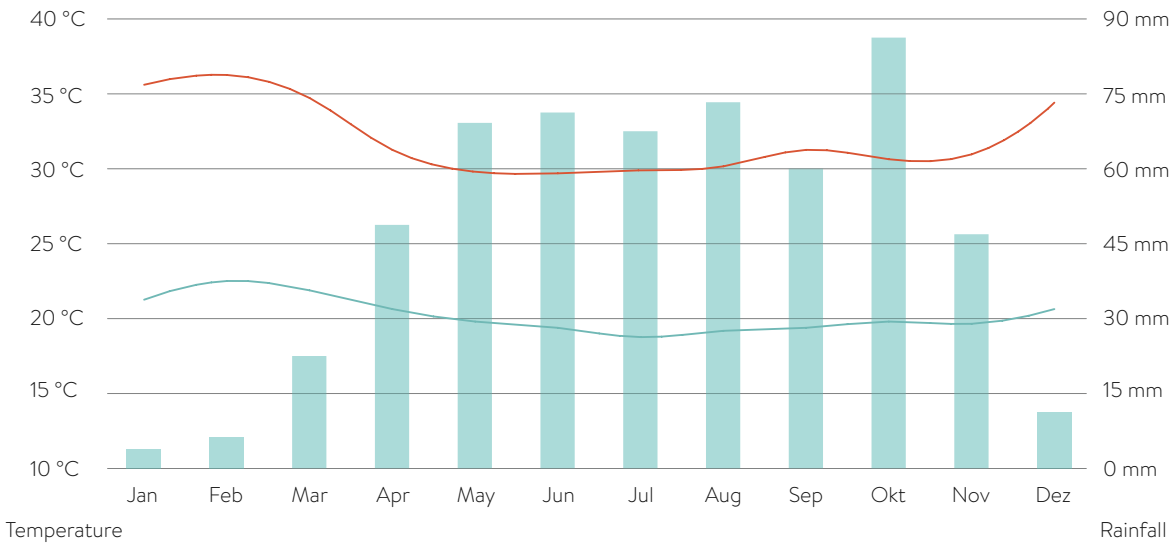


Abb. 4: temperature and rainfall in Buliisa

CLIMATE

Despite the proximity to the Equator and the tropical climate, Uganda has a moderate climate throughout the whole year. In the Wanseko region, the daily average temperature ranges between 24.5 - 29.5 °C.[13] The hot, dry months are limited to the period between December and March. Despite daily temperatures of 35°C during the day, the nights are still chilly with temperatures of 22 °C. The Wanseko region is a rather wet area in comparison to the rest of Uganda. While most parts of Uganda have two rainy seasons with a break between May and September, the area around Lake Albert has only one, starting in April and lasting until November. Within this rainy season, temperatures of maximum 30 °C occur and cool down to 18.7 °C at night. During the day, the highest temperatures are between 2 and 6 p.m. Outside this time of day, the climate is pleasant to warm.[14] The highest wind force occurs between February and May, with wind speeds above 6 km/h. After reaching a peak in May, it decreases to 4 km/h in September and from then it starts to increase again. In general, most winds come from the east (45%), which is also the dominant wind direction in the dry season from January to March. The south wind (20%) occurs mainly in the months between March and August, whereby in these months the north wind (25%) reaches its lowest and increases in August. The least frequent wind direction with a percentage of 10% is west.[15]

[13] Klima in Bulisa in: <https://de.weatherspark.com/y/96885/Durchschnittswetter-in-Bulisa-Uganda-das-ganze-Jahr-über> (30.11.2022).

[14] Klima in Uganda in: <https://abendsonneafrika.de/ugandar-uanda-reisen/informationen-und-angebote/?gclid=Cj0KCQiA1ZGcBhCoARIsAGQ0kkrdpenJg-PUnSjvdOd7N0hmMUa5Won1m6KN1ZHB7sMCVrsGygS7dEaAiJ8EALw_wcB> (29.11.2022).

[15] Climate Wanseko in: <https://www.weather-atlas.com/en/uganda/wanseko-climate#temperature> (30.11.2022).

Abb. 5: women in Uganda

THE ORGANISATION

The MUCCO is an association of local guides to support their village through donations. The members are all from different cultural groups and thus reflect the diversity of the population in their village. Officially, MUCCO was founded in 2014 as a non-profit association called Mubaku Community Conservation Organization, intending to improve the living conditions of the people in their village and the surrounding area. The main focus is on infrastructure, education, transport, and the health system. The goal is to give children and young people access to education, as well as to acquire knowledge themselves, from which they will all profit in the long term. By learning skills themselves and getting a well-paid job, members thus escape poverty, have a respectful attitude towards the environment, and also have the knowledge to protect themselves from diseases such as HIV. Passing on skills plays a major role, as many people have no training or schooling. Therefore, the MUCCO wants to give vocational training courses which in turn serve the local population.[16]

Primary school

The construction of a school building was the first step in giving children access to education. The way to the nearest government school was too dangerous for the children and there was no money for transportation.

Therefore, in 2014, with the help of the parents, enough money was raised to pay a teacher who initially taught the children under a tree. With only one teacher, the number of students was limited to 73 children.

This changed in 2015 when two more teachers were hired and the first temporary school building was built out of mud and wood. 135 students were taught until 2018, when the construction of the Mubaku Bright Future School began. Initially, funds were raised to purchase a plot of land on which the first brick school building, which consists of four classrooms and a staff room, was built. Thus, a total of eight teachers can now teach the 215 children on the new premises.[17]

Women`s Empowerment Center/ nursery school

The vacant mud building of the school was initially used for the nursery until 2020, when a separate building was constructed on a separate plot of land not far from Bright Future School. The newly constructed building consists of three rooms for the daycare center and a „Women Empowerment Center“. On the one hand, the building provides space for a sales outlet for items handmade by women, and on the other hand, it is designed for women to study writing, reading, and arithmetic while their children are being cared for.[18]

[16] MUCCO Organisation in: <https://mubakuschool.org/mucco/> (4.1.2023).

[17] School building Mubaku in: <https://mubakuschool.org/progress/> (4.1.2023).

[18] Nancy Wright building in: <https://mubakuschool.org/second-building/> (4.1.2023).

Abb. 6: children in the country site

EDUCATION

Despite the general compulsory education, Uganda has an illiteracy rate of 23.5% (2022).[19] On one hand, there are free state schools, but there are too few, and in most cases, they are too far to walk to. On the other hand, most people cannot afford the school fees for private schools. Moreover, many children have to contribute to the livelihood of their families by participating in crop harvesting or taking care of their younger siblings and therefore cannot attend school regularly.[20]

The school system in Uganda has its roots in the British colonial period; thus, wearing a school uniform is obligatory.[21] Education starts in nursery school from the ages of one to six with reading, writing, and counting. Primary school starts from the age of six to twelve, but it is not uncommon for older children to attend. After that, children can attend secondary school for another six years, where the attendance rate (17% in 2006) is much lower than in primary school.[22] The school year is divided into three terms, each lasting three to four months. The school education includes subjects like English, Mathematics, Social Studies and Science.

Before the Mubaku Bright Future School was built, children could not attend school because the next state school was too far away and way too dangerous. The newly built dorms enable children from further away to attend school and to stay there during the school terms. It provides sleeping spaces for 34 boys and girls who not only sleep there but also get additional lessons in the morning, before the day schoolers come, and in the evening. For a child, living in the dorms means that he/she only comes home during the holidays. Thus, it is a privilege for a child to attend school as their daily school schedule is very packed. In the morning they have lessons until 1 pm with a break in between. Lunchtime is from 1-2 pm, followed by another teaching session until 5 pm. After that children can do sports and have some spare time until 7 pm when dinner is ready. Day schoolers then walk home to their families, in contrast to a dorm residential child, who has the opportunity to do homework or have reading lessons.[23]

[19] The word factbook, Uganda, in: <https://www.cia.gov/the-world-factbook/countries/uganda/> (5.1.2023).

[20] Bildung in Uganda in: <https://www.kampala-view.de/index.php/bildung-in-uganda> (5.1.2023).

[21] Schulsystem, Uganda in: <https://www.uganda-ewaldi.de/uganda-das-land/schulsystem/> (5.1.2023).

[22] Primary school attendance, Uganda in: <https://www.epdc.org/sites/default/files/documents/Uganda_coreusaid.pdf> (5.1.2023).

[23] Questionnaire: Charles Oyer, (12.2021-1.2023).

Abb. 7: boys with wooden bike

LIVING IN MUBAKU

Mubaku is inhabited by 2314 people, 1180 female and 1134 male, who mainly generate money by selling food.[24] They are active as cattlemen, fishermen, and to a smaller extent as farmers, whereby cassava, corn, and cotton are mainly cultivated. Furthermore, it is common for people to grow their own crops and make their own fermented beverages, which results in a common alcohol consumption of 12.5 liters annually per person. Uganda is thus in seventh place in a worldwide ranking.[25]

Although Uganda's largest national park is located in the region, the locals profit only to a small extent from tourism. The goal of the people and also the MUCCO is to educate the people in order to have the knowledge to work in the tourism sector. Currently, however, the future goals look different, as oil was recently found in the bordering national park. Even the first road in the region was paved to ensure access to the extraction site. According to locals, this should become the main source of income in the future.

Even though most Ugandans are Christians' they still practice ancient traditions. About a third of the population believes that the reverence of spirits can protect them from bad luck.[26] It is common to call the spirits of their ancestors to help them get through tough times. When a family member is sick or animals are dying, the whole family gathers for a feast where a chicken or goat is the main meal. Due to poor education and lack of access to the healthcare system, many people still believe in witchcraft.

It still happens that men kill a hippo when their wife is expecting a child in the belief that the baby will be born healthy or will have more beautiful skin. Witchcraft also leads to mistrust within the society. It is not uncommon for people to believe that others are to blame for diseases within the family. When a loved one is ill, they think someone is wishing them bad luck. Meanwhile, they suffer from diseases like malaria, but they do not have access to a doctor who could educate them.[27]

[24] Questionnaire: Charles Oyer, (12.2021-1.2023).

[25] Alcohol Consumption by Country in: <https://worldpopulationreview.com/country-rankings/alcohol-consumption-by-country> (4.1.2023).

[26] Religions in Uganda in: <https://www.theugandaguide.com/about-uganda/religions-in-uganda> (30.11.2022).

[27] Interview: Charles Oyer, Executive Director, Chairman of MUCCO (zoom-interview on 5.12.2022).

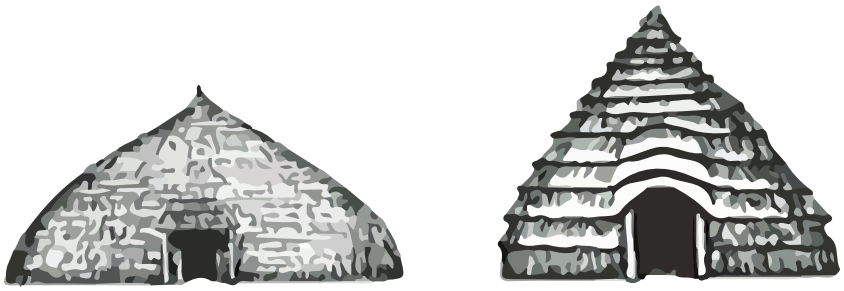


Abb. 8: beehive type

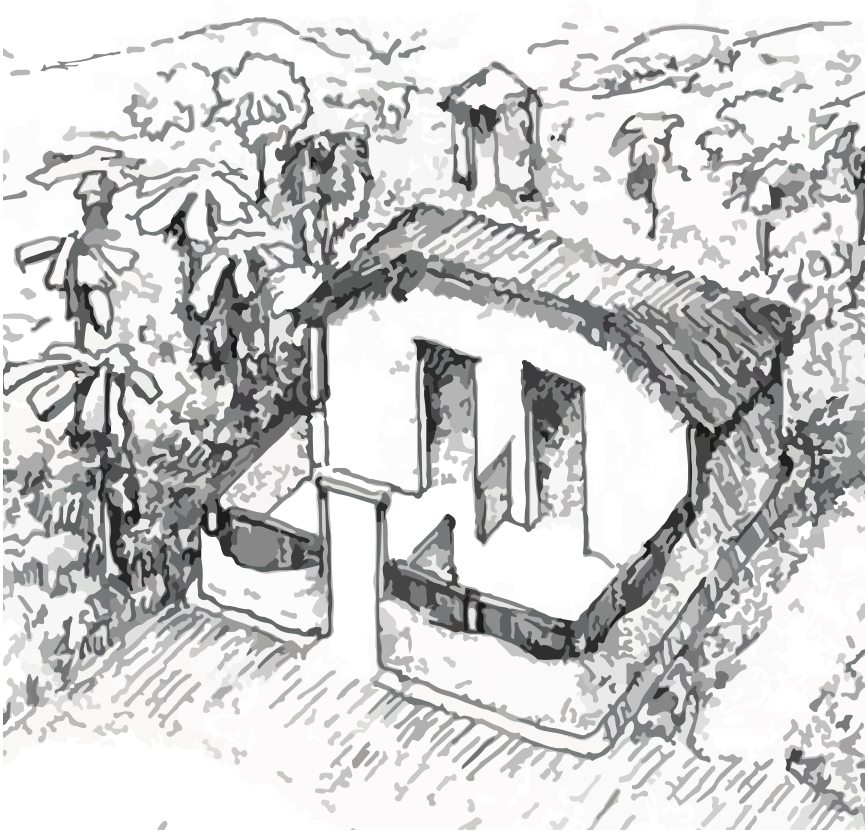


Abb. 9: Baganda house

VERNACULAR ARCHITECTURE

The traditional Ugandan building was a free-standing dwelling with a circular ground floor, constructed with flexible poles, which were attached to the ground and tied up on top, resulting in a convex construction form for the roof, which gave the hut its name called 'the beehive type'.[28] To give the building construction its stability, sometimes a central pillar was used in the center. The roof was created with layers of banana leaves grass or reeds. Depending on the region, a perimeter wall was built inside the building. The execution, such as the building process and the use of materials, varied according to the different regions. Every ethnic group has its own traditional building style. Traditionally, as in many tropical regions, living space was not only limited to the built interior but rather was extended to the outside space.[29] Therefore indigenous buildings possessextended eaves, not only at the entrances, such as on the Baganda house, but also all around the building, as on the Acoli house.[30]

Baganda

The Baganda are located in the central west near the big cities like Kampala. Due to this proximity, their lifestyle and the dwellings were strongly influenced by Europeans. The Baganda house therefore evolved early from the circular tribal house to a square ground floor with a pitched roof in the 1940s. As in the rest of Uganda, for the Baganda it was common to use wood for the building construction. The roof construction consisted of purlins made of reed or sticks in combination with palm fiber and rafters bearing onto the outer wall, replacing an elaborated trussed roof.

The thatched roof was made of dried strands from the banana tree over a lattice of elephant grass. The supporting walls were made from wicker of vertical and horizontal elephant grass rods in combination with adobe. To stabilize the building and anchor it to the ground, palm posts were used in the corners. Due to the high fiber percentage in the palm tree, it is resistant to termites. In comparison to this, the original house was constructed out of palm stems arranged in concentric circles, decreasing from six meter in height in the center to one meter in the outer row. The partition inside was made of packed earth walls or hanging bark cloth, with four divisions for different uses, such as the parents' room, a living room and two rooms for either storage or for the children. The division was inspired by the traditional Ganda house, which was organized around a central fireplace the 'ekyoto' (E).[31] The interior , in addition to the pillars and the door, was originally completely covered in reedwork. The width of the eaves allows for a small porch in front of the hut, similarly to the original Ganda house. Because of heavy rains in the region, a small apron of packed earth surrounded the whole dwelling to facilitate rainwater drainage.

[28] DENYER, Susan: *African traditional architecture*, New York (Africana Publishing Company), 1978, p 132, 135

[29] HERRLE, Peter; HEGERHOFF, Erik: *Architecture and Identity*, Berlin (LIT Verlag), 2008, p 179

[30] MEUSER, Philipp; DALBAI, Adil: *Architectural Guide Sub-Saharan Africa, Volume 5 Eastern Africa: From the Great Lakes to the Indian Ocean*, Berlin (DOM publishers), 2021, p 167

[31] TROWELL, Margaret; WACHSMANN, H. J.: *Tribal Crafts of Uganda*, London (Oxford University Press), 1953, p. 84.

[32] OLIVER, Paul: *Encyclopedia of Vernacular Architecture of the World, Volume 3: Cultures and Habitats*, Cambridge (Cambridge University Press), 1997, p 1998-1999.

Abb. 10: original Baganda house

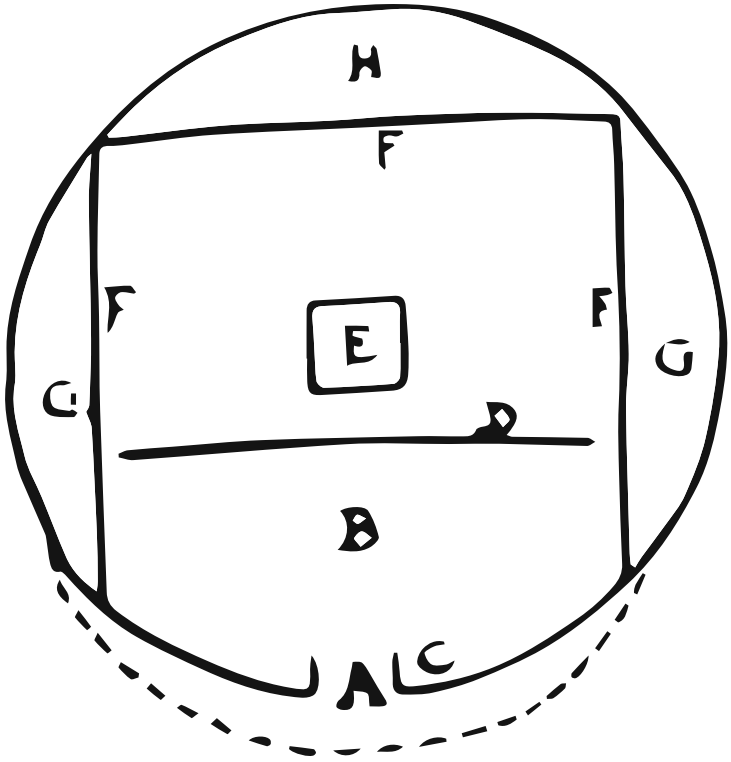


Abb. 11: Baganda house floorplan

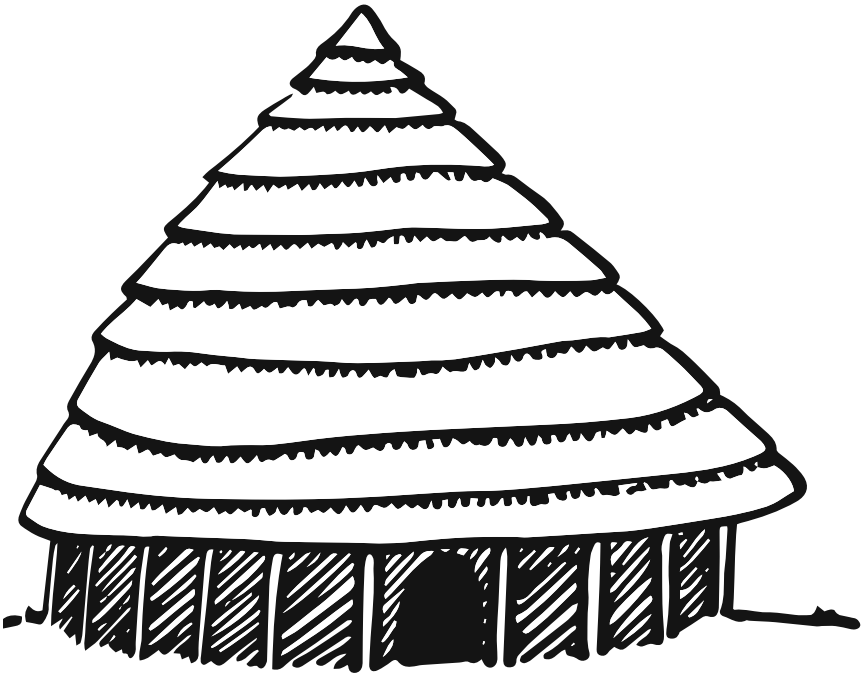


Abb. 12: Acoli house

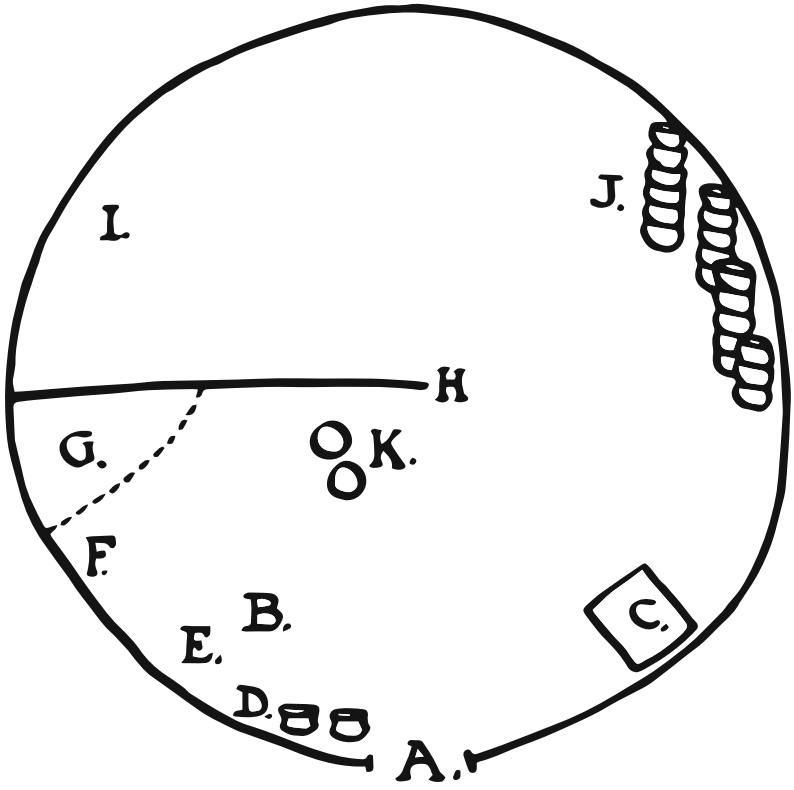


Abb. 13: Acoli house floorplan

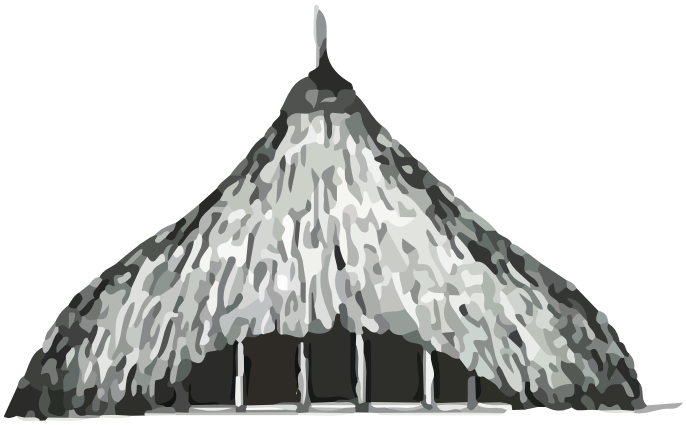


Abb. 14: Kasubi tomb

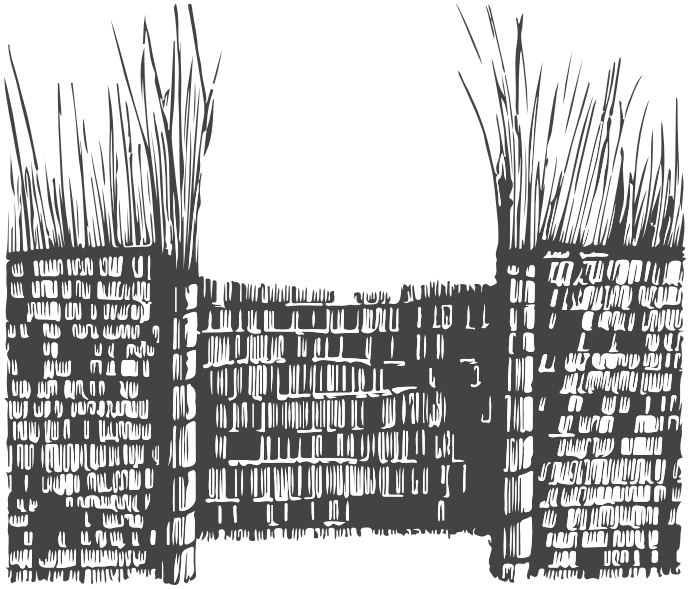


Abb. 15: gate of ganda palace

Kasubi Tomb

The largest dwelling in Uganda is the so-called ‚Kasubi Tomb'. It is one of the best-preserved examples of traditional Ugandan architecture. The Kasubi Tomb was built in 1882 and served as the burial place for the last four kabakas (kings) of the Buganda Empire. Its distinctive feature here is that this was the first time the kabaka was buried in one piece. In contrast, it had previously been customary to bury the lower jaw separately in its own shrine, as it was believed that the lower jaw contained the soul. The tomb has one of the largest grass-covered roofs and is one of the 31 traditional shrines still standing today. The roof is supported by a 12-meter-high ring construction of 52 palm fronds, which in turn is supported by wooden posts. These 52 palm fronds represent the different peoples of the Buganda Kingdom, each with its own significance. The thatched roof is inspired by the Ngeye (woolly monkey) people and the interior by the Ngo (leopard) people. The main room is covered with large sheets of bark mull, which separates the public area from the sacred place where the four kabakas (kings) are buried. The Kasubi Tomb is part of the royal complex with a central public forecourt where the kabaka received his guests. This area was surrounded by smaller buildings, which served as dwellings for the family of the kabaka, and an entrance building.[33]

The enclosure was often surrounded by a woven fence which was about three to five meters. It was woven out of elephant grass supported by posts made of wild fig trees.[34]

Acoli

The northern part of Uganda is settled by the Nilotic folk of the Acoli, who mainly live in houses made of wood and thatch. When building a new home, men and women cut and collect grass and poles for the building. Depending on the shape of the posts, they are used in different places. Forked poles are arranged in a circle to support the roof poles from a central pillar. For the ring beam resting on the forked posts, curved poles are tied together. The walls are moved inwards and are separated from the forked posts; these walls are made of straight poles which are tied together with bands of reed and twines, which are then plastered with mud and polished to appear smooth and shiny. The roof is constructed of hoops made of fibers and twigs, which are connected to a framework of straight poles. After that, the roof is inverted and placed on the poles to be thatched with the available grass.[35] The interior is divided by a partition wall, which does not reach to the top, to separate the goats from the sleeping platform. In the lower right corner just behind the wall is the fireplace, with a water pot to the left and kitchen utensils to the right.[36]

[33] MEUSER; DALBAI: *Architectural Guide Sub-Saharan Africa*, Volume 5 Eastern Africa, p. 167-173

[34] DENYER: *African traditional architecture*, p 129

[35] OLIVER: *Encyclopedia of Vernacular Architecture of the World, Volume 3*, Cambridge, p 1996-1997.

[36] TROWELL; WACHSMANN: *Tribal Crafts of Uganda*, p. 86, 74.

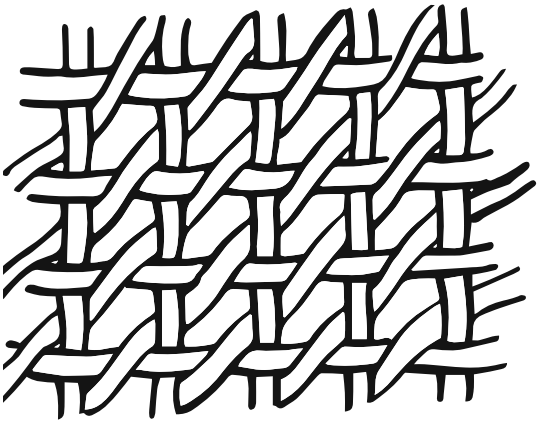


Abb. 16: hexagonal weave

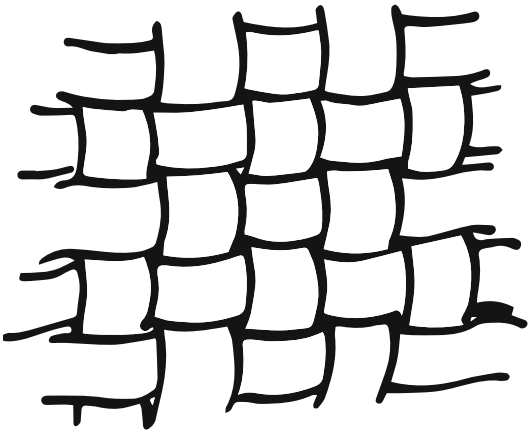


Abb. 17: check weave

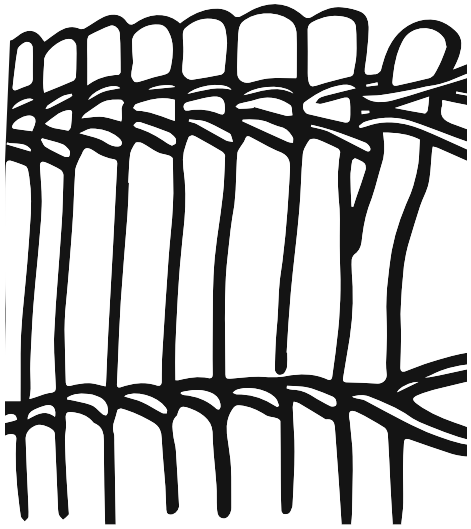


Abb. 18: tying technique of mats and fences

Gisu

Different from the rest of Uganda, in the region around Mount Elgon, near to the border to Kenya, it is common to build only with earth except the roof. Because of the lack of trees and grass, the Gisu developed building with earth. For the construction of the house, the topsoil is removed to dig trenches of 60 cm in depth, which are then dried for three days. These are filled with compacted soil for the foundation. The walls are made the same way as the foundation whereby the thickness is a sign of status. Additionally, they are decorated by using different types of clay. The roof is built by creating a wood structure by tying it with banana fibers. To protect the building from termites, cow dung is applied.[37]

Samia

The Samia are located on the shores of Lake Victoria near the border to Kanya. Like the Baganda, they use a mud and wattle technique for the building construction in combination with a thatched roof. For the walls, wood poles are interwoven with smaller branches and filled with packed earth. The roof has a steep conical shape and is woven like a basket. Between the wall and the roof, a gap is left to ensure ventilation and to protect the roof from termite attacks. Moreover, the roof has a large overhang to prevent the interior from overheating and to protect the walls from rain.[38]

Basketry

The art of basketry is known as the most highly developed art in Uganda and was used before iron, wood or clay. Traditional techniques were used to create baskets for food storage, bigger baskets for fieldwork and as drinking vessels when covered with mud. For the construction of buildings, basketry was used to create a reinforcement within clay walls, called wattle and daub, and for enclosure fences. Materials like splints, sticks, reeds and fibers were used, and by covering it with mud it becomes waterproof. Most common basket material was raffia palm, Borasus palm, papyrus, sorghum, grasses and shrubs. The fence was made using elephant grass canes stitched perpendicularly on both sides of an inner framework. The canes were left at full height to prevent animals and intruders from entering. Both, women and men knew the braiding technique; while men were responsible for the fencing, thatching and traps, women braided things like smaller baskets.[39]

[37] OLIVER: *Encyclopedia of Vernacular Architecture of the World, Volume 3*, p. 2003-2004.

[38] OLIVER: *Encyclopedia of Vernacular Architecture of the World, Volume 3*, p. 2010-2011.

[39] TROWELL, WACHSMANN: *Tribal Crafts of Uganda*, 1953, p.71p. 134-135

Abb. 19: burned brick house

BUILDING MATERIALS

Due to the rehabilitation of the local building industry after independence in 1962, the traditional huts are getting replaced by buildings made out of burned bricks, supported by a concrete frame, lumber for the roof construction, and corrugated iron instead of grass-thatched roofs.[40] Traditional mud houses can still be found in rural areas, such as in the Lake Albert Region, but they have mostly been replaced by modern versions. In Uganda, clay such as air-dried bricks and fired bricks is mainly used for wall construction. Building with clay is considered outdated and is only used by people who cannot afford burned bricks. In addition, people associate traditional loam buildings with the process of maintenance in comparison to other building materials, but this is not due to the material itself, because if well executed and protected, adobe architecture is just as durable as other architecture.[41] Although timber is often considered an inappropriate material for building, because of deforestation, it is still very common in use for roof construction.[42] Wood has been used for a long time to build houses, especially for structural elements. Due to heavy rains during the rainy season, wood must be protected, either by a roof overhang or wattle and daub.[43] In addition, wood must be protected from termites and is therefore often separated from the wall construction so it can easily be replaced, which can be observed at the Acoli house. Even though eucalyptus is a foreign plant, it is one of the most common types of lumber for roof construction besides pine.

Another very popular building material in Uganda is cement. It is used as a binder in the production of fired bricks and concrete, which is used for the foundations as well as the ring beam.[44]

Earth as a building material

Building from earth is the oldest and one of the most widespread building techniques, especially in India and Africa. One-third of the world's population is still living in clay houses. The type of rock found in Uganda called laterite, is particularly suitable as a building material. Clay is a natural product and is formed by the weathering of rock. Pure clay is not suitable for building, because of its low stability.[46] Loam appears in the ground as a mixture of sand, silt and clay. Depending on the composition of the soil, the earth is used in different forms, as a building material.[47] Loam is a monolithic building material and thus can only absorb compressive forces. Therefore, it is used as rammed earth walls or in combination with straw or branches as cob loam or wattle and daub. Moreover, loam can be processed into bricks, which can be used air-dried or burned. Due to its natural composition, it can absorb and release humidity, is a good heat accumulator and absorbs pollutants.[48]

[40] OLIVER, *Encyclopedia of Vernacular Architecture of the World, Volume 3*, p 2005.

[41] Interview: Charles Oyer (5.12.2022).

[42] MEUSER, DALBAI: *Architectural Guide Sub-Saharan Africa*, p 151.

[43] OLIVER, *Encyclopedia of Vernacular Architecture of the World, Volume 3*, p 1996-2010.

[44] Questionnaire: Charles Oyer, (12.2021-1.2023).

[45] OLIVER, Paul: *Encyclopedia of Vernacular Architecture of the World, Volume 1: Theories and Principles*, Cambridge (Cambridge University Press), p 278

[46] KEEFE, Laurence: *Earth Building, Methods and materials, repair and conservation*, London (Routledge) 2005, p 5.

[47] Lehm in: <https://de.wikipedia.org/wiki/Lehm> (5.1.2023)

Abb. 20: kiln for burning bricks

Material selection

When designing in Uganda, the biggest goal was to make the buildings as sustainable as possible, by using locally available materials. Earth, therefore, was the most favorable choice, with an energy consumption of 5-10 kWh/m3 in comparison to fired bricks (1.140 kWh/m3) and cement (2.620 kWh/m3).[49] Therefore, building with unprocessed loam would be the best option to choose. While it is most common to build with burned bricks, where wood is needed for the burning process, air-dried bricks would be a preferable option since the production is associated with lower costs, because of zero energy consumption. In consultation with the responsible persons in Uganda, it became clear that the realization of the buildings would not be possible from the air-dried bricks, since the organization would hire a construction company which does not produce adobe bricks for building the project, which does not produce adobe bricks. Alternatively, the purchase of a stabilized earth block machine was considered. Despite having a cement content of over 10%, the blocks wouldn not be more sustainable compared to burned bricks. To enable the realization of the project, it was decided to execute the plans with adobe bricks, the same size as the burned ones, to make it possible to also build it with burned bricks. The burned bricks are produced within 75 km of distance to Buliisa District, in the neighboring town of Hoima, with one truckload costing about 2 million Ugandan shillings (550 US dollars).[50]

[49] KEEFE, Earth Building, Methods and materials, repair and conservation, p 4.

[50] Questionnaire: Charles Oyer, (12.2021-1.2023).

Abb. 21: elevation classroom

SCHOOL DESIGN

The design is inspired by traditional Ugandan loam architecture. Even though Uganda is a very diverse country with many ethnic groups, they all have the use of loam as a building material in common. Because of the locality and its low costs, loam is a suitable building material for the school in Mubaku. While designing, the main focus was to integrate local skills, such as the art of basketry, which is used to create woven fences, which were also made in the past by the Baganda to fence their enclosures.

The aim of the design was to blend in with the existing building and create a structure, where children and teachers have their own spaces. Therefore, there are two complexes: one for the teachers‘ units with their own latrine and showers and one for the school.

The main concept was developed from the local climate. Due to the warm climate and rainy seasons, the aim was to create shaded and protected outdoor spaces beside the interior. This is partly done by built structures in addition to the existing vegetation.

SPACE ALLOCATION PLAN

PLOT	20.200 m²

PHASE 1 | BUILT, PLANNED

1	**school**	320 m² | 4 classrooms 1 teachers office
2	**pit latrine**	17 m² | 8 toilets
3	**dorm**	180 m² | 35 beds
4	**teachers houses**	demolishion
5	**showers with toilets**	66 m² | 10 showers, 4 toilets

PHASE 2 | DESIGN

6	**library**	68 m² | homework area 34 m² | library with working area 34 m² | outdoor reading area 45 m² | outdoor reading relaxing
	30-50 pupils	
7	**teachers units**	18,7 m² | 10 residential units 44 m² | shower, latrine
	10 teachers	
8	**cafeteria**	20,5 m² | kitchen with a food bank 24,8 m² | storage room 185 m² | indoor dining area 57 m² | outdoor dining area
	250 pupils	
9	**classrooms**	224,6 m² | 3 classrooms 57 m² | outdoor playing area
	120 pupils	
10	**outdoor**	4050 m² football field 360 m² | volleball field 7200 m² | school garden bicycle parking solar water point
	facilities	

PHASE 1

1	**school**	320 m² | 4 classrooms 1 teachers office
2	**pit latrine**	17 m² | 8 toilets
3	**dorm**	180 m² | 35 beds
4	**teachers houses**	demolishion
5	**showers with toilets**	66 m² | 10 showers, 4 toilets

built
planned

Abb. 22: aerial view from the plot

THE PLOT

The school area is located within Mubaku village.
The plot extends over an area of around 20.000 square meters and is located about 700 m from the Mubaku Nursery School and the Medical Center. The terrain rises from 661 m in northeast to 668 in the southwest.

latrine

sausage tree

dorm

copaifera tree

school

Abb. 23: pictures of the plot

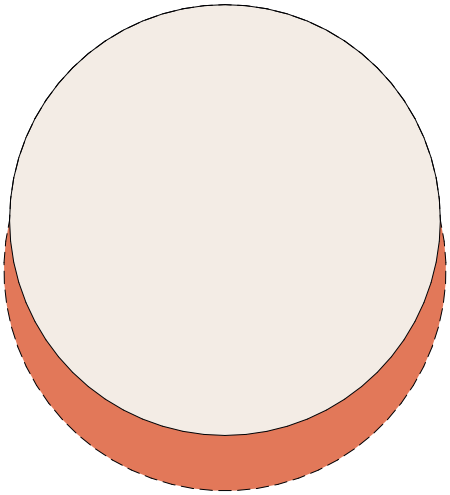
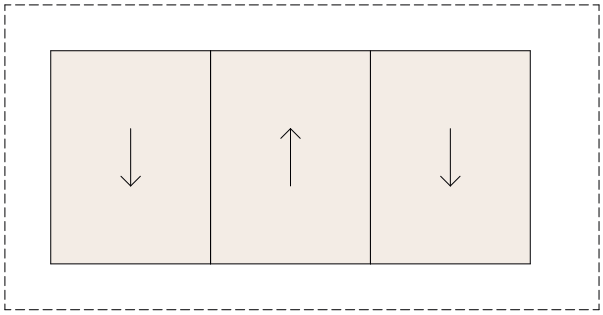


Abb. 24: floorplan of the Baganda house



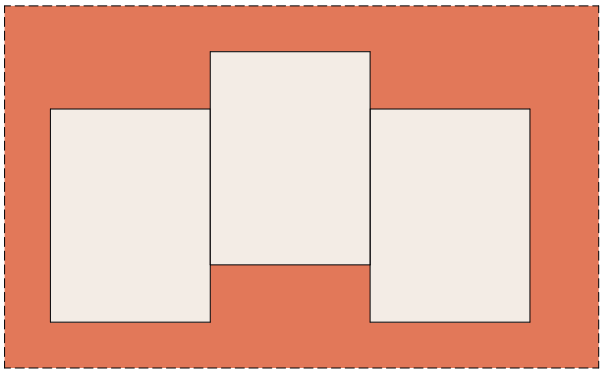


Abb. 25: concept of shaping

FORM

The shape of the floor plan was inspired by traditional Ugandan houses. The enlargement of the roof created an additional vestibule. To implement this in the design, setbacks of the interior spaces in a variety of forms; were used, creating protected outdoor spaces.

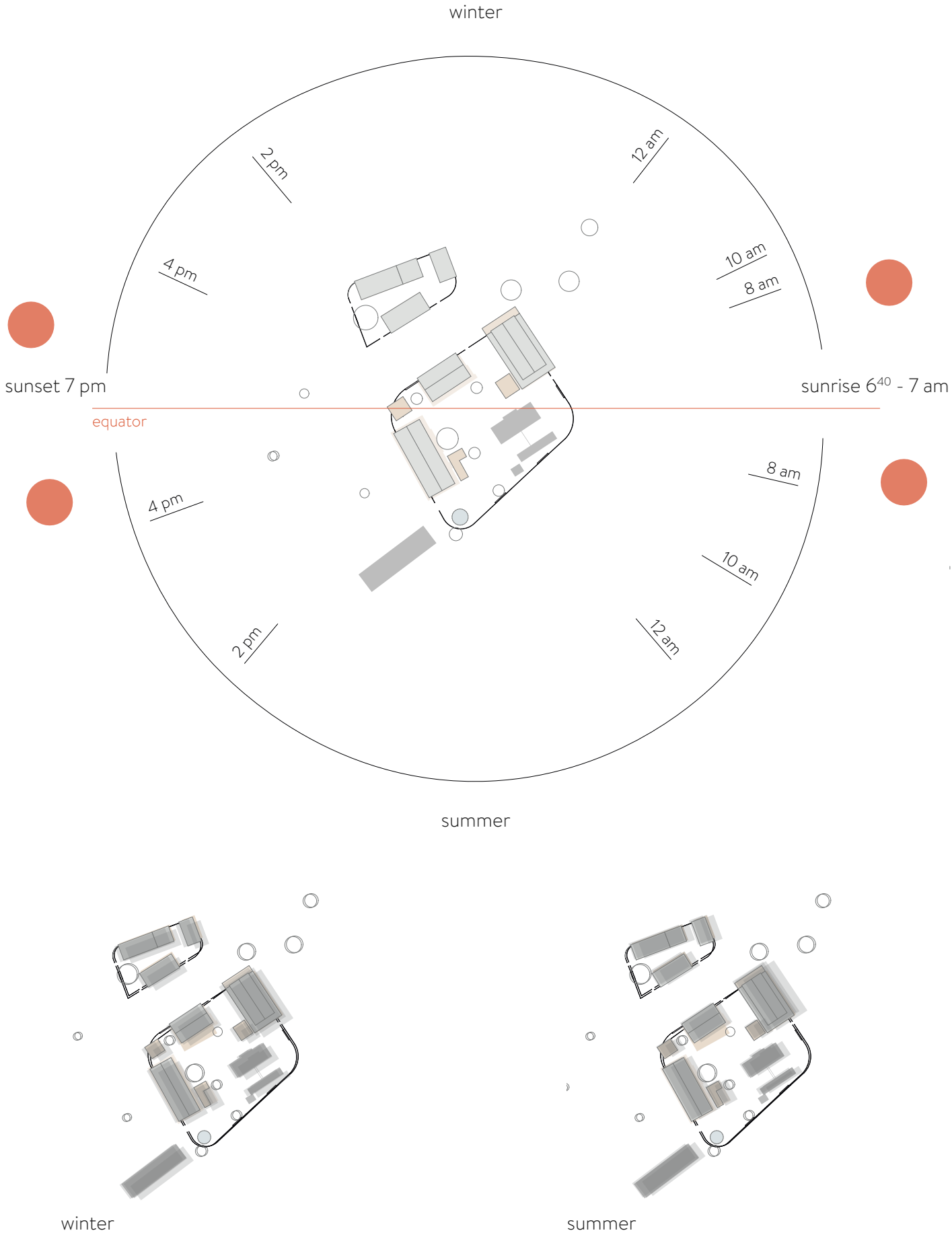
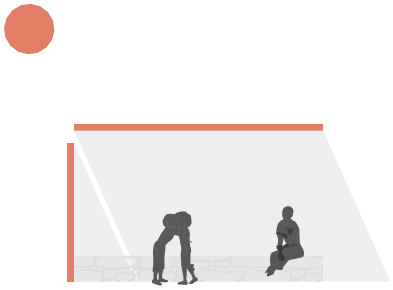


Abb. 26: solar progression plot

SOLAR PROGRESSION

In many tropical countries, the outdoor area is equal to the indoor area. The the goal of this design is to create shaded and protected outdoor spaces, which can be used similarly to the indoor area. Due to the countries‘ proximity to the equator, in the summertime, the sun is mainly coming from the south and in wintertime from the north. This requires a shading system for all cardinal directions, thus horizontal and vertical elements were used.



sun protection

rain protection

ventilation

Abb. 27: concept protected outdoor area

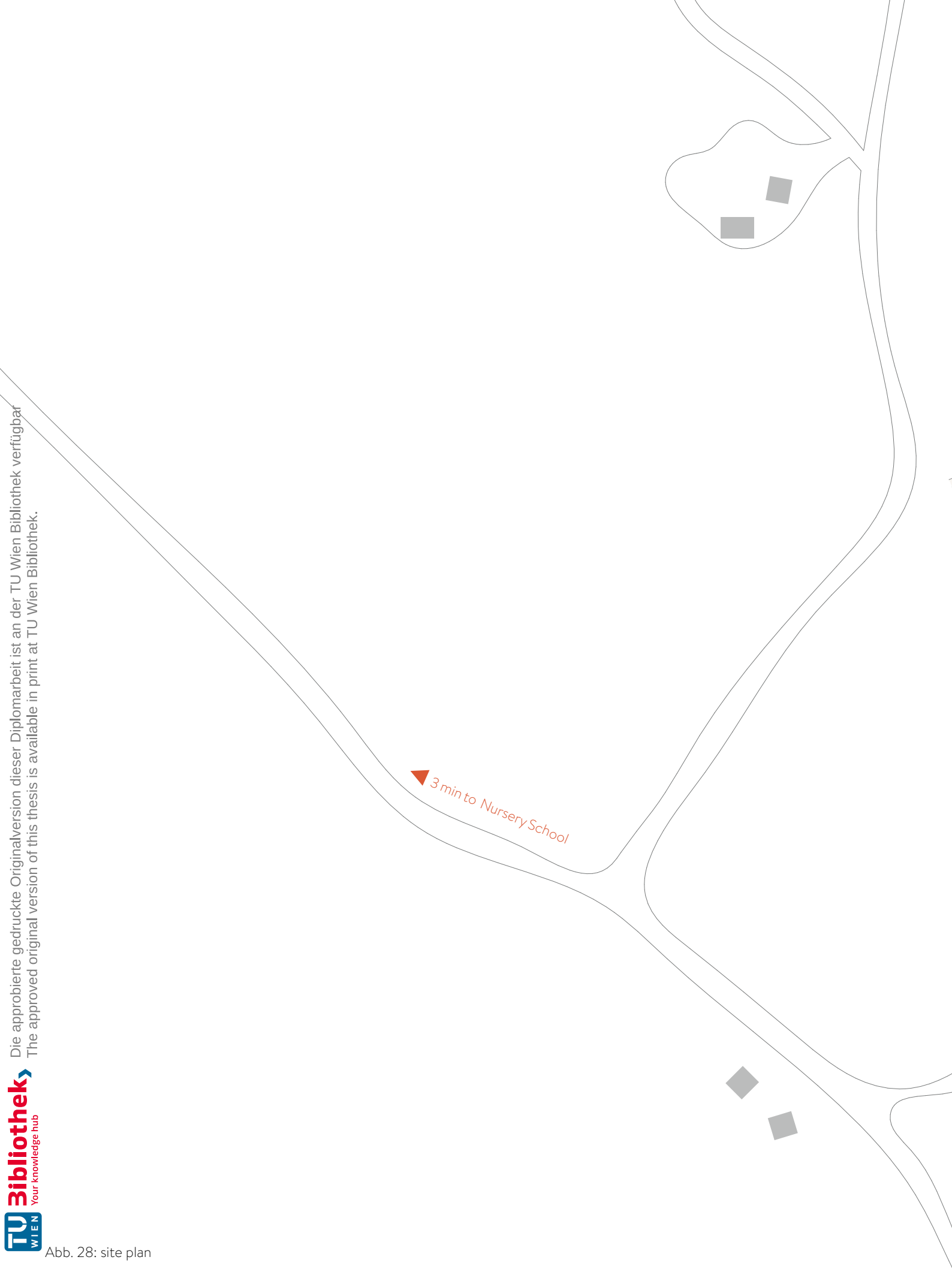
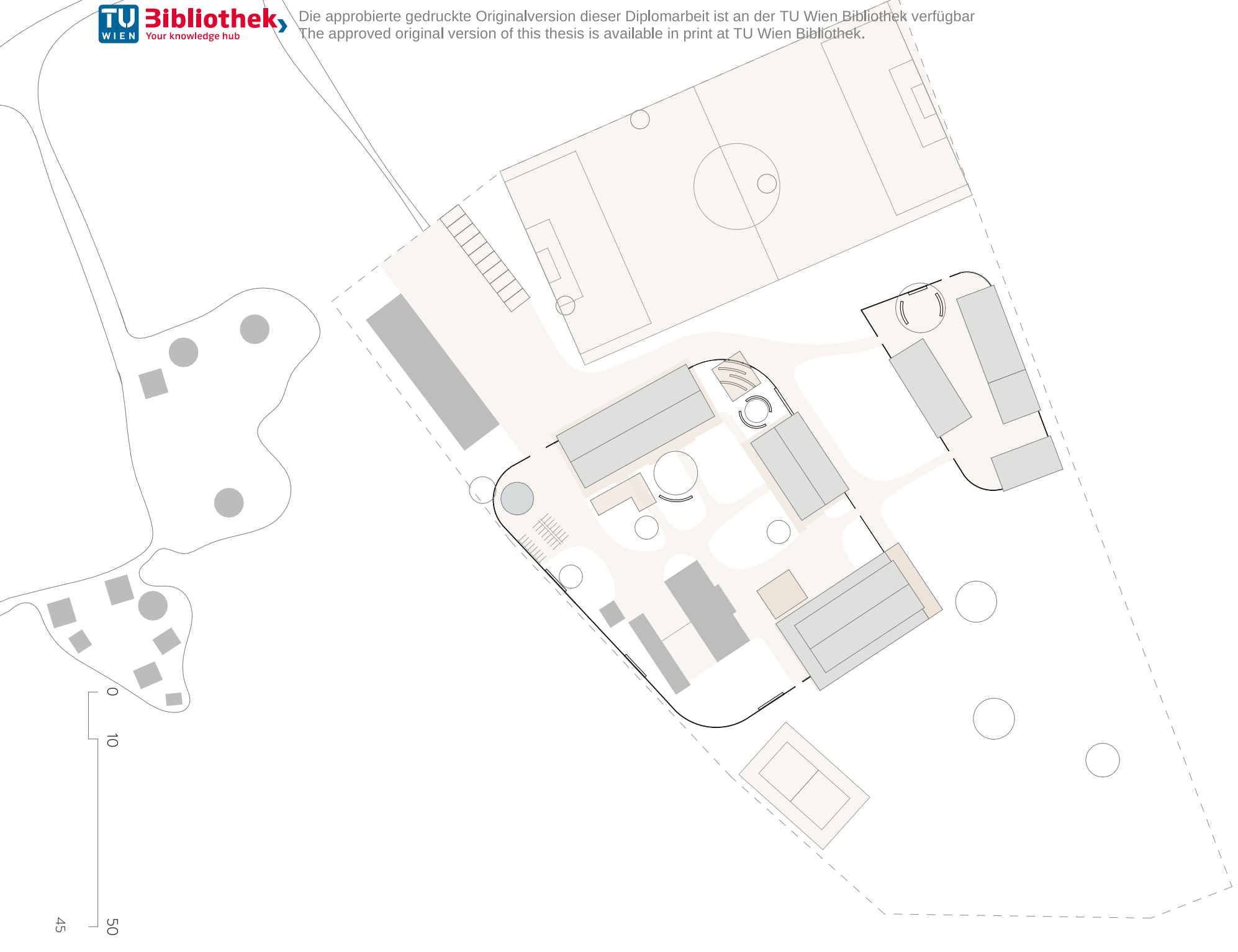


Abb. 28: site plan



PHASE 1 | BUILT, PLANNED

1	**school**	320 m² | 4 classrooms 1 teachers office
2	**pit latrine**	17 m² | 8 toilets
3	**dorm**	180 m² | 35 beds
4	**teachers houses**	demolishion
5	**showers with toilets**	66 m² | 10 showers, 4 toilets

PHASE 2 | DESIGN

		68 m² | homework area
		34 m² | library with working area
		34 m² | outdoor reading area
6	**library**	45 m² | outdoor reading relaxing
	30-50 pupils	
		18,7 m² | 10 residential units
7	**teachers units**	44 m² | shower, latrine
	10 teachers	
		20,5 m² | kitchen with a food bank
		24,8 m² | storage room
		185 m² | indoor dining area
8	**cafeteria**	57 m² | outdoor dining area
	250 pupils	
		224,6 m² | 3 classrooms
9	**classrooms**	57 m² | outdoor playing area
	120 pupils	
		4050 m² football field
		360 m² | volleball field
		7200 m² | school garden
10	**outdoor**	solar water point
	facilities	

Abb. 29: site plan 1:1000

1 classroom
2 latrine
3 dorm
4 shower
5 library
6 homework / study
7 reading / relaxing
8 outdoor reading area
9 teachers unit
10 shower
11 latrine
12 kitchen
13 storage
14 indoor dining
15 outdoor dining
16 classroom
17 playing
18 football
19 volleyball
20 school garden
21 parking lot
22 bicycle
23 solar water point

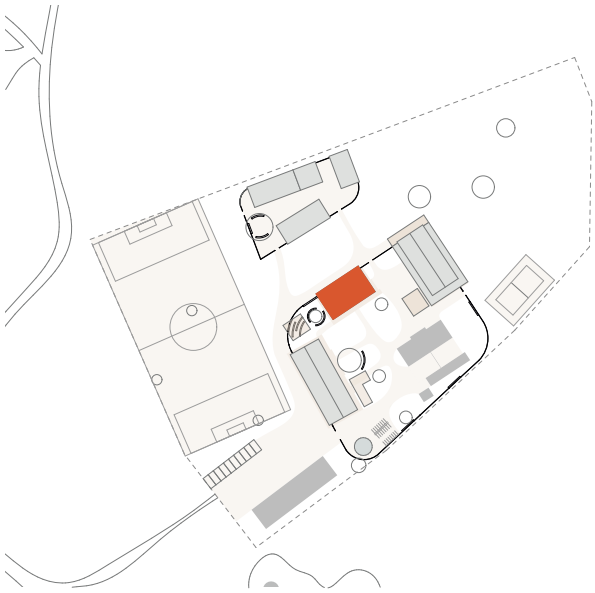
Abb. 30: masterplan with functions

LIBRARY

The library is situated in the northern part of the school area as close as possible to the classrooms, to enable a short walk when books are needed. It consists of one large working area for homework, a library area with a place for the librarian, and a covered outdoor reading area. The setbacks of the walls enable the integration of workspace, reading space, and shelves into the wall, which creates a retreat and a better working environment.

outdoor reading area

Between the library and the classrooms, there is a sheltered area for reading, relax-ing, or alternative teaching. A solid mud wall offers sitting niches for the children.



1. foldable door p. 97
2. window p. 96
3. shelves in niche
4. desk in niche
5. bench in niche
6. wicker p. 102
7. brick bench
8. wicker fence p. 102
9. mud wall p. 103
10. wicker fence with mud p. 103
11. stone benches
12. pavillion p. 112

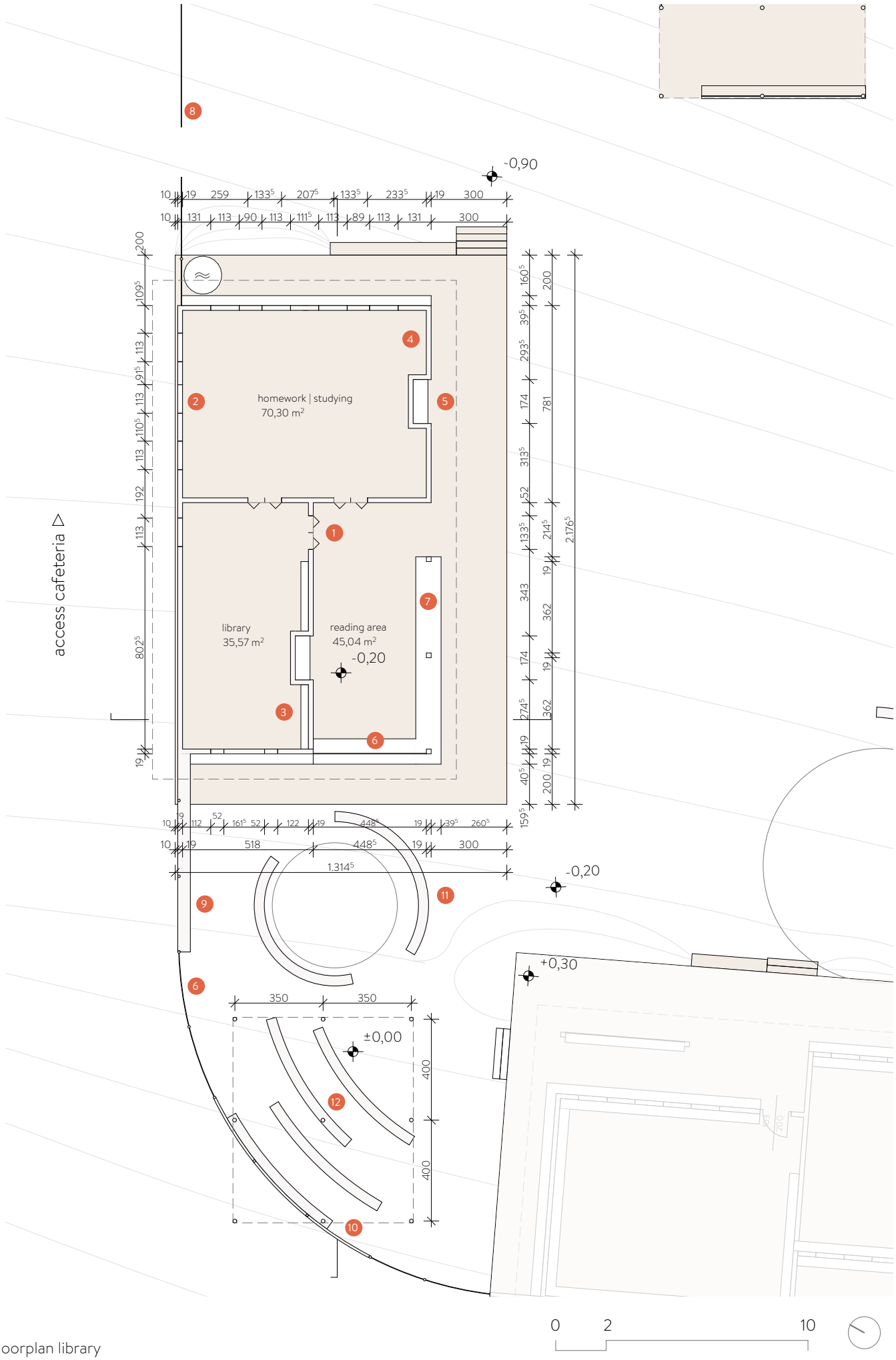


Abb. 31: floorplan library

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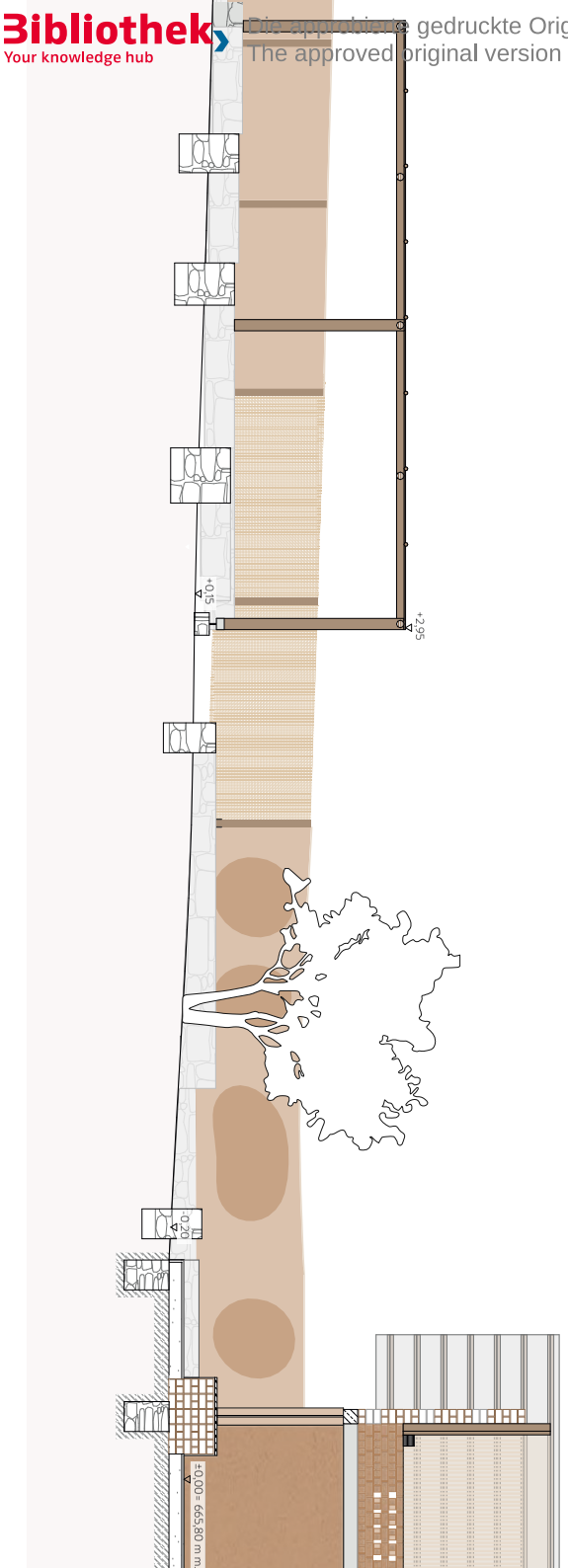
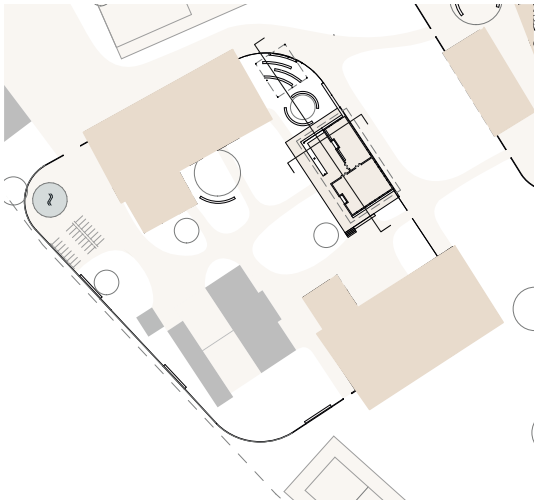




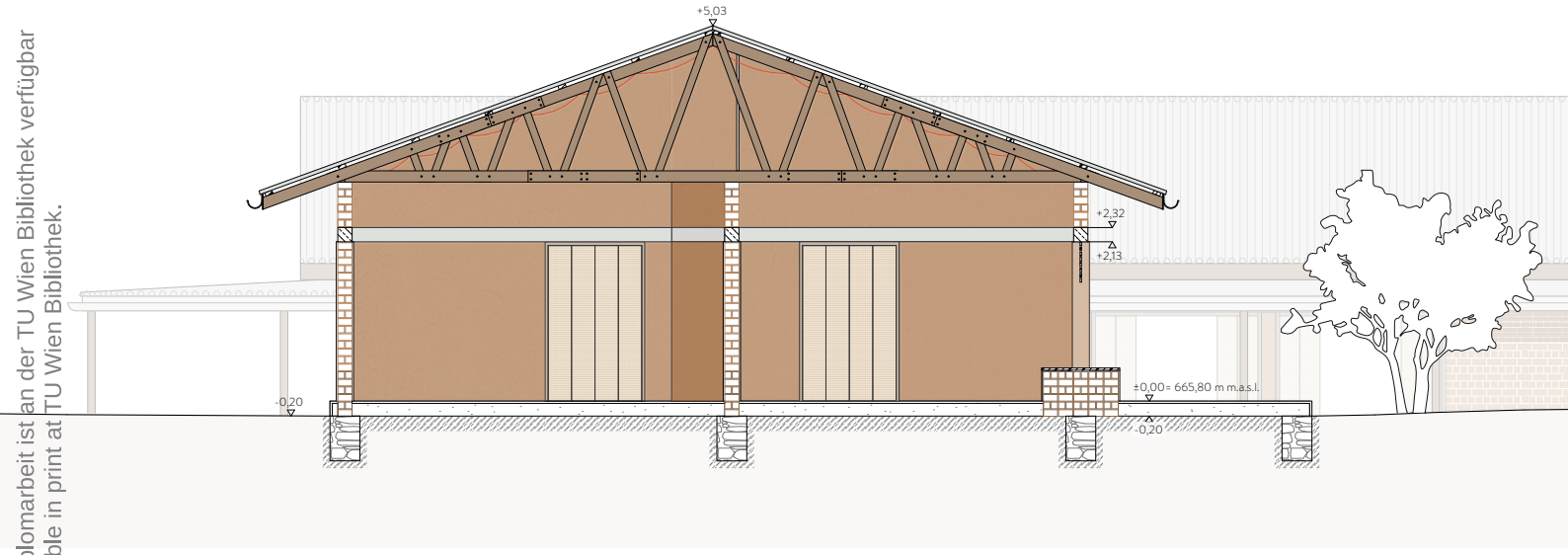


Abb. 32: library section 1

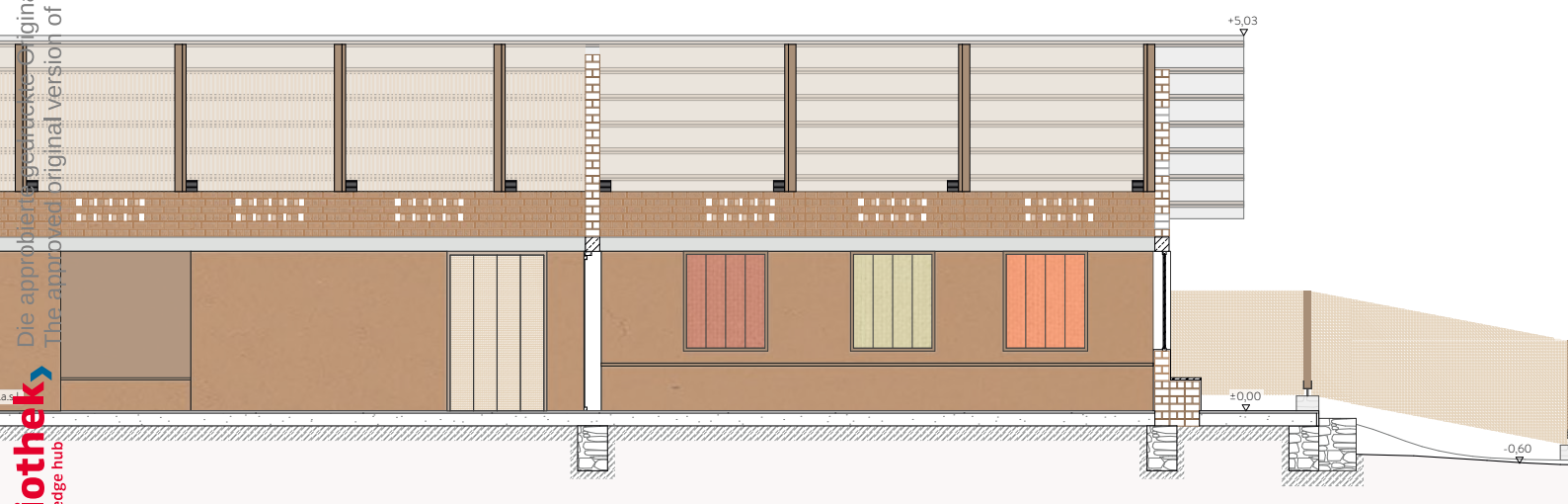
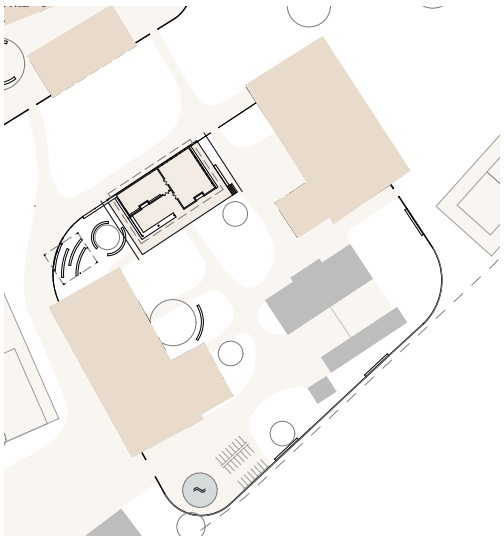
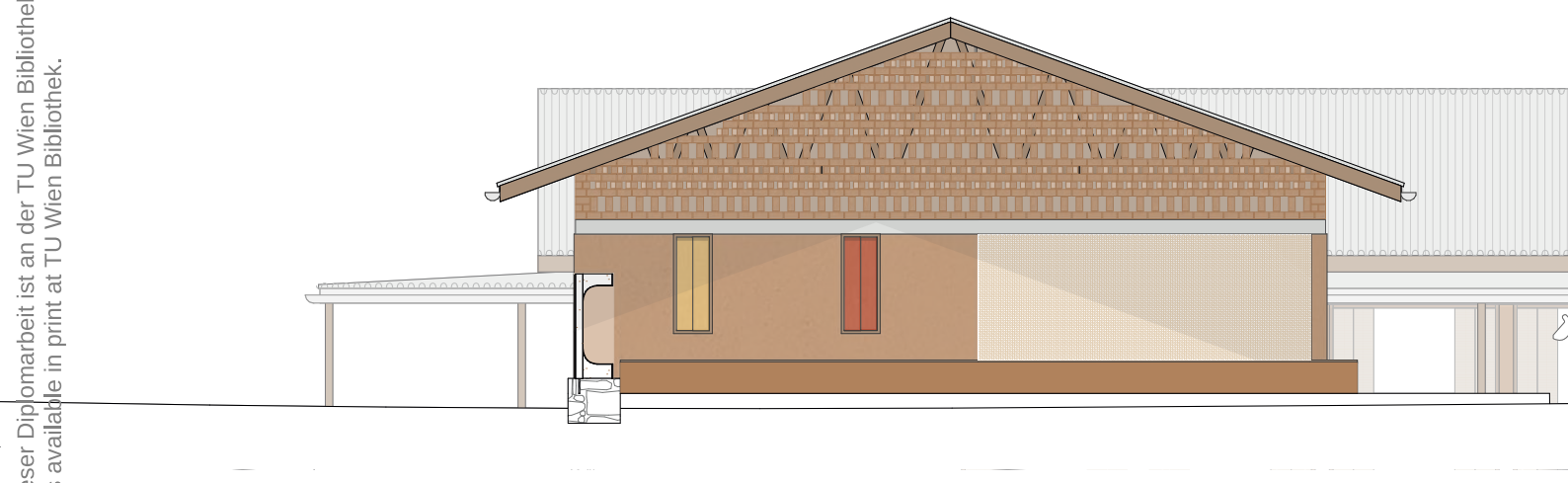
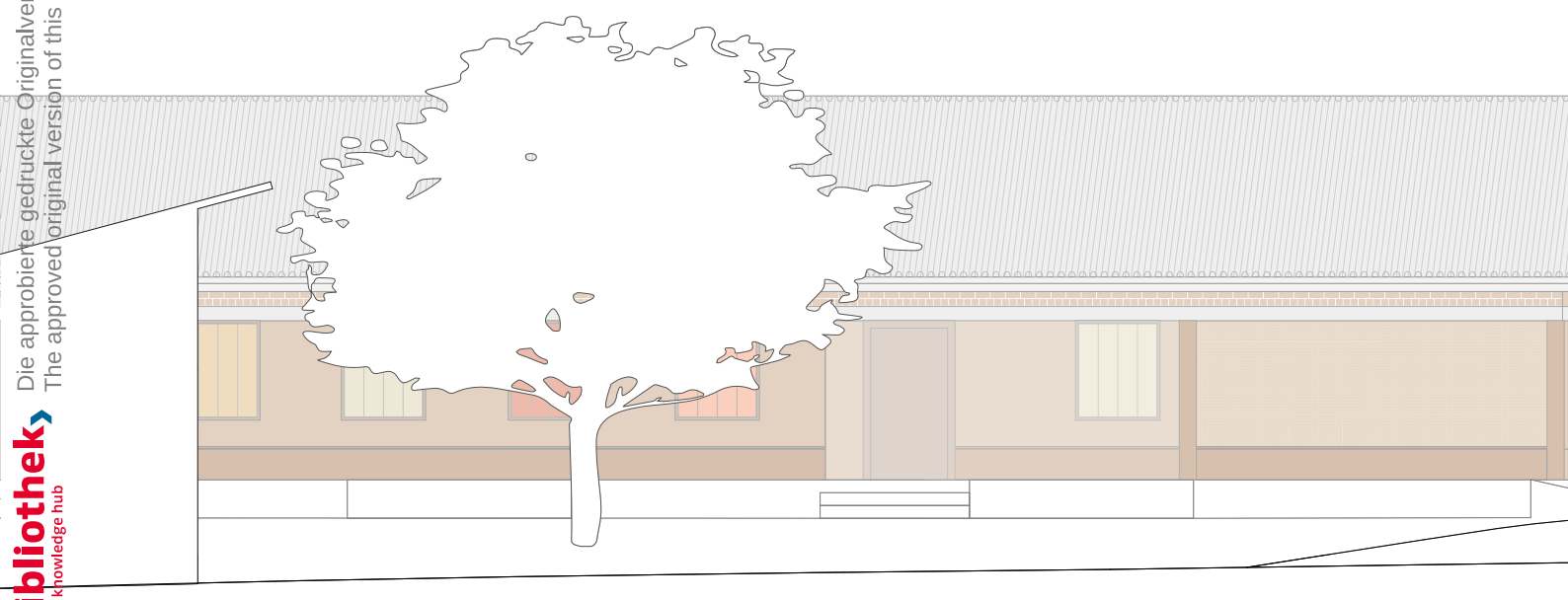


Abb. 33: library section 2







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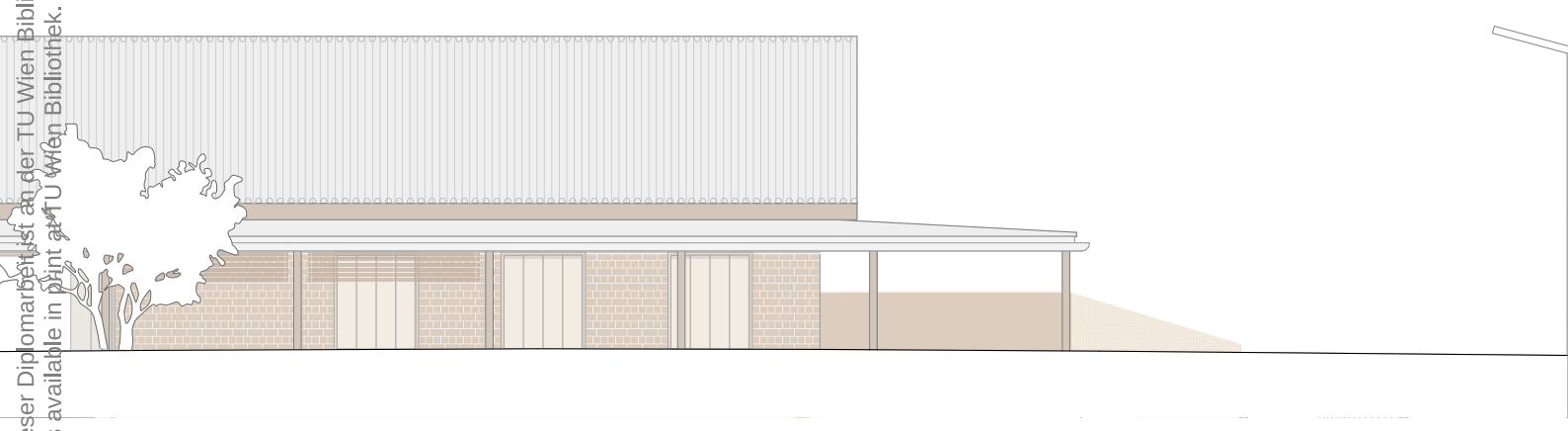


Abb. 34: library elevation east

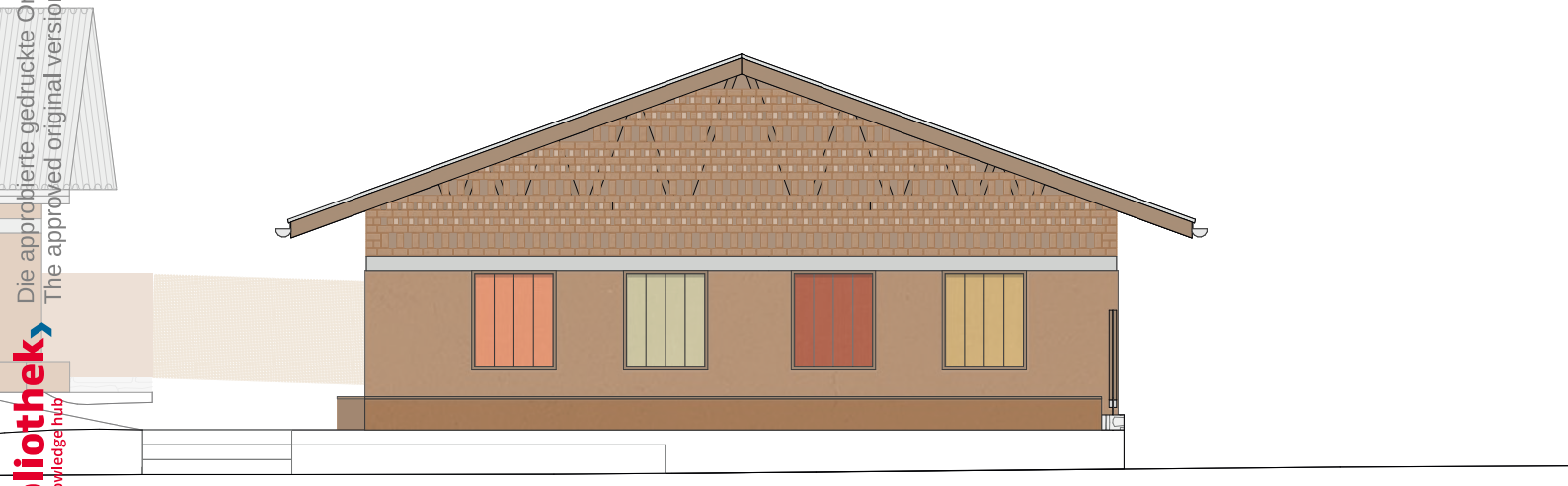
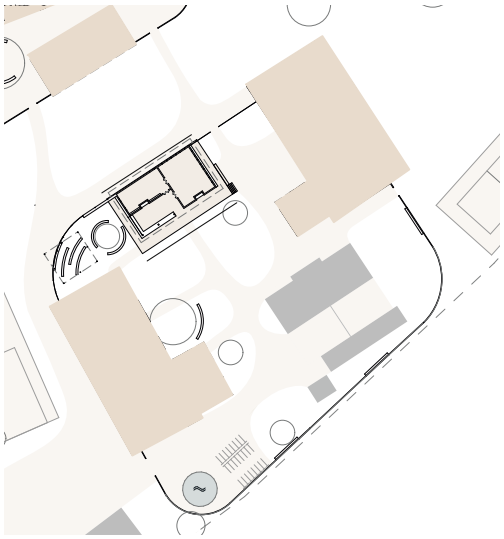
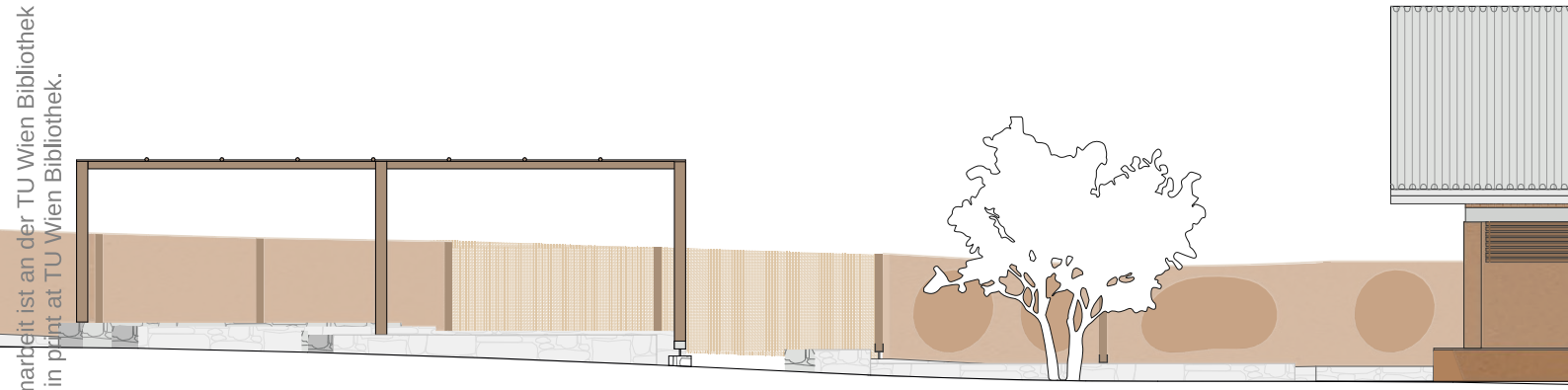
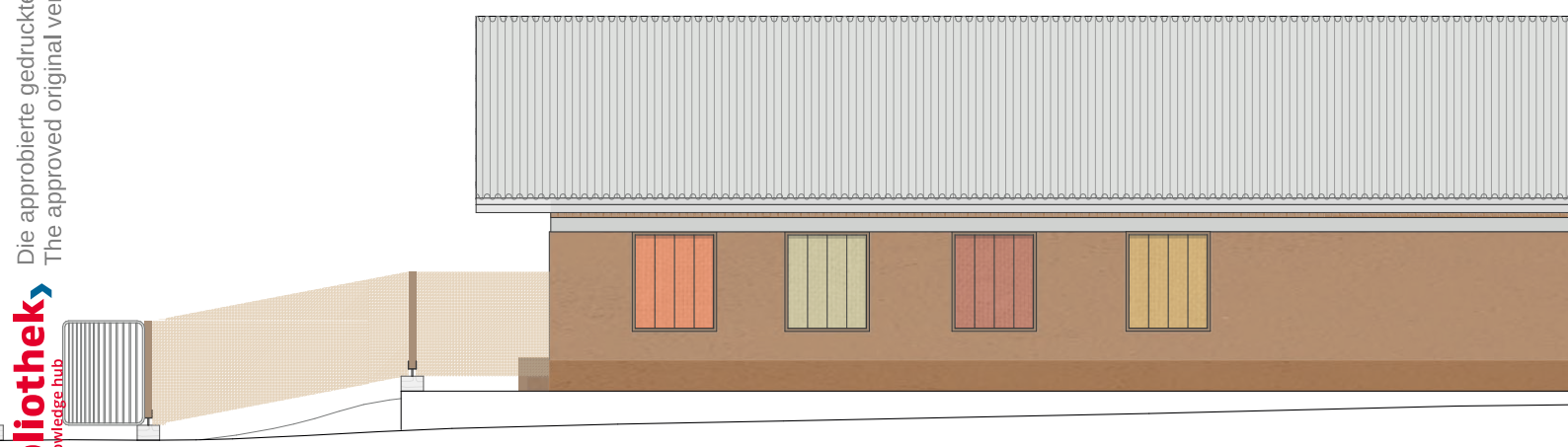


Abb. 35: library elevation west







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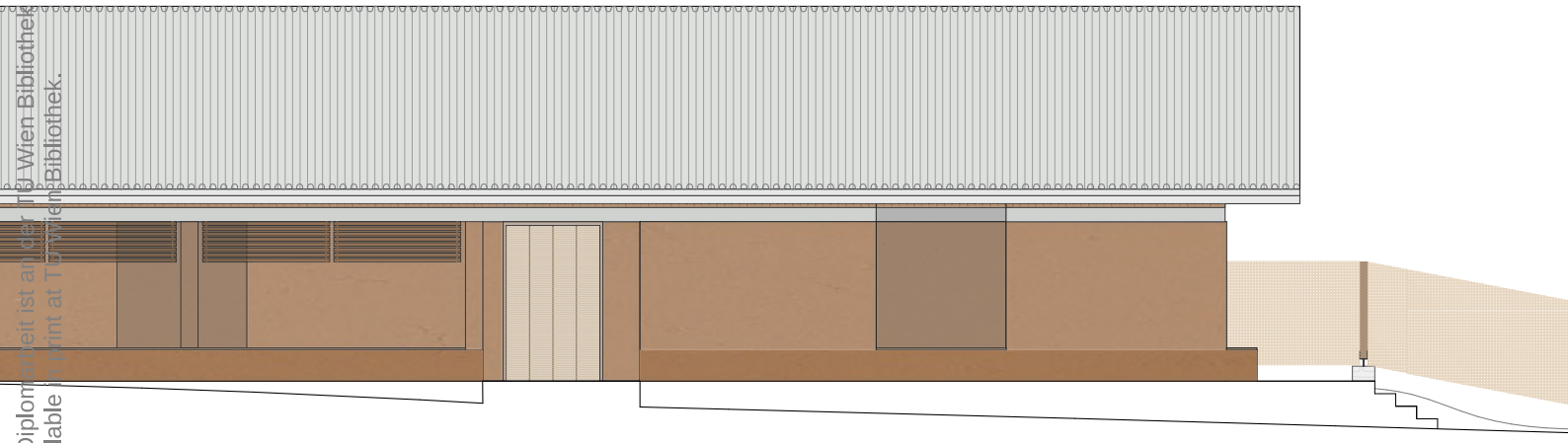

Abb. 36: library elevation south

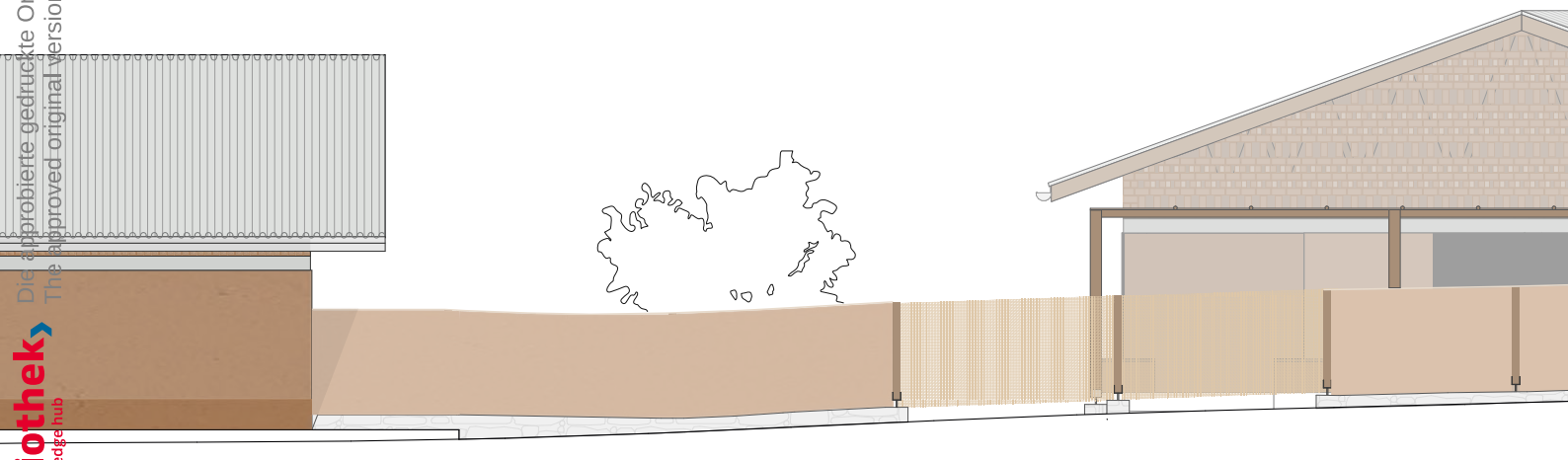

Abb. 37: library elevation north

CLASSROOMS

The first building upon entrance is the classroom building with three additional classrooms, each with a separate entrance. By shifting the rooms, sheltered outdoor spaces were created in front of the classrooms. Benches are placed indoors and outdoors not only to provide seating options but also to stabilize the wall construction.

outdoor playing area

The outdoor area is extended by a Pergola for a shaded playing area, where swings can be attached to the scaffold.

1. window p. 96
2. brick bench
3. wicker p. 102
4. wicker fence p. 102
5. wicker fence with mud p. 103
6. stone benches
7. earth wall
8. pavillion p. 112

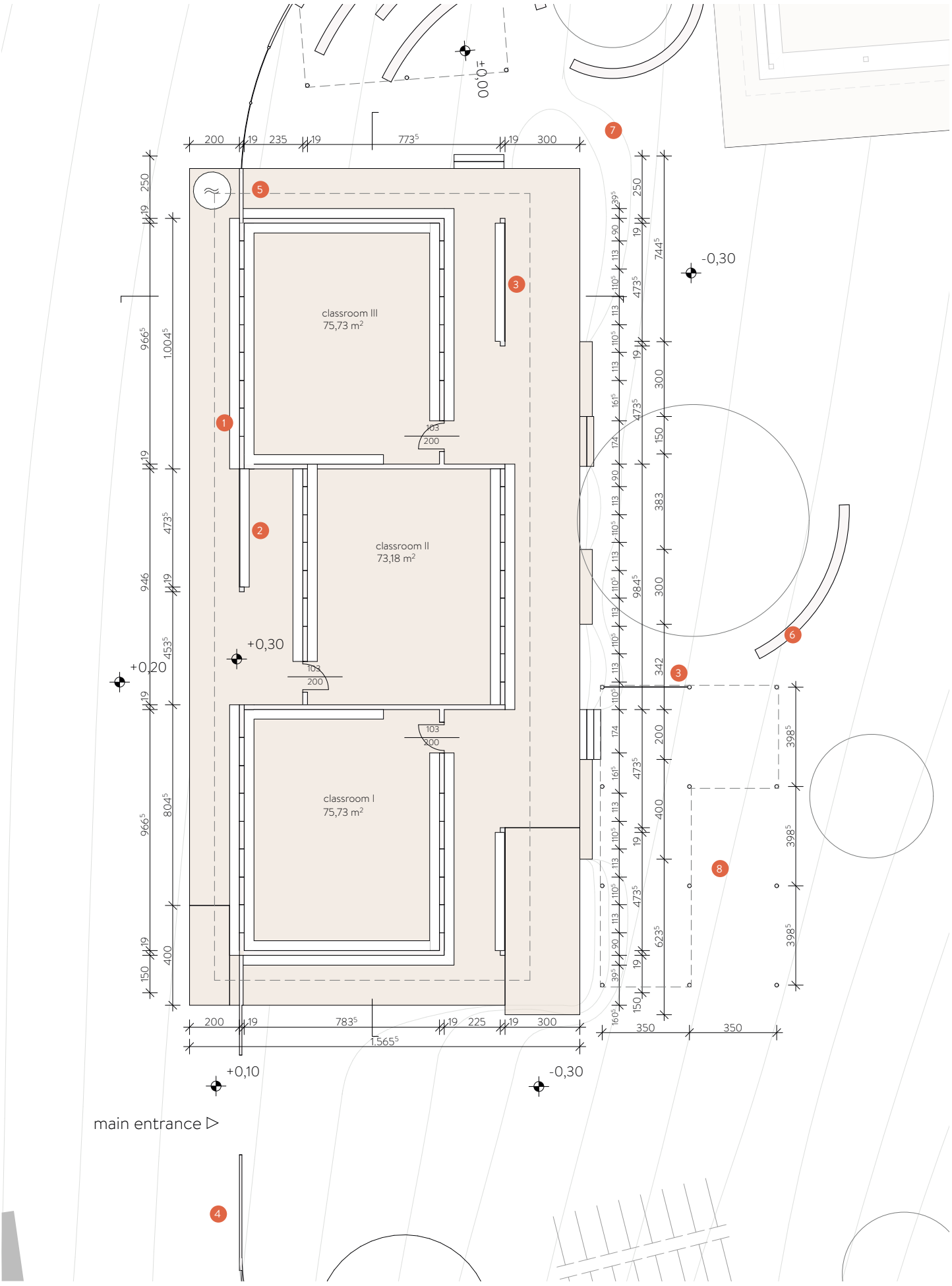

Abb. 38: floorplan classrooms

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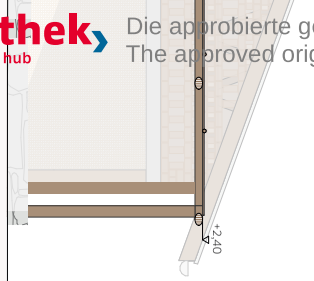
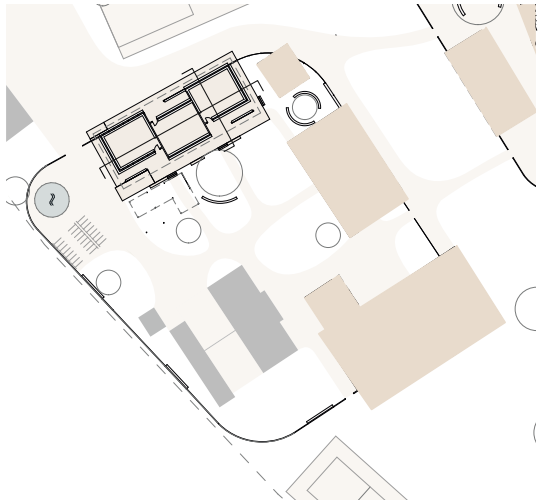
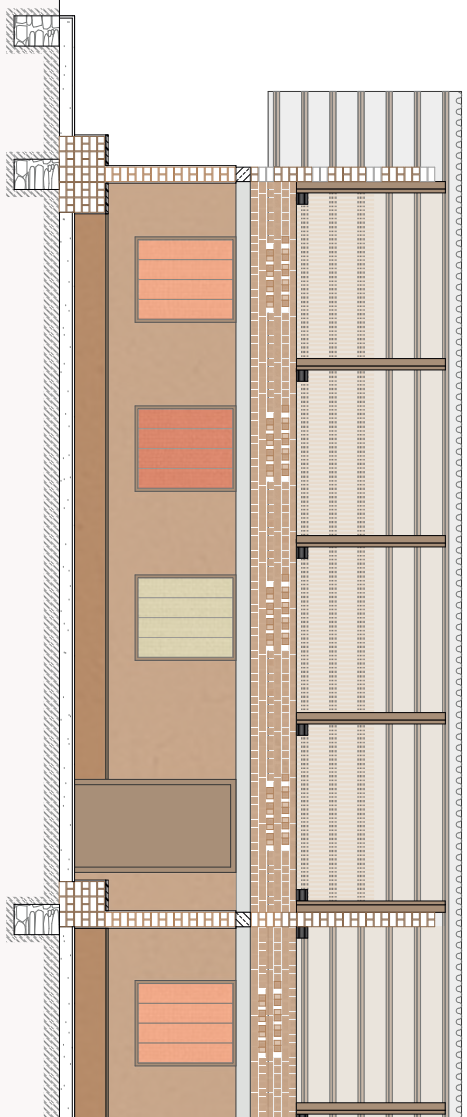
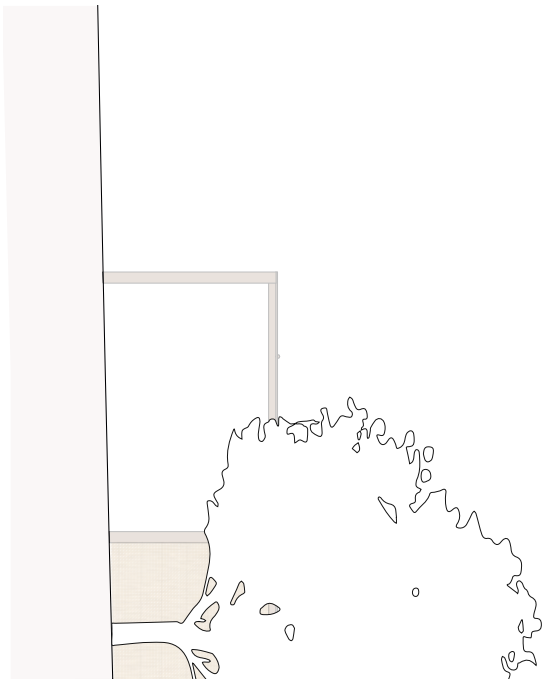








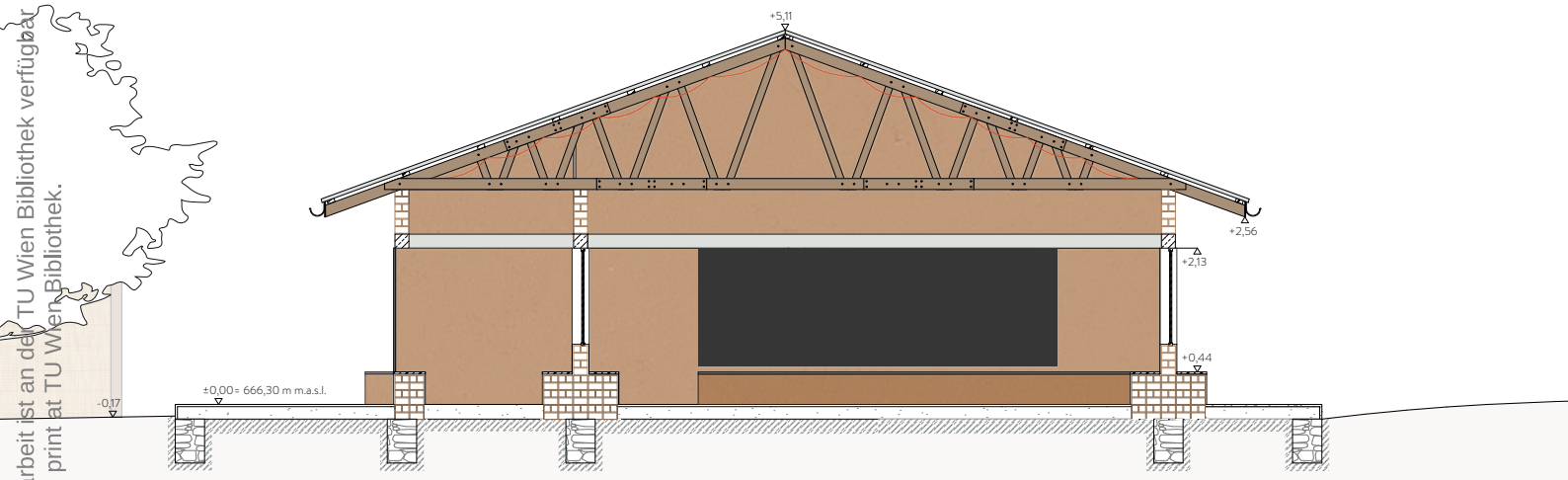


Abb. 39: classroom section 1

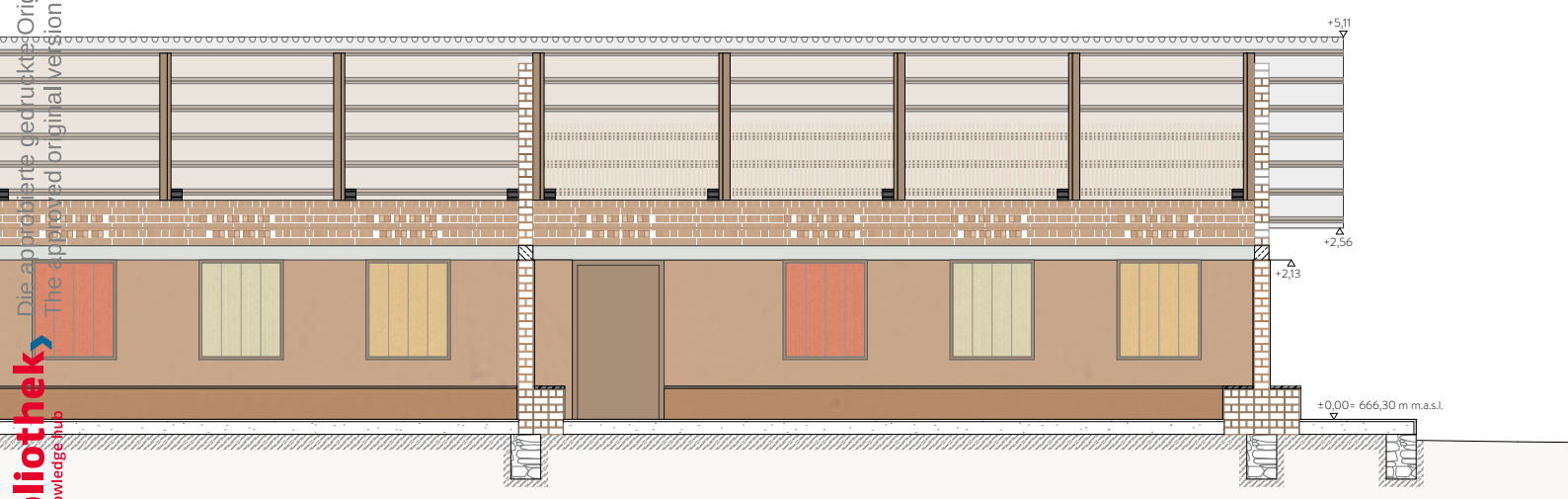
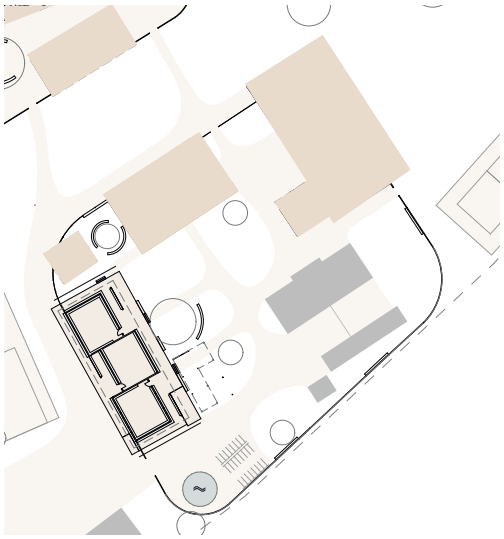
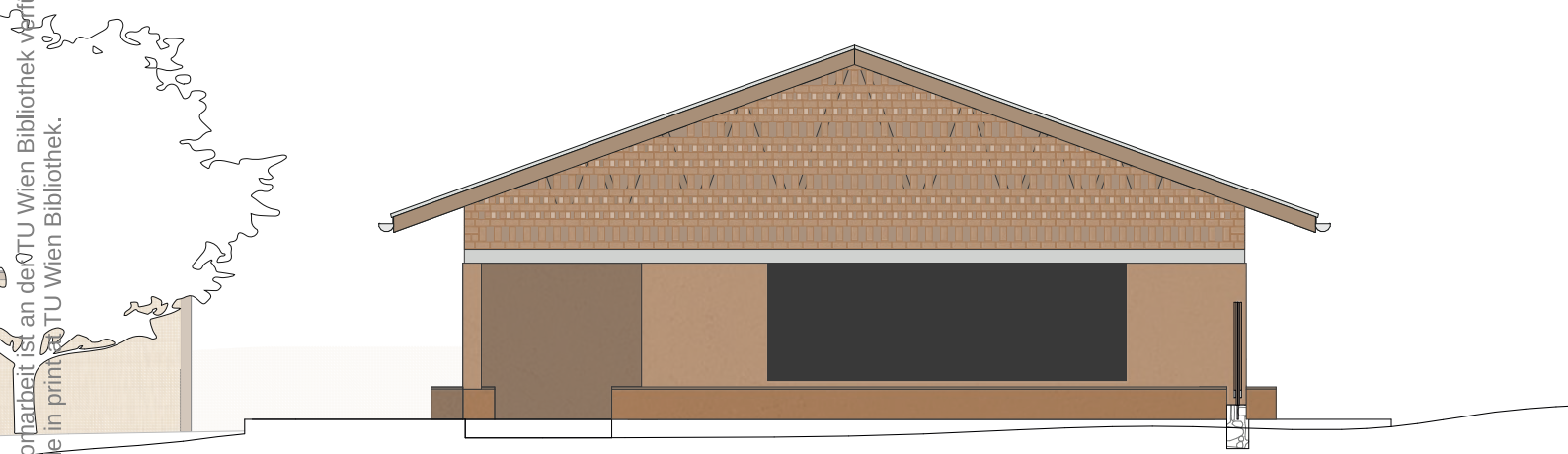
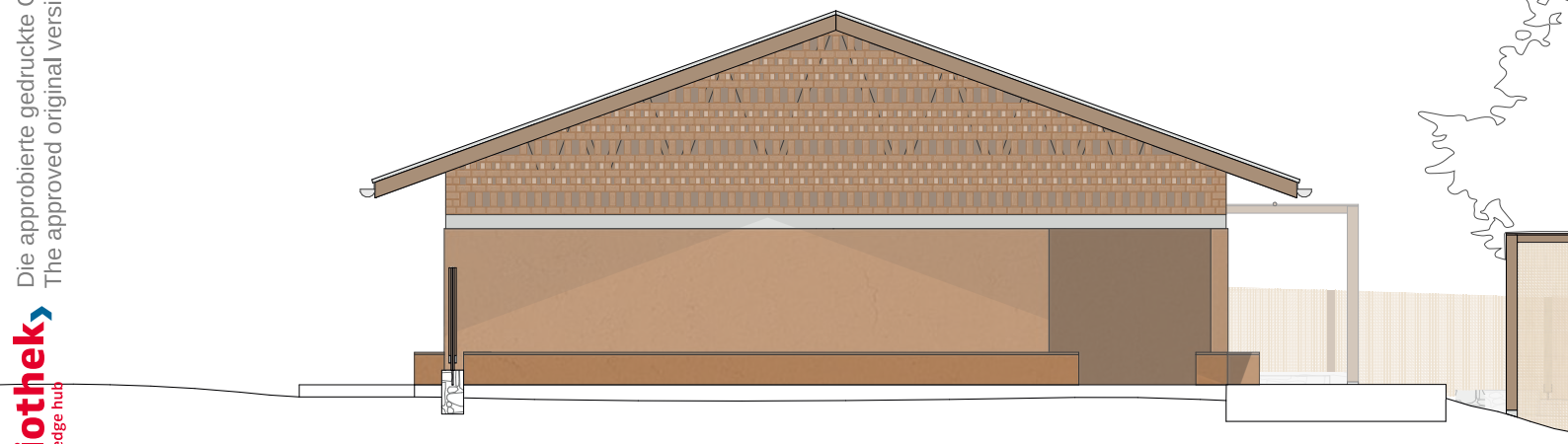


Abb. 40: classroom section 2







0 1 5

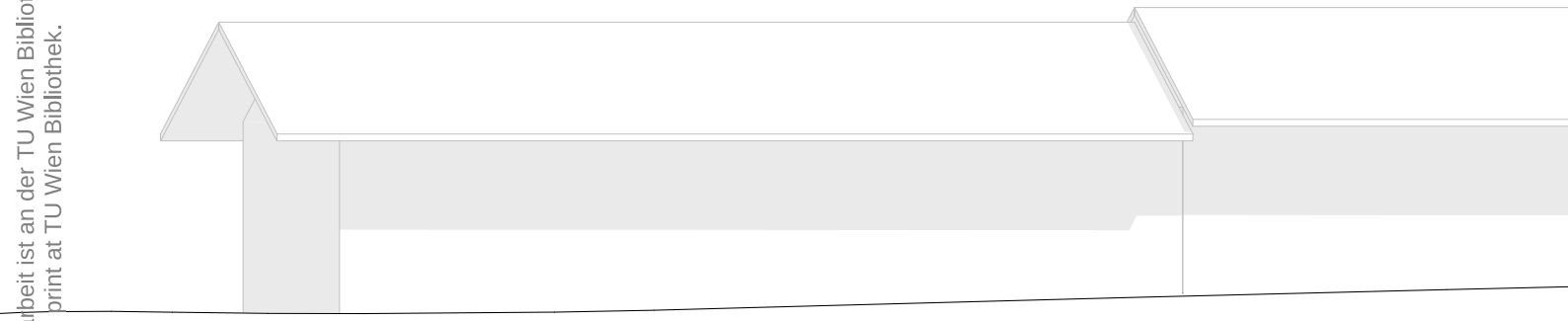


Abb. 41: classroom elevation north

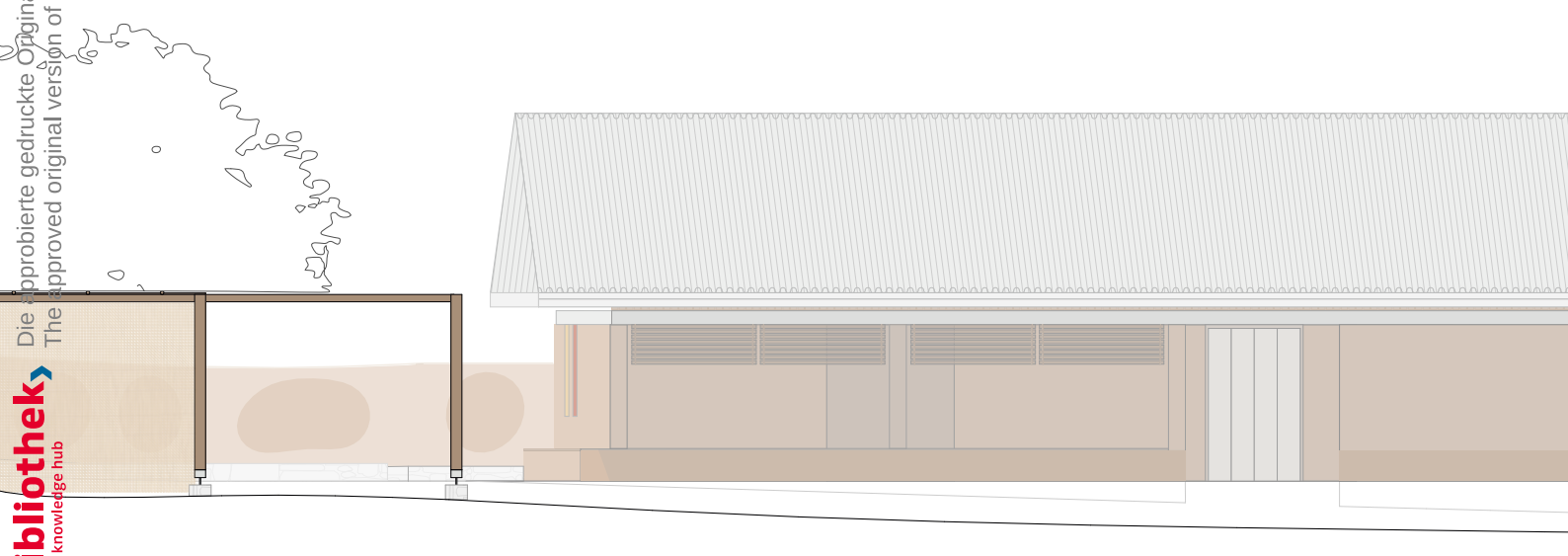
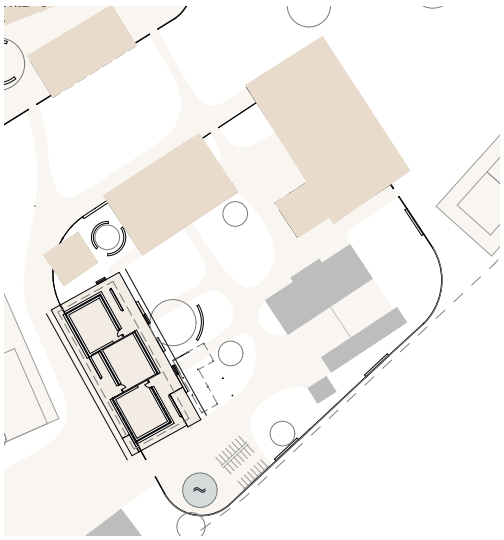
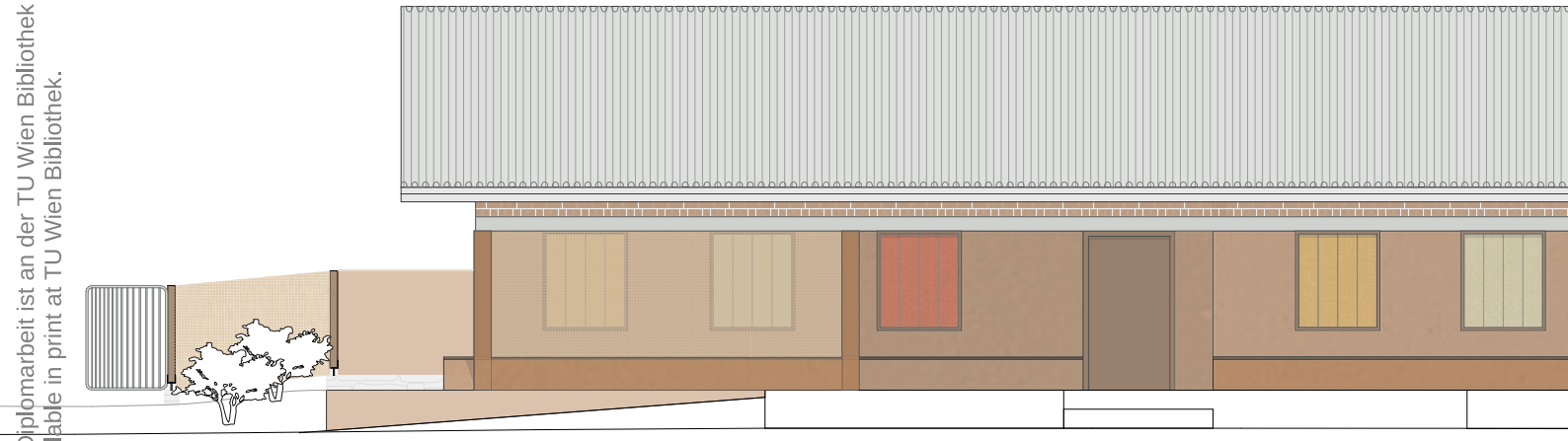
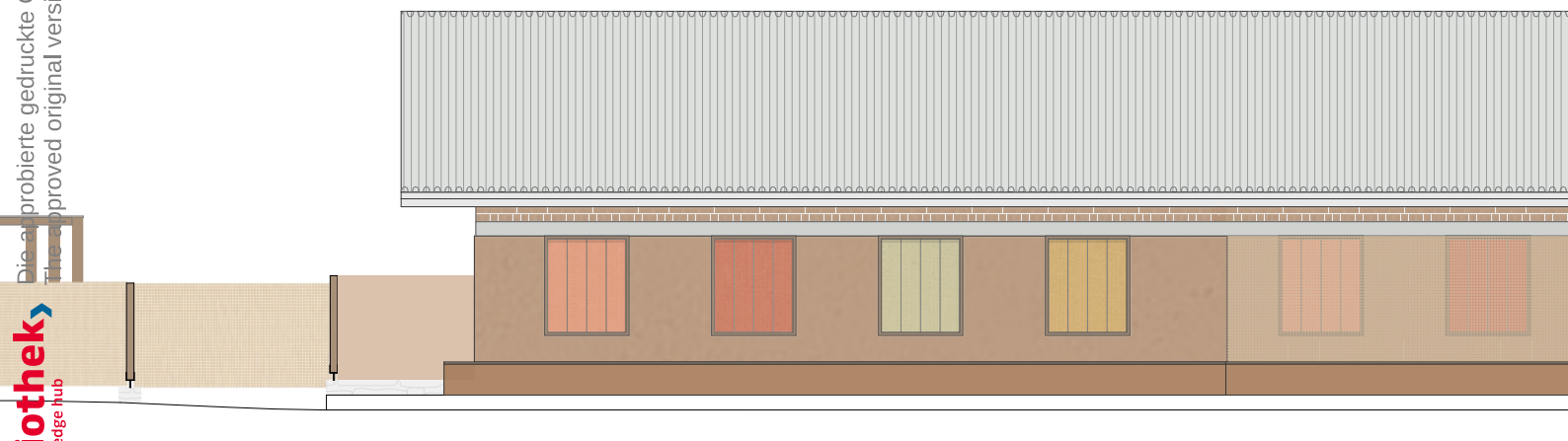


Abb. 42: classroom elevation south







0 1 5

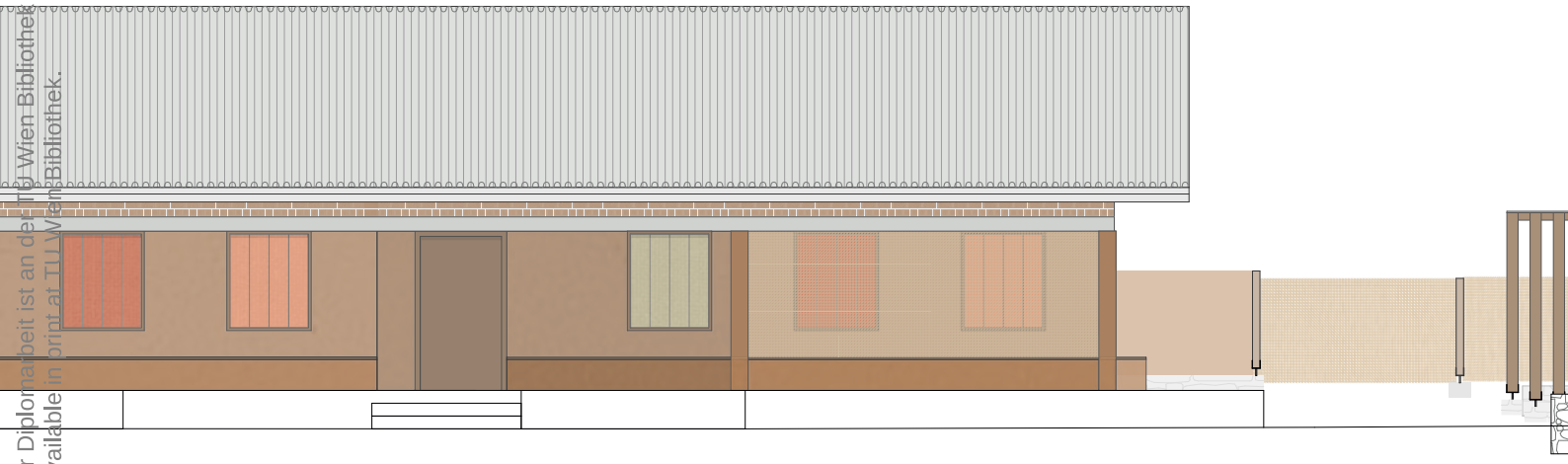


Abb. 43: classroom elevation west

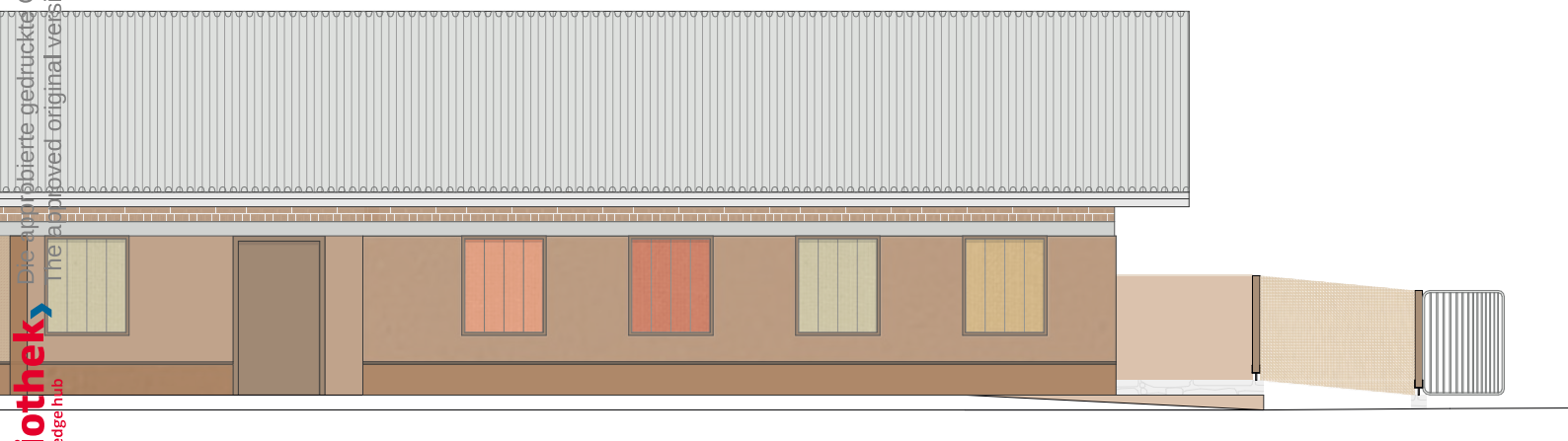
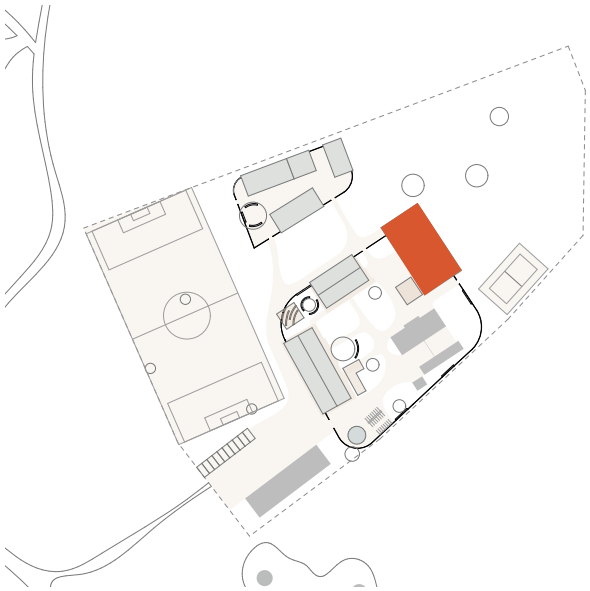


Abb. 44: classroom elevation east

CAFETERIA

In the other part of the complex, the cafeteria is situated in such a way to create a spacious courtyard. It consists of a kitchen area facing the school garden to shield the courtyard from smoke and is connected to a storage room. A large open dining area connects the kitchen with a more closed area. The surrounding pergola provides additional seating space, as does the outdoor pergola.



1. foldable door p. 97
2. window p. 96
3. brick bench
4. wicker p. 102
5. wicker fence p. 102
6. wicker fence with mud p. 103
7. earth wall
8. pavillion p. 112
9. porch p. 116
10. porch with wicker cover

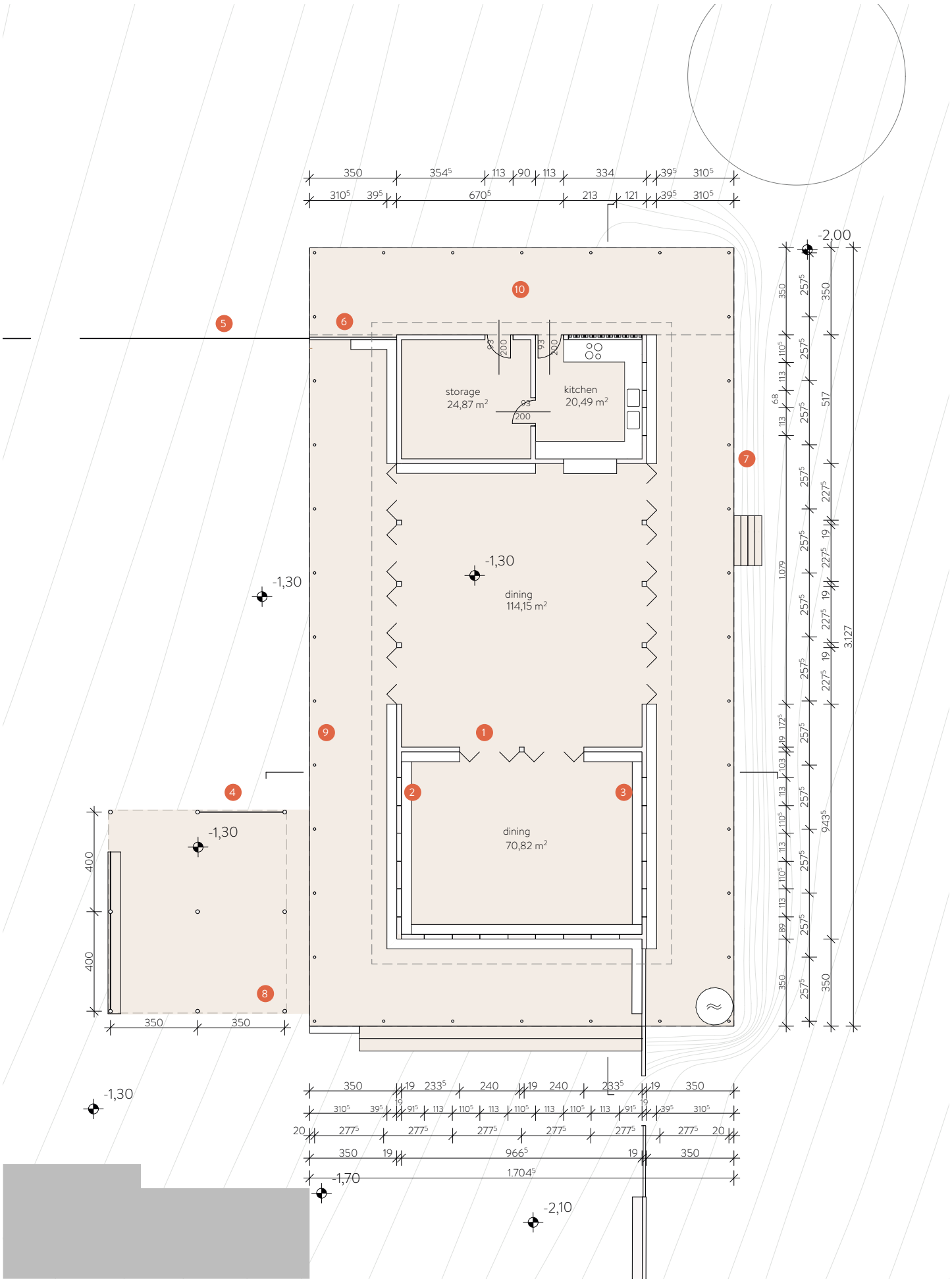
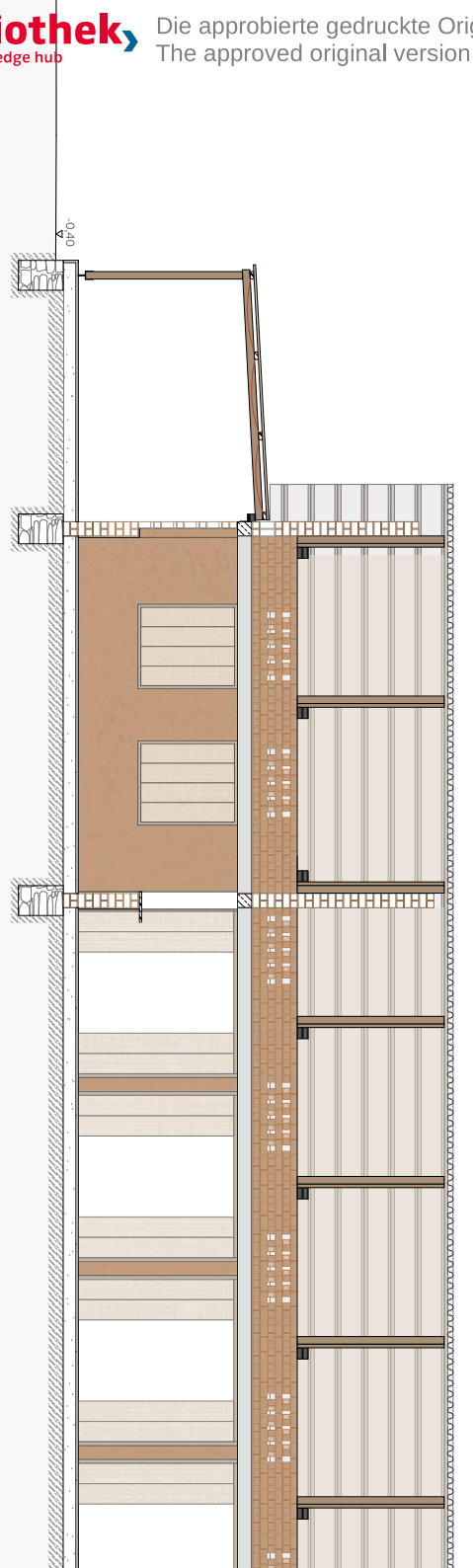
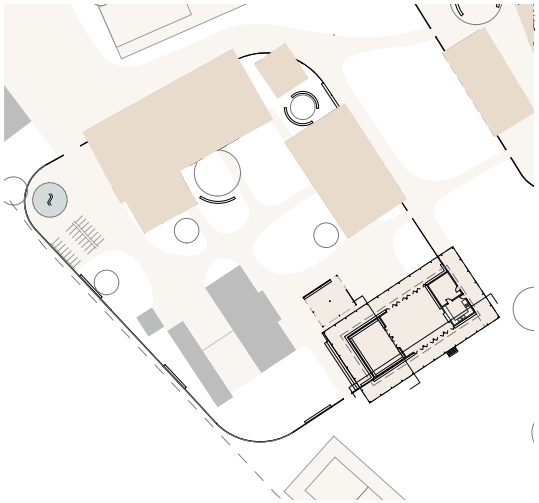


Abb. 45: floorplan cafeteria

0 1 5





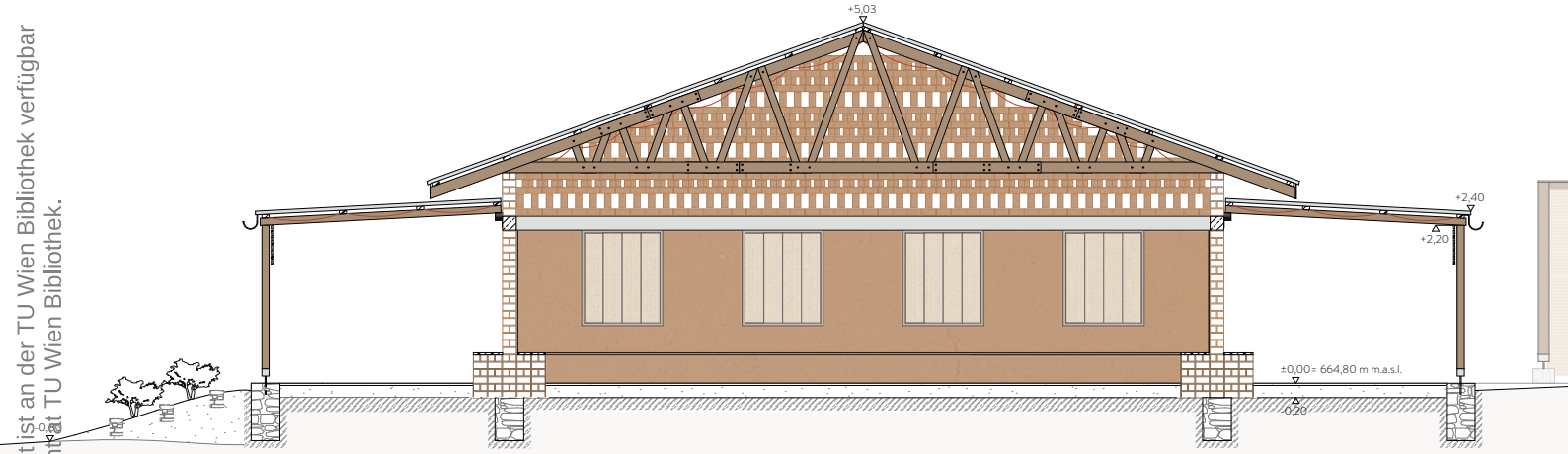


Abb. 46: cafeteria section 1

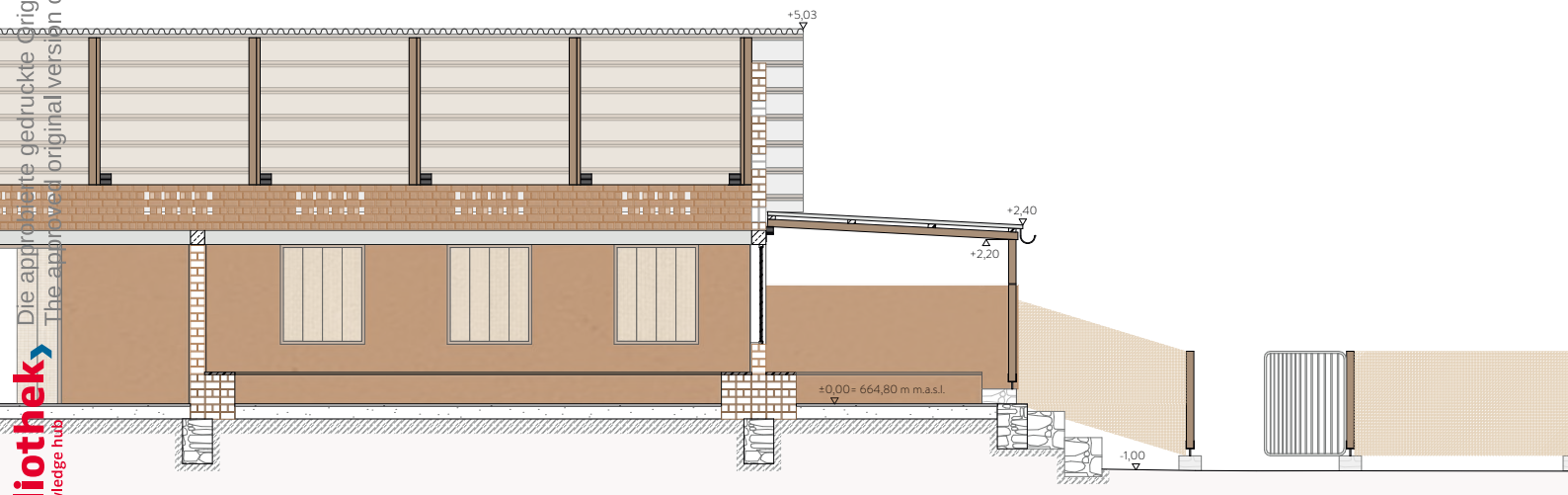
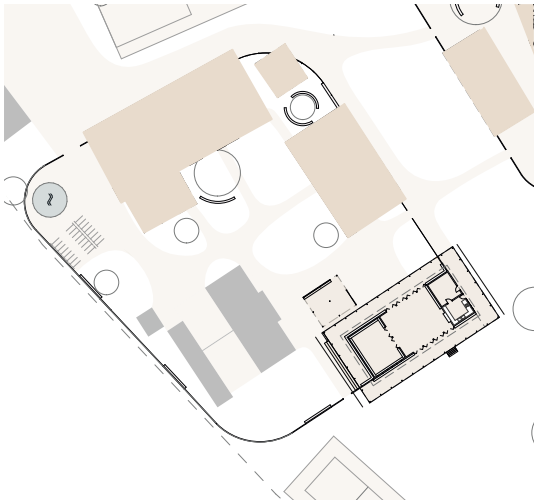
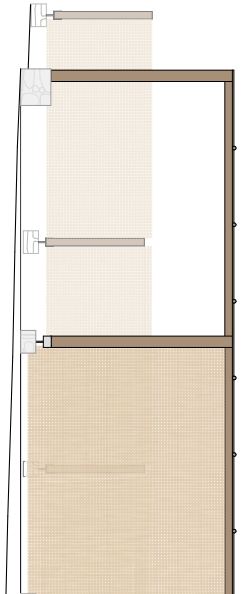


Abb. 47: clafeteria section 2

0 1 5





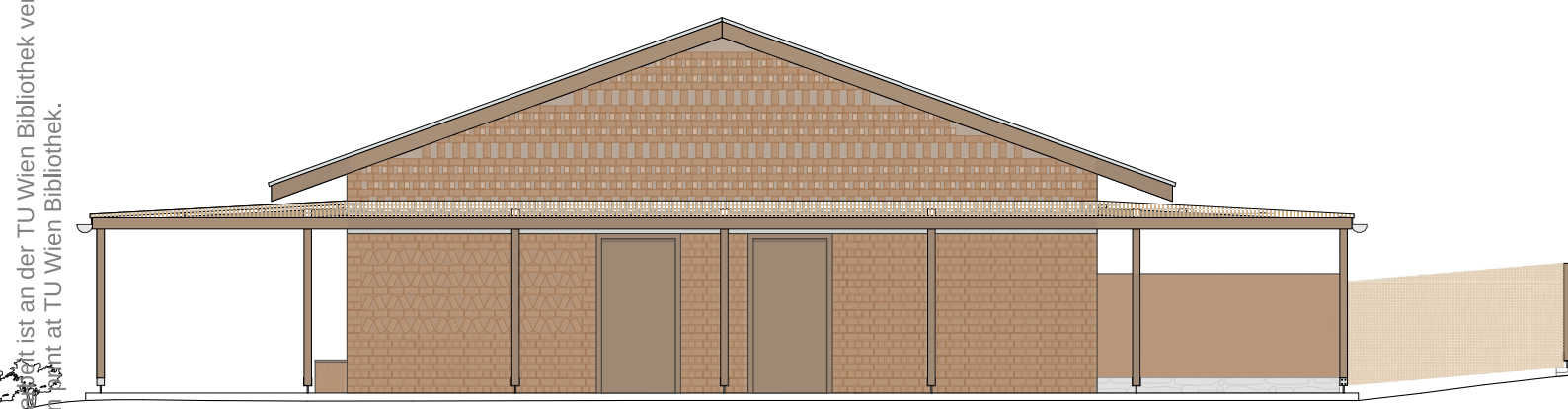


Abb. 48: cafeteria elevation north

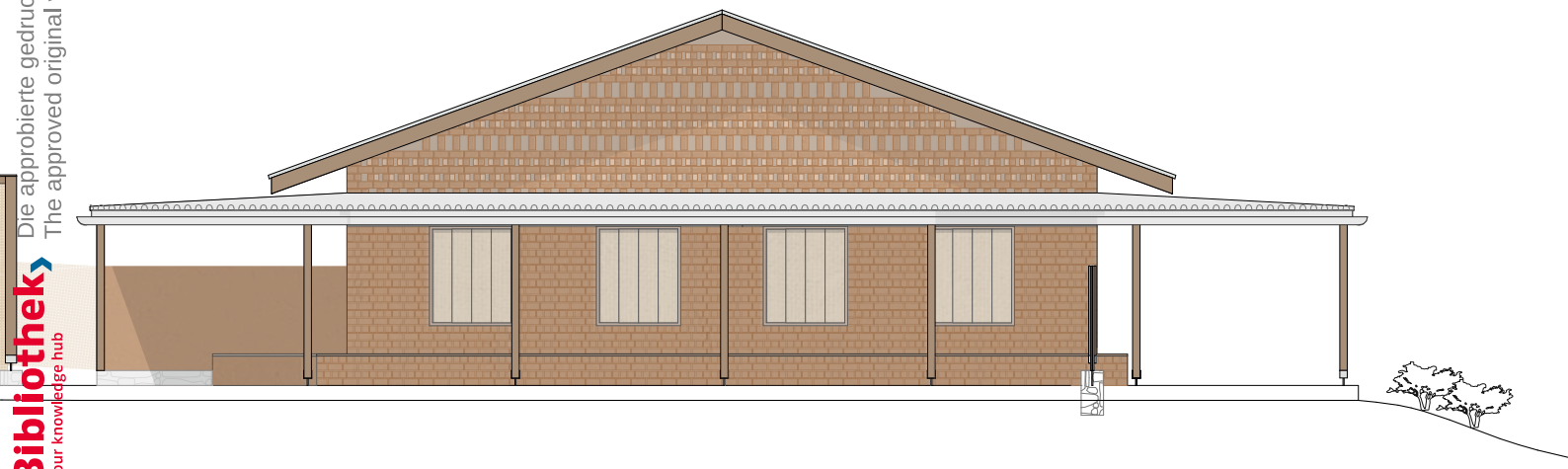
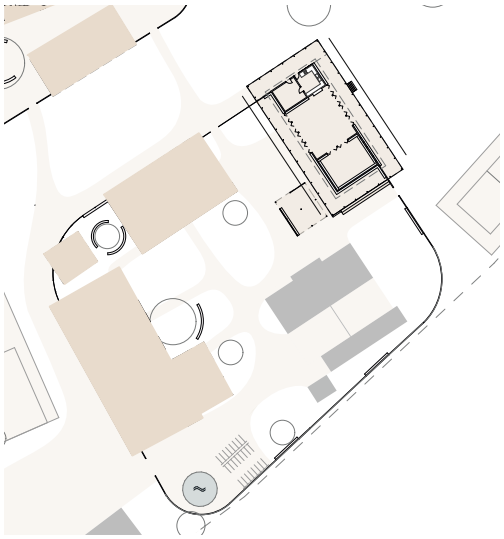
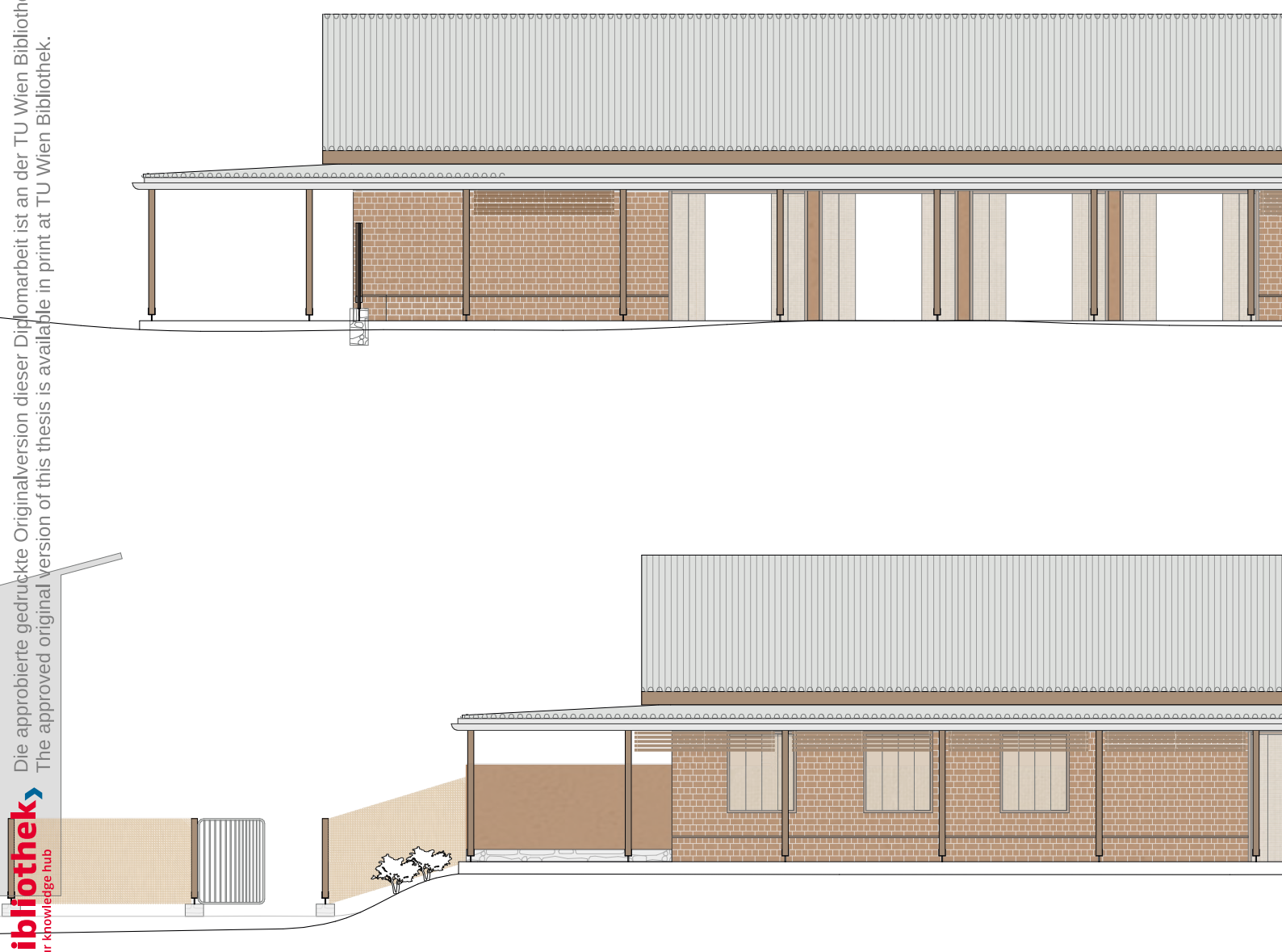


Abb. 49: cafeteria elevation south





0 1 5

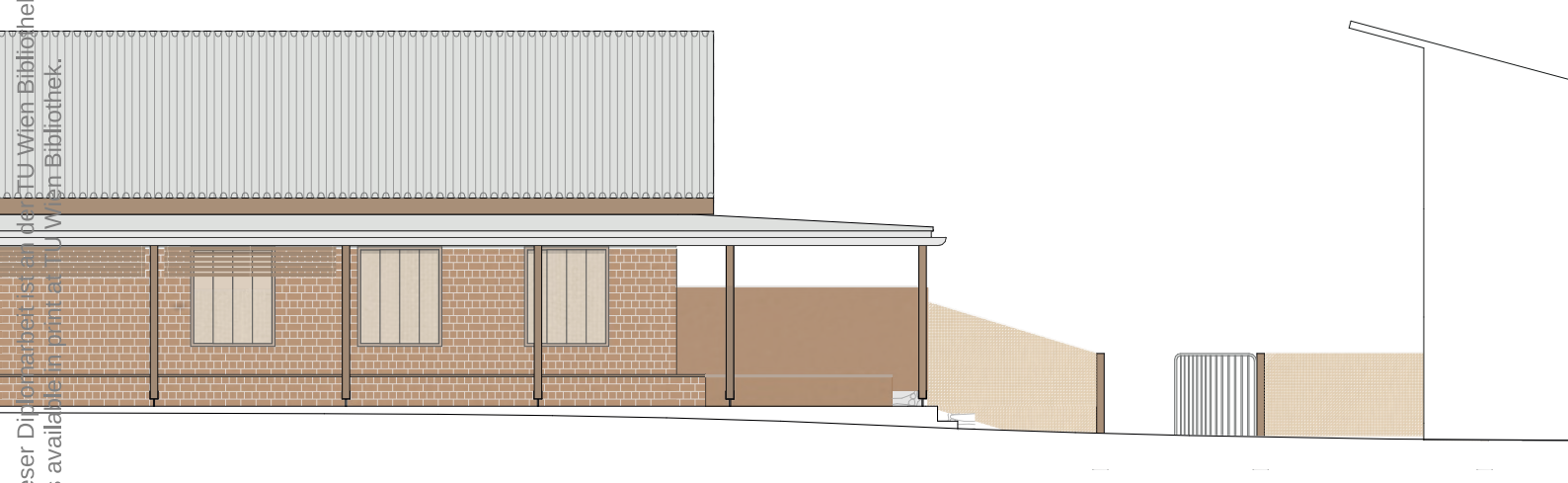


Abb. 50: cafeteria elevation west

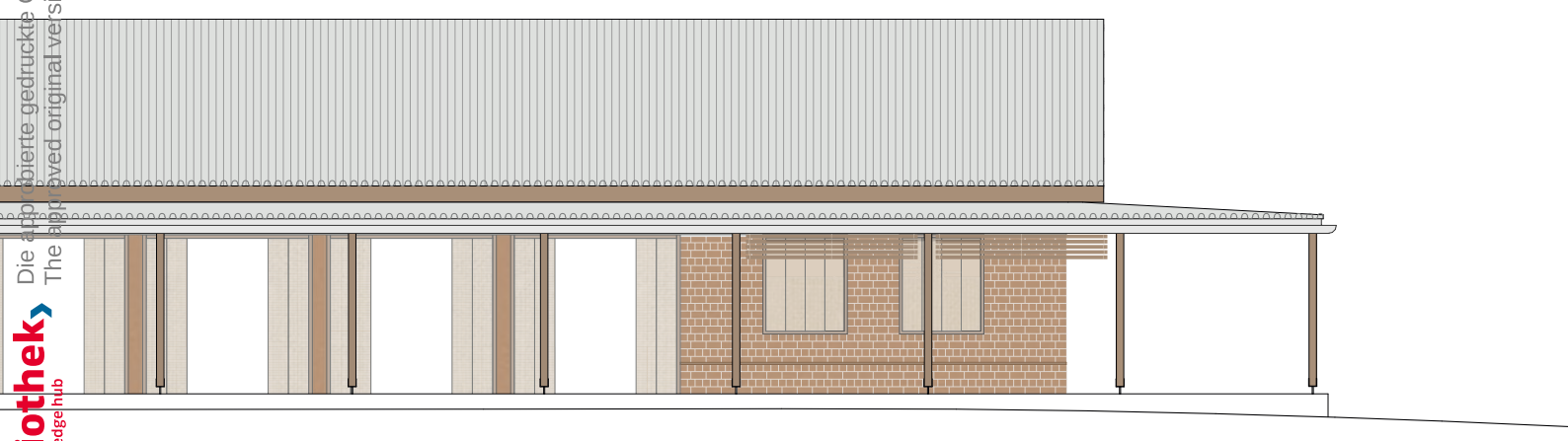
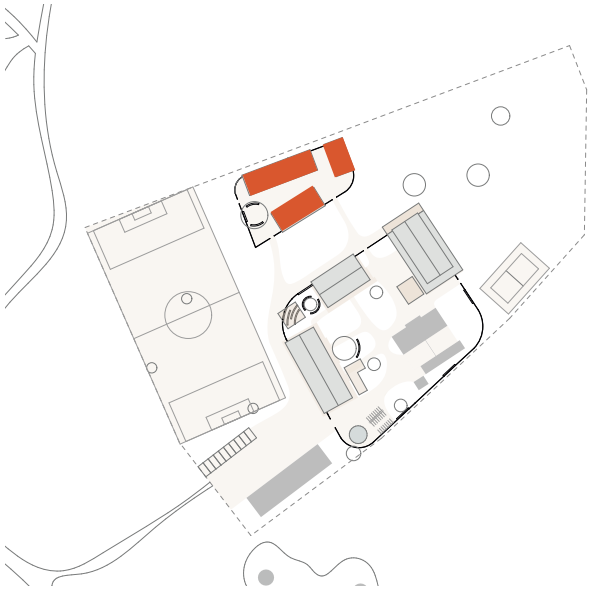


Abb. 51: cafeteria elevation east

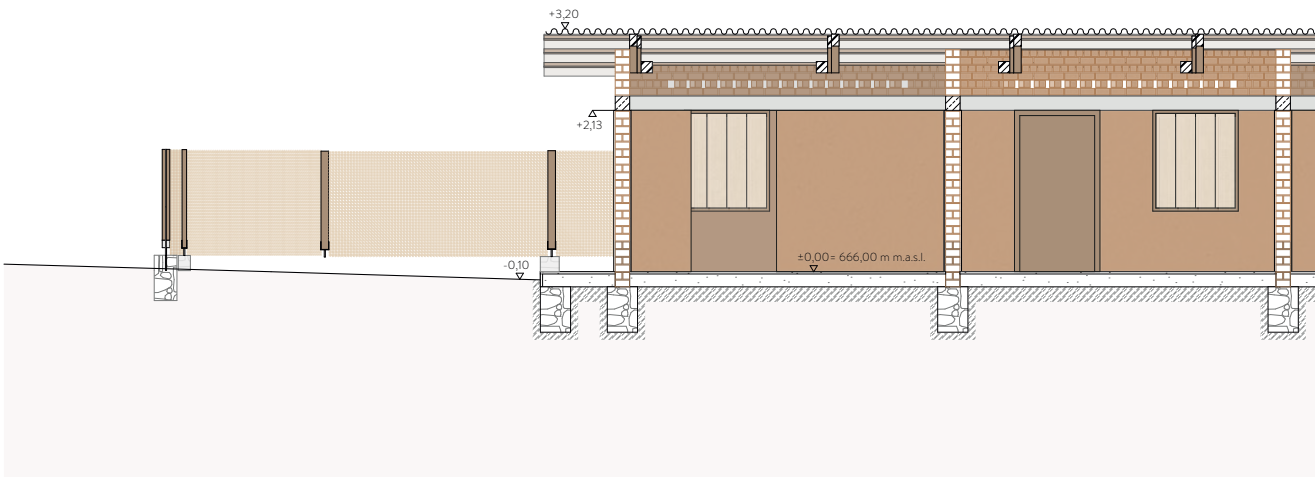
TEACHERS‘ UNITS

There are ten residential units and a latrine with a shower. Like as the classrooms, the teachers‘ rooms are shifted towards each other, creating a private outdoor area. Each room has its own living area and working space. A wicker wall partly plastered with mud encloses the area. Through the nonparallel orientation of the buildings, an outdoor area is created around a consisting tree, for gatherings.



1. window p. 96
2. brick bench
3. wicker p. 102
4. wicker fence p. 102
5. wicker fence with mud p. 103
6. stone bench

Abb. 52: floorplan teachers units



0 1 5

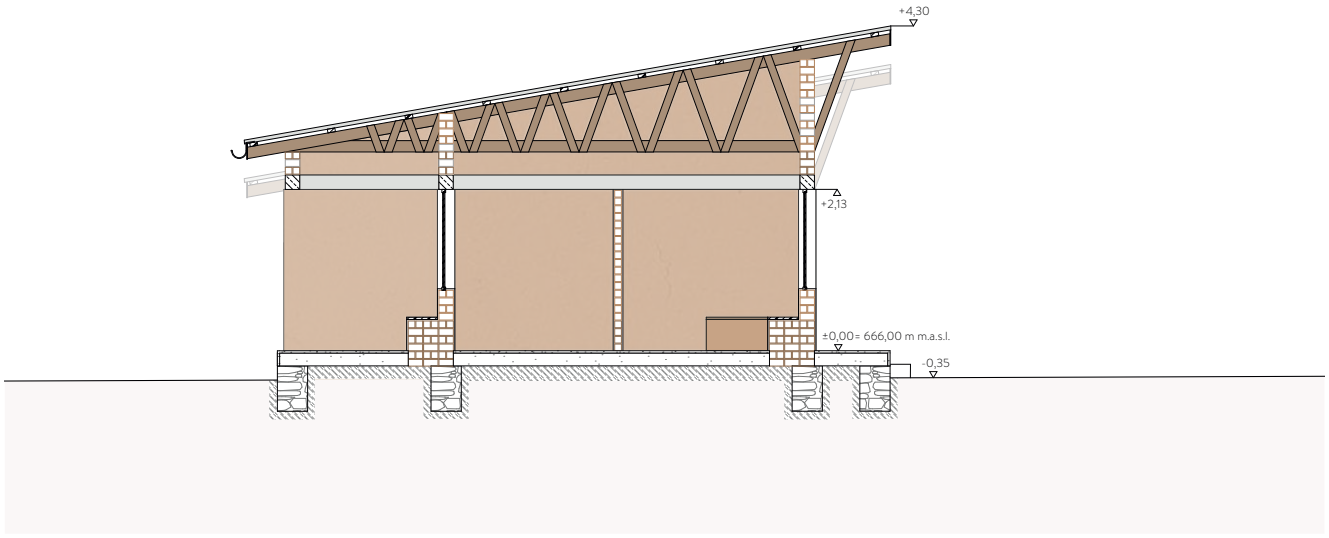


Abb. 53: teachers units section 1

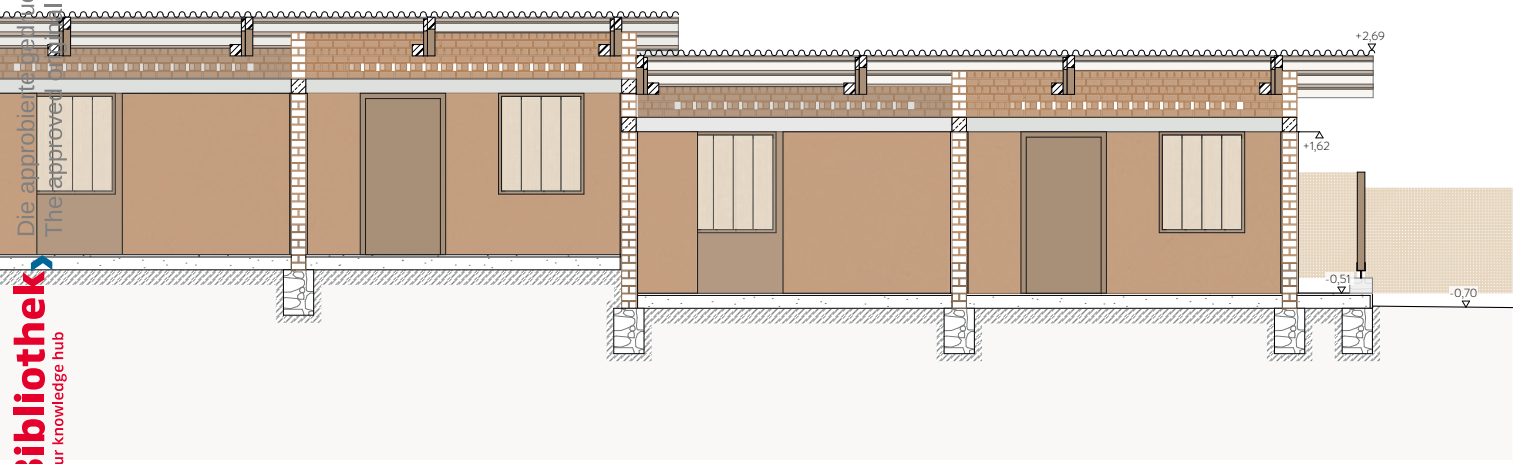


Abb. 54: teachers units section 2

0 1 5

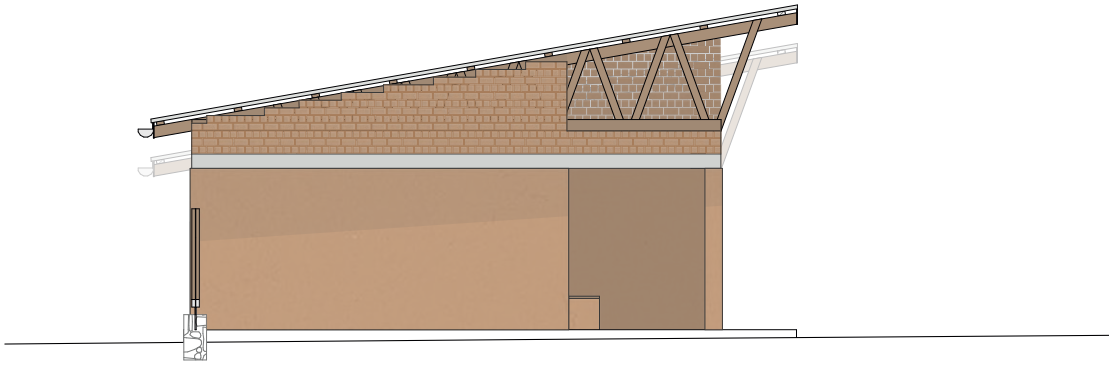


Abb. 55: teachers units elevation west

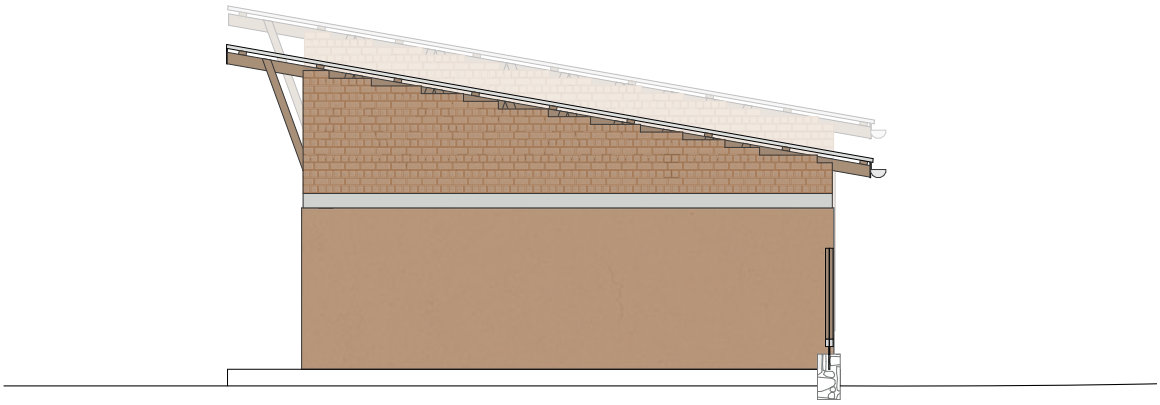
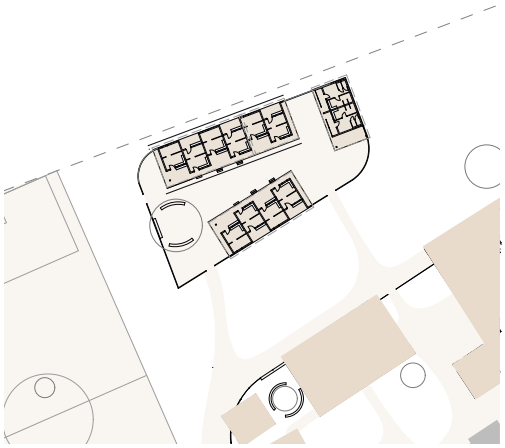
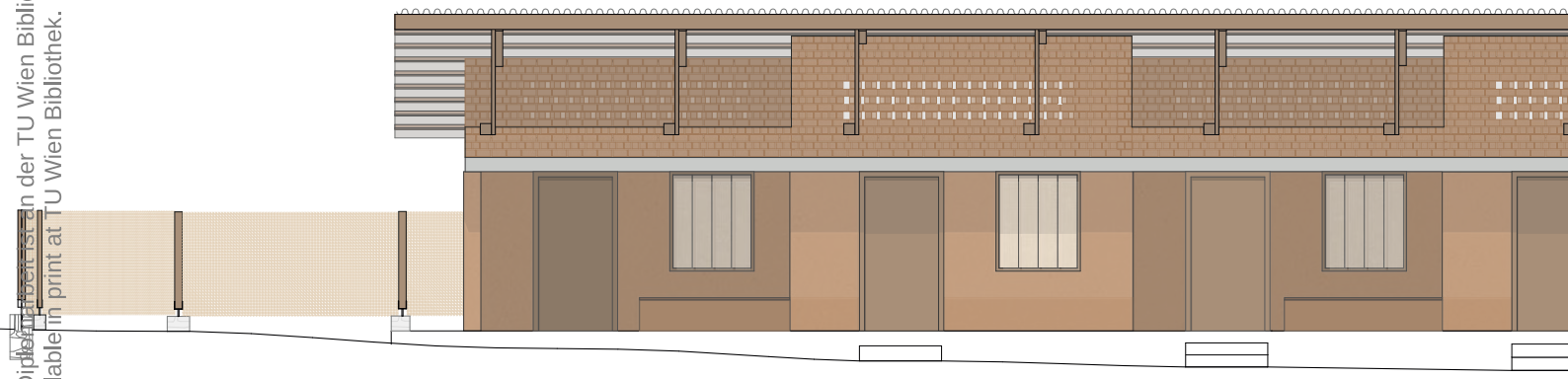
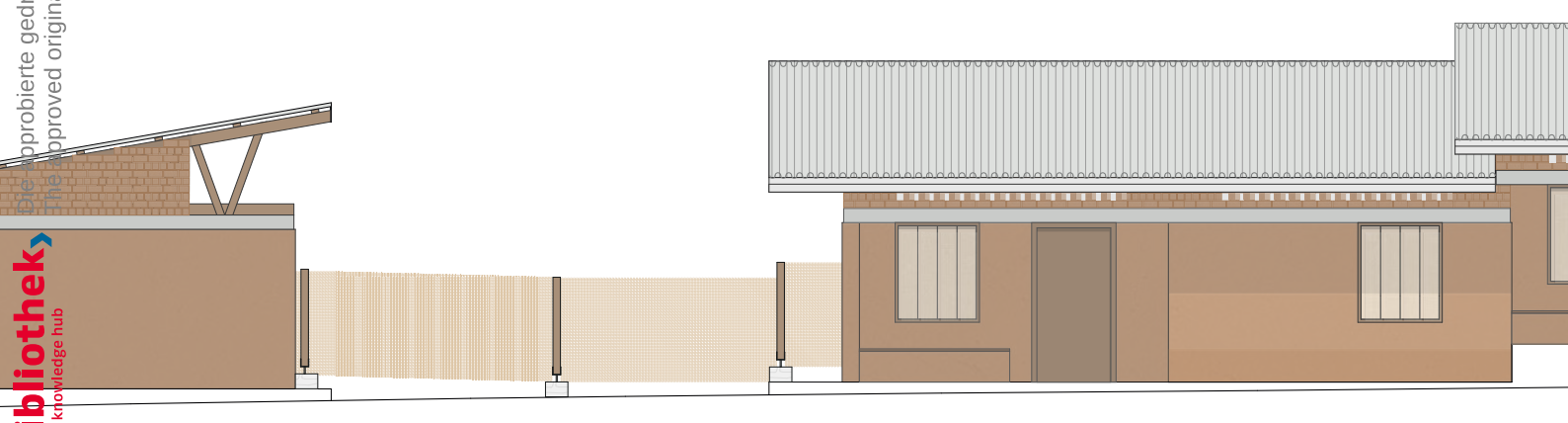


Abb. 56: teachers units elevation east







0 1 5

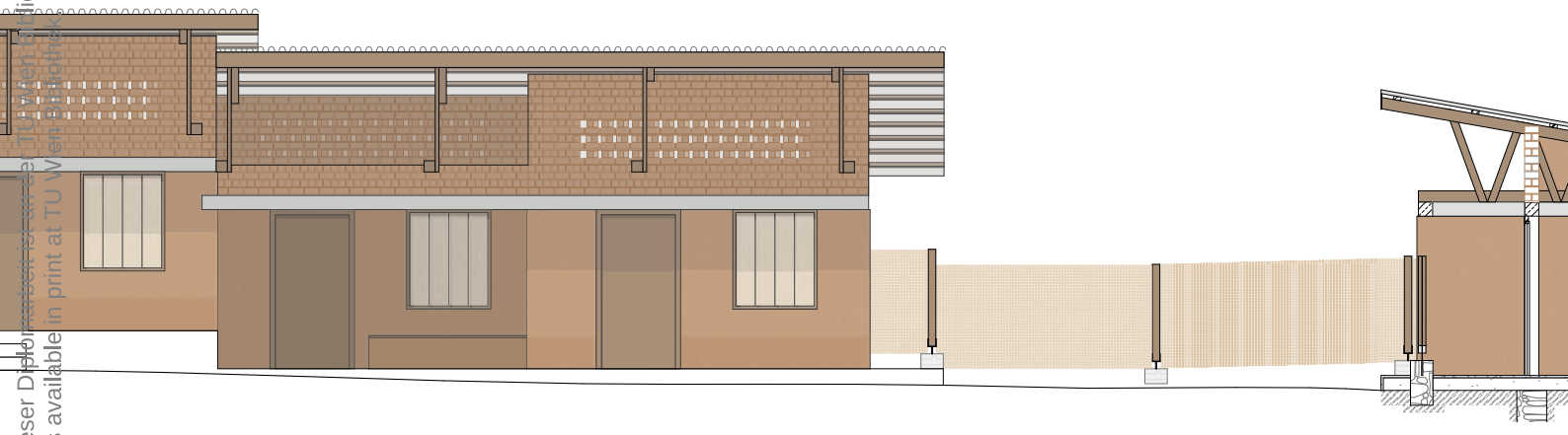


Abb. 57: teachers units elevation south

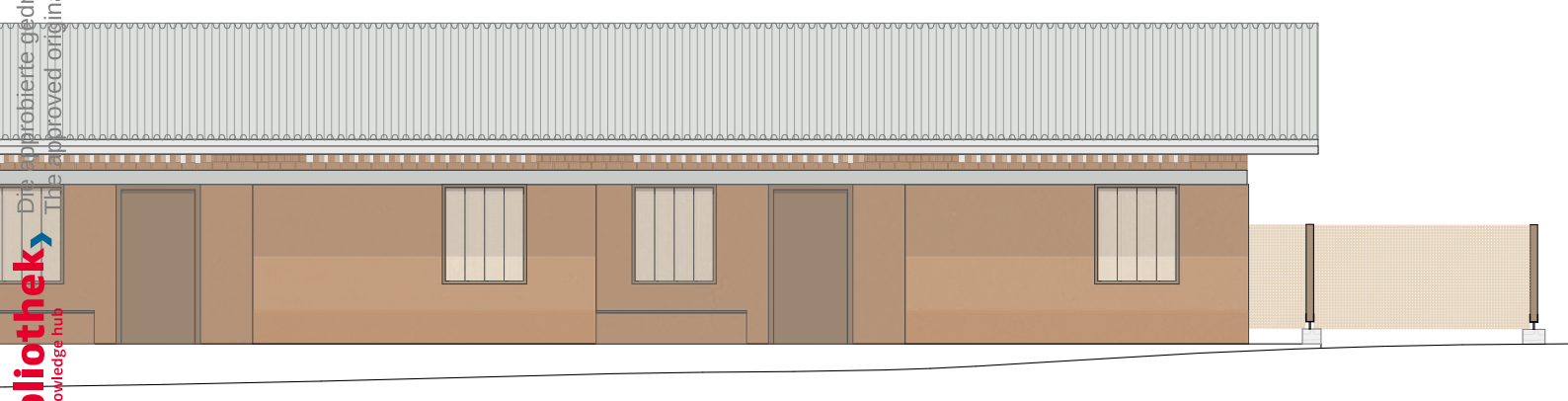


Abb. 58: teachers units elevation north

0 1 5

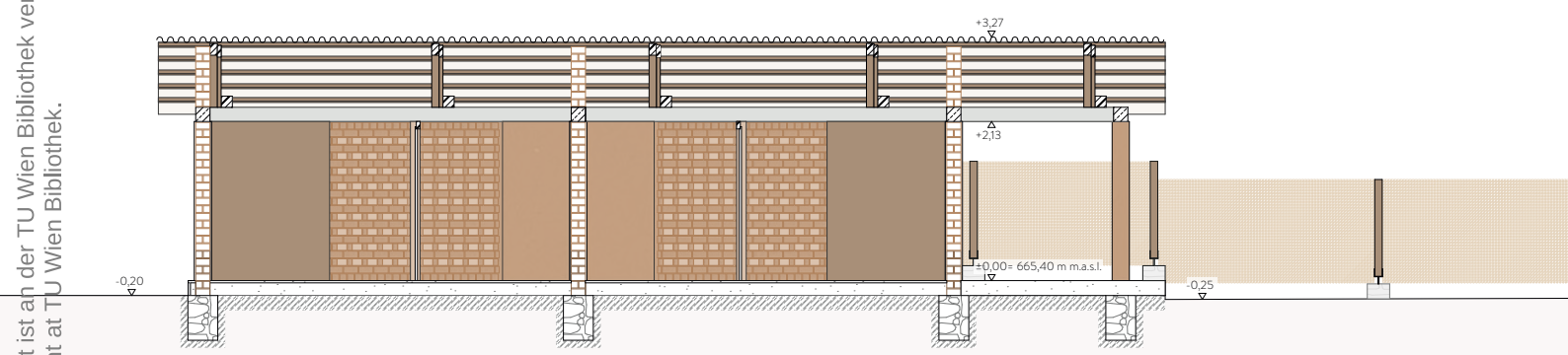


Abb. 59: teachers latrine section 1

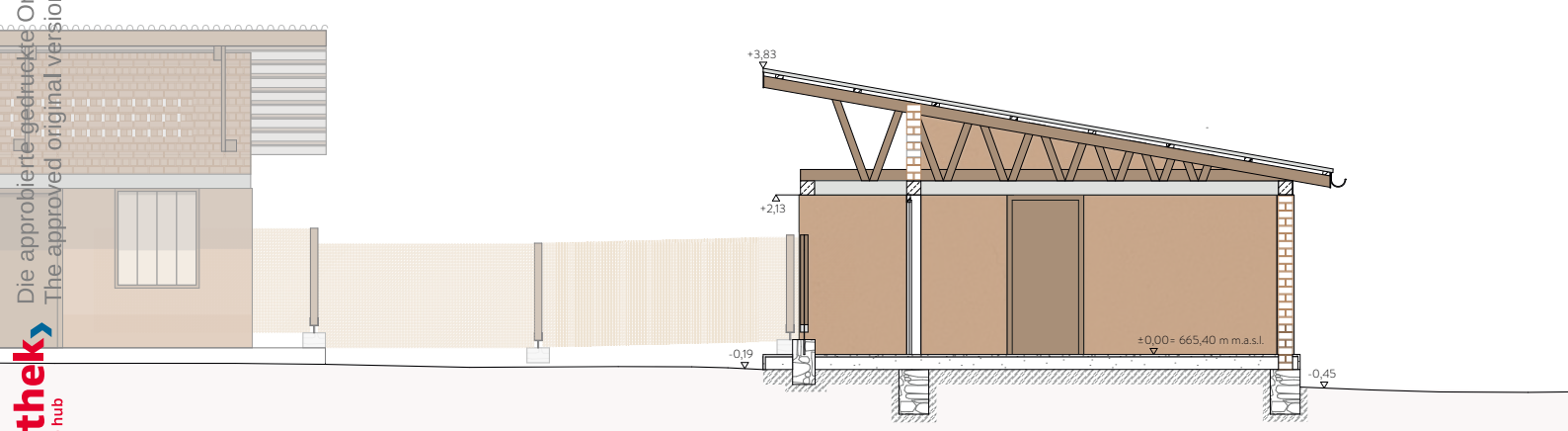
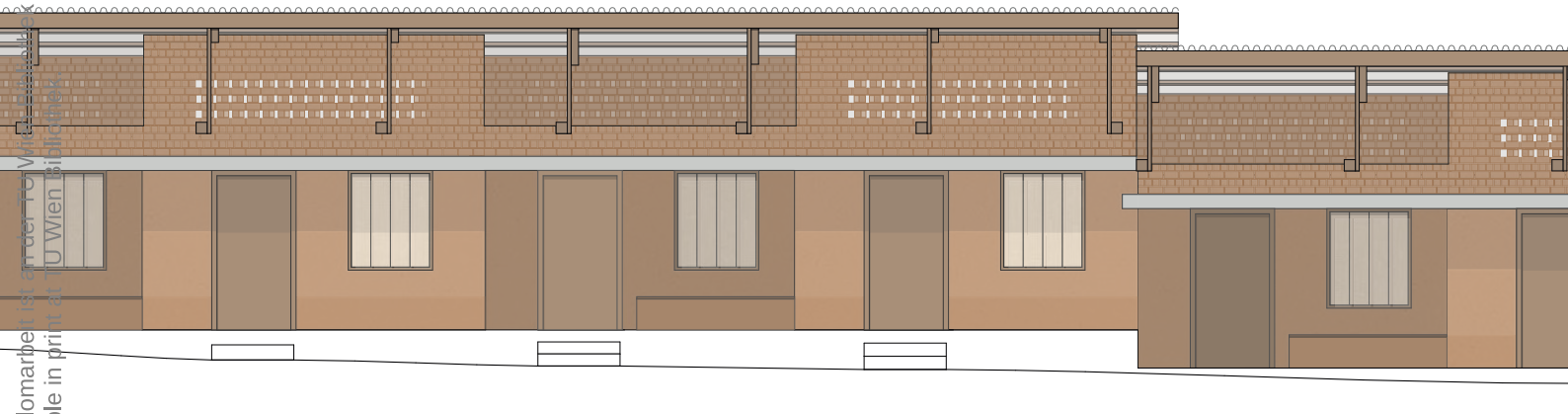
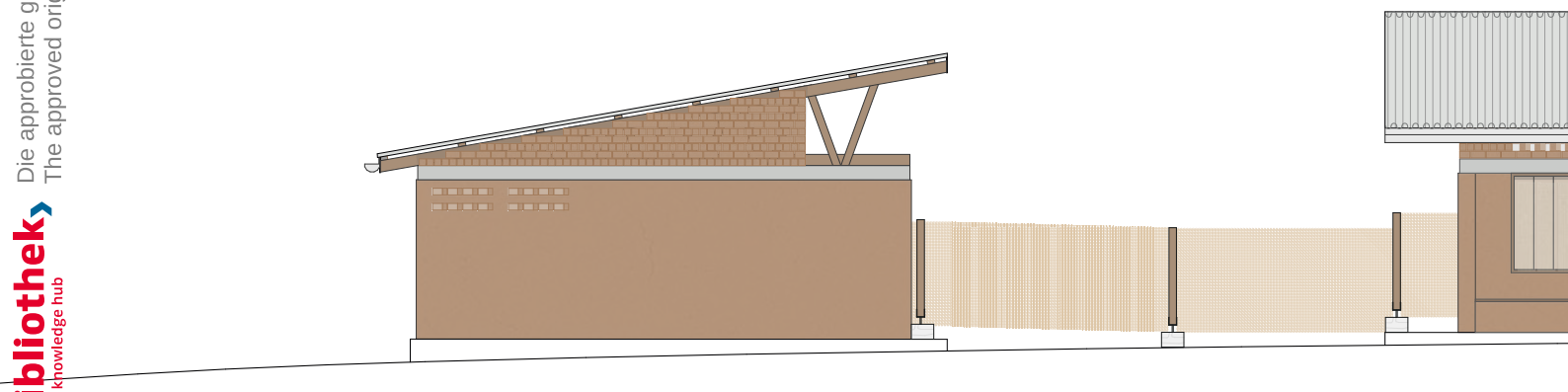


Abb. 60: teachers latrine section 2





0 1 5

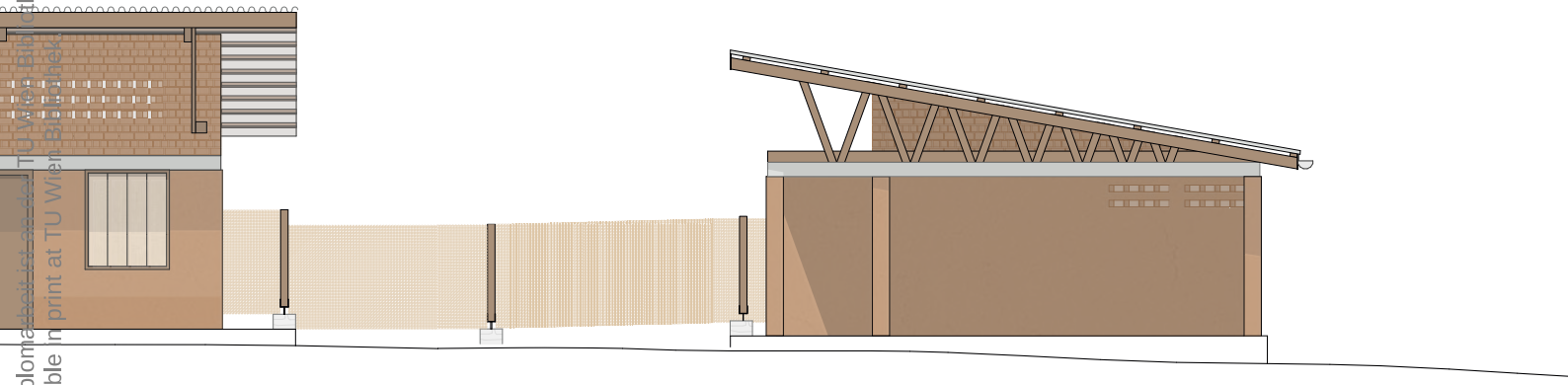


Abb. 61: teachers latrine elevation south

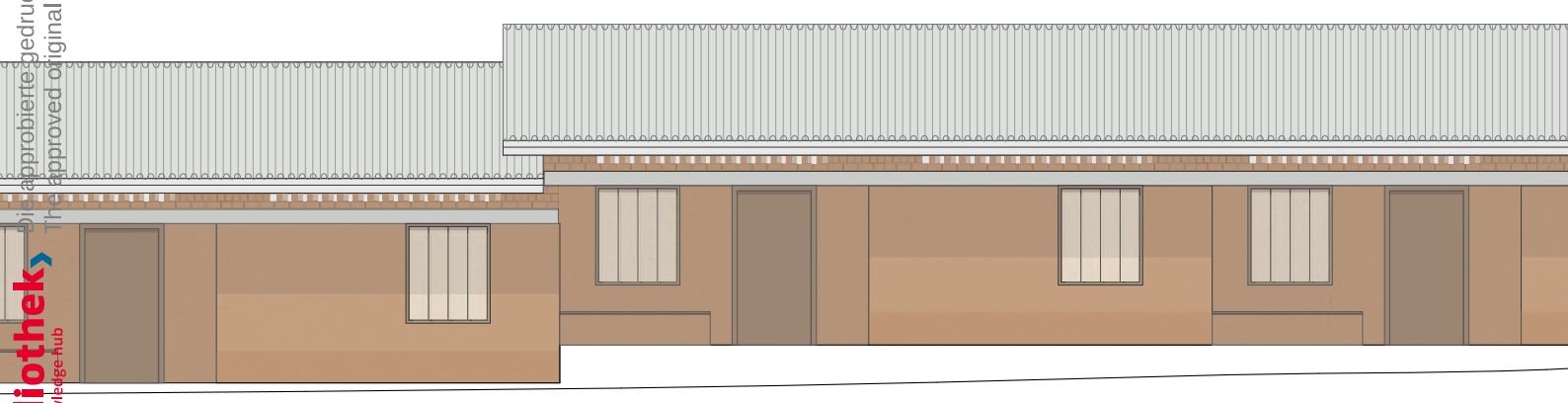


Abb. 62: teachers latrine elevation north

0 1 5

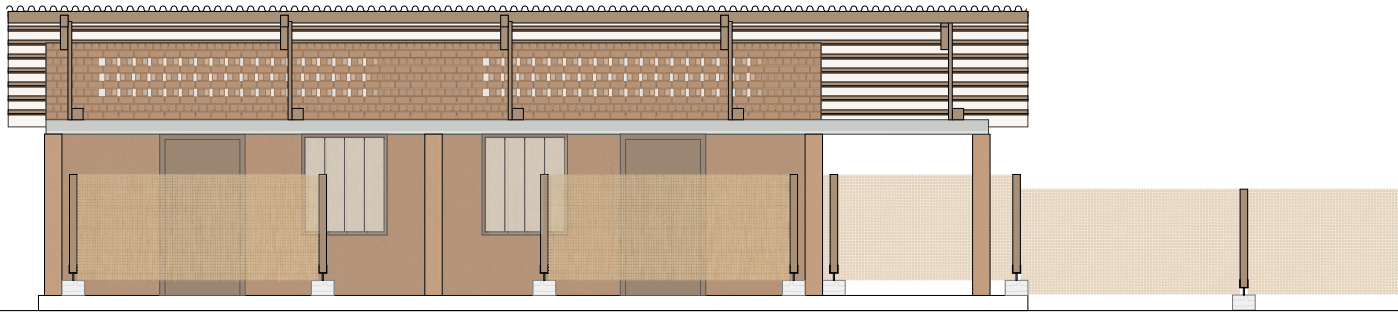


Abb. 63: teachers latrine elevation west

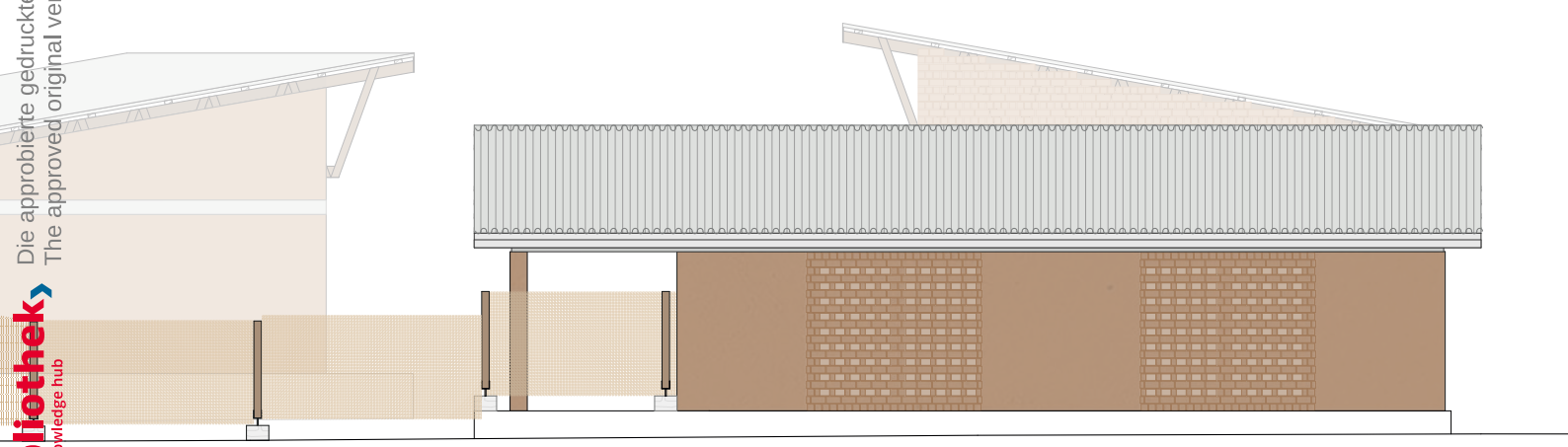
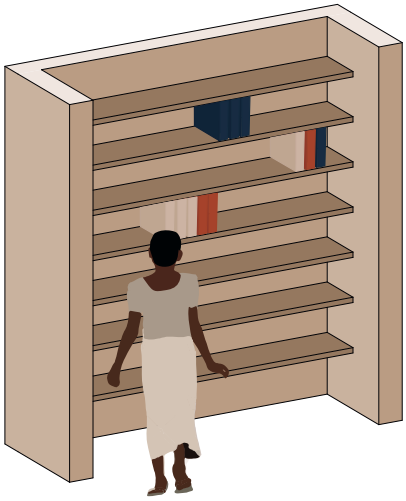


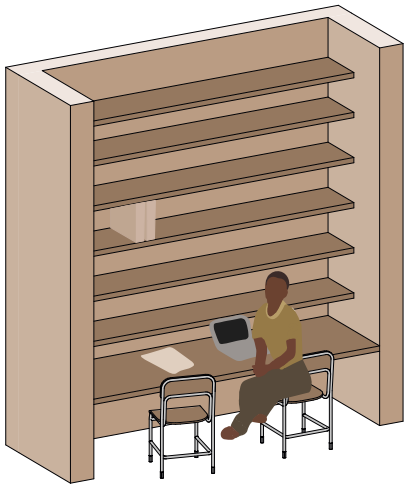
Abb. 64: teachers latrine elevation east

FURNITURE

1 niche bench



2 shelves



3 working / computer

Abb. 65: walls library

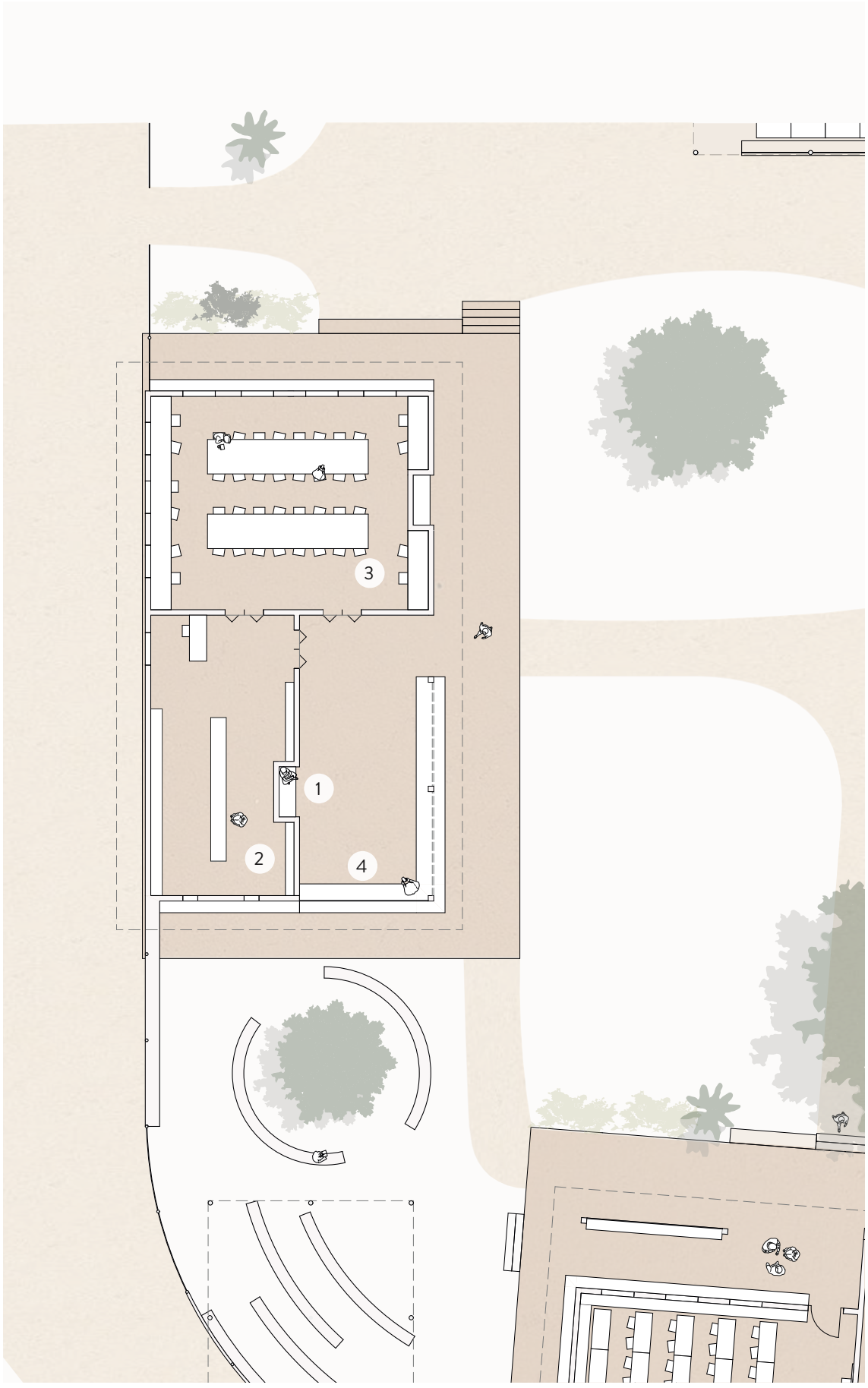
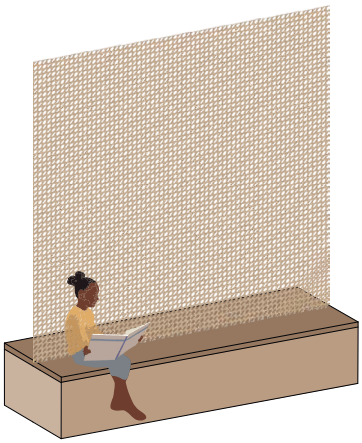


Abb. 66: furniture plans library



4 seating options

5 windows

Abb. 67: walls classroom

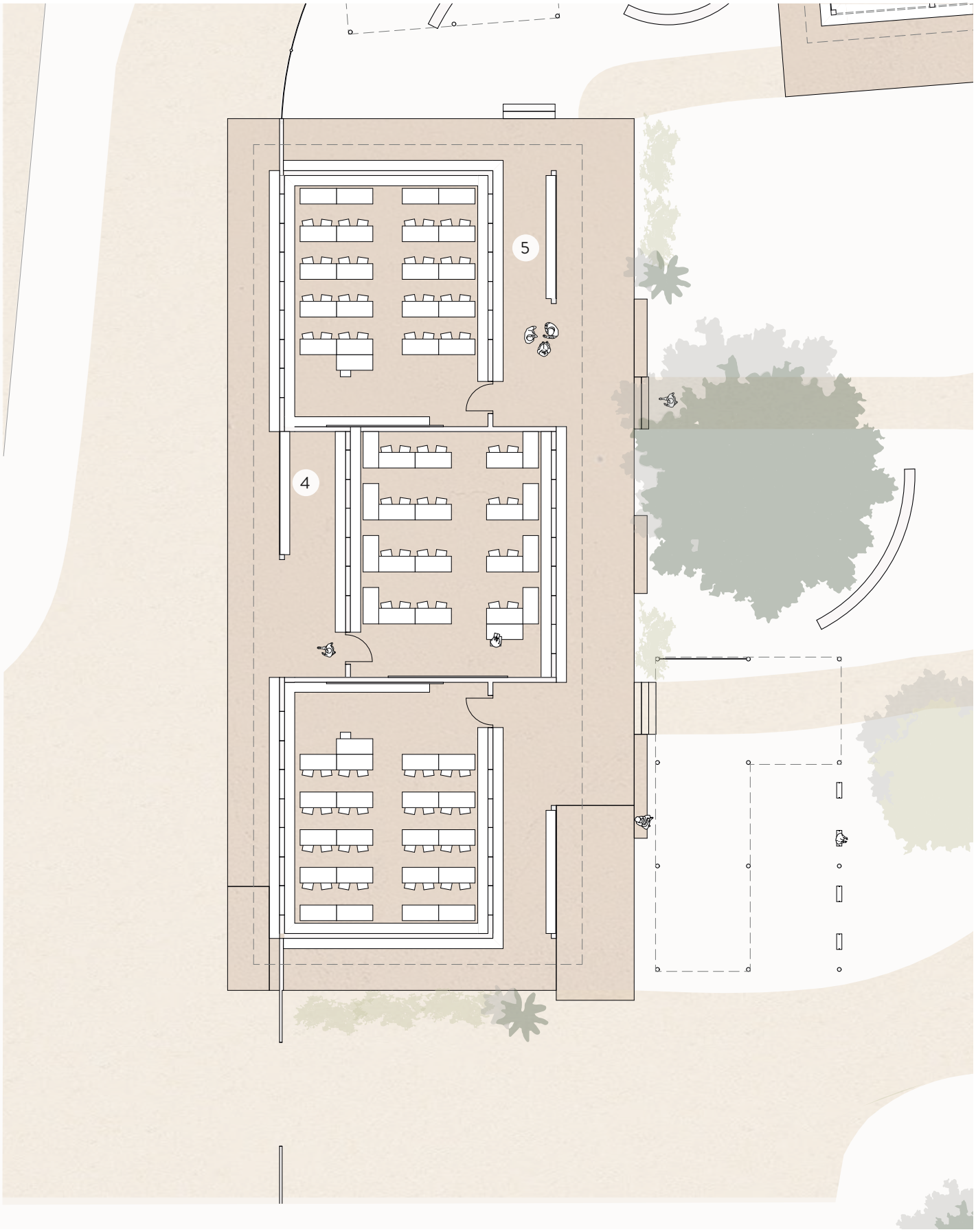
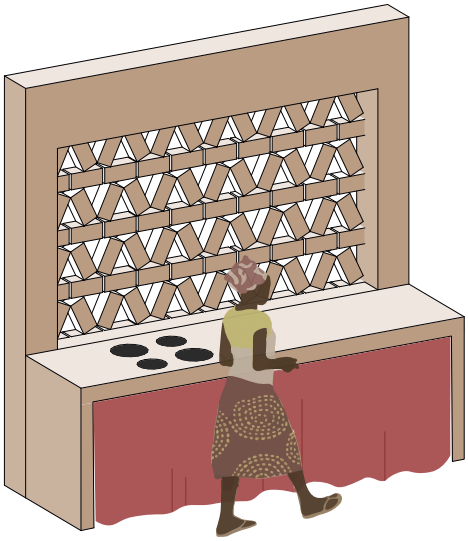


Abb. 68: furniture plans classrooms

(6) windows



(7) ventilation

Abb. 69: walls cafeteria

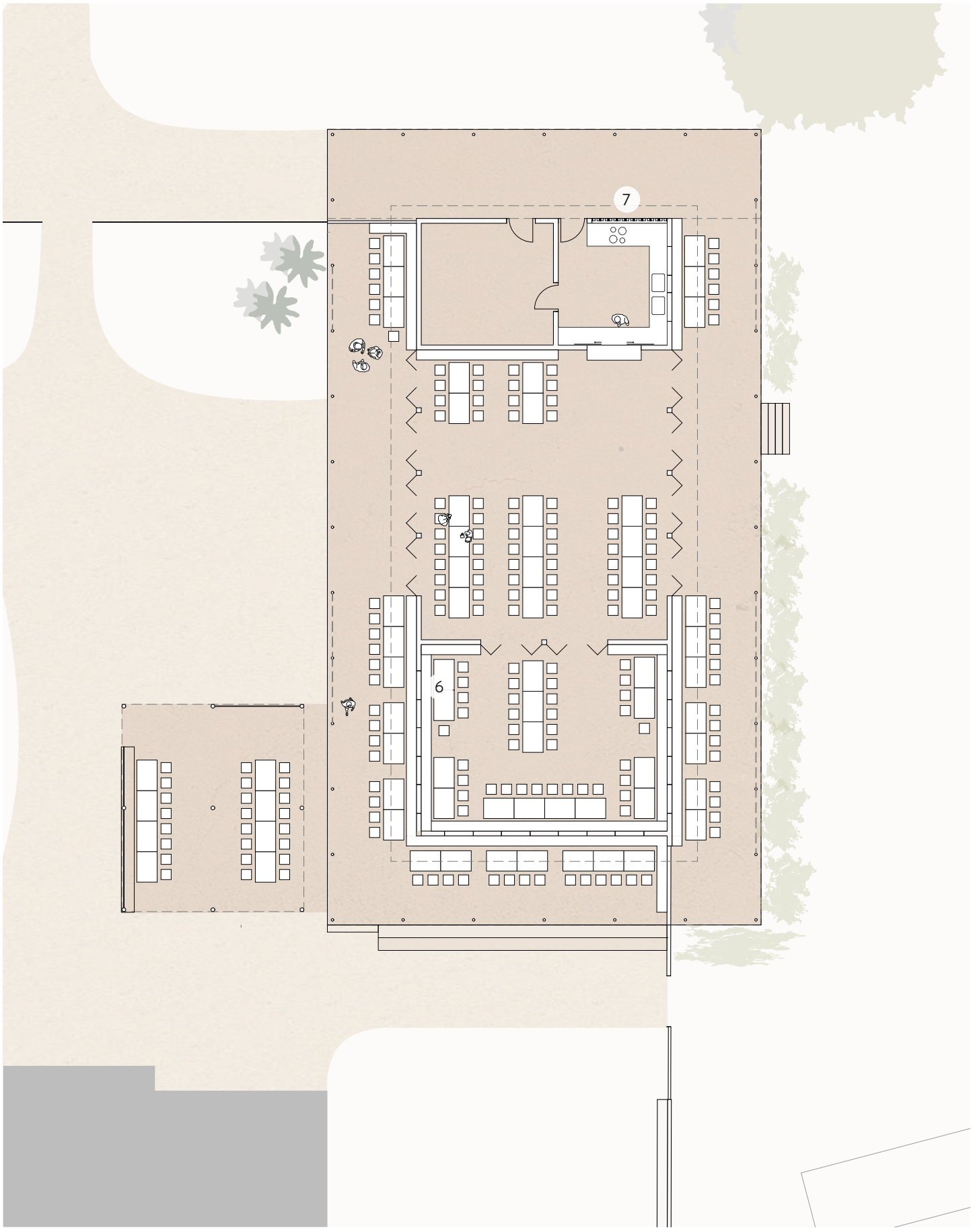


Abb. 70: furniture plans cafeteria

7 window with bench

Abb. 71: wall teachers units

Abb. 72: furniture plans teachers units

WINDOWS

Wooden-framed window with rotatable wooden elements covered with fabric fixed on the outer frame with round steel, to make the window burglar-proof.

DOORS

Foldable doors made of wood construction are covered with traditional wicker work.

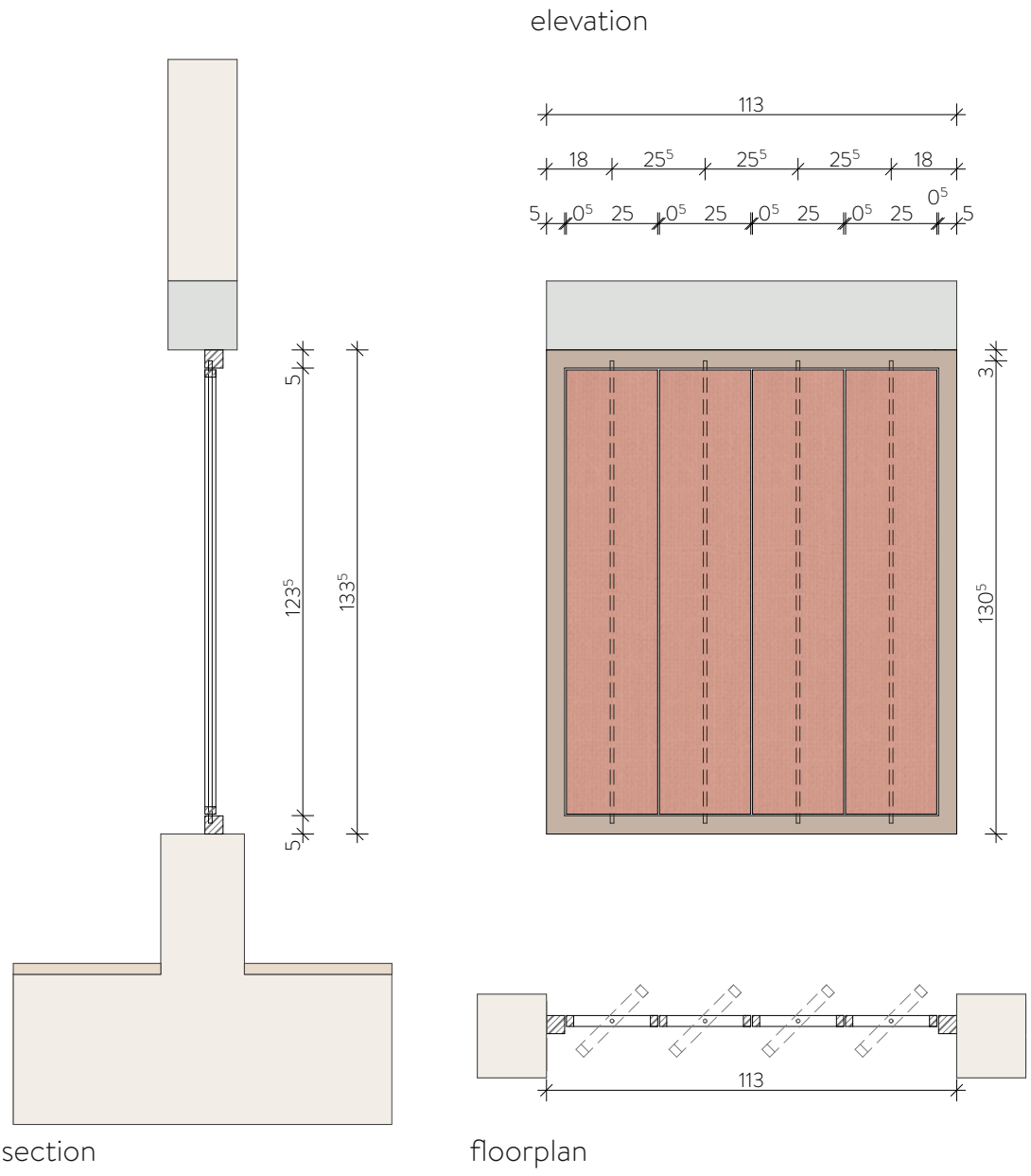


Abb. 73: window detail

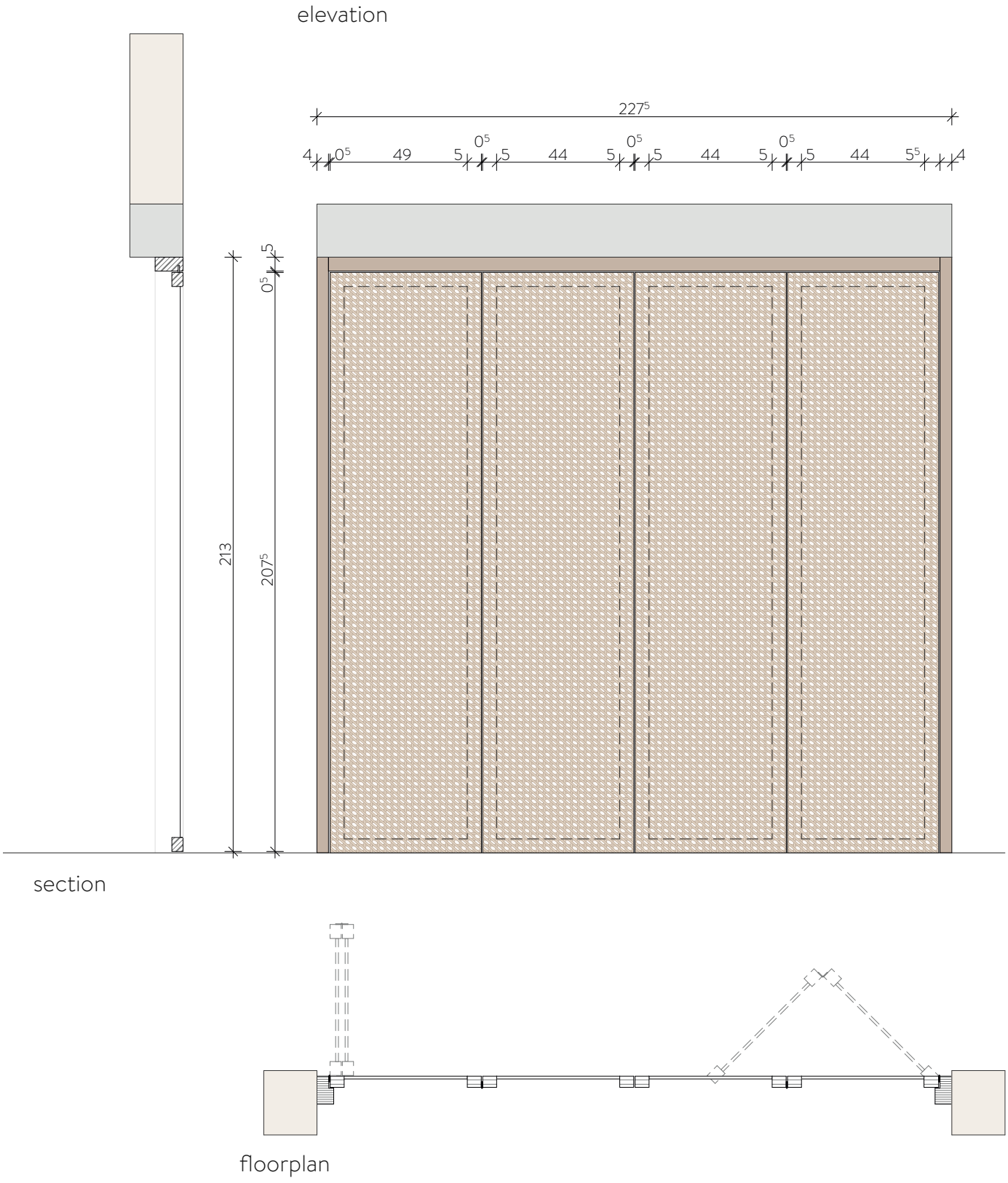


Abb. 74: foldable door detail

VENTILATION

To ensure ventilation in the interior, there are air openings in the plane above the ring beam. Via rotation of the binders into two directions, the wind can enter even though it is coming from different directions.

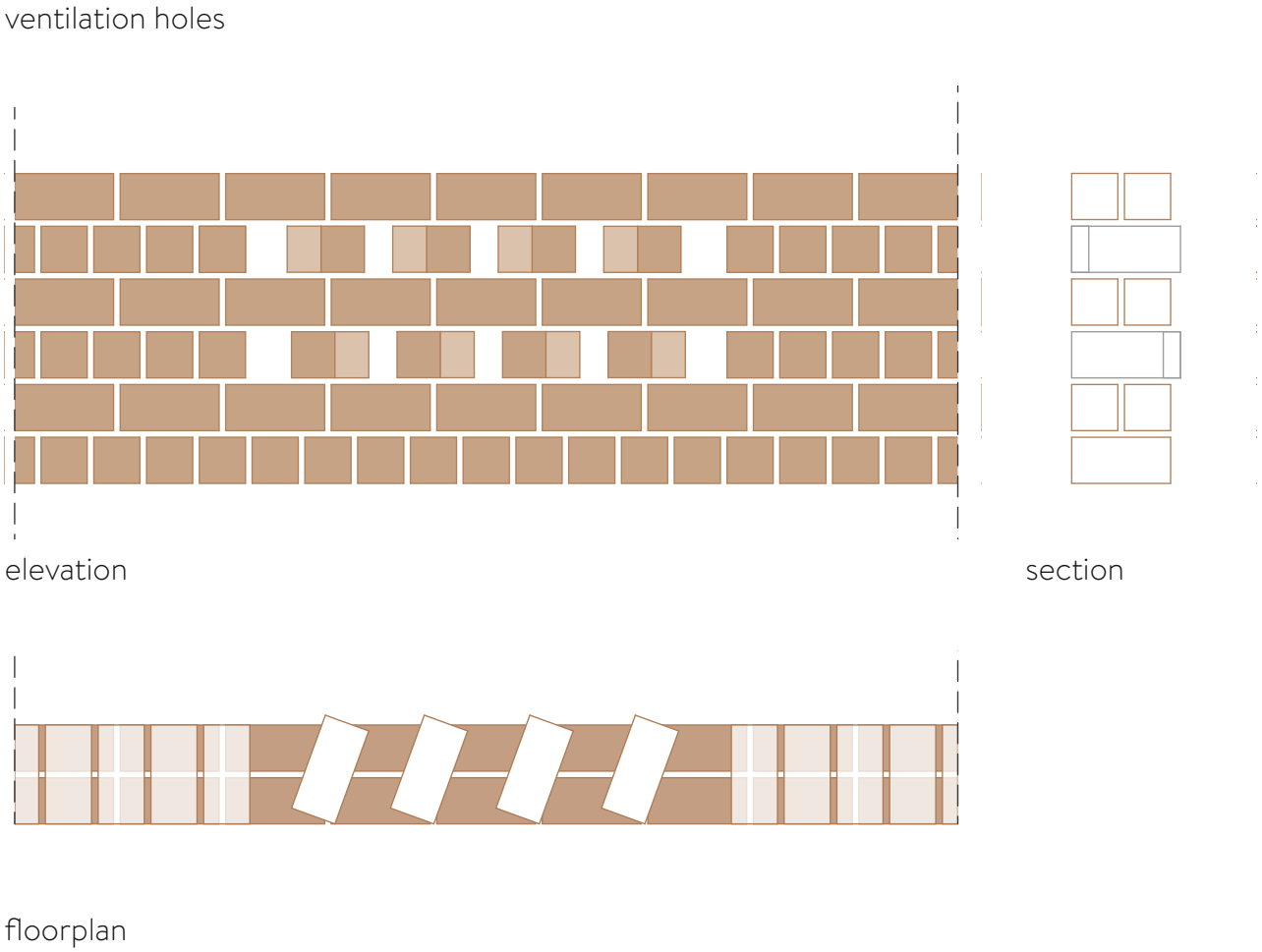


Abb. 75: ventilation holes in block bandage

LIGHT EXPOSURE

Through many small openings on the gable front, in addition to the window openings, additional light can reach the interior.

ventilation holes

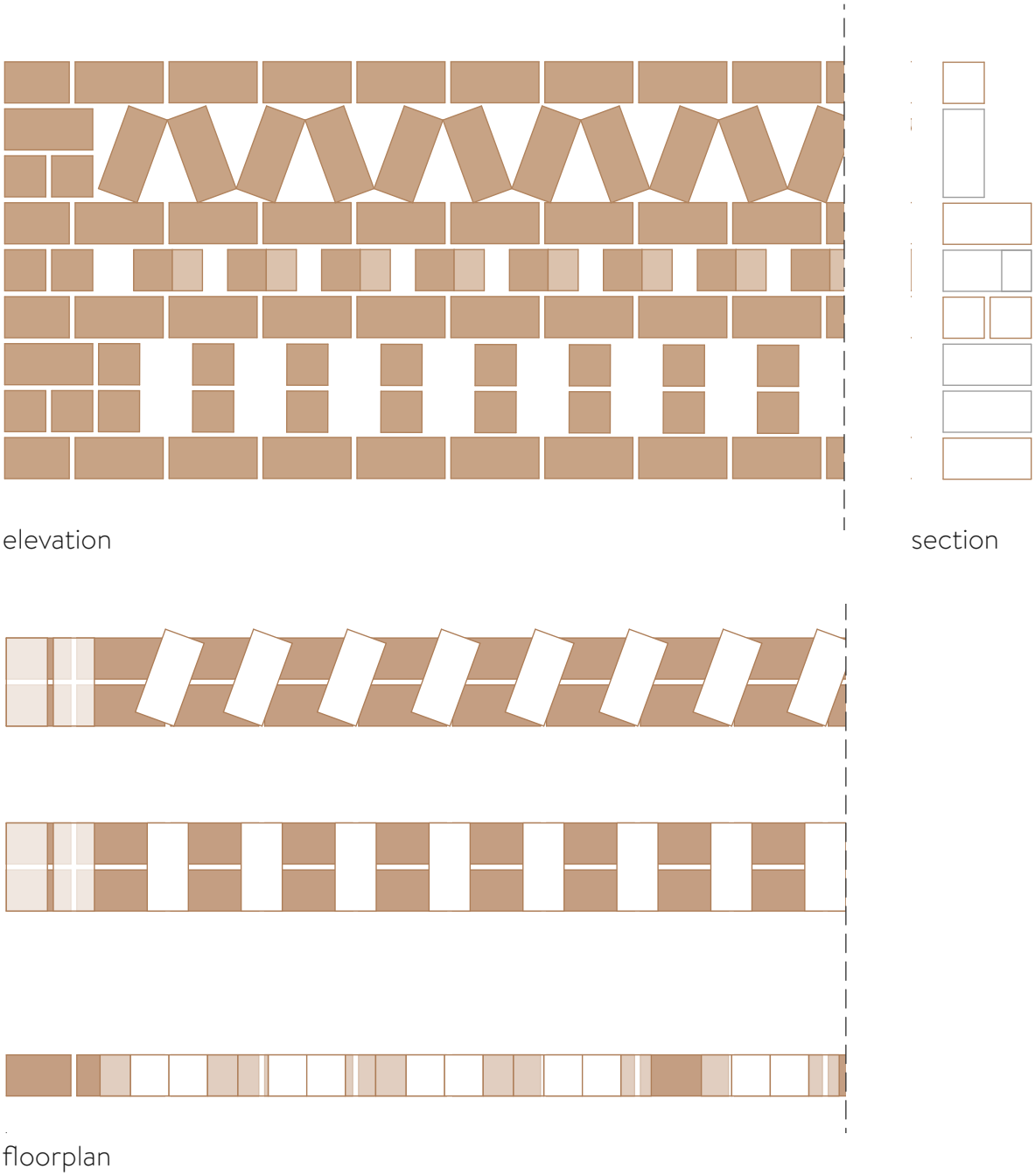


Abb. 76: light holes in block bandage

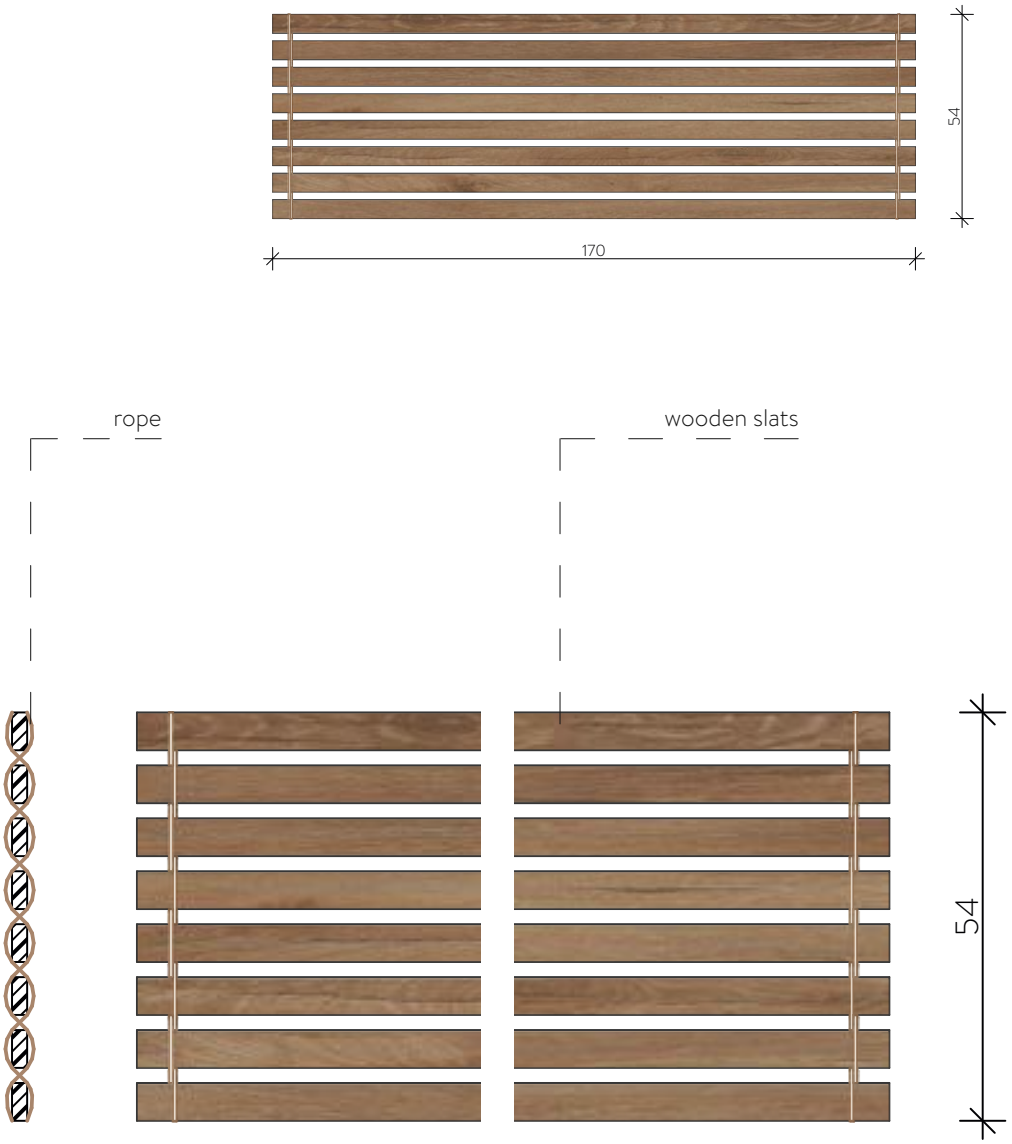
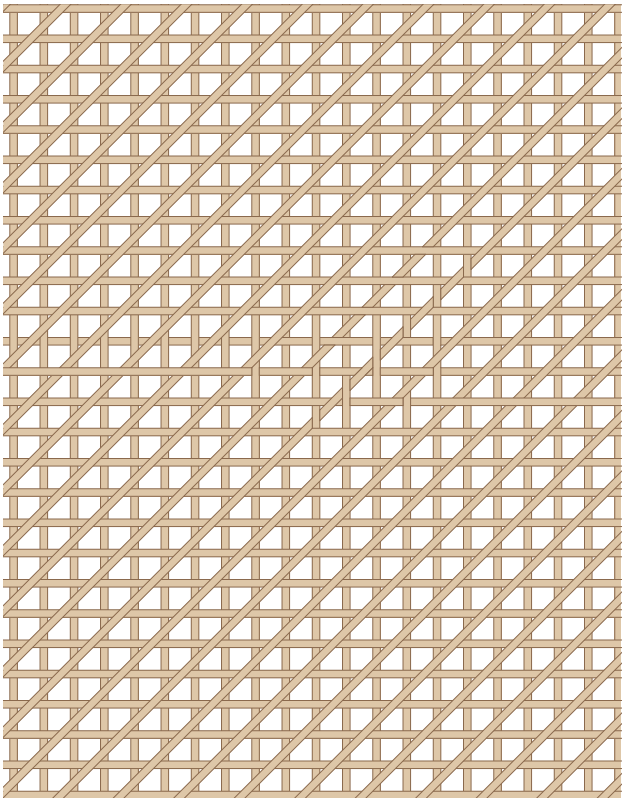


Abb. 77: shading system

WICKER FENCE

Both the school area and teachers‘ accommodation are fenced with traditional wickerwork made of elephant grass. The wickerwork is supported by two eucalyptus logs and is connected to the ground with a stone foundation. The fence is partly plastered with mud where seating options are situated. On one part the fence merges into a thicker wall with sitting niches. This is achieved via a braided body filled and plastered with straw clay.



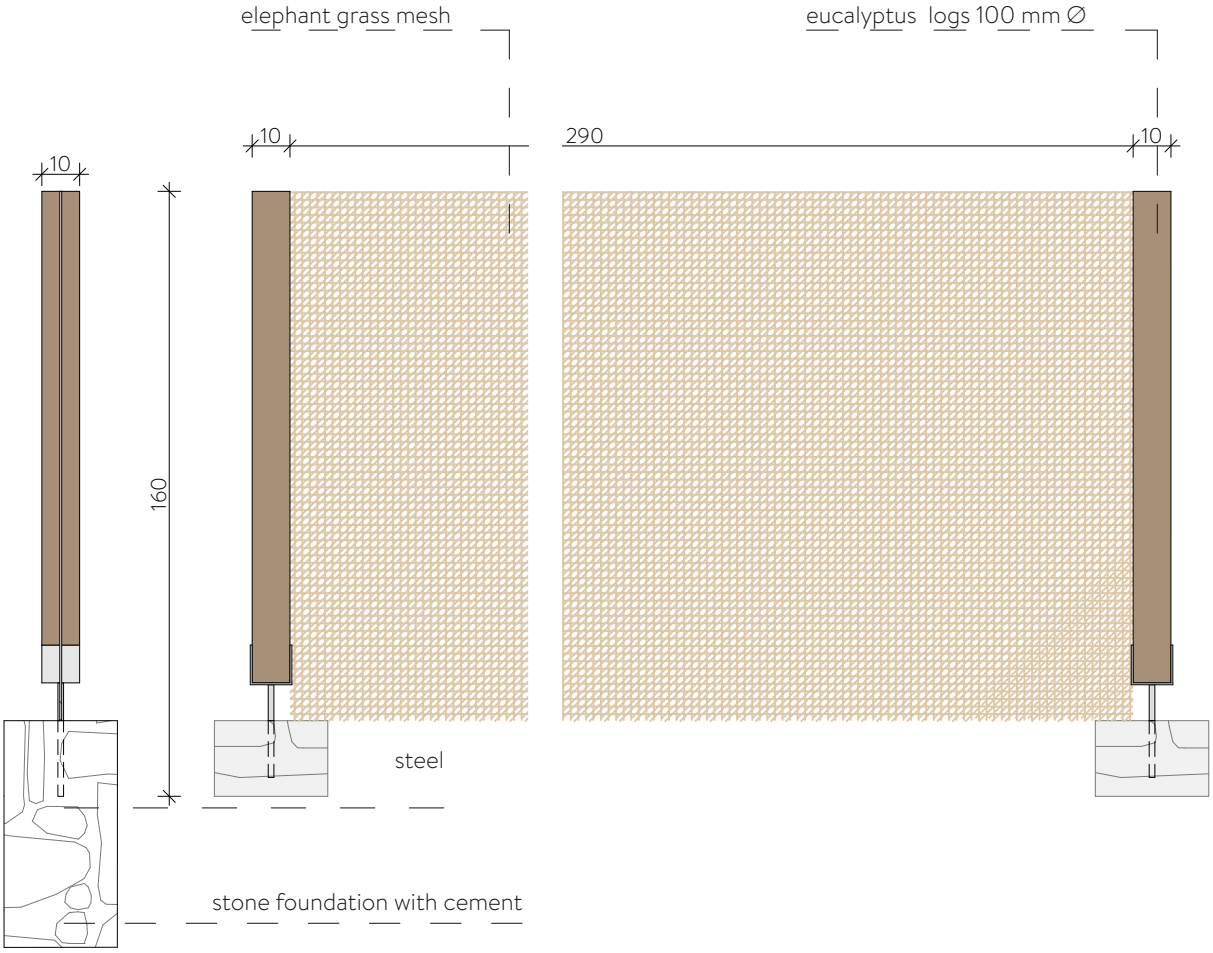


Abb. 78: wicker fence

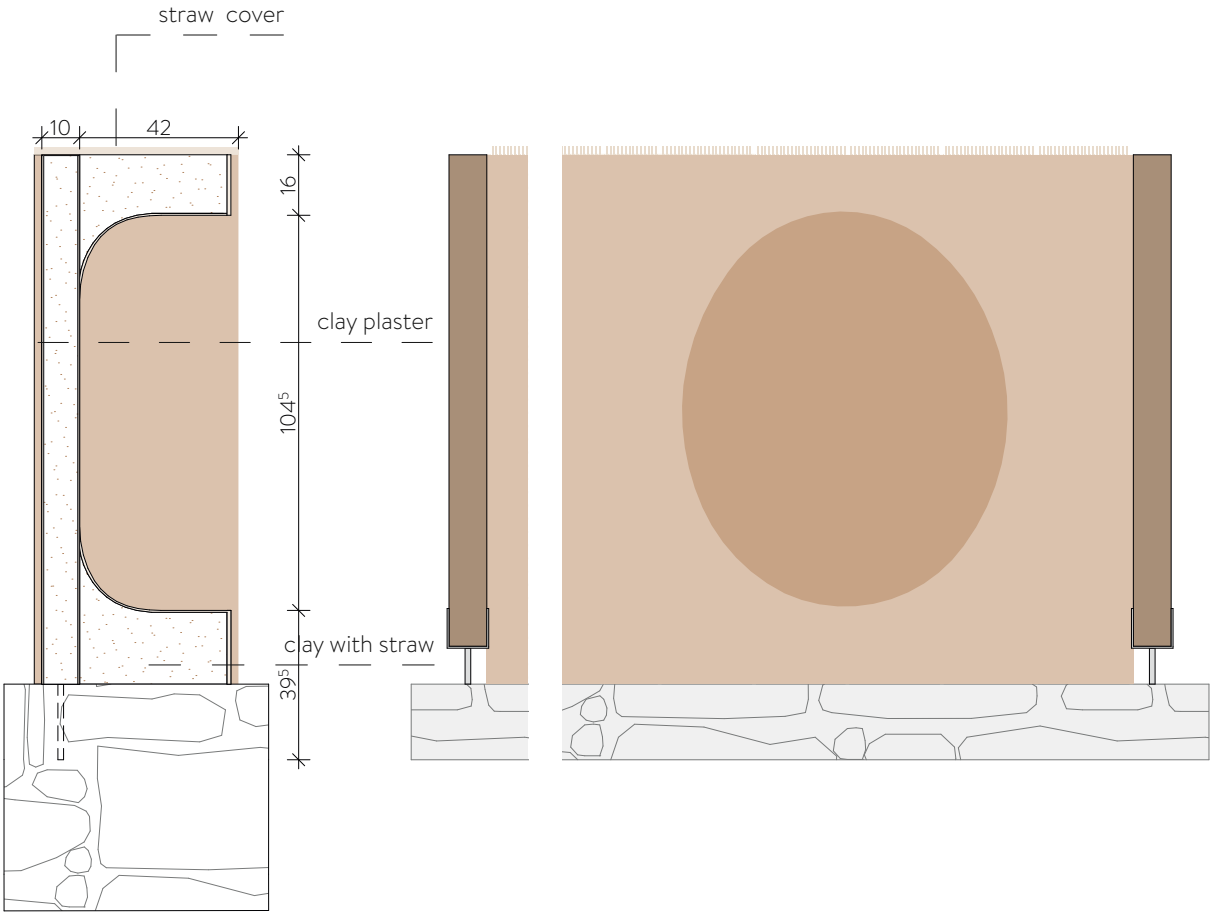


Abb. 79: braided body filled with straw clay

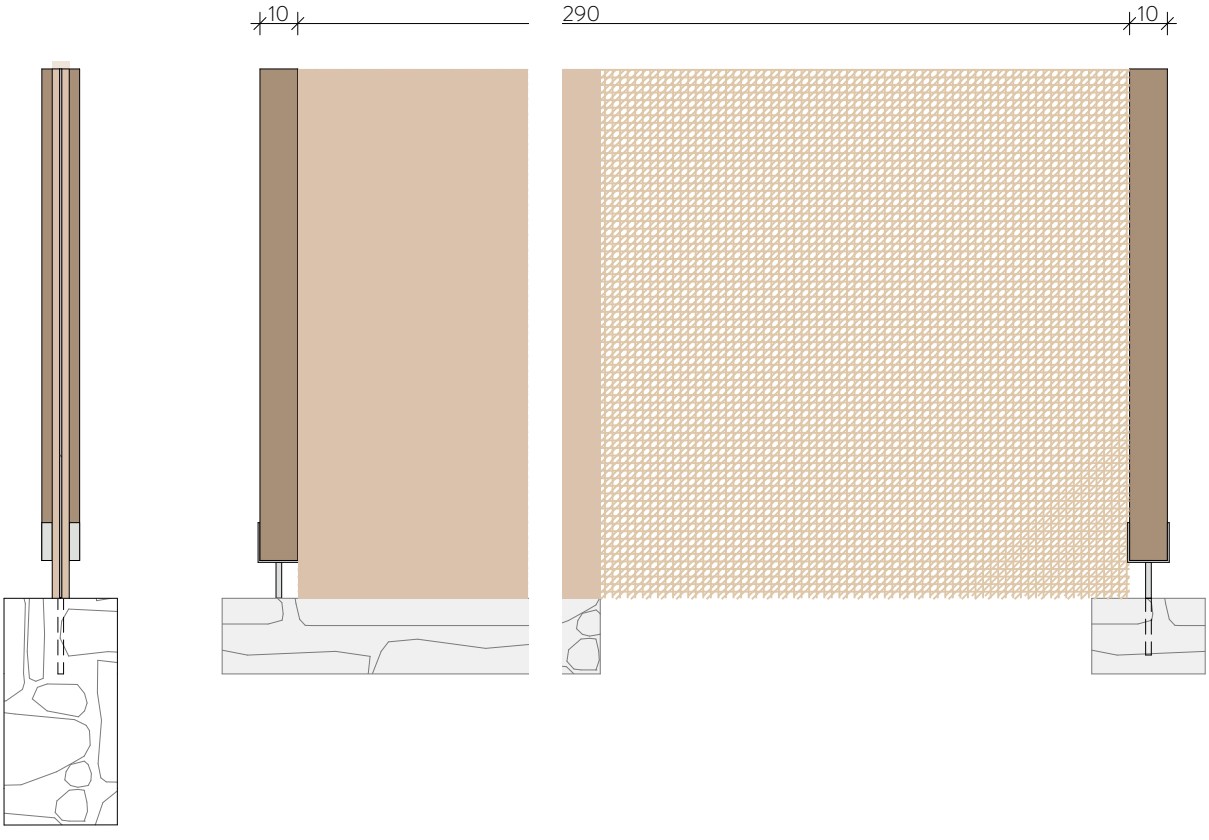
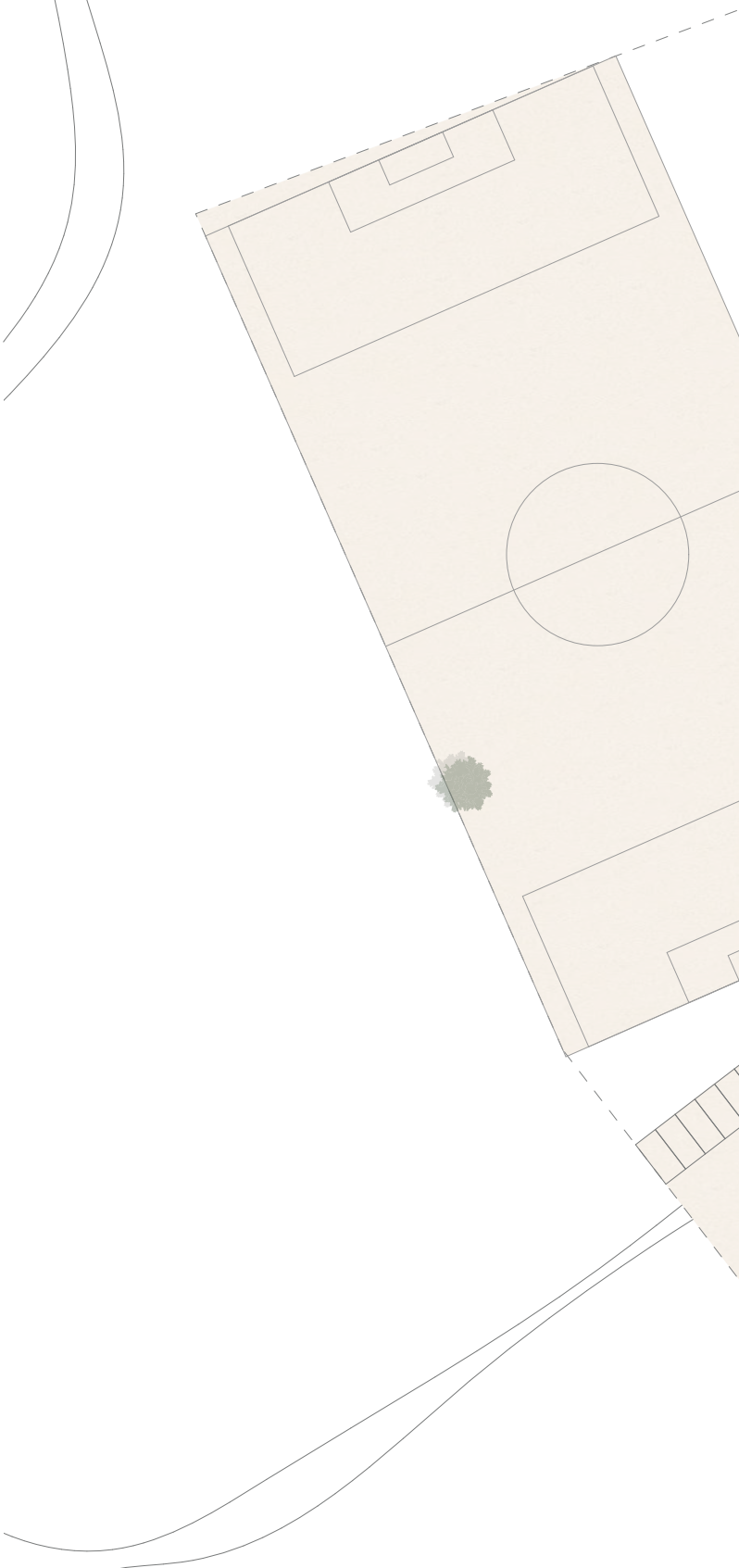


Abb. 80: wicker fence plastered with mud

Abb. 81: axonometry with outdoor area

OUTDOOR AREA

Between the buildings, trees are planted to generate shade. The school garden, which is maintained by the staff, is located in the eastern part of the plot, where fruits trees like mango and banana are cultivated. Resulting differences in ground level are filled up with a mound of earth, which is secured by mesh and small shrubs. The pathway is framed with small stones and filled with sand.



1 Sausage tree
2 Acacia tree
3 Banana tree
4 Mango tree
5 shrubs

sand
new trees
existing trees

Abb. 82: outdoor area

0 10 50

CONSTRUCTION

The construction is inspired by the buildings that have already been built, to ensure a safe implementation. Therefore, the roof is designed as a gable roof, resting on eucalyptus wooden beams, with a span of 10 meters. In order to dampen the pattering of heavy rain, wicker or fabric is stretched between the beams and the counter-battens, depending on availability.

The wall is made of air-dried bricks and, in the base area up to 40 cm in height, of fired bricks, with a wall thickness of 19.05 cm. The concrete ring anchor and the benches in the base area, which are also made of fired bricks, serve to reinforce the walls. The ring anchor is positioned in such a way, that it also serves as a lintel for windows and doors. Above the ring anchor there is another wall made of air-dried bricks, with air openings for ventilation. Because of the roof construction resting on the wall, the last row is made of burned bricks. The enclosure consists of a mesh of thinner branches and elephant grass, which is partially plastered with clay.

The foundation is made from stone with cement mortar, as is the plinth area under the walls.

corrugated iron

eucalyptus slats

eucalyptus truss

burned bricks
support truss with ventilation holes

ring beam
19 cm concrete with steel reinforcment

enclosure
wicker wall plastered with clay

wall 4x4x8 inch / 8,89x8,89x19,05 cm
block bond
40 cm base burned bricks
adobe brick wall

foundation
40 cm foundation stone with cement
20 cm base stone with cement

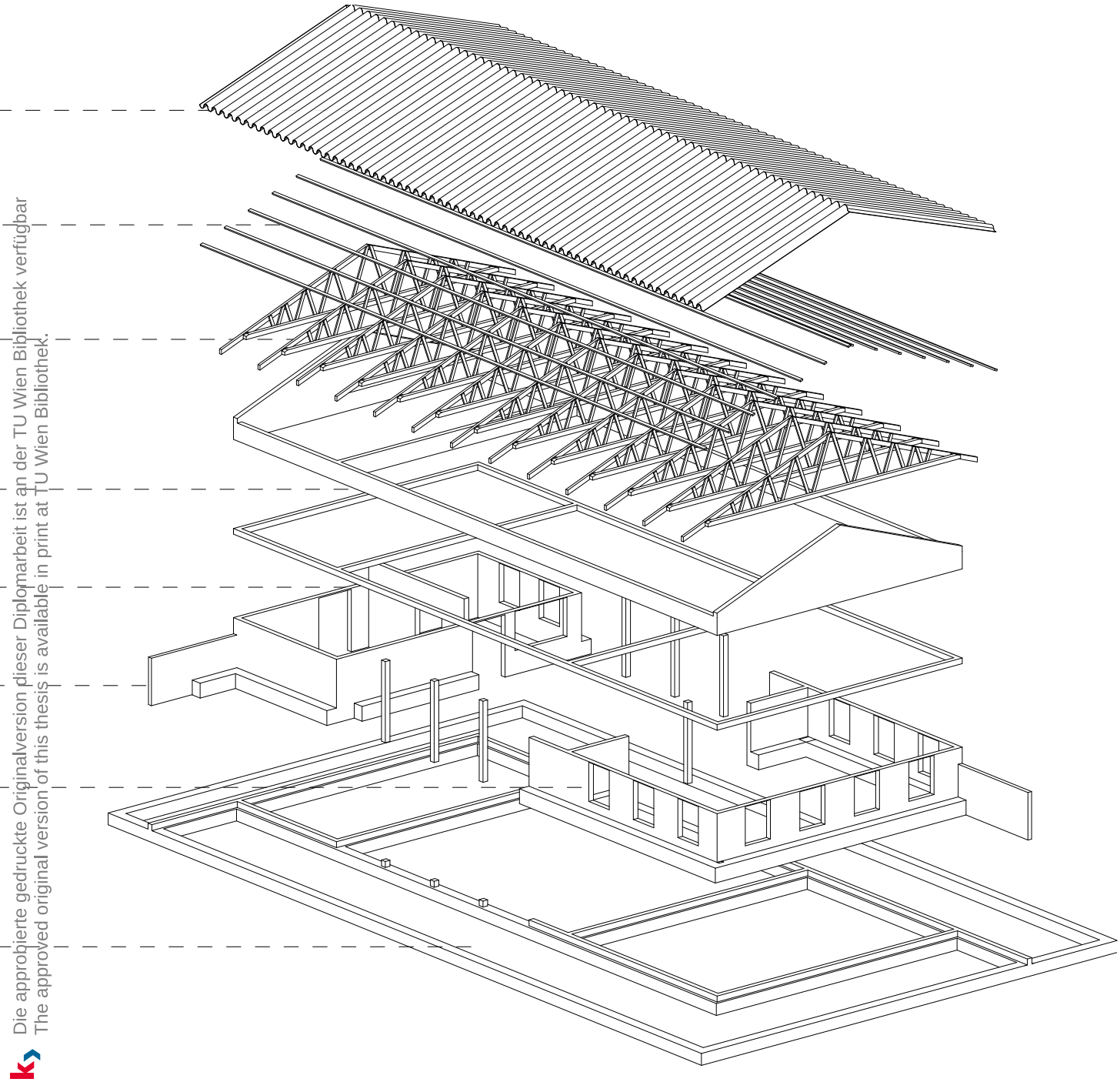


Abb. 83: explosive axonometry

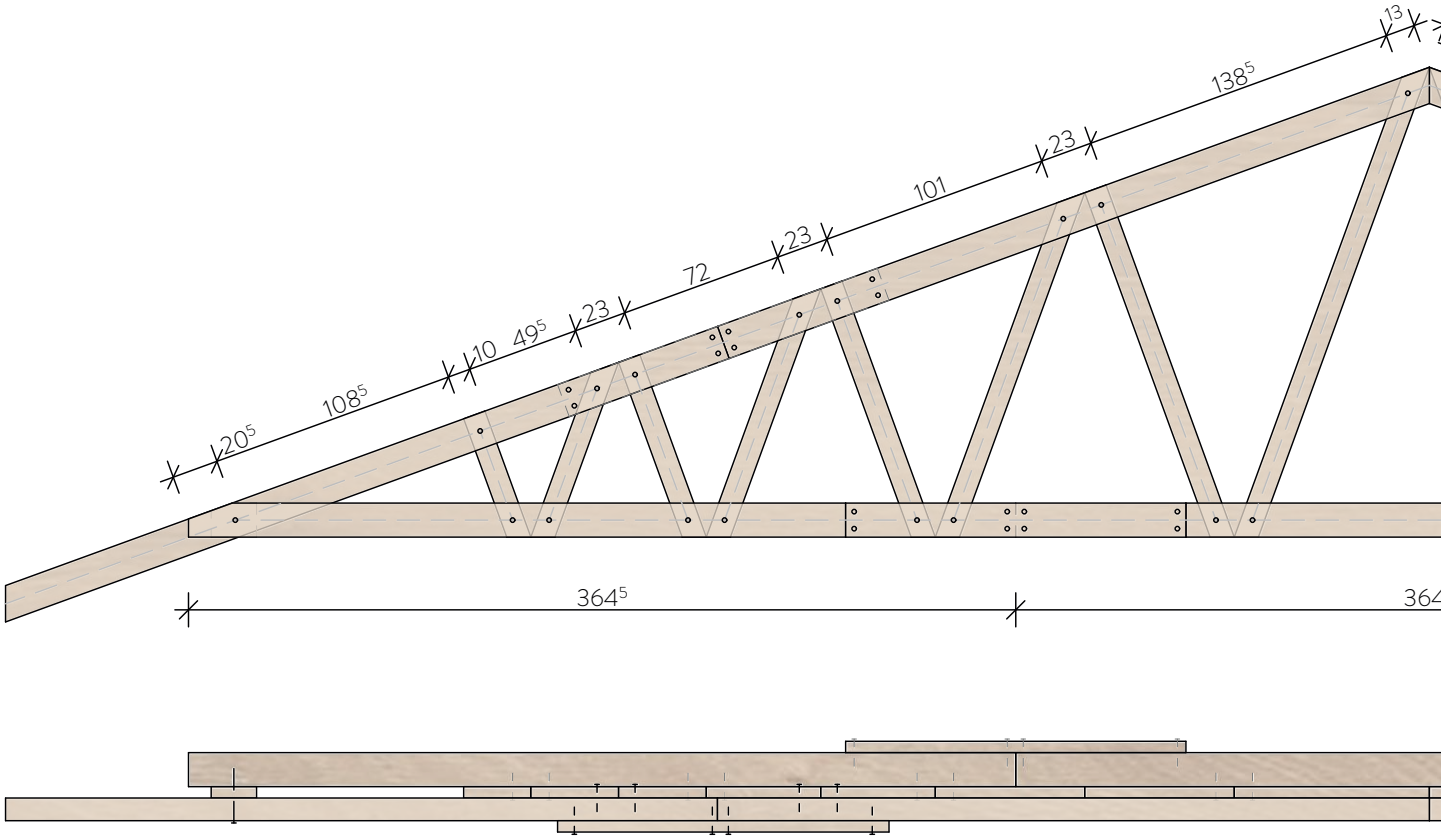
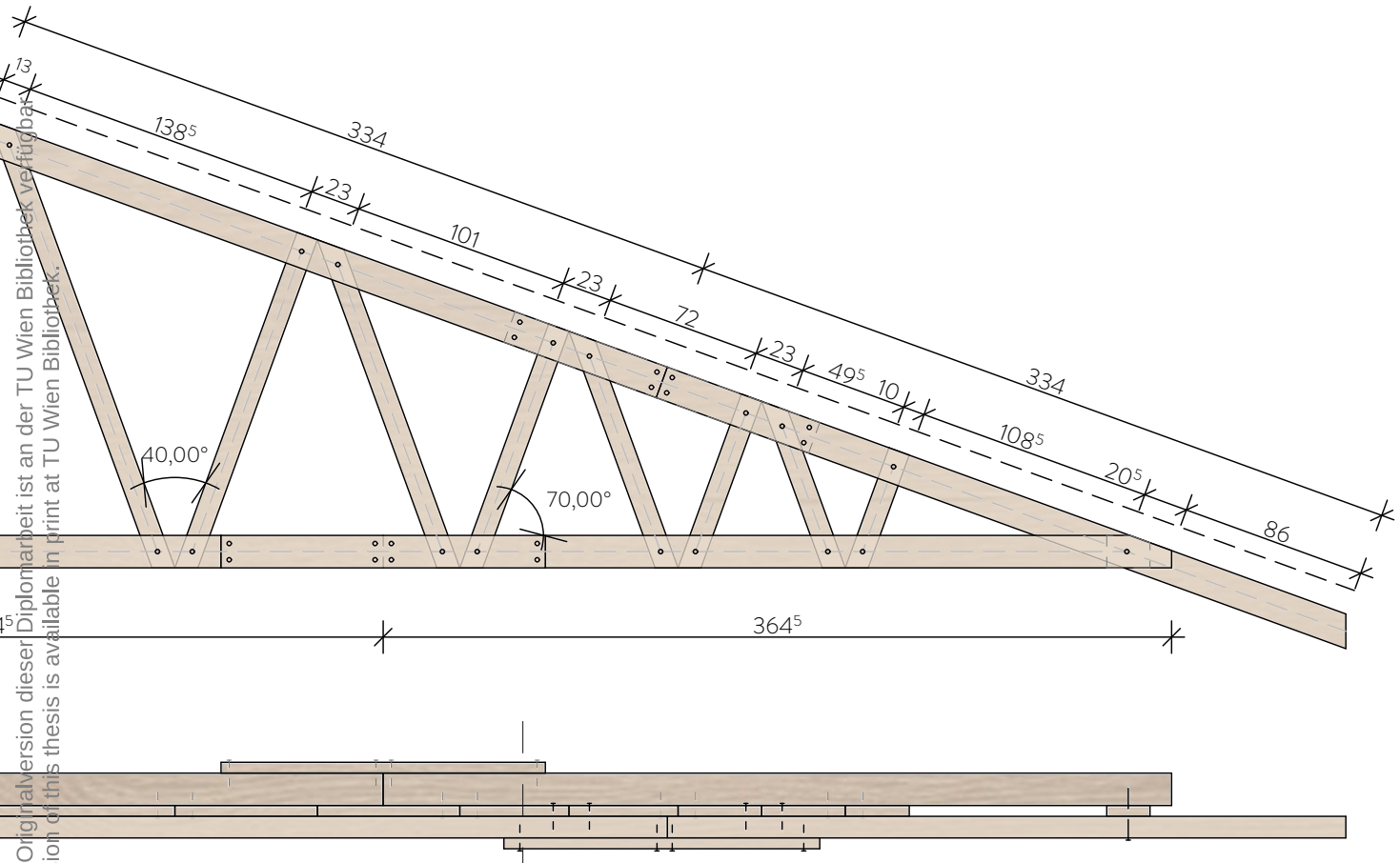
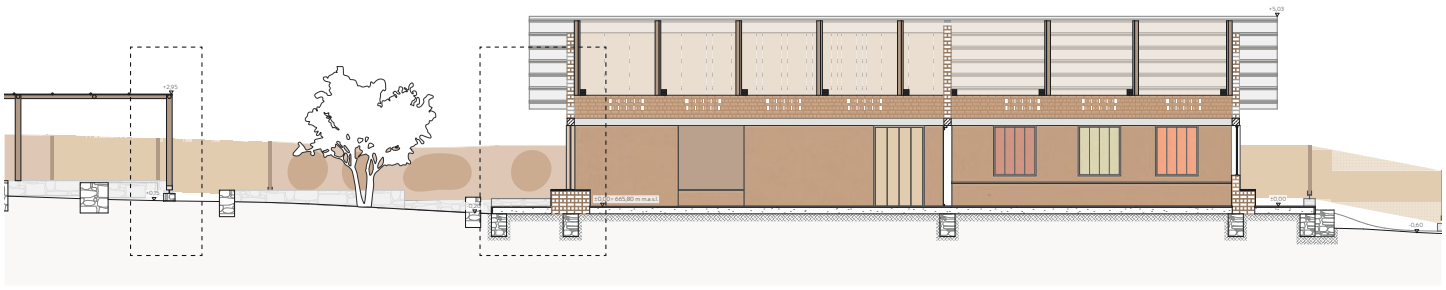
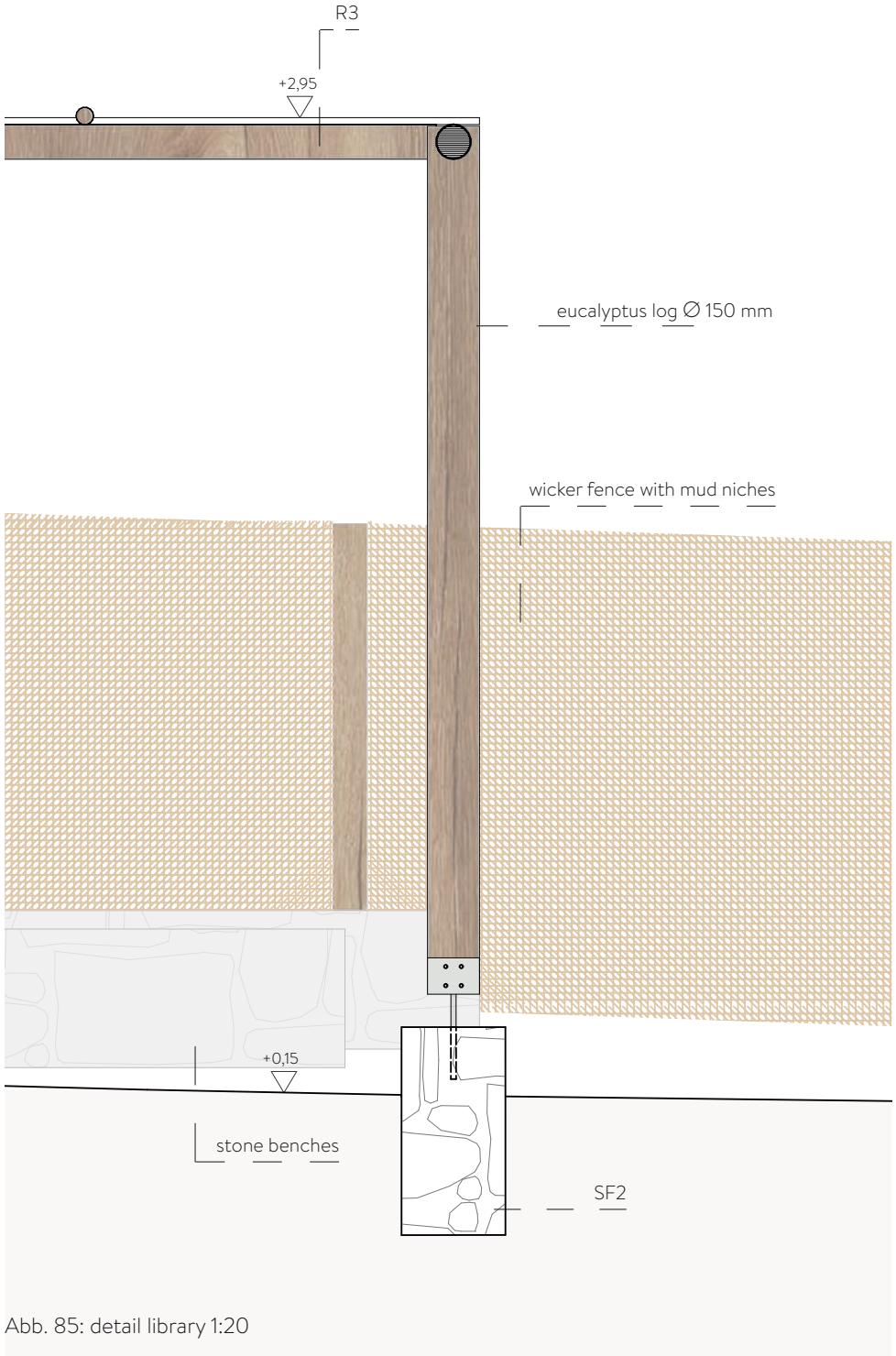


Abb. 84: roof truss library



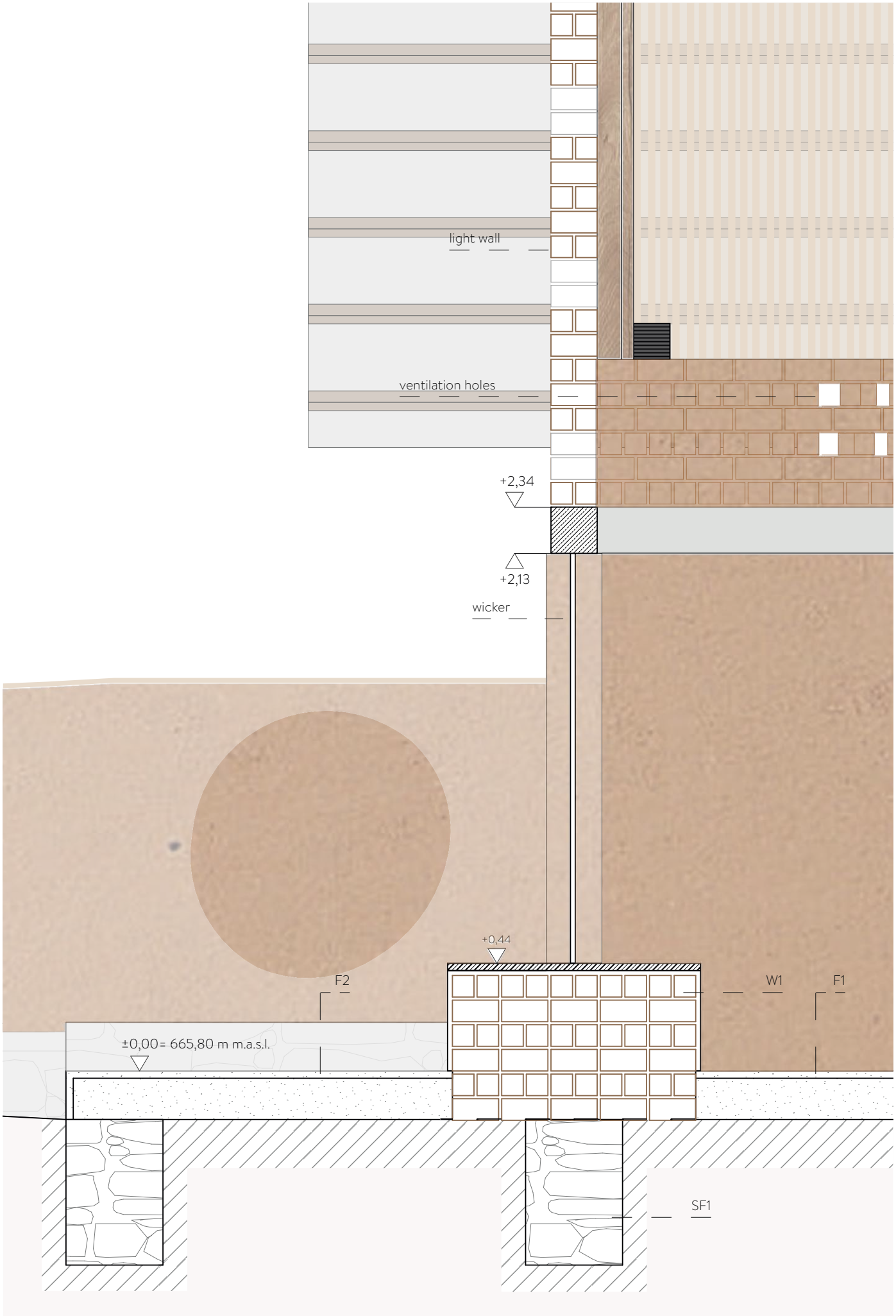
beam eucalyptus lumber 150 x150 mm
framework eucalyptus lumber 100x50 mm
rafters eucalyptus lumber 150x100 mm





W1	adobe bricks 4x4x8 inch (1/2 inch joint) 19 cm base area with burned bricks clay plaster 2 cm inside and outside plastered
R3	wicker mesh cover eucalyptus log 50 cm ∅ eucalyptus log 100 cm ∅
F1	poured earth (5-8% cement) 3 cm compressed eart compressed soil
F2	poured earth 3 cm compressed earth 2% sloped compressed soil 2% sloped
SF1	bituminous waterproofing Strip foundation stone with cement mortar 400x 600 mm
SF1	single foundation stone with cement mortar 200x 400 mm encased column steel base 15 mm

Abb. 85: detail library 1:20



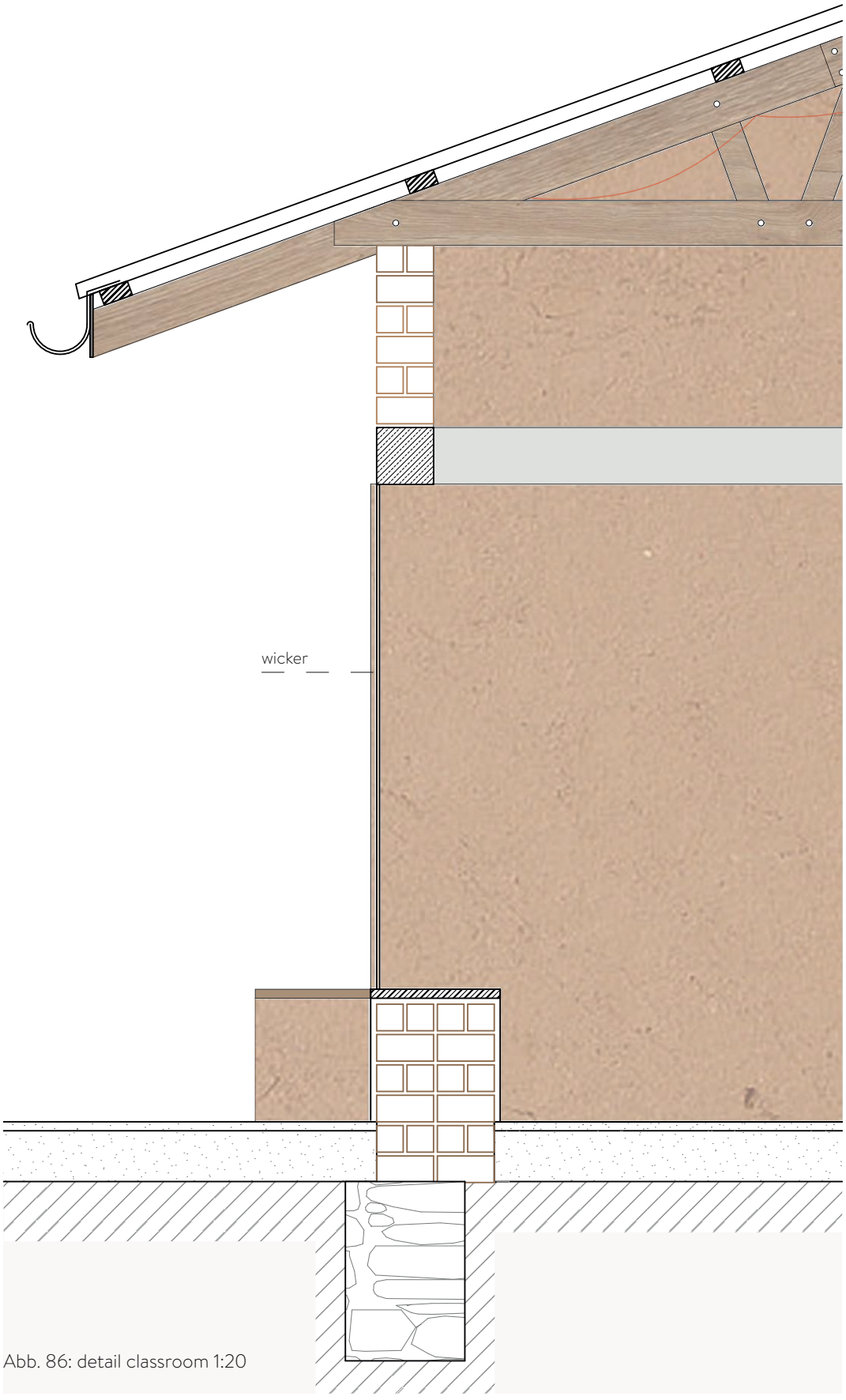
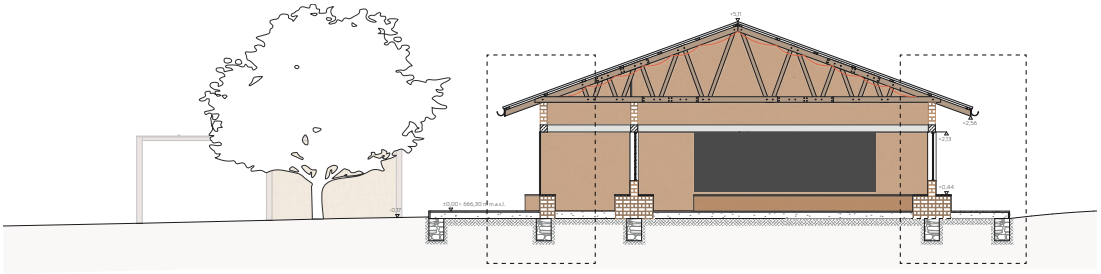
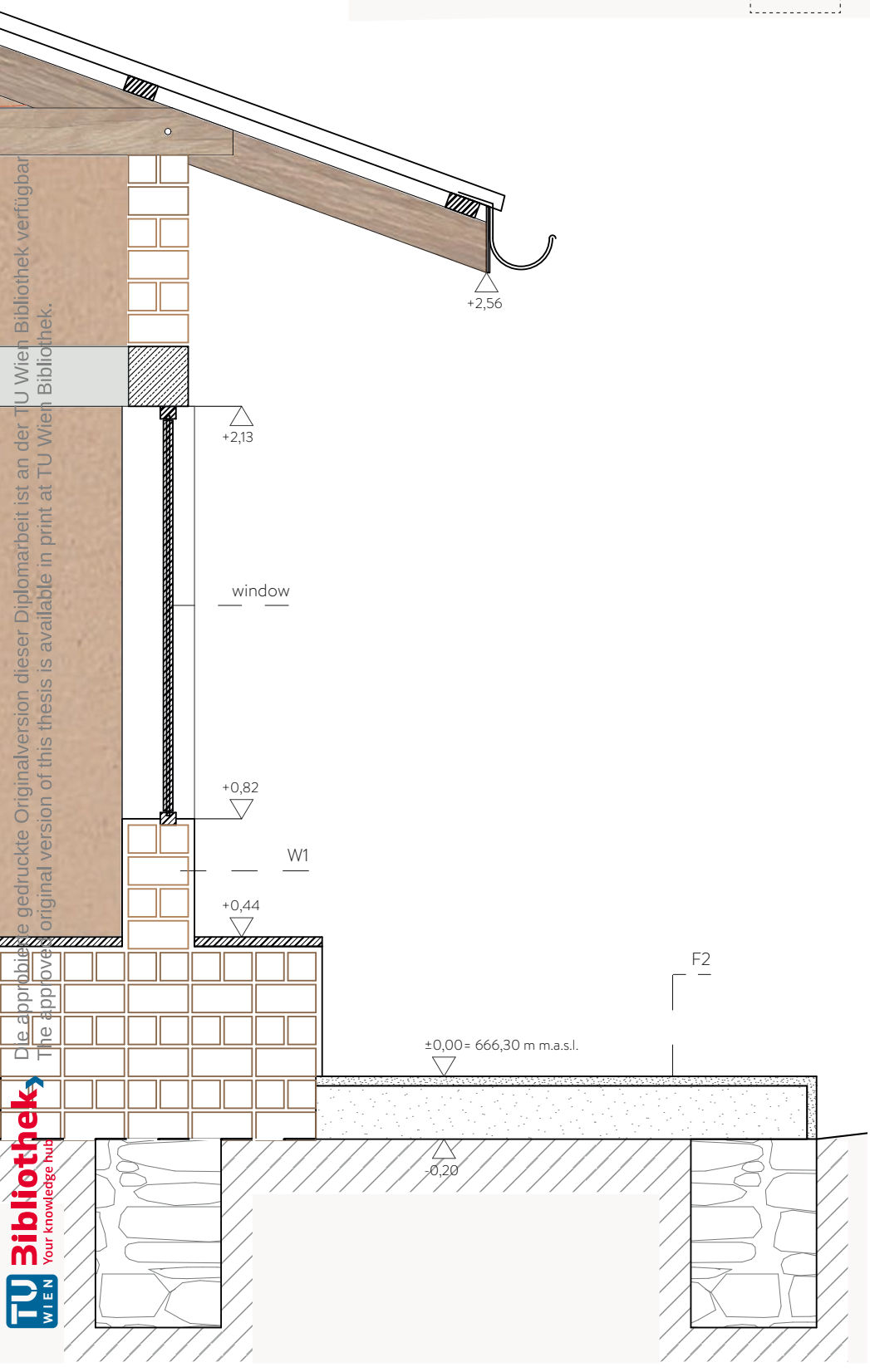


Abb. 86: detail classroom 1:20





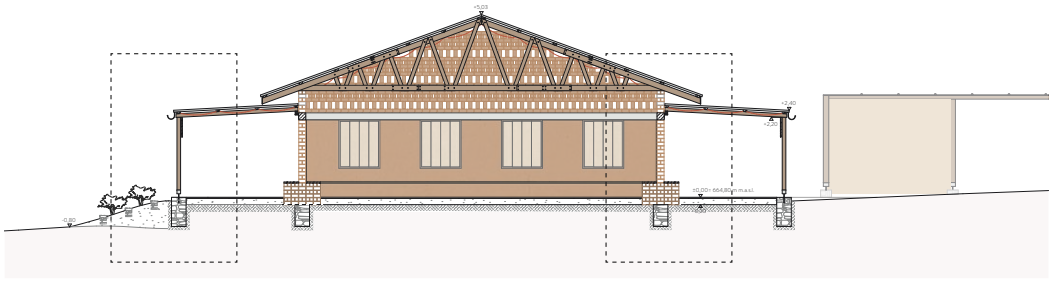
W1 adobe bricks 4x4x8 inch (1/2 inch joint) 19 cm
base area with burned bricks
clay plaster 2 cm inside and outside plastered

R1 corrugated iron sheet
counterbattens
wicker mat / fabric (against noise)
rafters eucalyptus lumber 150x100 mm
truss eucalyptus lumber 50x100 mm
girder eucalyptus sawn lumber 150x150 mm

F1 poured earth (5-8% cement) 3 cm
compressed eart
compressed soil

F2 poured earth 3 cm
compressed earth 2% sloped
compressed soil 2% sloped

SF1 bituminous waterproofing
Strip foundation stone with cement mortar 400x 600 mm



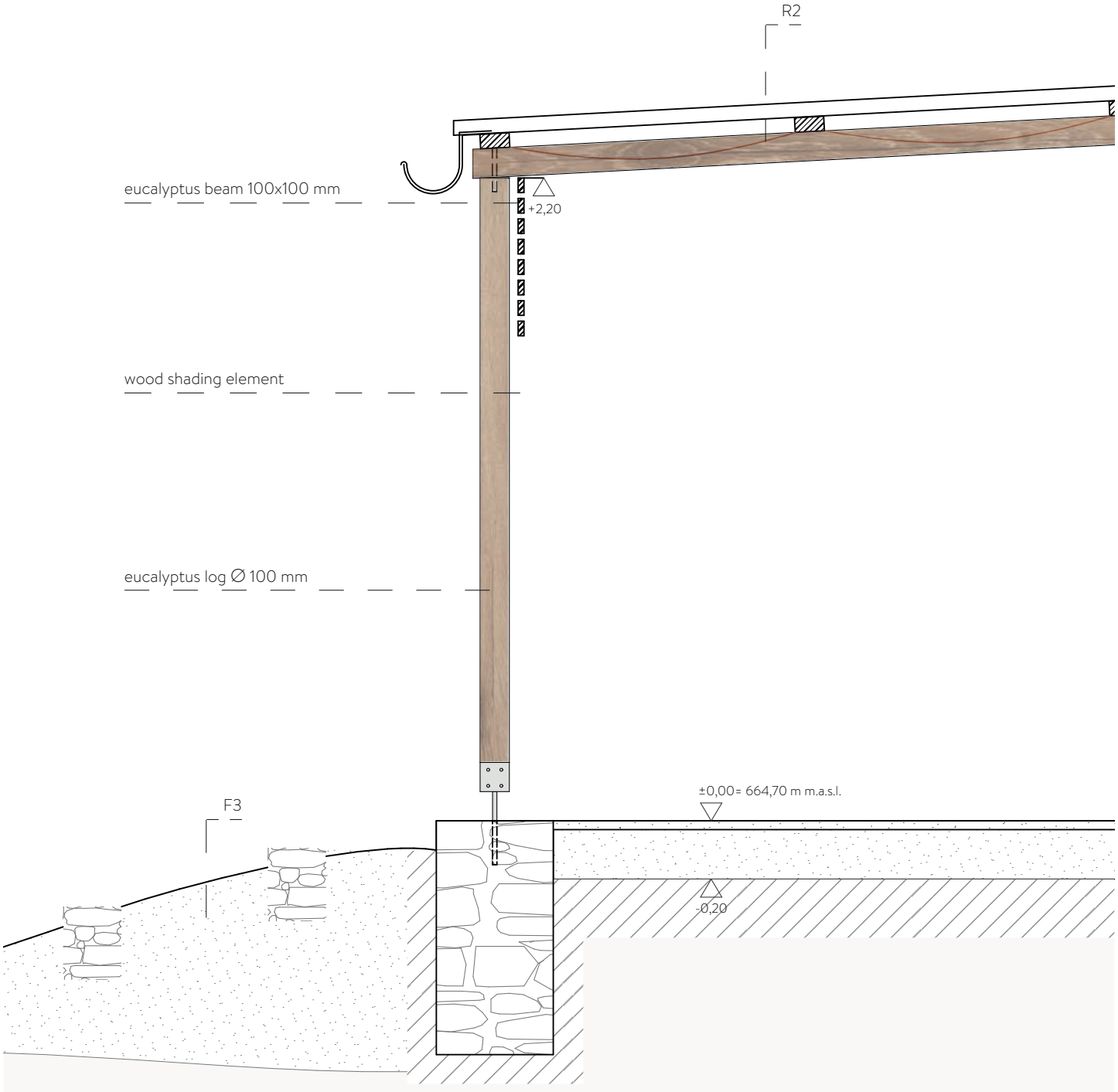
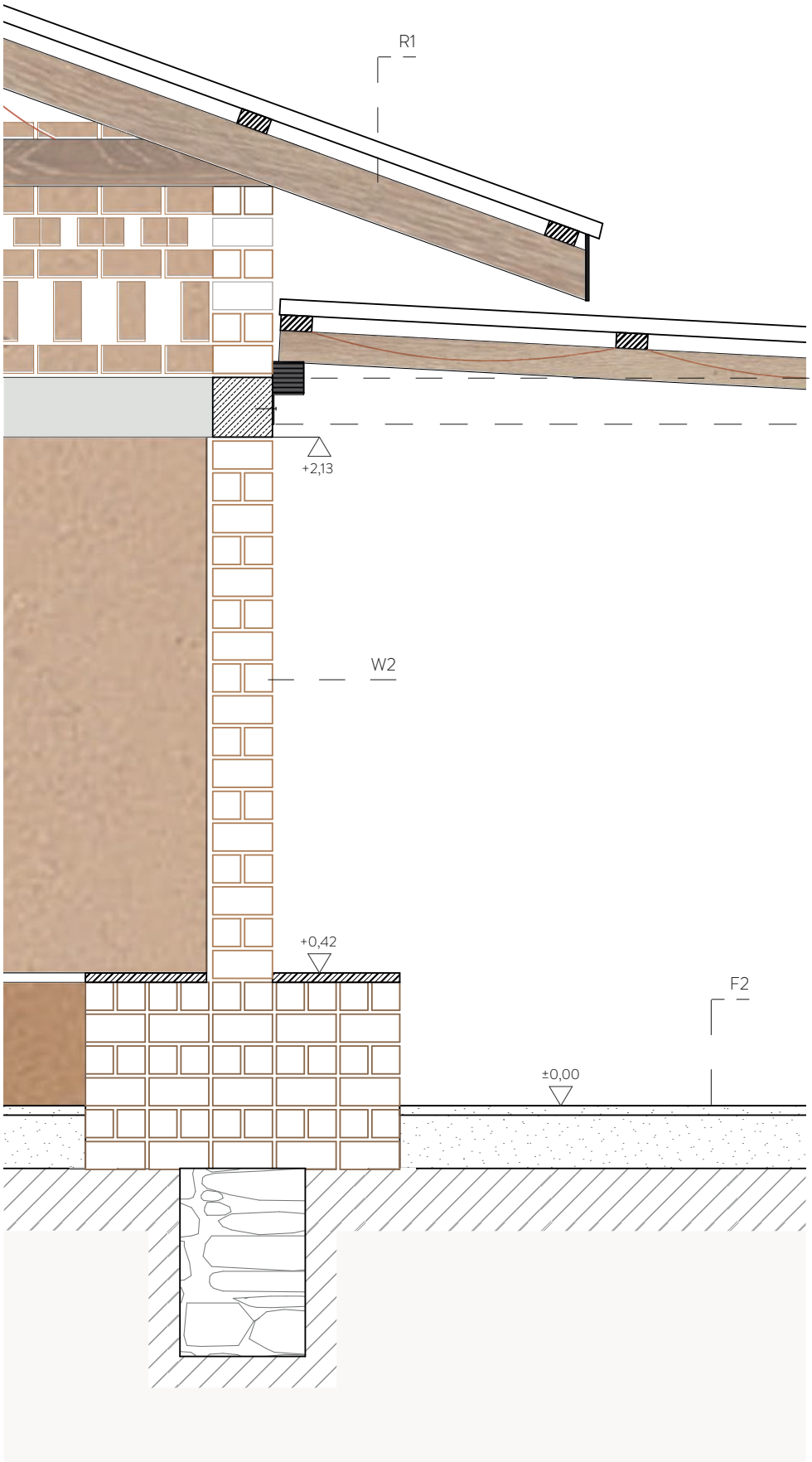


Abb. 87: detail cafeteria 1:20



W2	adobe bricks 4x4x8 inch (1/2 inch joint) 19 cm base area with burned bricks
R2	corrugated iron sheet counterbattens 50x100 mm eucalyptus beam 100x100 mm wicker mat / fabric (against noise)
F2	poured earth 3 cm compressed earth 2% sloped compressed soil 2% sloped
F3	filling 30 % sloped wicker stones

Abb. 88: outdoor perspective courtyard

Abb. 89: indoor perspective classroom

Abb. 90: outdoor perspective cafeteria

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First of all, I would like to thank Univ.- Prof. DI. Dr Andrea Rieger-Jandl, who made this thesis possible and gave me her support. Furthermore, I want to thank Mr. Charles Oyer for being available at any time and providing me with all the information I needed to participate in this project; it was a great pleasure to work with him. Many thanks also to my parents, who always supported me and who enabled our trips to Africa; without them I never could have done this thesis.

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TABLE OF FIGURES