Traditional building methods – such as those used in pueblos, timbered houses, or the Japanese minka – exist in fascinating diversity and create the face of a region. However, as a result of globalization they have been marginalized in many places. In the fastest developing countries in particular, a wealth of experience that goes back hundreds of years is being irretrievably lost, even though valuable insights can be gained for modern building.

Using the examples of selected domestic buildings from all continents, 36 international experts demonstrate why we can still learn from vernacular architecture; they analyze the cultural context and the adaptation to topographic/climatic conditions, and focus on the local materials used as well as on the construction, the building process, and the necessary maintenance.
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The study of vernacular or traditional architecture, that is, the dwelling houses of the population of ordinary people, is an exciting field. Often erected directly by users or a village community without professional help with the design, these buildings exist with an astonishing variety of shapes and technical solutions around the globe, sometimes next to each other in a very confined space. Built from locally available materials such as wood, stone, and clay, they often seem to virtually grow out of their environment and, in this way, also directly impact the face of their surroundings and landscapes.

In the course of industrialization and globalization however, traditional architecture is losing ground worldwide and in some places can no longer be admired other than in a museum. In the developing countries of Asia, Africa, and South America in particular, currently much is being irretrievably destroyed. An enormous wealth of experience that has been passed from generation to generation over the centuries is lost, even though it can truly be of interest for modern building as well.

This book shows a representative cross section of vernacular dwelling houses around the globe, demonstrating their enormous variety. Structured by continent, international experts – including architects, anthropologists, and building researchers – present about 40 different building methods and house types and analyze these in their respective cultural, climatic, and topographical context, not forgetting functional and construction criteria. The different contributions deliberately focus on different aspects — each author presents his or her individual approach within the given framework.

Some articles are based on research carried out by their authors several decades ago, which means that in some cases the illustrated forms of building unfortunately have already disappeared or changed significantly. For this reason, the year the photograph was taken is stated, wherever possible, particularly in the case of older photographs.

Nevertheless, we should point out that vernacular architecture was subject to permanent change in the past too. Since time immemorial, new technologies, materials, and tools led to changes in design and construction. The description of a certain type of building is therefore always a snapshot within an ongoing development process — a process, however, that in times gone by proceeded slowly and continually, whereas today, globalization and the associated rapid spread of modern building methods and styles leads to radical changes in many places. In this context, the book is intended to make a contribution to help us become more aware of vernacular architecture and to capture its enormous wealth of experience and range of designs.

Christian Schittich
On the Sociocultural Significance of the House

From the yurt of the Central Asian nomadic herders to the pueblo of the Indians in New Mexico, from the Japanese minka to the Korowai tree house in Papua New Guinea or the half-timbered house in Central Europe, residential buildings of the ordinary population around the globe display an incredible spectrum of designs and constructions. They are, also, in many places, optimally adapted to the local climate and topographical conditions and are examples of the sustainable use of locally available resources. But a house is much more than just a technically functioning structure. As the living space of its inhabitants, it almost always also has symbolic and sacral significance. Traditionally, its shape and appearance are also largely determined by sociocultural and religious aspects. In many cultures people create their houses not only as their own microcosm, but also as a mirror image of the universe – to this day, this can be seen above all in the buildings of indigenous peoples. In the view of anthropologists, the three-part division of space, that is, the substructure, the living area, and the roof of the stilt houses in large parts of Southeast Asia, represents the underworld, the earth, and heaven. In their book *Peoples of the Golden Triangle*, Paul and Elaine Lewis graphically describe how ritual ideas are associated with housebuilding using the example of mountain tribes in the north of Thailand.

For example, members of the Karen, Hmong, Akha, or Lisu will ask an oracle when selecting a suitable building site in order to ensure that the ancestors or spirits of the soil have no objection to the choice. They will again seek advice – possibly also from the village priest – in order to determine a suitable period for building. The positioning of the houses in the village follows established rules similar to those for the arrangement of doors or windows to ensure that nothing obstructs the good spirits but access is denied to the bad ones. Once the house has been built, a shared process that involves the whole village community, an altar is installed at a place in the building that is determined by tradition; this is used to make offerings to the higher powers or the ancestors. As in many traditional cultures all over the world, people here are firmly convinced that they live together with their ancestors. In this context, they often assign a symbolic meaning to individual construction elements. On the Pacific islands of Oceania for example, the posts and beams of the house represent the ancestors and therefore become objects of ritual (see page 262); in the Xingu area of Brazil, indigenous people believe that the central post represents the center of the universe (see page 366). With the Dogon in West Africa, the symbolic content is particularly vivid. The entire settlement and the house itself resemble the figure of a person lying on the ground (see page 304, 314).

Vernacular dwellings and houses reflect mythical and religious ideas but also the social structures of the inhabitants’ society. The position of the house in the village, formal criteria, or the house’s size may express the social standing of its owners or indicate their membership of a certain caste or social strata. The subdivision of houses into rooms provides clues as to how the family or the clan share their lives. In particular, it may provide an insight as to the relationship between the sexes.

In many cultures there is a clear separation of space for men and women, and even the places for guests are predetermined and can vary in accordance with their standing and rank. Vernacular building is almost always determined by a set framework, with the arrangement of the different functional areas following a standard scheme that is always repeated. The yurt used by the Mongols and Turkic peoples in the steppes of Asia consists of a single room, but here too the division of space is strictly defined; the men sit to the left of the entrance, opposite the entrance is the place of honor (the Mongols also place their altar there), the women keep to the right of the entrance, and the...
fireplace is exactly in the center of the tent (see page 160). This principle has been adhered to for many centuries and across very diverse ethnic groups. As a microcosm of its inhabitants, the yurt implies a high degree of ritual symbolism, which is why traditionally determined ceremonial events such as weddings or the laying out of a deceased person should preferably take place in a yurt rather than other types of rooms. This is the main reason why many Mongols still have a tent in front of their house, even if they have long abandoned their nomadic lifestyle and moved to the city.

Forms of Communal Living: Tent, Courtyard House, and Clay-built Fortresses

Before Homo sapiens became settled, they spent by far the longest period of their 100,000-year history as hunter-gatherers and led a nomadic life. Initially, people left their simple dwellings of branches and twigs, leaves, or grass behind when their clan moved on, re-erecting them at another place. They later developed tents that they could take with them and that were quick and easy to put up and take down. To this day, nomadic lifestyles have survived in various regions of the world, even though they are being increasingly abandoned almost everywhere. In many places, nomadic life is even close to extinction.

The life of nomads is particularly attuned to nature. Nomads often live in very inhospitable regions—the north of Siberia or Alaska, the high steppes of Asia, the deserts of Africa—and rely on maintaining an easily disturbed balance in order to find enough pasture for their animals throughout the course of a year. When they take down their tents to move to another campsite, they leave almost no trace on the earth. Usually a tent is used by one family unit; sometimes there is also space for servants, as with the reindeer herders in the very north of Russia (see page 102).

In permanent houses, too, people mostly live together in a close family unit. There are, however, also many forms of shared communal living. Examples are what are known as the longhouses of various native peoples in North America, in which several nuclear families of a clan live together under one roof. The buildings of the Iroquois are reported to have been up to 130 m long in extreme cases, providing space for several hundred people. To this day, people in remote jungle areas near the Amazon and Xingu Rivers in Brazil build and live in malocas, each of which provides space for an entire clan.

In these dwellings people sleep in hammocks that are tied to the rafters of the large palm-leaf-covered roofs, and families eat around their respective family hearth (see page 366). Whereas most tribes use predominantly oblong forms of houses, those of the Yanomami—located very remotely in the dense jungle in the border area between Brazil and Venezuela—are round and on the inside are open to a courtyard-type space. As in many longhouses, each family here has its own fireplace. Overall, however, the interior space is largely open and food is shared in the community. Having a closed wall around the outside, the footprint of these round structures may be up to 80 m in diameter. They stand for collective, communal living and also help to protect the inhabitants from wild animals and enemies.

The tulou of the ethnic Hakka in Southeast China are also designed with defense in mind: they provide space for numerous nuclear families of a clan (the members of which all have the same surname) who live together in an almost egalitarian way (see page 172). By contrast to the indigenous peoples of South America, each family there has its own rooms in an equal-sized segment of the structure. The largest of these clay castles in either round or rectangular shape measure more than 70 m in access and provide space for up to 800 people.

In terms of construction too, tulou are unusual. On the outside they are unusual. On the outside, there are, however, also many forms of shared communal living. Examples are what are known as the longhouses of various native peoples in North America, in which several nuclear families of a clan live together under one roof. The buildings of the Iroquois are reported to have been up to 130 m long in extreme cases, providing space for several hundred people. To this day, people in remote jungle areas near the Amazon and Xingu Rivers in Brazil build and live in malocas, each of which provides space for an entire clan.

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In terms of construction too, tulou are unusual. On the outside their inner, rectangular footprint usually predominate—either completely on their own or together in parishes and villages, or built close together in cities that previously were enclosed by a city wall. Another type of building is the courtyard house, which is widely used in a range of different climate zones. In countries with an Islamic culture, from Morocco to Iraq, which are characterized by a very dry climate and hot summers, this is the predominant type of building (see page 122). It is an environment that shields family life and provides safety from intruders as well as effective protection from the heat, depending on its design. Likewise, courtyard houses dominate in India (see page 208, 218) and throughout ethnicultural China. From the hot and humid south to the north with its very cold winters, people have optimally adapted this form of housing to the prevailing climate. For example in Beijing, with its northern climate, courtyards enclosed on four sides (siheyuan) are rather large in order to admit much light and sun, whereas in the south they are very narrow, which means that the adjoining buildings provide shade to one another. In tianjingyuan (heavenly well houses) in Jiangxi, the central courtyard is so narrow and covered by wide roof overhangs that direct solar irradiation does not reach the facades, while rainwater from the roofs is let into the courtyard where it is collected in a well. The high, white-plastered external masonry walls have almost no windows and protect from the heat and the often strong storms as much as from marauding gangs.

Courtyard houses—in different sizes and designs—can be easily extended to form larger structures. It is fascinating that in China the same urban design principle—based on symmetry and Confucian order—can be observed in even the very remote villages through to the monumental Forbidden City in Beijing, the former seat of the emperor.
The cave dwellings in the Chinese loess belt on the Yellow River represent a special type of courtyard house that is remarkable; in these dwellings, individual rooms are grouped around an approximately square courtyard that has been cut out of the ground. By digging their houses into the ground, farmers can make use of the land on top for crops. At the same time, the thick layer of loess – a relatively loose, loamy sediment – has a strong temperature-balancing effect. During the very cold winters in that area, the rooms, the construction of which requires hardly any building material, remain relatively warm, whereas in the hot summers they stay cool. Where the topography makes it possible, that is, in the more hilly regions, the dwellings are cut horizontally into the slopes and sometimes have a small extension out front or a small courtyard at the front of the house.

Until a quarter of a century ago, an estimated 35 million people in the loess region lived in such cave dwellings, spread out across roughly seven provinces. However, owing to the lack of comfort, the amount of maintenance required, and the general rural exodus, most of these buildings are now vacant and dilapidated. In the few remaining cave settlements, inhabitants consist primarily of single older people. Some other dwellings have been refurbished and upgraded to be used as hotels and thereby ensure their future existence. Like in China, cave dwellings can be found all over the world where the terrain and the prevailing ground conditions make them possible. Without any doubt, those in the Turkish region of Cappadocia are among the best known; in this already bizarre landscape with its cones of volcanic tuff rock, dwellings feature numerous windows and loggia-type recesses. They are the visible signs of the often multistory dwelling units that are common in the region and are dug deep into the mountains. Tuff is a hardened volcanic rock that is relatively soft and hence easy to work with. In Cappadocia the material excavated during construction is used as building material for internal walls and facades, as well as for the construction of freestanding houses. Whereas in some places people literally sink their houses into the ground, others cannot have their houses far enough above it; an example are the tree houses of New Guinea, which can only be reached by climbing extraordinary forms of ladders (see page 278). Far up in the trees, and hence protected from enemies and evil witchcraft, members of the Korowai and other tribes create their microcosm in the midst of nature. But even in these dwellings, people adhere to a traditional, always repeated organizational scheme that reflects the familiar order.

Making Do with Locally Available Resources

Due to the absence of alternatives and sheer necessity, indigenous people had to rely on locally available resources for the construction, maintenance, and operation of their houses until the situation gradually started to change as a result of industrialization in the nineteenth century and the development of a transportation network. This often led to sustainable structures in combination with sophisticated concepts for passive climate control, which made life more bearable in very hot regions as well as very cold ones and helped save generally precious fuel for heating. Such measures start with positioning the building in the topography where it is protected from prevailing winds, and include the deliberate utilization of existing sources of energy, such as natural solar irradiation, or the heat from cattle, which is used by placing the stable next to or beneath the living quarters. On the cave dwellings in the Chinese loess belt mentioned above, which are dug deep into the ground and therefore only use a small part of the precious farmland and only small quantities of building material, the thick covering layers of earth have a temperature-balancing effect, which helps to save heating
fuel, particularly in winter. Similarly, the wind towers in Iran and the Arabic countries, which in a sophisticated way provide a draft and hence cooling in an oppressively hot climate, or the malocas of the indigenous peoples of South America, which consist exclusively of renewable raw materials, are impressive examples of the careful use of natural resources. However, this does not necessarily mean that all vernacular buildings and indigenous lifestyles are sustainable. Because where people have access to an excess of materials and space, they will always use them. For example, in the seemingly endless jungle areas of Asia or South America, many tribes traditionally relocate their villages or houses within a few years. They practice agriculture as monoculture, and as soon as the soil is exhausted they move on and create new farmland by fire clearing. This applies to some of the mountain peoples of northern Thailand mentioned earlier, as it does to the Yanomami in the Amazon. In other places, whole forests were cut down for firewood that was used to heat insufficiently insulated houses in winter; this was the case in some valleys of the Himalayas and the Karakorum. The disagreeable side effect there is soot-blackened rooms, which are full of smoke day and night, which often leads to diseases of the respiratory system or of the eyes.

Traditional building methods are a visible characteristic of a society that is rooted to its ancestral land and deeply connected to its houses – not least because inhabitants usually build these themselves and have to take an active part in their ongoing maintenance. It is not surprising, therefore, that often the lack of comfort and the extensive effort required for maintenance and repair are the main factors motivating people in many places to give up their traditional homes. For example, the fascinating clay buildings in the Sabel zone of Africa, which look so appealing to us, need fundamental repair every year after the rainy season. Likewise, the plant-based raw materials used for construction, such as bamboo, palm leaves, and jungle grass, which are widely available in Asia and South America, tend to disintegrate quickly due to insect attack and humidity, which means that some building components have to be renewed on a regular basis. This leads to the seemingly contradictory phenomenon that natural building materials in particular, such as clay or bamboo, the use of which we in the West admire, are considered by the locals to be materials of the poor, whereas the use of concrete and corrugated iron seems desirable. How an improvement in comfort and durability can have a direct effect on the consumption of resources can be demonstrated using the example of the manufacture of bricks. Even though fired bricks have been known for thousands of years, they were almost everywhere in the world reserved for the houses of the rich and for important public buildings due to the high energy consumption in their manufacture. However, in the nineteenth century at the latest, this building material became increasingly popular in Europe and Asia, as well as in some African countries, where it was introduced by colonial powers in some places. With the advent of fired bricks, even ordinary people finally had a weatherproof and durable replacement for their air-dried bricks and maintenance-intensive walls. On the downside, however, there was the fact that many thousands of trees and other raw materials disappeared in the kilns. In some areas this even led to the complete loss of forests. Nevertheless, bricks belong to the classic building materials of vernacular architecture.

Learning from Traditional Architecture

When we set out to analyze traditional building methods for possible incentives and stimuli for our current architecture, we have to consider not only the ecological, formal, and construction-based factors, but also the social framework...
conditions that define the way we live together. On the one hand we can see many positive aspects that, unfortunately, are being lost today. These include the close-knit cohesion of the family structure and within a village or urban neighborhood. In many cultures people are highly dependent on one another, and often an entire village community helps to build a house for a single family. At the same time, however, life in the dwelling is usually subject to strict rules; specific areas are allocated to the sexes and access to certain rooms is forbidden to women and girls. Individuals' freedom of action is strongly limited and, conversely, social control within the community is extensive and certain groups, such as members of lower castes, the supposedly “unclean,” or servants, often are not allowed access to the house or the option to settle in the village (see page 148). The fact that house plans in some ethnocultural areas have been designed for a long time in accordance with the same scheme can be largely ascribed to such sociocultural conditions. By contrast, living together these days is much less formal and not so much determined by rigid ideas. Of necessity, this is also reflected in the design of houses. Even if, in our view, these considerations may lessen the value of traditional forms of building, they do not put into question their enormous cultural value, and we do not intend to doubt that there is an enormous potential stimulus from vernacular architecture that can enhance our approach to architecture today. However, in view of the fact that a house must always be considered as a whole, we cannot hope to adopt complete solutions but rather need to understand and apply the inherent principles of traditional building. Without any doubt, one of these aspects is the sustainable use of resources—a subject that cannot be emphasized enough in view of accelerating climate change and mounting problems caused by environmental pollution. In this respect, vernacular building methods can provide numerous pointers, ranging from the systematic use of renewable raw materials to passive concepts for natural ventilation and cooling or the use of already existing sources of heat. Clearly, the broad idea of sustainability also includes the parsimonious use of space—both in terms of settlements and in terms of the floor plans of houses. Traditionally, individual buildings in a village or town stand close together not only for reasons of defense, but also in order to lose as little as possible of the precious land used for farming. Similarly, the spatial organization of the dwellings is characterized by frugality. In many cultures this is achieved by carrying out various activities in the same space; this is particularly evident in the minka, the traditional Japanese house of the ordinary people, where inhabitants roll out their futons at night to sleep in the same place in which they live, eat, and work during the day. Smaller living spaces mean a saving in building material, and leave more open space as well as requiring less heating during the cold season. This kind of traditional living concept continues to thrive in Japan, where currently the average use of space per person is only about half that of people in Germany or Switzerland. The minka’s flexible layout is enhanced by a high degree of variability. Using sliding doors, rooms can be either enlarged or divided as required (see page 246). The traditional Japanese house can also give us ideas with regard to standardization. Everything here is based on the dimensions of a tatami mat (ca. 0.9 × 1.80 m). This leads to a uniform construction grid and makes it possible to prefabricate individual building components. In spite of that, necessary personal design freedom is retained for each building owner. Residential construction as it is currently practiced in our society, which is confronted with the task of cheaply and quickly producing well designed and functioning residential space, can benefit from such principles. The least we can learn from studying traditional building methods is that a house is far more than just its shape, appearance, or construction. As the habitat of...
its inhabitants, it is a firm component of their culture. For this reason alone it is problematic to transport the principles of an international, modern architecture that has its origin in the West to the remotest regions of the world without adapting them to the physical and cultural local conditions. It is perhaps not by chance that the (initially still tentative) interest in anonymous architecture arose precisely at a time when the criticism of an international style, with its strong uniformity rapidly spreading across the globe, began to erode.

In 1957 the art historian Sibyl Moholy-Nagy, in her publication Native Genius in Anonymous Architecture, in which she describes the hidden qualities of North American settler buildings, probably for the first time used the adjective *vernacular* in the context of architecture, which, in accordance with its original Latin meaning, means something like “home-grown” or “colloquial.” The term *vernacular architecture*, which essentially refers to building by ordinary people without the help of a professional designer, has since become an established term in the English language, whereas in German no corresponding term exists to this day.

At the end of the nineteen-fifties, following numerous journeys, the Dutch architect Aldo van Eyck pointed out at various events – including the CIAM congress in Otterlo – the different levels of meaning and the symbolic content of the buildings of the Dogon in Mali and of the pueblos in New Mexico, comments that were also intended as a criticism of the lack of soul in modern architecture. In 1964 this was followed by Bernard Rudofsky’s much-noted exhibition Architecture Without Architects at the Museum of Modern Art in New York. For a long time, his supporting book of the same title remained the only globally relevant publication on the subject, even though it is largely a collection of images with commentary. Paul Oliver is probably right when he suggests, in the foreword to his comprehensive Encyclopedia of Vernacular Architecture of the World published in 1997, that the author placed too much emphasis on formal aspects and hardly took note of the cultural background or daily life of the inhabitants. On the other hand, it was precisely Rudofsky’s one-sided focus on anonymous buildings as works of art that managed to arouse the interest of many architects.

However, in spite of their increasing popularity, traditional building methods as a whole have not been adopted in architectural teaching at universities. We can therefore only hope that this will change in the near future and that anonymous building, together with the wealth of experience gained over the centuries, will be given appropriate weight in addition to established architectural history, which primarily focuses on prestigious architecture such as sacral buildings, palaces/castles, and museums. There can be no doubt that there is sufficient material and many concepts to learn from.

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**Endnotes**

1 Lewis and Lewis, 1984


4 Oliver, 1997

**Bibliography**


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The design of traditional Japanese houses follows the grid of the tatami mats, but is nonetheless quite variable. Rooms can be closed off or extended using movable sliding elements. Regarding the material and fit-out, there are only small differences between feudal villas and simple farmhouses.

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**Endnotes**

18, 19 Grand villa in Takayama

20, 21 Farmhouse from the Edo period (1603–1867) in central Honshu

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Locally available building materials influence to a high degree the construction and hence the appearance of vernacular architecture. It is fascinating to see how similar conditions in regions that sometimes are geographically far apart lead to similar types of building— and sometimes also to completely different types. How much material and shape are mutually dependent can be seen in the roof. Whereas thatched roofs have to be particularly steep for technical reasons, roofs covered with wooden shingles that are weighed down with stones must be relatively shallow; tiles, on the other hand, allow for different roof angles depending on their design. Changing the covering material therefore usually results in a considerable change in the roof slope and hence in the overall shape of the house. For example, in the south of Upper Bavaria, thatched roofs predominated for a long time, as they did in many other parts of Central Europe. When the material became scarce owing to changes in agriculture, wooden shingles used as a roof covering became popular, spreading from the Alpine area, and as a result roof slopes became significantly shallower. Finally, in the middle of the nineteenth century, machine-made interlocking roof tiles conquered the market not least because of the better fire protection, which in turn meant that roofs had to become a little bit steeper.

The development of completely flat roofs is not only due to a low-precipitation climate, but is often associated with a shortage of timber, with the latter frequently being the result of the former. The construction of flat roofs requires significantly less timber—a precious construction material—compared to the often complex roof structures of sloping roofs. For example, when only short distances need to be spanned, a supporting layer of irregular wooden sticks is sufficient; for larger spans, just a few beams are often enough to support a layer of branches, twigs, reed, or bamboo. Flat roofs in traditional architecture often need much maintenance; on the other hand, they can be used in a number of different ways—as an extension of the living space and for drying foodstuffs and animal feed for winter.
Timber and Renewable Raw Materials

Timber is probably the oldest building material and, in vernacular buildings, also the most universally usable. Where this natural material is available in abundance, it usually plays the most important role. But in areas where hardly any trees grow and therefore wood has to be transported from far away, it is also used—with just a few exceptions—at least as ceiling and roof beams. Timber is not only a renewable raw material with all the associated ecological advantages, it can also be processed easily and with relatively simple tools. For thousands of years, people around the globe have used the material in creative ways and have developed fascinating timber construction methods. These depend heavily on local forests and their trees. In the east of Europe and in the Alpine region, where long, straight tree trunks can be obtained from dense forests, log houses were developed as pure timber buildings; by contrast, half-timbered buildings dominate Central Europe.

In the Far East, a post-and-beam construction method with deflection-resistant tenon joints developed. Whereas in Japan and Korea the wall areas between the structural timbers are usually closed with infill panels, in China it is more common to enclose the freestanding timber structure with thick walls consisting of rammed earth, stone, or brick. Generally speaking, timber buildings can be easily dismantled and put back together at a different location; alternatively, it is often possible to reuse well-preserved parts in a different construction.
14 Cross section through an Upper Bavarian farmhouse with second floor and loft in log construction. Drawing from: Ottmar Schuberth, Führer durch das Freilichtmuseum des Bezirks Oberbayern an der Glentleiten (Grossweil bei Murnau, 1978)

15 Window in a log wall in Tyrol, Austria

16 Corner detail of log building with round logs, Sweden

17, 18 Facade with shingle cladding, Vorarlberg, Austria

19 Farmhouse in log construction in the Museum for Tyrolian Farmhouses at Kramsach, Austria
In many areas in Southeast Asia and in Latin America, the timber sections used for the structural part of the building are combined with bamboo components—often in the form of woven wall elements using flat strips of split bamboo tubes. Bamboo is a fast-growing raw material with high tensile strength and, like timber, can be used in a very wide range of applications. Owing to its structurally strong tubular form, its low weight, and its straight growth, bamboo is easy to handle and quick to process. Almost all work processes can be carried out using just one special type of knife as a tool. This is used to fell the stems, cut them to length, and split them. The outer shell of young shoots can be used to make ropes which, like rattan, are used to tie timber sections together. In the areas where bamboo grows it is not only used in house construction but also for furniture and household items, including cups, plates, and bowls.

In traditional construction, roofs are often covered with plant material such as reeds, grass, or palm leaves. To do this, the people of many different cultures have developed sophisticated methods: the majestic roofs of the farmhouses in Shirakawa, Japan, consist of layers of rice straw that have been woven into thick bundles and tied to the roof structure. The Zulu in South Africa, having detailed knowledge of the specific material properties, use up to ten different types of grass for covering their round huts. Likewise, the indigenous people at the Rio Xingu in Brazil, similar to their neighbors in the Amazon, or people in the Caribbean, have developed sophisticated techniques for covering their roofs and walls with palm leaves. For their maloca (longhouses), they sometimes use more than twenty different types of plant to build the load-bearing structure and make the cover material.

In some very poor countries, such as Myanmar, even today people build complete houses in rural areas using only renewable raw materials. However, those who can afford it increasingly choose corrugated iron instead of palm leaves or grass due to the effort involved in maintaining the plant-based roof covering. For example, woven wall panels have to be renewed every four to five years, and the roofs made of plant material even more often in order to withstand the next monsoon rain.
Tents and huts of African nomads, built from renewable materials.

24. The Dassentech people in southern Ethiopia use bendable branches to build their mobile huts. The branches are tied together with bast fiber and covered with bark, reed mats, and animal hides.


27. Construction of a house of the Dorze people in Chencha, Ethiopia. The woven exterior is subsequently covered with grass.


29. The traditional houses of the Marsh Arabs in Iraq are completely built of reed. The load-bearing structure of the vaulted roof consists of reed tied into bent bundles. The outer skin consists of several layers of woven reed matting (photos around 1975).
Roofs built of renewable raw materials

30 Rice straw, Japan
31 Straw, Sweden
32 Turf, Faeroe Islands, Denmark
33 Reed, Rajasthan, India
34 Straw, Scotland
35 Straw and palm leaves, Myanmar
36 Banana leaves, Thailand
37 Maranta leaves, Cameroon
38 Bark, reconstruction of a Wampanoag house, Massachusetts, USA
39 Palm leaves, Myanmar
40 Farmhouse covered with seaweed, formerly on the island of Læsø, Denmark, currently in the Frilandsmuseet in Lyngby
Natural Stone

Natural stone is one of the oldest building materials. In vernacular buildings it is primarily used in the form of rough stonework, which is laid either dry or using clay or lime mortar as a binding agent. Occasionally natural stone is used in walls in the form of round rubblestone. Splittable stone, such as slate, is also often used as roofing material. But even in regions where natural stone is widely available, the material is not necessarily used for building simple houses because it is very laborious to process. On the other hand, buildings built of natural stone are very long-lived. For this reason, the material has traditionally been used for important buildings for thousands of years. In some areas, however, such as the Ticino (where local granite can be split into slabs), we find entire villages where the houses seem to consist of this one material only: the walls are built of natural stonework, the roofs are covered with heavy granite slabs, even the balconies and projecting steps consist of the same material, as do footpaths and floors. The buildings almost seem as if they have grown from the rocky ground.

Houses built of natural stone from their immediate environment often seem to be particularly at one with the surrounding landscape.

41 Mountain village Kahel in the Yemen
42 Simple stone-built houses at Lake Yamdrok in Tibet
43 Alpine cottage above Cornipes in the Ticino, Switzerland
44 Farmhouse on Öland, Sweden
45 Farmhouse in the Bregaglia Valley, Switzerland
46 Stone house in the Périgord, France
Clay as a Building Material

Earth is one of the oldest and traditionally most used building materials worldwide. The mixture of clay and quartz sand can be found almost everywhere in the ground and usually can be dug out directly on-site. Depending on its composition—the clay components consist of extremely small platelets of eroded stone—the material can have different properties and colors. Walls built with it are constructed using the rammed-earth method with movable shuttering or a technique using preformed round elements. However, they can also be modeled directly, as is the custom of various peoples in West Africa, who construct real works of art in this way. The raw material is also often used in the form of air-dried bricks, which, after being laid, are finished with a smooth coating of the same material. Building components made of clay have a positive effect on the room climate. They store heat and moisture and release these again with a beneficial delay in time.

Clay is liable to suffer from erosion, particularly when exposed to direct rain. For this reason, clay-built structures normally require a high degree of permanent upkeep and maintenance. On the other hand, the material can be recycled without any residue, because it will return to its original components. In order to make the material more durable it is often mixed with additives: shredded straw reduces the formation of cracks during drying; sometimes animal manure is used; and oil or plant saps are added to render the surface water-repellent. In addition to its use as a primary building material (for load-bearing walls or for covering flat roofs), clay is also used in combination with a wattle of branches or bamboo strips, making what is known as wattle and daub to fill the open spaces in timber buildings, and as mortar and plaster on stone masonry.
Material and Construction

51 Rammed earth wall in Fujian, China
52 Joint between a rammed earth wall and air-dried brick masonry in Turfan, Xinjiang, China
53 Wall built of rough clay bricks, Xinjiang, China
54 Wall built of stone with clay mortar and clay bricks in Jiangxi, China
55 Wall of fired bricks and natural stone with clay mortar in Jiangxi, China
56 Whitewashed flat-brick wall in Jiangxi, China: the cavities are filled with earth.
57 Clinker masonry in England
58 Farmhouse in Denmark with masonry in face bricks
59 Half-timbered building with brick nogging in northern Germany
60 Workers in a brick factory in West Bengal, India
The quality of clay bricks can be improved by firing, a technique that started being used more than 5,000 years ago. This makes the bricks stronger and harder, and much less vulnerable to the effects of the weather. In Europe, fired bricks were used since Roman times. As in other parts of the world, they were not available to ordinary people due to their high price, and were mostly used for important buildings. Bricks have different properties and colors due to the regional variation in the composition of the clay, as well as different temperatures and firing practices.

At a temperature of over 1,100 °C the material undergoes a sintering process and becomes particularly resistant to the penetration of water. Traditionally, bricks are used as a building material for walls, where they are laid in bonds and joined with lime mortar. They are also used to fill in the open panels in half-timbered buildings or to construct vaulted ceilings. Last but not least, clay is also used in fired roof tiles, which are widely used in different ways in vernacular architecture as a weather- and fire-proof roofing material.

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The Low German House

Michael Schimek

Designation, Distribution, History

The Low German house, or byre-dwelling, is an agricultural dwelling that combines living quarters with stables for livestock and storage areas for the harvest under one roof. This type of dwelling appeared in the Late Middle Ages and can be found in the Bergische Land in the southwest, in the Lower Rhine area, in the eastern Netherlands, in Westphalia, and Lower Saxony; through to Holstein in the north and Mecklenburg and Pomerania in the northeast. The distribution of the house largely coincides with the Low German language area; this fact, and the layout, which is dominated by the large interior hall, in the nineteen-thirties led to the designation in use today. The terms used in older literature, such as Low Saxon house, rely on outdated research assumptions, which interpreted the distribution of this type of building – which exists in many regional versions – as an indication of areas where Germanic tribes had settled before the Migration Period. In their core, that is, in parts of the internal timber structure, the oldest surviving Low German houses date from the last third of the fifteenth century and can be found primarily in the eastern Netherlands and also in the Elbmarsch area near Hamburg. To date it has not been possible to demonstrate a continuity linking the style to early byre-dwellings with a similar floor plan before the Migration Period. The style of building became increasingly unpopular toward the end of the nineteenth century, largely due to changing requirements in terms of both comfort and commercial viability. Previously, the so-called Gulf house, which had become popular at the Dutch and German coasts of the North Sea in the sixteenth century due to its timber-saving construction method, had started to replace the Low German house in the northwest of Germany because it better suited the agricultural lifestyle. The last newly built Low German houses...
The central hall that dominates the three-bay floor plan fulfilled a number of purposes: it served as a circulation area and workroom, in particular for manually threshing crops with a flail during the winter months; the floor usually consisted of rammed clay unless stone slabs could easily be obtained locally. On the sides of the building, cows were stabled along the external walls with their heads pointing toward the hall. In Lower Saxony, horses were stabled behind the gable wall of the working area, to the right and left of the large door that in most areas was placed centrally in the gable wall and which was large enough to allow wooden carts or horses to enter the building so that the harvest products could be unloaded in the hall. In other areas, horses were also stabled in one of the side bays and the main door was placed slightly off-center. The harvested product — primarily grain on the stalk and hay — was stacked in the mighty loft area using forks. But the hall was also used for celebrations, and it was the place where the dead were laid out. At the rear end of the hall, stretching from one external wall to the other, was the Flett, an area used mostly for household work; in the typical examples of this house an open fire was maintained at its center, which was used for cooking with the help of an adjustable cauldron hook and which — until into the nineteenth century — often did not have a chimney. When chimneys and flues were introduced, there were differences both regionally and in terms of social standing. In some areas surveys have revealed that this constituted a later addition to the building. For example, in Mecklenburg there were also houses without Kammerfach areas, in which the living quarters were placed separately in one or two side bays, the open fire was also placed in one of the side bays, and the main hall allowed carts to pass straight through. The Kammerfach contained heatable rooms which were free of smoke, as well as small unheated compartments; the rooms were heated with metal stoves that were filled from behind the wall, that is, from the Flett. Above these living quarters, threshed grain was stored in the grain loft. The Kammerfach was inhabited by the farm family, often together with members of the older generation. The bedsteads were usually built into the walls in the form of cabinets known as Durken, Butzen, or alcoves. Where farmhands were present, such as was the rule at medium or large farmsteads until the Second World War, they were allocated the working areas for sleeping, with the male farmhands preferably above in the Kammerfach or near the horse stables and the maidservants in the alcoves that were installed around the Flett. Barns, storage buildings, bakehouses, pigsties, and later also garages for vehicles.

Construction and Volume

The three-bay floor plan of the Low German house is mirrored in its construction: two rows of timber studs on the inside are placed parallel to the ridge and support the main structure and the roof, thereby forming the three bays. If the head plate is positioned above the middle line, the inclination of the rafters is often slightly greater than that of the ceiling joists. One end of the rafters is supported on a wall Plate and the other end is supported on the head plate. The rafters are typically in a slightly diagonal position, which means that the head plate is positioned above the upper of the rafters. The head plate is supported on the wall Plate and the ceiling joists are connected to the rafters with the tenon projecting out of the wall Plate. The rafters are connected to the studs with the tenon projecting out of the wall Plate, which means that the head plate is positioned above the ceiling joists — sometimes by a distance of several centimeters. Struts brace the inner construction of the building in longitudinal and transverse direction; braces were used to bolster the external walls and vary in design depending on the region and over time. The bottom ends of the rafters of the usually straightforward
collar beam roofs are either fitted to the ends of the tie beams (tied system) or to a foot purlin. Sprockets are used to extend the rafters across the external walls, and wind braces are fitted to strengthen the roof in the lengthwise direction. The oldest forms seem to have had hipped roofs that were extended on the sides down across the side bays (Klübbungen) and included a large door to the hall; this form mostly survived in the smaller houses of the lower social strata. In the different regions the styling of the gable sides varied, in particular the gable leading to the barns and stables, which in most areas was considered to be the show side of the building. Outstanding examples of these are the half-timbered balloon-framed gables of higher-class farmhouses in the Osna- brick Artland region, which, for reasons of prestige, featured rich carvings, inscriptions, and several projecting stories supported at the ends by consoles or cleats. Further to the south steep boarded gables dominate, whereas more to the north half-hipped roofs with so-called owl holes are more common. Until far into the nine- teenth century roofs were covered by thatch or rye straw unless materials such as sandstone were available, as in the Solling area. Once it became necessary for property owners to have a fire policy, and building laws became stricter, the tendency was to use fireproof clay roof tiles or pantiles – frequently applied to shallower roofs. Besides the construction with two load-bearing rows of studs, which carried the roof structure, a system using four rows of load-bearing studs became popular in the southeast; in these build- ings the external walls reached up to ceiling height and the tie beams run all the way from one external wall to the other, across the four rows of studs. In addition, a mixed form using three rows of load-bearing studs also existed; in this system only one external wall is raised up to ceiling height and the tie beams/ceiling joints run across three rows of studs. The distance between the two rows of load-bearing studs varies between approximately 1.50 and 4.00 m, and the number of subdivisions could range from 4 up to 20 m, depending on the particular farming requirements; the width of the hall can be up to 10 m and its height in the four-stud row version up to 4.50 m, which is enough to accommodate another floor. The external walls, which in the two-stud row structures mostly have to carry their own weight, are initially built in the following year at the construction site. A master carpenter in charge of the building and supported by about ten carpenters needed about four to five months to prepare the timbers for a large Low German house measuring, say, 15 m in width by 45 m in length. Putting up the framework and roof structure only took about a week, with possibly up to 300 helpers from the neighbor- hood assisting in the process; in many areas the topping-out date was carved into the lintel together with the names of the owners and, in some places, that of the master carpenter. After that it took another year until the roof was covered, the walls closed with wattle and daub, floors were laid, and all rooms were decorated.

Building Process

Unless the construction of a half-timbered Low German house became urgent because the previous version had burnt down, the process of collecting all the necessary timber – up to 200 m\(^3\) (primarily oak) – took more than a year.\(^8\) It was usual to fell the logs in winter and then to saw and process them in the following year at the construction site. A master carpenter in charge of the building and supported by about ten carpenters needed about four to five months to prepare the timbers for a large Low German house measuring, say, 15 m in width by 45 m in length. Putting up the framework and roof structure only took about a week, with possibly up to 300 helpers from the neighbor- hood assisting in the process; in many areas the topping-out date was carved into the lintel together with the names of the owners and, in some places, that of the master carpenter. After that it took another year until the roof was covered, the walls closed with wattle and daub or brickwork, windows and doors were made and fitted, floors were laid, and all rooms were decorated.
Endnotes
5. See, for example, Pöller, Das altdeutsche Bauernhaus (see note 2).

Bibliography


12. The four-post construction with ceiling joists extending to the outside walls makes higher side walls and therefore two-story use of the building possible. House in Kamen-Methler, district of Unna (built in 1820; photo: Michael Schinke, 2019).
13. Rookhuus Göhren: squat and timber-saving; Low German house in the form of a sugar loaf, built around 1720 in Göhren (Rural District of Vorpommern-Rügen), today at the Mönchsgüler Museums.
Half-timbered Buildings in Southern Germany

Konrad Bedal

Timber framing is an elementary and universal method of building with wood that was the predominant construction method for secular buildings in many parts of southern Germany for at least 800 years – ranging from small stables to grand country houses. Timber frame construction was not only widespread in southern Germany, but also in many Western and Central European regions where timbered construction is the most important historical construction method, taking into account the sheer number of buildings. To date, the number of historical half-timbered buildings has not been quantified in detail. An approximate quantified survey of timbered buildings is only available for Franconia. Most of these are located in the former imperial cities in what is now Middle Franconia. When looking at buildings up to around 1750, it is likely that Franconia still has at least 10,000 half-timbered buildings, and the number in Baden-Württemberg is likely to be quite similar. Nevertheless, this is only a fraction of the buildings that once stood.

Timber framing as a wall construction method started to wane at different times in different regions, sometimes already in the sixteenth century but certainly increasingly so from the middle of the eighteenth into the nineteenth centuries. From that time onward, existing and newly built timber structures were also frequently rendered hidden, so to speak, which means that they are no longer evident in many parts of towns and villages. However, a few rural areas did not follow this trend in quite the same way; examples include Hobenlohe, northern Franconia, and the area to the east of Nuremberg, where exposed half-timbered construction remained popular up to the middle of the nineteenth century – and for ancillary buildings such as barns and stables, even up until the early twentieth century.
When considering the extent of building activity over time, it is not surprising that the number of buildings in existence continuously increased from the end of the thirteenth century to around 1800. However, in Franconia, for which the best statistical data is available, the number of buildings in existence was also subject to significant fluctuation which, to a large extent, is likely to apply to the rest of southern Germany, too: a case in point is the rapid expansion around 1400 to about 1450 and a certain dip in the first three decades of the sixteenth century before the numbers grew exponentially from 1550 to reach a peak in the decade between 1680 and 1700. A deep trough occurred in the middle of the seventeenth century, reflecting the effects of the Thirty Years’ War, which was not compensated for until the decades around 1700 when building strongly picked up again. The basic principles of half-timbered building and the change over time of its construction and design details are very similar throughout the whole of southern Germany. Many regional variations exist, but there are no differences in the general principles.

Craftsmen and the Building Process

The construction of a half-timbered house – be it a farmstead or townhouse – needs careful logistical preparation and relies on professional methods of working. Since the Late Middle Ages at the latest, specialized craftsmen (carpenters) carried out the work; from the fourteenth century or earlier, they had to go through several years of training that was precisely regulated by guilds or similar organizations. The most important members of a half-timbered building were either hewn into square profiles with an axe or – a method less common in southern Germany – sawn with the log placed on elevated scaffolding. Before being erected, the timbers are joined up temporarily on the carpenters’ yard (framing ground) and are marked with paint or are punctured. For more complex buildings it is likely that simple working drawings were also used, although reportedly not before the end of the fifteenth century. For the purpose of erecting the timber framing, carpenters were assisted by unskilled helpers, for example members of the family, neighbors, day laborers, and sometimes even women. This labor force was also involved in the application of wattle and daub, that is, in filling in the panels between the timbers. In towns in particular, this work was carried out by a special branch of craftsmen referred to as daubers.

On average, the time needed to build a half-timbered house was just short of a year: logging in winter, dressing and erecting the logs in spring, filling and daubing in summer, and interior fit-out with doors, windows, floors, stores, and ranges in autumn. Faster logging did not take place until the summer and still the house was erected over before the onset of winter.

Whereas in some rural areas roofs were covered with thatching and shingles until late into the nineteenth century – stone roofing was limited to the central Altmühl area – tiles became the dominant roofing material of half-timbered buildings in towns and cities during the fourteenth century at the latest. The underlying roof construction for the respective type of roofing material does not need to vary much, except perhaps as regards the usually wider spacing between rafters under thatched roofs and the lower pitch of roofs covered with stone.

Frame and Jointing

The basic frame in half-timbered construction consists of vertical members, that is, the posts or columns (hence “post-and-beam construction” as opposed to “log construction with horizontal wall timbers”), and the wall plate or head beam at the top of the vertical members, that is, the posts or columns. Diagonal members (braces) are used to brace the basic frame and additional horizontal members, called nogging or blocking, are inserted to make the panels between uprights smaller. Usually these upright members of the frame stand on a timber threshold, also called sill beam or abovement piece, that is placed at the base of all peripheral walls. The existence of a sill beam has even been used to try to define half-timbered construction. However, there is a region in southern Germany and Middle Franconia where buildings, dating from the very oldest examples through to the nineteenth century, largely exist without a rectangle of sill beams, and the...
A critical construction detail in half-timbered buildings is the jointing between the different timber elements, such as posts (kolumna), nogging, bracing, plates, and beams; the specific way in which these timber connections were made follows basic structural and craftsmanship rules, but also reflects variations in terms of region and time period. The two most important jointing methods in traditional Central European timber frame construction use the scarf, or half joint, and the tenon joint, with the half joint being the older form dating from the Middle Ages and the tenon joint being a more recent form. However, in reality the situation was much more complex. For example, in most parts of southern Germany, timbers meeting at right angles – posts/nogging, posts/plates, etc. – already featured tenons even in the oldest buildings; that means that an offset, narrow tenon engages in a mortise at the post and is secured with a wooden peg. Buildings dating from the fourteenth and fifteenth centuries rarely feature nogging pieces that are connected to upright members using scarf joints. By contrast, up until about 1520, the angled connection of the braces was mostly made using scarf joints, with the tenon joint not appearing until the sixteenth century as the generally accepted method of jointing. Unlike the tenon, the scarf of the scarf joint can always be seen from one side; it engages in the seat (recess) of the mating member, which is shaped exactly to receive the scarf, which is then secured with one or several wooden pegs. Braces attached using a scarf joint can be considered the main form of Medieval timber construction; even in later buildings, such joints were discovered during demolition – an indication that the respective building can be provisionally classed as (late) Medieval. Some surprising early exceptions exist. For example, the short, straight jerry brackets supporting a jetty were often fitted with tenon joints as early as the fourteenth century. In post-1400 buildings there are numerous examples of braces fitted with tenon joints, although these are mostly found in the northwest, that is, in the region where, in the same period, the noggings were mostly fitted with scarf joints. As a result, we cannot really allocate the joining methods of scarf joint and tenon joint to the Medieval and modern periods respectively; instead, both jointing methods existed side by side for a long period of more than one hundred years, from about 1440 to 1560, constituting a gradual transition – with many exceptions. But very generally we can say that the further east and southeast we go within our area, the longer scarf jointing was used in building houses. In rural areas especially, the last traces of scarf joints can be found as late as the eighteenth century, albeit mostly as part of the roof construction.

It might seem that the use of scarf or tenon is a purely technical consideration to do with the traditions prevalent in the timber upright members are placed on individual stones or a complete stone foundation. Apparently this construction detail does not diminish the quality and structural integrity of the building, as is evident from the numerous half-timbered buildings still in existence today in these areas. On the other hand, in the other areas even the very oldest examples of half-timbered buildings feature a distinct rectangle of sill beams. The reasons why buildings in Middle Franconia don’t have a sill beam have not been unequivocally established. It is likely that the stone nogging, which was used from quite early on, plays a role in this detail.

Not taking into account archaeological finds and remains in the ground, evidence of the oldest proven half-timbered buildings points to the second half of the thirteenth century. Most of these can be found in the Middle Neckar area, in particular in Esslingen, and some also in Schwäbisch Hall, Amorbach, and Bad Windsheim. According to current research, about 20 buildings have been found that were built prior to 1500. The early buildings in particular are not very conspicuous due to later additions and render finishes; their old core cannot be seen and, without the use of dendrochronology, it would not be possible to determine their age. In the fourteenth century, the remarkably generous and diverse construction forms from before 1500 were continued and elaborated. The uprights are placed at relatively large spacings because they are only fitted in a wall where a cross-wall needs to be attached. In combination with the widely swept braces and the few
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timbered construction. to taller – also in terms of stories – in the development of half-
bered houses in the town. We can conclude that no  fun damental
400 m² footprint is larger than that of all the younger, half-tim-
building in Windsheim, dating from 1296, only has two stories, its
the southwest. Even though the oldest proven half-timbered
three-story buildings can be found surprisingly often, especially in
as much later examples, even often boasting vast interior spaces;
buildings from between 1260 and 1400 were quite as large and tall
fourteenth century.
lingen. Other examples are the small rural agricultural storage
buildings of the Main-Franconian fortress churches of the early
fourteenth century.
Another striking feature is that, on average, the half-timbered
buildings from between 1260 and 1340 were quite as large and tall
as much later examples, even often boasting vast interior spaces;
three-story buildings can be found surprisingly often, especially in
the southwest. Even though the oldest proven half-timbered
building in Windsheim, dating from 1296, only has two stories, its
400 m² footprint is larger than that of all the younger, half-tim-
bered houses in the town. We can conclude that no fundamental
change has taken place from smaller to larger or from less tall
to taller – also in terms of stories – in the development of half-
timbered construction.

Balloon Framing and Platform Framing
For a long time, a differentiation has been made in half-timbered
building construction between balloon framing, considered to be the “older” form of construction, and platform framing, the more “progressive,” modern version. In balloon framing (also called post-and-beam construction), the vertical studs and posts extend across two or more stories, without any jetties, whereas in platform framing, each story is framed individually and stacked one upon the other; the studs and posts are only as high as the story, and upper stories cantilever out from lower ones. In residential buildings, pure balloon framing without any cantile-
vering stories is rather rare. In most cases, at least certain parts are fitted as individual stories so that cantilevering can be achieved at least at one side of the building in the upper floors; for example, at the gable end or along a side; balloon framing is then used for the walls on the other sides and the interior.
In three-story buildings it is possible to combine the different framing systems; either the two lower floors are constructed using the balloon framing system with continuous uprights and the third story is added using the platform framing system, or the first floor is built as an independent story and the two upper floors are built together using continuous uprights. Pure platform
buildings, with the upper floors cantilevering on all four sides, are
in evidence from as early as 1300. The further south we go, the
more we find evidence of earlier platform framing. For a long time, balloon framing and platform framing existed side by side, even though in the earliest examples balloon framing seems to have dominated. In the years after 1400 /1420, pure platform framing prevailed in most towns and cities in southern Germany, whereas as in the countryside balloon framing remained popular for a while longer.
The reasons why platform frames prevailed in the end is that they are easier to construct, even in higher frames, as the upright elements are relatively short; another reason may be the prestig-
ious effect of the cantilevering jetties, which seemed to have been
the fashion throughout Europe in the Late Middle Ages. The ad-
vantages of platform framing are evident in such densely developed larger cities as Nuremberg, where we find houses more than three stories high. These half-timbered houses are often quite narrow and shallow, but have an extended volume on the upper floors.
Wall Braces and Panel Braces
The different forms of bracing determine the appearance of half-
timbered construction throughout time and their analysis is an
important method for dating. Two fundamentally different types of bracing are known, which can be found even in the oldest buildings known to us: bracing across the whole wall – or a large part of it – and individual bracing of the loadbearing timber posts. Wall bra-
cing is mostly found in balloon frame buildings, where long bracing members are used, frequently from the sill beam to the top plate, to provide bracing to the whole wall, possibly across several stories. These long braces run across noggings and, if necessary, uprights; they can be distributed more or less at regular intervals. Wall bracing of this kind can be found in the oldest buildings we know of. After 1560, bracing across several stories gradually disappears in southern Germany except for crossing braces in the gable walls that run parallel to the rafters. The other method of securing the building against deformation – individual braces fitted to up-
rights – which was more frequently used until about 1700, can nevertheless also be found in the oldest buildings, often with sym-
metrically arranged head and foot braces.
Half-timbered Construction and the Layout Grid
By far most of the half-timbered townhouses follow this scheme: they have two stories, two bays, and three zones, and are often extended to include five zones; all this is already present in the
oldest examples. In balloon-framed buildings this division is strictly applied to the timber frame, which accordingly uses 12 posts (three zones), 15 posts (four zones), or 18 posts (five zones), which are only shortened to story height at the gables or side walls of the building where platform framing is used. The size of these buildings varies a great deal; the footprint of a house in Bad Windsheim dating from 1406 measures no more than 4.5 × 10 m, whereas the mighty volume of the Corn Market 4 building dating from 1318 has a footprint of 12 × 22 m. The range of users of these buildings varies accordingly in terms of social standing, ranging from modest tradesmen in the side streets through to the well-to-do citizens at the main squares. The main differences in the houses therefore do not relate to the basic structure but to the overall size and to the size of the rooms, in particular the parlor. To make it possible for this room to be larger than the other rooms, a slight irregularity in the layout grid is accepted. The two-bay layout with three or more zones remained common until beyond the sixteenth century; however, the differences between the first floor and the upper floor became more and more marked due to the increasingly popular platform framing method. Another reason for changing the rigid layout grid was to accommodate more variable layouts with several rooms.

Framing in Farm Buildings

There is a close connection between the construction method used in towns and that of the countryside; no fundamental differences can be detected. Like townhouses, farmhouses frequently featured a half-timbered construction and used the three-zone, two-bay layout, quite often modified to include three bays and even two stories. The “nine-field” grid, with a square three-bay and three-zone layout, was the earliest application of half-timbered construction in a rural area; it is based on two rows of interior partition walls (similar to the balloon framing principle) and was applied initially in 1340 to a small peasant house and can also be seen in houses originally built in 1367 that have now been re-erected in the Franconian Open Air Museum at Bad Windsheim; further applications, without the interior framing, can be found in Middle Franconia dating from subsequent centuries, creating the wide farmhouses typical of the locality. These “wide houses” with their many rooms already existed prior to 1660, with entrances on the gable front or side of the house, featuring steep thatched full hipped roofs, high gable roofs or – in the central Altmühl area – low-pitched stone-covered roofs. In the Late Middle Ages, other rural forms of houses existed, such as houses with an upright post supporting the ridge (crown post buildings). These are single- or two-story rural buildings with two bays and three zones, the main feature of which is the main load-bearing column in the center of the building that reach from the first floor right up to the ridge. Most examples of this type of structure have survived in the Neckar River area around Stuttgart through to the area around Karlsruhe, mostly dating from the fifteenth century. Other dispersed examples can be found in the Odenwald region through to the Main. Further to the north and east, no examples of this style of building have been found, leading to the assumption that the balloon and platform framing methods popular in the towns had reached the villages in large parts of Lower and Upper Franconia at a relatively early time.

Refinement and Denser Application in the Late Middle Ages (1400–1520)

Whereas many of the early half-timbered buildings have a relatively loose and irregular frame pattern, buildings toward the end of the fourteenth century gradually show greater unification, with timbers placed closer together. The scarf-jointed braces are fitted closer together, often doubled up, and are grouped in a more regular and symmetrical pattern in the wall and around the uprights – obviously following a desire to produce a more aesthetic design.
Further to the south and east, the first crossing head and foot braces cannot be found until around 1450. There is, however, no linear development from the scarf-jointed to the tenoned joints; instead, a great variety of crossing head and foot braces coexists in the late fifteenth and early sixteenth centuries.

Large Public Half-timbered Buildings

Half-timbered construction is not at all limited to dwelling houses and outbuildings in towns and villages, but was also used for important buildings used for public functions. Surprisingly, many of these impressive communal buildings were built in the first half of the fifteenth century. Examples include urban grain storage buildings up to four stories tall, salt stores, and trading and other commercial buildings that existed in almost any larger town. In many cases these are the grandest half-timbered buildings in terms of both volume and painstakingly applied carpentry skills.

One of the most challenging buildings in a town is the town hall. There is a surprising number of sophisticated town halls dating from the Late Middle Ages that were partially or wholly built in half-timbered construction and sometimes have an almost monumental appearance.

First Flourishing of Ornamental Half-timbered Construction (ca. 1520–1620)

Half-timbered construction in the Middle Ages was largely used for purely functional purposes, even though some examples were impressively and powerfully executed. Any artistic embellishments, if at all, can only be found in small details: on cleats, on window hinges, and on interior columns. In these cases, which are mostly found in Nuremberg, delicate carving was used in contrast to the rather sober half-timbered construction.

Toward the end of the fifteenth century we can observe the first tendency to use beam ends for decorative and representative purposes. The small Saint Andrew’s cross beneath windows becomes the key motif of ornamental half-timbered construction in Franconia. Simple horizontally oriented crosses are created automatically by crossing over closely arranged, sometimes curved, foot braces, such as those in the half-timbered buildings in Aschaffenburg and Miltenberg (before and around 1500), with their more closely spaced arrangement of uprights.

In the first decades of the sixteenth century we find, for the first time, the bent (swept) Saint Andrew’s cross with ornamental points in full splendor; such buildings in Rothenburg date from 1513, in Windsheim from 1517, and, particularly richly embellished and...
carved, in Forchheim from 1535, and can also be found in Swabia somewhat later. With their trefoil motif, the early examples of the swept Saint Andrew’s cross in particular are reminiscent of Gothic tracery. Since the middle of the sixteenth century, this swept and nibbed Saint Andrew’s cross has been ubiquitously applied on half-timbered building facades and remains popular until the time around 1700, with only few variations in form. Some examples dating from as late as the early nineteenth century can be found in the Nürnberger Land district. The embellishments are always purely ornamental, but mostly can only be found beneath windows. Occasionally carvings can be found, such as on roof oriel in Nuremberg. Toward the end of the sixteenth century, the Saint Andrew’s cross is supplemented by further embellishments, such as crossed diamonds, circles, and discs, to mention only the most important ones.

In terms of construction, there were hardly any changes in half-timbered buildings compared to the Late Middle Ages; only the cantilevers with cleats were reduced in size or missing completely in Franconia. The crossing over of foot and head braces that was already common in the fifteenth century was developed into the K-brace in the sixteenth century; this means that the head brace only extends to the foot brace, without crossing it. After 1550 the K-brace is one of the most important features of half-timbered construction in Middle and Upper Franconia. Another more representative bracing configuration is created by the juxtaposition of foot braces and a short head brace, with the foot brace often slightly extended and the head brace swept and embellished with ornaments. This feature is used at corners and joints with internal walls and has been found in many places, primarily in the western areas, since the early sixteenth century until around 1700.

The change from a more functional timber frame to embellished half-timbered buildings only occurs at the gables, which become the main point of design features and ornaments, and the visible side walls of houses. In functional buildings such as barns and other outbuildings the rather wide-meshed construction remained the same. In functional buildings such as barns and other outbuildings the rather wide-meshed construction remained the same. However, it is likely that a black stain coat on the timber components was widely in use; we do not know whether this was applied as decoration or simply to protect the timber. The first indications of the color red being used to paint timber appear in the fifteenth century. From the sixteenth century, black, gray, red, and ochre paint was generally applied both in the cities and in the countryside; this took the form of black lines, sometimes widening the appearance of the timber members, sometimes using cassette patterns and shading as additional framing. There were also a few examples where ornamental or figurative painting had been applied to the timbers or the infill panel, some of them depicting imitation brick or stone nogging. Overall, however, elaborate embellishments were the exception and never dominated the appearance of a whole street. Despite the joy of decoration and the application of embellishment to half-timbered features, the basic character of half-timbered construction remained the same.

The Second Flourishing of Decorative Half-timbered Construction (ca. 1660–1720)

After a distinct phase of exhaustion in the middle of the seventeenth century – the time of the Thirty Years’ War – decorative half-timbered construction experienced a second flourishing. It can be found everywhere but, more than before, has regional differences and special features.
The style is characterized by an even closer application of timber members with conspicuously thick cross sections and a reduction to a few motifs while otherwise retaining ornamental patterns. By doubling up the braces, these half-timbered buildings have so much timber in the panels that the rendered infill areas are smaller and almost insignificant compared to the timber surfaces. At this time the geographic distribution was reversed compared to the time before 1620: the east, in particular the Upper Main area around Bamberg and Coburg, clearly exceeds the west, both in terms of the extraordinary richness of the half-timbered style and the number of houses built.

Upon close examination we can see some changes in decorative half-timbered construction compared to earlier styles. Half-timbered construction from around 1600 still accentuated the walls: the columns were emphasized by the configuration of braces and the panels beneath the windows by crosses. By contrast, in its second heyday, the entire gable shows an even network of different fitted timbers; crossed diamonds and even formal grid fields become the main motif in addition to the Saint Andrew’s cross. The symmetry in the gable is much more prominent than around 1600 and often is not modified to accommodate windows for the rooms behind. In contrast to the structurally oriented styles of half-timbered construction, we can find early examples of these rather more graphical, ornamental styles in Upper Franconia in the early eighteenth century. Instead of the braces in the panels, the infill now became the key design element. The corner columns were sculpturally carved more than before, even in the form of spirals or pilasters; richer carvings are limited to a few outstanding buildings. Again, as around 1600, carved panels beneath the windows are used to achieve a stone-like impression with the half-timbered construction; this resulted in rich designs with extensive sculptural patterns that have few stone-built comparisons in this region.

Unembellished Final Stages

In the time after about 1740 we rarely find the confident, prestigious design of half-timbered buildings; ornamentation soon disappeared completely: only the simple diagonal braces remained, and the size of timber cross sections was reduced. Instead the uprights were placed closer together, creating an almost grid-like half-timbered construction lacking conceptual interest; this remained popular in rural areas from the end of the eighteenth century up until the early nineteenth century before exposed timber framing disappeared completely.

Bibliography


23 The Deutsche Haus in Dinkelsbühl features very ornate timber framing and carved figures, 1595.
24 Decorative framework of a former inn at Winterstettenstadt, 1702.
Umgebinde Houses in the Border Triangle Between the Czech Republic, Germany and Poland

Kerstin Richter

The general meaning of Umgebinde refers to supporting frames with arches placed in front of visible log walls. Today, houses with this conspicuous characteristic can mostly be found in the border triangle between Germany, the Czech Republic, and Poland, where they are plentiful and often determine the local architecture. In North Bohemia there are still about 11,000 Upper Lusatian houses, in East Saxony about 6,500, and in Lower Silesia about 1,500. However, such houses can also be found in East Thuringia, West Saxony, Egerland, Upper Franconia, Upper Palatinate, and Lower Lusatia, as well as in the Elbsandstein and Erzgebirge mountains. Frank Delitz provides a detailed description of the different styles of Umgebinde construction in the different regions. Most of them can be found on both sides of the Fichtelgebirge and Riesengebirge mountain ranges. In this contribution, the author examines the elements of construction that determine the style, that is, the Blockstube (the living area behind the log wall) and Umgebinde.

Umgebinde Construction Method and Floor Plan

Very generally speaking, the verb "umbinden" refers to the fact that a load-bearing structure encloses another self-supporting structure, usually the living area ("Stube"). The load-bearing structure can be built of timber or stone/brick, and the enclosed structure can consist of half-timbered construction or masonry. Since the beginning of research into buildings and construction in the rural context in the middle of the nineteenth century, a wide range of different reasons were put forward to explain the origin of the Umgebinde construction method. Is the construction motivated by structural considerations? Was the availability of building materials the reason for the particular details? Was it a combination of traditional building methods of migrating ethnic groups? Or...
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The term used for these timber-built rooms in German is *Umgebinde*. Of timber ensures that the relative humidity remains balanced.

Like in other forested areas with a continental climate, the living space was placed inside an existing load-bearing structure. In this way an indirectly heated – that is, smoke-free – living space was created within what before was an unpartitioned dwelling with an open fireplace. This idea, here only touched upon very briefly, sounds plausible. According to that idea, the typical Umgebinde styles we find today (only dateable to the sixteenth century in some cases) could represent a separation of the functions of the external wall, leaving only the minimal structurally required support.

The Umgebinde house is a version of the hall house (Ernhäus) – an extended oblong building with stables and living quarters with eaves along the sides (Eève – corridor). The access to the house is roughly in the middle of the side and leads into the central corridor, which originally also accommodated the hearth and cooking area. To one side of this was the heated (smoke-free) living area, and on the other side were the stables and vaults. If this was extended into a fourth zone for a barn, all important functions needed by agricultural smallholders were under one roof (an Einfirsthof, or single-ridge farmstead). In the Doppelstubenhaus, a second living area is located in the place of the stables; this could be used for members of a growing family or as a workroom for craftsmen.

### Building Materials

Timber was available locally from forest clearance activities; in the Lusatian highlands it was spruce and fir, and in North Bohemia it was primarily spruce. The regionally available natural stone, primarily granite and sandstone, was used as masonry in solid parts of the building, such as the base of the Umgebinde structure and for door and window frames. Limestone could also be found as an important raw material around the Lusatian Fault. Clay and sand were quarried from local pits. Additional auxiliary construction materials such as straw and flax, linseed oil, animal hair, cow and horse dung, as well as resin and beehive, were obtained from local enterprises in the region.

As a result of the extension of the railway network, it was also possible to ship slate from Thuringia into the region, which meant that soft roofing materials such as straw and wood shingles were replaced. The only slate of any regional significance is the flaky gray-green Reichenberger slate in North Bohemia.

To one side of this was the heated (smoke-free) living area, and on the other side were the stables and vaults. If this was extended into a fourth zone for a barn, all important functions needed by agricultural smallholders were under one roof (an Einfirsthof, or single-ridge farmstead). In the Doppelstubenhaus, a second living area is located in the place of the stables; this could be used for members of a growing family or as a workroom for craftsmen.

### Log- or Plank-built Living Area

Like in other forested areas with a continental climate, the living areas are built in timber construction, so the interior stays cool in summer and warm in winter. In addition, the hygroscopic properties of timber ensure that the relative humidity remains balanced.

The term used for these timber-built rooms in German is *Umgebinde* (log room). Even though the method of construction varies by region, with different cross sections of timber used for the walls.

For example, the walls of log structures in North Bohemia are built with timbers bevel or sawn on the sides; the log edges are left untouched on the inside and outside. A bed of clay is placed between the timber layers. Hardwood dowels are inserted at intervals in order to secure the timber members from shifting sideways. In Lusatian wall construction, logs were also hewn by axe but then split or sawn to make planks. The planks (approximately 12 to 16 cm thick and up to 40 cm wide) are placed such that the log edges face outward, creating a flat surface on the interior.

The corner connections developed from notch connections with wedges or simple cogging into scarf and tenon joints. The walls are made windproof by plugging moss, animal hair, or caulk (short fibers, flax, or hemp) into the gaps. In the Bohemian Blokstube the walls on the outside and on the inside are skinned with clay flush with the log edges. Small wooden wedges stop the masonry from sliding down. On the outside, this skim coat is painted with lime to protect it from the weather. In some places it was customary to cover the joints with a wooden batten. In the relatively regular Lusatian log walls, triangular profiles are inserted into the joints between the log edges on the outside. The method of securing the horizontal position of the planks in the log wall was subject to progressive change. In more recent wall constructions using planks, the different forms of tongue-and-groove connection prevent lateral movement and ensure that the walls are airtight.

In addition to the ceilings constructed with timber beams, Umgebinde houses built with the platform framing method have a special feature: a double ceiling in the area of the Blokstube. This means that the living space has its own distinct ceiling beneath the actual separation between the stories, usually inserted into the structure. This separate ceiling is tied in to the surrounding log work and, like the living area itself, is independent of the other parts of the construction. The void between the floor covering of the second story and the ceiling above the living area could be up to 60 cm deep.

### Umgebinde

In the specialist literature of the twentieth century, structural, dynamical, and physical reasons are cited in an endeavor to explain Umgebinde construction. Fiedler and Helbig provide a rational definition of Umgebinde,* which Roland Ander further summarized and supplemented: the name Umgebinde is given to the supporting structure placed in front of the external wall of log rooms [...], which supports the load of the roof or the upper story. This Umgebinde is a necessary secondary structure to prevent deformation; the reason is that timber will shrink ten to fifteen times more perpendicular to the fiber than along it, which means that the horizontal logs or planks in the log walls shrink significantly more in terms of the height of the wall than the vertical members of a timber-framed structure.\(^5\)

In this way, the shrinkage and swelling of the log structure has no effect on the support structure of the Umgebinde and the other parts of the building. The horizontal timbers in the log structure are subject to significant shrinkage as a result of drying. In view of the fact that all loads from the building elements above are supported by the Umgebinde, the significant changes in height of the log room do not affect the other parts of the house.

#### Notes

1. The cross section through the eaves and gable sides of the Blokstube shows the inserted double ceiling.
There are only two fundamentally different structural solutions in the specific regional Umgebinde constructions, which are referred to by Delitz as “Umgebinde as load-bearing structure” or “genuine” Umgebinde. In balloon framing, the long load-bearing uprights reach from the base to the roof beams. The floor between the first story and the second story rests on transoms inserted into the uprights. The entire structure is braced using scarf-jointed cross braces. In this type of Umgebinde construction, the first story and second story form a unit in terms of construction. We can only find single- and two-story buildings using this form of construction. Balloon-framed buildings can be found in areas in Saxony to the west of the River Lusatian Neisse and also east of the river in Lower Silesia, and in the area around Frydland in Bohemia. In platform framing the stories are joined and added individually, independent of each other. The corner, field, and tie columns end at the cross member of the Umgebinde frame. Above this plate lies the girt of the upper story, which it supports. In the Lusatian style of building we find a timber-framed “basket,” whereas the Bohemian house features log walls. Whereas in Upper Lusatia a half-timbered first floor dominates, both forms can be found in North Bohemia. In single-story houses the roof structure rests directly on the top members of the Umgebinde. Long braces in balloon framing and head braces and cleats in platform framing ensure that the Umgebinde structure is secured against horizontal loads. Joints, including tenon joints, are secured against tensile forces using a form of notching and wooden pegs. The term Joch (yoke) refers to the field between two Umgebinde columns. Balloon-framed buildings can be found in areas in Saxony to the west of the River Lusatian Neisse and also east of the river in Lower Silesia, and in the area around Frydland in Bohemia. Platform-framed buildings with a half-timbered upper floor are widely distributed in the German Umgebinde regions, as well as in the Sluknov Hook area in Bohemia; they can also be found in the area around Děčín, in Ústí nad Labem; Litoměřice, and more rarely also in the area around Mělník. Platform-framed buildings with log construction upstairs can be found in the area of the tableland of North Bohemia, as well as to an extent in Lusatia, for example in Wahrensdorf. No explanation has been found in the literature on the Umgebinde house as to why the upper story built in log construction in Bohemia is not, or rather is only rarely, supported by a structure beneath the roof imposed on it. This leads to the assumption that an Umgebinde structure (around a living space) was only necessary where there was a combination of a rigid, solid structure and one subject to significant shrinkage on the first floor. Supporting this idea is the fact that, in many Umgebinde houses, the first insert field of the log ceiling tends to slope, which is likely due to the fact that one side rests on the masonry corridor wall and the other on the first joint of the log ceiling, which in turn is subject to the shrinkage of the log walls that support it. Delitz also mentions other forms of Umgebinde construction in addition to those already stated: Umgebinde as scaffolding, or “false” Umgebinde. These include the gables and eaves. Furthermore, he refers to log walls with screwed or double uprights and plank constructions with balloon framing as Umgebinde-type structures.

Base of the Room and the Umgebinde

The log room and the Umgebinde stand on a base that is designed very differently in different regions. Typical is the topping of the base consisting of several long plinth stones in a row that are...
also exquisitely dressed, featuring horizontal surfaces for the placement of the log walls and the Umgebinde columns, as well as slanted surfaces between the columns to allow precipitation to run off. In regions with sandstone deposits often only the plinth area that supports the columns projects. In these cases, the plinth in the area between the uprights recedes back to the log structure. This means that rainwater has little chance of causing damage.

Epilogue

There are many other notable components and forms of embellishment in Umgebinde houses. What is unmistakable, however, is the typical support construction around the domestic living area that over the centuries developed from a purely functional design to the diverse adornments that we can find today. Given sufficient support for traditional regional construction methods, the Umgebinde house will be preserved as “one of the most distinctive and charming examples of vernacular architecture.”

Endnotes


3 See Frank Nürnberg, ed., Schönhe Home (Spitzkunnersdorf: Oberlausitzischer Verlag, 2006).

4 See Alfred Fiedler, and Jochen Helbig, Das Bauernhaus in Sachsen, Institut für Deutsche Volkskunde 43 (Berlin: Akademie Verlag, 1967).


6 Delitz, Umgebinde im Überblick (see note 1).

7 Ibid.
The Engadin House
Marc Antoni Nay

The Engadin is a valley in the canton of Grisons, in the southeastern part of Switzerland. It is located directly adjoining the Alps and, in its upper part, consists of a series of high plateaus through which the River Inn meanders in wide bends; in its lower part it is a classical Alpine valley with permanently inhabited sunny terraces. The river flows at the very bottom of the narrow valley floor. The typical Engadin house is a solid masonry building that contains a small, tower-like log structure. Only in the oldest examples does this partially support the roof. In most cases the roof is supported by the masonry that surrounds the log building.

The Facades: Symmetry in Asymmetry

One might say that the facades of an Engadin house speak to their observer. They tell a tale of what happened on the inside when there was still livestock in the stable at the rear and the hay wagons were driven through the big doors into the house, and from there on into the barn.

While the door had to be as tall as possible, the living room and – especially – the bedroom were low and hence could be heated. In the facade, the two living room windows and that of the bedroom form a triangle. In the entrance facade the different room heights create an asymmetric image which, through the application of sgraffito decoration, is balanced even though this balance appears slightly unstable. Often, parts of a previous building in the lower areas contribute to the irregularity of the Engadin house. Even where these houses were built in one continuous process, orthogonality was made impossible due to existing plot boundaries and neighborhood rights.

The varying input factors give each Engadin house its individual character. Sgraffito, which is an extremely weatherproof scratch...
plaster technique, could be compared to makeup which corrects and balances. Together with the fanned-shaped, whitewashed windows, the forged iron window grilles, and the decorations at the timber doors and window frames, a simple farmhouse becomes a beautiful piece of jewelry. Lower down the valley, painting was sometimes used instead of sgraffito.

Centralized Agriculture and the Culture of Driving

The term *Engadin house* does not really cover all its forms. The farmhouse type the term refers to can also be found in the adjoining valleys, for example in the Albula Valley, in the Val Bregaglia, in the Val Müstair, in the upper Vinschgau, and in the continuation of the Inn Valley on the Austrian side.

The Engadin house is the product of a form of agricultural organization that could be referred to as centralized. Housing, stables, and barn were all included in the same building. Hardly any buildings with an agricultural function could be found in the central barn. The term *Engadin house* sometimes used instead of sgraffito.

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**The Rooms and Their Functions**

The route of the hay into the barn is unusual in the Engadin farmhouse. It leads through the living area of the building, the so-called sulàr, the access room at residential level. The hay wagon went past the living quarters which, as a rule, consisted of a living room, a kitchen, and a scullery/larder (chamineda). The store connected the kitchen and the living room. The living room (stüva) is mostly situated in the corner of the house; in buildings dating from the Late Middle Ages, it is often oriented toward the sun. In most living rooms however, the view out is to the well, which is the social center of the neighborhood.

The Engadin style was used for farmhouses as well as for patrician houses. Houses differ in the design of the living room as well as of the drive-through to the barn. In patrician houses the living room is lined with opulent paneling, the kitchen is spacious, and occasionally there is also a dining room. In the simplest living rooms the walls consist of horizontal log timbers. The drive-through area in farmhouses is covered by timber joists, whereas that in patrician houses usually has a grained barrel vault. The kitchen (cha da fò, literally “fire house”), in its oldest version is a narrow room with walls covered in black soot and with a barrel vault or volto piano ceiling. Originally it had an open range; immediately next to this was the stove hole for the living room stove. The chamineda can have a vaulted or flat ceiling. The walls are usually whitewashed. During special events such as a wedding, christening, or other festivity, the chamineda was cleared out and set up as a festive venue.

At first sight one cannot see that these mighty buildings built of rough stonewall hide a two-story timber construction because, toward both the outside and the sulàr, this is usually concealed by a masonry wall. The little two-story timber tower consists of a log construction (in Switzerland also referred to as Strickbau) with horizontally stacked logs that are joined at the corners with interlocking cutouts. The structure rests on a masonry cellar and includes the living room and sleeping chamber. The living room (in Rhaeto-Romanic the stüva) has a brick-built store that is fueled from the kitchen. On the upper floor is a low sleeping chamber (chambra). This is kept at such a low height in order to conserve thermal energy. The stüva and chambra are linked with each other via the burrel, a flap directly above the stove which is accessed via a narrow wooden staircase. At night this flap was opened to let the warm air of the living room rise into the sleeping chamber. A short time later the people themselves went up and left their clothes on the warm stove in the living room.

The idea of keeping the living room free of smoke by fueling it from the smoky kitchen goes back to the Middle Ages. Living rooms from the late Gothic era have slightly arched timber plank ceilings. The principle of this carpentry construction goes back at least to the Late Middle Ages. A form that is even simpler can sometimes be found in the chambra, where the ceiling may just consist of burt-jointed beams – the same timbers used for building the walls of the log tower.

**The Southern Border of Log Construction Is the Southern Border of the Engadin House**

Log buildings were found in the Oberhalbstein region as early as the Late Bronze Age. In the Engadin itself, one such construction dating from 1440 BC remains almost completely intact. This is the structure built around the mineral water sources in St. Moritz-Bad. The oldest log towers in the Engadin houses date back to shortly after the Swabian War of 1499. The rough stone masonry with which these were enclosed contributed significantly to their preservation. The timber sections needed for the log construction require straight tree trunks of relatively small dimensions compared to those for
beams and roof purlins. In the Engadin, these were primarily found in the Swiss stone pine forests. The trunks of young fir and larch trees were also used for walls and ceilings. However, the beams supporting the floor of the living room usually consist of mighty larch logs.

When comparing the house type in the Engadin with those of the adjoining valleys to the north (Grisons) and south (Valtelline, Italy), we find the following: in the north the spread of the Engadin house is the result of economic and cultural contacts. The Albula Valley, the Val Müstair, and the Upper Inn Valley have the same type of farmhouse as the Engadin. By contrast, in the Oberhalbstein area the Bregaglia house type was adopted because the two valleys lie on the same transit route across the Alps via the Septimer Pass, which does not go near the Engadin. Further north in Grisons, there are regions with farmhouse types that are related to the driving culture. However, the log-built living room has been an important component of every farmhouse in Grisons since the fourteenth century. In the very south of the canton there are a few exceptions. On the southern slopes of the Alps there is a southern border demarcating the existence of the living room; this border is never really far from that between coniferous forest and chestnut forest. Usually the border demarcating the living room is a little bit further south, because farmers from just below that border went to collect building materials from the coniferous forests in the higher elevations. The timber of the chestnut tree is not suitable for producing the relatively long, narrow beams that are needed for log construction.

The fact that the log-built living room is a mandatory component of the Engadin house means that, at the southern slopes of the Alps, a limitation boundary exists owing to the change from coniferous to chestnut forests. This shift in vegetation also indicates another change, one of climate. For the chestnut to flourish, it needs warm autumns and at least six months with temperatures above +10°C. The omission of the living room in the lower altitudes of the Misox, the Val Poschiavo, and the Valtelline has its reason in the climate conditions in two ways: first, the warmer climate made it possible to survive winter without a smoke-free heated room; and second, the growth of the chestnut tree was possible.

Relations and Predecessors
The oldest predecessor of the Engadin house is most probably the Roman domus. Its next relation is a farmhouse type with a passage through the living tract common in Lombardy. In both these types of houses, the living quarters and working areas are arranged behind each other. Both have a through-passage from the living quarters to the working area which, however—owing to the climate—is not fully roofed over. These related house types to the south of the Alps also have a kitchen and storage rooms. The one thing that is missing in them is the living room. What was needed in these houses was a kitchen with an open fire and an unheated sleeping chamber, as well as the chestnut as a basic foodstuff. It seems that more was not necessary at these lower altitudes in order to survive the rather milder winters. By contrast, the temperatures in the Upper Engadin can drop to -30°C. Therefore the Engadin house was designed for people to survive cold winters. Having said that, we cannot compare the standard of heating with the interior climate of a modern dwelling house. The only heated rooms were the living room and the kitchen. The stables were also a little warmer because the stock of hay provided some insulation, and when the flap above the living room stove was open, heat rose into the sleeping chamber.

Bibliography
As late as the beginning of the twentieth century, farmsteads with their houses and outbuildings constituted the largest proportion of buildings in the Ticino. Industrialization and the development of the transportation infrastructure, which in the nineteenth century brought about fundamental changes to infrastructure in many areas in Switzerland, hardly left any traces in most valleys of the Ticino. Whereas small towns such as Bellinzona, Lugano, and Locarno developed into administrative centers and tourist destinations from the nineteenth century onward, the valleys in North Ticino and South Ticino (Sopra- and Sottoceneri) remained agricultural up until the second wave of modernization after the Second World War. The traditional economic structures were largely based on self-sufficiency and offered little scope for change. The economy consisted of small units engaging in mixed aspects of agriculture, such as arable farming, horticulture, and animal husbandry. In most valleys, agriculture involved droving livestock up and down mountain pastures. Every farm had various buildings at several vegetation levels, from the floor of the valley to the higher mountain pastures, which were used temporarily in an annual cycle. A house in the village was often only inhabited by all family members at the same time for a few weeks in winter.

Another source of income aside from agriculture consisted of male family members’ taking seasonal work in nearby Milan or other European cities. While the men were absent, the women ran the farms together with children and older relatives. The combination of subsistence farming and temporary emigration made it possible for families to achieve a reasonable standard of living and contributed significantly to the long preservation of traditional social and commercial structures. When they returned, the few who became prosperous abroad often built houses for themselves elsewhere.
in their home village in the style of houses they had seen in the city. Up until the twentieth century, these so-called returner houses—in addition to sacral buildings—formed the only architectural contrast to the modest farmhouses.

Tower Houses: A Traditional Building Type Lasts for Centuries

Today, the stone-built tower house is seen as a typical example of a farmhouse in the Ticino, even though it cannot be found everywhere in the canton. The traditional house landscape was far more diverse: in the northernmost areas of the canton, houses built of timber represented the majority—at least up until the nineteenth century. Some of the last remaining byre-dwellings in the Valle di Blenio and the tower houses of the Vallemaggia date from the fourteenth and fifteenth centuries and are thus among the oldest (known) timber buildings on the south side of the Alps. It is not certain whether these house types are ancient types that have disappeared elsewhere or these buildings only existed in the two valleys. Also, the style of the houses in the Leventina allows the conclusion that it was influenced by the inner alpine timber construction method. In the southernmost part of the Ticino, a large type of byre-dwelling developed, such as in neighboring Lombardy; these were suited to the large farms at the foothills of the Lombardy mountain ranges and—since the Middle Ages—had been operated by tenant farmers. The majority of traditional farmhouses still in existence today are tower houses in masonry construction. Their distribution in the Ticino began in the Late Middle Ages at the same time as the oldest recorded timber buildings. An important characteristic of this extremely long-lived form of dwelling is the external stairway to the individual entrances of the vertically stacked rooms—there are no internal stairs. The rooms include a kitchen with an open fireplace on the first floor, and above that one or two rooms for sleeping. In wine-producing areas the buildings have cellars. Outbuildings such as stables and barns are also constructed using a tower house principle, with the animal stalls at the bottom and hay storage above. Characteristic of the uniform appearance of the houses and settlements is the use of stone for almost all the building components; floors and stairs were also built of stone slabs. Timber is used only for the roof construction, the ceiling beams, intermediate floors, and doors. From the Middle Ages to the nineteenth century, these houses feature an almost identical arrangement of rooms. Social and economic differences in the status of inhabitants were expressed only in the size of the farmstead or in the use of ornamentation.

Building and Living with Stone

The landscape in the North Ticino (Sopraceneri) is dominated by the geological shapes, moraines, and boulders created by the receding glaciers at the end of the last ice age 10,000 years ago. The inhabitants of the valleys—in particular in the Centovalli, Val Onsernone, Valmaggia, and Valle Verzasca—used these stone landscapes as a unique resource for living and working. Chestnut trees were planted and outbuildings constructed on areas between historical landslides; overhanging rocks were used as pens for small stock and as herdsmen’s huts; man-made cultivated vegetable gardens could be found on flat boulders. People also used the natural store of stone for building houses and constructing terraces in the terrain. The stones found in moraines were sorted in accordance with the functions for which they were needed; ordinary stones were used for masonry walls and terracing, whereas boulders of special material quality were used to produce important building elements, such as door and window frames and cornerstones in the masonry. By far the largest part of the stone buildings consists of dry stone walls. Laying dry stone walls without joints for larger buildings is an extremely skilled job and was carried out by experienced local
stone masons, with farmers’ help. Doors, windows, and the external stairs were arranged to suit strictly functional purposes. For the frames of doors and windows, special boulders were selected and heaved. In terms of style, designs were modeled on Romanesque examples. Originally the windows were very small, the reason probably being structural limitations and the climate. Even as late as the middle of the nineteenth century window openings were closed with fabric and boards; pane glass was expensive and so was only gradually adopted for ordinary farm buildings in the late nineteenth century. When window openings were enlarged, the stone lintel was usually replaced by a chestnut lintel. Window frames were often whitewashed in order to bring more light into the room and also to embellish the house.

Smoke from the open fireplace in the kitchen was discharged via a hole in the external wall. Usually, the opening was protected against the rain with a covering stone plate. Chimneys were not built until the nineteenth century, initially as a smoke duct added to the external wall and later incorporated into the wall and extending above the roof. From the nineteenth century it became customary to render or whitewash the walls, either to extend their life or for reasons of prestige.

To this day, double-pitch roofs covered with heavy gneiss slabs are the predominant feature in many parishes and villages in the Ticino, particularly in the gneiss areas in North Ticino and in some valleys around Lugano. In the Valle di Maggia and in other locations in South Ticino the locally found limestone was used as a roofing material. The construction of the mighty stone roofs is extremely hard work and requires large quantities of material; the service life of these roofs of up to 300 years is truly impressive. The enormous weight of the stone slabs is carried by purlins that rest on the gable walls. Each of these slabs weighs around 50 kg; a square meter of roof area requires eight slabs. The slabs are laid starting from the eaves and ending at the ridge. Each row covers the one below by one third; in this way the stone slabs are held in place by
their own weight and the roof remains watertight, even if one of the slabs should break at some stage. The roof pitch tends to be 15 degrees, which ensures that the stone slabs don’t slip and the water can drain off freely.

The stone-built tower houses are modest dwellings designed to provide shelter from the weather and space for eating and sleeping. Farmers spent most of their time working in the open; accordingly, the houses were only sparsely furnished: table, a bench, chairs, and sacks filled with leaves as mattresses. People slept mostly in the rooms set aside for sleeping, whereas the elderly usually slept on the bench next to the fireplace in the kitchen. Children and youngsters in large families had improvised sleeping areas under the roof or were put up in nearby haylofts. The fireplace on the first floor was the only source of heat in the house. Drinking water was collected from the village well or a stream. In many places this rather impoverished form of living did not disappear until the economic and social changes of the middle of the twentieth century.

In the process of farming villages becoming residential, many historical buildings were lost; any buildings still remaining stand empty. Today there is large demand for traditional tower houses as holiday homes because, like hardly any other house type, they fit in with the nostalgic idea of a simple life.

Bibliography


The Alpine Log Construction
Roland Flückiger-Seiler

All rural buildings of former times are characterized by the fact that they used materials that were available in the immediate proximity or that could be procured within a reasonable period of time. The available building materials gave houses their characteristic appearance. It was not until the railway network was built in the second half of the nineteenth century that this limitation was reduced for the first time. Finally, in the twentieth century, the extended road network made it possible to use a wide variety of materials. Compared to other European countries and with regard to the building materials used in rural house construction, Switzerland lies on the border between masonry construction in the southern and western areas and timber construction in the north and east. Timber construction is the dominant building method throughout the entire Swiss Plateau and the Alpine regions between Lake Geneva and Lake Constance. According to the construction method of the external walls, timber buildings can be subdivided into stud construction (with a vertical load-bearing post structure) and log construction (with vertically layered external walls). Current research into forms of settlement generally sees the construction with studs in prehistoric times as the older type of construction. The notion is that log construction did not appear until metal tools were available, that is, in the Bronze Age at the earliest.

Log Construction
In the construction of log buildings the timbers of the external walls are notched close to their ends and are horizontally layered, crossing at the corners. This creates a rigid structure in which the individual timbers are additionally tied together with wooden pegs. The moss filling of the horizontal joints and the weight of the

1 Village street in Saanen, canton of Bern, ca. 1900: the log buildings, with their gables facing the street, are built on lower floors of masonry.

2 Houses built using masonry and logs in Soglio in the Engadina Valley.
Logs above together create an airtight construction. The most popular method of preparing logs for residential and utility log buildings in the Swiss Alpine area was by hewing, and, from the eighteenth century, mostly by sawing into beams. Log buildings built using round timbers of entire tree trunks with just the bark removed were mostly used for utility purposes. Tree trunks that are split in half (called Hälblinge in Switzerland) are only used for storage buildings outside the Alpine area. The oldest preserved log buildings in the Alpine area are of an extraordinary age: in the historical Swiss area (Schwyz region) they date back to the twelfth century, and in the Valais the oldest dwellings have been dated to the fourteenth and fifteenth centuries.

Normally, the gable-end Alpine log buildings are built on a masonry plinth with a cellar that is not, or only a little, sunk into the ground. Above this, the log walls are raised one to three stories high, interlocking at the corners and central walls. Older buildings dating from the time before 1500 often projects beyond the cellar walls; in the historical part of Switzerland the decking plants of the intermediate floor are detectable in the external facade. The subdivision into individual rooms is also usually visible in the facade, because the ends of the wall logs project from the face of the wall. In buildings up until the early sixteenth century, few of these log projections have been recorded; in addition, the triangle of the gable of log buildings features a vertical post, the Heidenkreuz (heathen cross). This unique structural feature is used to brace the gable triangle and, judging by the name, is deemed to have been inherited from an earlier, “heathen” time. After 1600, a log bracket was used in place of the heathen cross. Depending on the region and time of construction, different forms of construction and decoration exist, which are part of the characteristics of the respective regional building style. Decorative elements developed from basic versions to the bold, curvy baroque pieces of art of the eighteenth century that were sometimes even embellished with color.

The Swiss Timber Style

Prompted by the glorification of Alpine natural landscapes popular in the Romantic era, the traditional Alpine log buildings (seasonal chalets, dwellings, and stables) were an important source of inspiration for painters and travel guide authors. It could be said that they were the models for what became known as the new Swiss style. This can be characterized as a combination of a traditional urban building style with elements of classical architecture. Its typical characteristics are large windows, wide balconies, verandas in front of the houses, and mighty gable roofs. Owing to the different decorative elements on the facades, gables, and canopies, which were sawn from wooden boards, the style was also sometimes referred to as Zimmermannsgotik (carpenter’s gothic, though not to be confused with the North American style of building with the same name).

This new building style was epitomized by the chalet, which in Jean-Jacques Rousseau’s (1712–1778) writings appears as a reference to natural dwellings in Romantic landscapes, its first mention in literature. Shortly afterward, a garden theorist, Christian Lorenz Hirschfeld (1742–1792), praised the idyllic seasonal chalet and the Swiss house because of its simple and durable construction. The new fashion to travel that appeared in the Romantic age also promoted an interest in Alpine buildings. The acceptance of rural buildings and their decorative forms was further enhanced by the

3 The protruding timber sections of a traditional log house facade indicate the room layout in the interior.
4 Flückiger-Seiler’s Heidenhaus, with added stables dating from 1497 in Mühlebach, canton of Valais.
surveys and drawings of rural buildings produced in the course of the nineteenth century. An important contribution to this was the work of German architect Ernst Georg Gädgbuch (1812–1896), who was professor of building construction at the Zürcher Polytechnikum (today's ETH), where he was able to exert considerable influence over the architects of his time. Architects were first inspired by the Swiss farmhouse in the early nineteenth century. One of these was the Englishman Peter Frederick Robinson (1776–1858) who in the eighteen-twenties drew sample projects for so-called Swiss houses; around 1830 he produced a Swiss Cottage in London's Regent's Park. At around that time, the architect Karl Friedrich Schinkel (1781–1841) built a Swiss house in Potsdam on the Pfaueninsel. Chalets became successful export items to European courts: William I of Württemberg, who as Crown Prince admired the Swiss farmhouses, in 1822 commissioned the building of a “Bern house” to a design by the Italian architect Giovanni Salucci (1769–1849) that was based on a detailed study of the rural architectural forms. In 1854 the English Queen Victoria had a guest house built in a newly created park at Osborne House in the style of a Swiss chalet. The distribution of the Swiss timber construction method was also much enhanced throughout Europe by numerous exhibitions; at the World Exhibition in 1851 in London, the Swiss sector showcased a Bern farmhouse. In 1867 the Swiss Pavilion at the World Exhibition in Paris showed elements of Swiss farmhouses in combination with the Greek column styles and thereby, probably for the first time, defined the program of what later became known as the Swiss style. The first chalets with the new forms of decoration could be found in Switzerland before 1850. These were produced in special factories, most of which had started producing parquet flooring but soon also produced entire houses. The best known of these production companies were founded by Franz Josef Bucher-Durrer and Josef Durrer-Gasser in Kenna, Alexander Kuoni in Chur, Gaudenz Issler in Davos, and the Spring brothers in Geneva. Owing to the personal friendship of national councillor of the Berner Oberland and hotel owner Friedrich Seiler with Napoleon III, many chalets were sold to Paris. In the late nineteenth century, the Swiss style was adopted almost throughout the entire country. The main projects built in this style were tourist buildings (kiosks, guest houses, public buildings). But likewise, this new architectural styling was applied to railway stations and clerical buildings. The new style of building became popular in numerous European areas, particularly in Scandinavia and Eastern Europe. It may be considered Switzerland’s only “genuine” contribution to classic European architectural history.

Bibliography


5  Birth house of Huldrych Zwingli dating from the fifteenth century at Wildhaus, canton of St. Gallen: the window openings in the timber building were enlarged and fitted with bull’s-eye panes in the nineteenth century.

6  Traditional Alpine cottages from around 1890–1900 in Saas Fee, canton of Valais

7  Hotel Schweizerhaus in Maloja, canton of Grisons, built in 1882, is considered typical of the Swiss style. Drawing of the Kuoni & Cie chalet factory, 1892.

8  Hotel Schweizerhaus by the chalet factory Kuoni & Cie, ca. 1895

9  Chalet built in the Swiss style in St. Moritz in the Engadin, canton of Grisons

10  The influence of Romanticism on Swiss timber architecture is evident in Villa Planta in St. Moritz (produced by the Kuoni & Cie chalet factory), 1883.
Houses with Turf Roofs in Northern Europe

Gisle Jakhelln

Turf roofs1 have a long tradition in the Nordic countries of Europe2 that goes back to the Neolithic period. In Norway this tradition is still alive, even though much less so than 100 years ago. However, it is recently being revived owing to the outstanding ecological properties of these roofs.

In former times, turf roofs were common in all Nordic countries, but from the Middle Ages they fell out of fashion in Denmark, where thatch was increasingly used as a roofing material. By contrast, in Finland from the eighteenth century, timber boards were used from the eaves to the ridge as steeper roof pitches became fashionable.3 The same process took place in the north of Sweden. In Iceland and the Faroes however, turf roofs were the norm until the beginning of the twentieth century, mostly in combination with turfed walls.

Topography, Climate, and Cultural Context

The Nordic countries lie between the 54th and 71st lines of latitude and the 24th and 32nd lines of longitude. Both the climate and the topography vary a great deal in this relatively large geographic area. Iceland, the Faroe Islands, and the west of Norway and Denmark have a maritime climate. The Gulf Stream and the predominant westerly winds result in higher temperatures and more precipitation than one would expect in such northerly latitudes. In the interior of Norway, there is less precipitation than on the coast. The same is true for Sweden and Finland. The northern parts of Norway, Sweden, and Finland have a sub-arctic climate. These three countries form the westernmost extension of the Eurasian taiga, which is dominated by coniferous forests. Another tree that is common in these countries is the birch, especially along the coasts of Norway and Sweden.
Owing to their large forests, Norway, Sweden, and Finland traditionally used timber construction both for the load-bearing structure and the wall cladding. Their vernacular buildings have been optimally adapted to these conditions and exist in a wide variety of designs.

In the Nordic countries there is an abundance of lichens, meadows, and moors, which explains why turf was used as a roofing material. Turf was used on all types of buildings: dwellings, outhouses, and boathouses.

In Denmark reed is also very common; the same is true of the southernmost part of Sweden and, to an extent, of the southwest of Norway. In these areas roof thatching was developed early on and the use of turf roofs waned, particularly in Denmark. Since the Paleolithic era, the Scandinavian countries of Denmark, Norway, and Sweden have been part of the same cultural sphere. During the Viking period and the Early Middle Ages, this extended to Iceland and the Faroe Islands. By contrast, Finland was part of the Baltic cultural sphere until it fell under Swedish rule in the eleventh century.

The Saami people settled in the northern parts of Norway, Sweden, and Finland from about 500 BC. Their culture differs significantly from that of the more southern areas. Their building tradition is still alive today, even though only few house types have survived. One of them is the gamme.

**Turf Roof Constructions**

The term *turf roof* applies to different methods of covering roofs. They all have in common a layer of earth that contains different types of grass and (matted) roots. In Norway it is most common to use meadow grass. In the mountains or on the islands near the coast it is necessary to resort to heather or lichens.
In order to prevent the grass sod from sliding down, green roofs in Norway have a low pitch. Depending on the district, the roof pitch is commonly between 20 and 27 degrees, and the maximum is 35 degrees. On the coast, the roof pitch is steeper than that in the valleys inland. By contrast, the roof pitch of houses in Iceland is normally about 45 degrees and in the Faroe Islands it is only a little less. The reason for this steeper pitch could be that no birch bark is available in these countries.

The roofs consist of either a rafter or purlin construction, which supports a layer of timber boards or thin branches. On top of this layer the birch bark is applied in four, and occasionally up to six, overlapping layers, with the outside facing downward and the fibers running in parallel to the slope. The bark is an essential component for stopping moisture seeping into the building. At the eaves, the birch bark projects by 8 to 10 cm and, at the top, it should cover the ridge. Where birch bark is hard to come by—in the mountains or on the islands—small branches or boughs are used instead, and sometimes also stone slabs. The same is true in Iceland and the Faroe Islands. The branches discharge any water that may penetrate the grass sods. A steeper roof pitch supports this process.

The grass sods applied on top of the birch bark are cut from the natural ground; their size is such that they can just about be handled by one person. In some areas a second layer is laid on top of the first; in this case the green side of the bottom layer will face downward and that of the top layer will face upward so that the roots can grow together and bind the two layers. At the eaves, the grass sod is prevented from sliding down by a round or square log. This is held in place by naturally grown hooks, preferably consisting of juniper branches, which in turn are fastened to the substrate using nails or wooden pegs.
Outlook

Turf roofs have special qualities that also appeal to contemporary architects and master builders – above all those of an ecological persuasion – because they consist of natural materials obtained in the immediate vicinity. They absorb sound, have favorable thermal insulation properties, and retain rainwater over a longer period of time. Furthermore, they require little and only low-cost maintenance. The birch bark lasts up to forty years before it has to be replaced, the grass does not have to be cut. But it is important to prevent the growth of shrubs and bushes, because their roots will destroy the bark.

In order to comply with legal requirements for thermal insulation, turf roofs (for which various commercial products are available on the market today) are combined with industrially produced thermal insulation material.

In addition, nowadays it is popular in the Nordic countries and in the rest of Europe to plant flat roofs with sedums to create what are called green roofs. This is not done in regions such as those near the coast because there are strong winds and this covering material could be blown off.

It is a basic principle of vernacular architecture to use energy and resources efficiently, both in the construction and later in the maintenance of the building. The skillful knowledge of the cooling effect of the wind, the warmth of the sun, and local materials is an aspect of traditional construction that should also be of relevance in the future. Contemporary architects in Norway, as in other Nordic countries, try to learn from and make best use of this legacy. Turf roofs are part of this approach.

Endnotes

1 In England the term sod is also used; in Scotland, turf; in Iceland, torf; in Sweden and Norway, torv; in Finland, turve; and in Denmark, tørv.

2 The term Nordic countries refers to Norway, Sweden, Denmark, Finland, Iceland, Greenland, and the Faeroe Islands. Greenland with its arctic climate is not covered in this article.

3 According to personal information from architect Kirsti Kovanen, September 2018.

Bibliography

To this day, yurts (latticework tents in the steppes of Southern Siberia and Central Asia) and cone-shaped pole tents (in the tundra and taiga areas further to the north) are characteristic forms of nomadic dwellings in Siberia. This contribution focuses on the cone-shaped pole tent, which is also used in the northeast of the European continent and in North America, where it is known as a tepee.

Two examples will be presented to demonstrate its construction and function: the type used by the Evenki (Central Siberian) hunters and gatherers in the taiga and the somewhat larger and functionally more complex version used by the Komi reindeer herders in the tundra to the west and east of the Ural Mountains.

Tents of Evenki Hunters in the Forested Areas of Central Siberia

Traditionally, the Evenki inhabitants of the coniferous forest zone (taiga) were hunters, gatherers, and fishermen; they kept a small number of reindeer for the purpose of transport (as mounts or pack animals). During the coldest winter months they used to live in small groups nearly stationary; at other times they migrated, hunting fur animals and other game in regular cycles. On occasion they went to Russian trading points on the larger rivers in order to exchange furs for ammunition, flour, or tobacco. Depending on seasonal necessities, camps consisted of two or several tents. The cone-shaped pole tents (in the Evenki language, джем) consist of relatively simple construction, which, with a height of 4.5 m and a diameter of 4.5 m approximately, provides space for 6 to 8 persons. The material for the timber poles is easy to find in the taiga, which means that the poles do not have to be transported over long distances. Frequently they are left
behind where they were used (Fig. 3 and 4) and reused upon the hunters’ return. In winter, reindeer skins sewn together are used to cover the poles. Formerly birch bark and animal skins were used in summer, but in the course of the twentieth century these were replaced by tarpaulins. Likewise, the open fireplaces in the tents were gradually replaced by transportable metal stoves as part of the Soviet modernization project. From the mid-nineteen-thirties on, the general intention of the government was to encourage settlement, although it was accepted that part of the population would continue to live in mobile dwellings for at least part of the year. The photographs of the Evenki tents date from the years 1926–27; they were taken in the context of a census in the far north of the Soviet Union, which ultimately also provided the data required for the settlement policy. Interestingly, Evenki women complained that they found everyday life in the newly occupied house very cumbersome, because the functional areas were differently arranged compared to in the tent: “It is bad in the house; it is dark, and you have to walk.”

The drawing (Fig. 5) by Sergei G. Salatkin, who in the middle of the nineteen-nineties worked for the construction department of the Evenki Autonomous Region, not only shows the traditionally used coneshaped pole tent but also the more recent form of the tent that Evenki families adopted from geologists during the Soviet era; in addition, a traditional seminomadic winter dwelling (golomo) made of wooden slats, earth, and grass sods, which fell into disuse from about 1960.

**Tents of the Reindeer Herders in the Tundra and the Forest Tundra in the Far North of Russia**

In the treeless tundra regions of the far north, as well as in the adjoining areas of the boreal coniferous forest, a special form of animal husbandry developed in the course of the last 300 years: the husbandry of reindeer in large herds (comprising several hundred or thousands of animals) with the aim of producing marketable furs and meat. Between the summer pastures of the reindeer near the Arctic Ocean and the winter pastures in the wind-protected coniferous forests, the herds and groups of herders migrate along nearly linear routes, covering up to 1,000 km in the course...
of a year. The herds determine the general movement between tundra and taiga; the herders influence the movement of the herds, guard them, and select animals for slaughter. During the Soviet era, reindeer husbandry was organized in collectives; groups of herders were grouped into “brigades” (operating units). The individual brigades consist of four to twelve male workers who are primarily deployed as herdsmen and of one to two, usually female, workers who are responsible for running the shared tent (only one tent exists in each camp). The workers are made up of two families, who are usually closely related. Each of these families has a permanent base in a village or town, that means it has a permanent household in the form of a house or apartment and a mobile household in the form of half a tent. Members of the family combine various strategies of making a living and perform different activities in the respective household. From the end of December to the beginning of April the herds, people, and female tent workers usually live in the village with other family members; from April to December they live in the tent, with children and teenagers also occasionally living in the tent in the summer months. The lifestyle described above is typical of the northern group of the Komi and some groups of the Nenets in the tundra plains on both sides of the Ural Mountains – broadly between the rivers Dvina and Yenisei. The construction of the cone-shaped pole tent, which originally had been used by the Nenets, was adopted by the Komi and Yenisei. The construction of the tent (Russian: stolpina) is generally taller (approximately 6 m) and has a greater diameter (approximately 6 m) than the Evenki tent described above. Approximately 32 wooden poles are put up after a structure of three special poles that are tied together at the top is erected in the form of a tripod that also holds the metal flue pipe. Building the tent starts with laying out the floorboards; this is followed by putting up the stove and, at the same time, the three structural poles are arranged evenly, supporting the flue pipe. Then the remaining tent poles are added and covered with tarps or reindeer pelts. Finally, the lower edges of the tarpaulins or pelts have to be fixed. In most months this is done by heaping snow around the tent; in the summer, stones are used. Nowadays tarpaulins consisting of canvas or similar textiles have largely replaced reindeer pelts as the cover, at least during the winter months. When the groups are on the move, the tarpaulins, tent poles and stove, as well as all other utensils are taken along on sleds specially designed for the purpose. Along the migration route there is usually a place where seasonally used objects (for example pelts) can be stored in a lockable storeroom.

Lighting in the tents is provided by kerosene lamps, more rarely by an open fire, and by the opening at the top. The latter is also used for ventilation; fresh intake air can also come in through the entrance when the tarpaulins covering the entrance is folded back. The size of the opening at the top can be adjusted with the help of a small piece of tarpaulin. The stove is not operated throughout the night, even in the coldest months; this means that the fire will go out and the temperature inside the tent will drop below freezing. The entrance, the stock of firewood, the stove, and a bowl for waste water are arranged along the central axis of the tent (Fig. 5). All other objects and functional areas exist in duplicate – at least in the tents of the Komi reindeer herders – because there are the two halves of the tent, each of which is used by one family. The entrance/exit, the kitchen area, the lockable storeroom, and the waste water are arranged along the central axis of the tent (Fig. 5). All other objects and functional areas exist in duplicate – at least in the tents of the Komi reindeer herders – because there are two halves of the tent, each of which is used by one family. The entrance/exit, the kitchen area, the lockable storeroom, and the waste water are arranged along the central axis of the tent (Fig. 5). All other objects and functional areas exist in duplicate – at least in the tents of the Komi reindeer herders – because there are the two halves of the tent, each of which is used by one family. The entrance/exit, the kitchen area, the lockable storeroom, and the waste water are arranged along the central axis of the tent (Fig. 5). All other objects and functional areas exist in duplicate – at least in the tents of the Komi reindeer herders – because there are two halves of the tent, each of which is used by one family. The entrance/exit, the kitchen area, the lockable storeroom, and the waste water are arranged along the central axis of the tent (Fig. 5).
wooden planks are placed in parallel to the central axis but do not cover the entire interior space; to the right and left there are areas that are insulated from the cold ground using branches of spruce and reindeer pelts where bedding is spread out at night for sleeping; during the day the bedding is rolled up and stored along the edge of the tent, where it serves as a backrest. There is some furniture such as small stools and low tables for sitting and working; in addition there are metal urns for water, pots and kettles, tin plates, food containers, and lamps, all of which have their special place on one of the transport sleds. Other equipment includes harnesses, a sewing kit, fur boots and other clothing, as well as technical devices, which for many years have included generators or CD and DVD players. At night the beds are rolled out and fabric curtains are put up that shield the areas and therefore provide a certain degree of privacy, albeit no soundproofing. The curtains are one of the few decorated elements in the tent; during the day they are tied together at a height of about 50 cm.

Just like the inventory, nearly all functional areas exist in duplicate in the tent: next to the entrance there are areas for harnesses to the right and left and usually the sleeping places of older persons follow on from these, followed by the sleeping places of younger herdsmen, and finally the area for storing and processing food. The stove in the center of the tent (Fig. 7) is tended in turn by persons from the two halves of the tent (households). It is also used as a cooker and in this function again is divided into two. For the tent construction and the sleds, as well as for cooking and heating, wood is needed (primarily spruce, pine, and birch). While the group camps in the boreal coniferous forest or the forest tundra, obtaining suitable wood is rarely a problem; however, at the summer pastures wood is a very scarce resource. A certain number of tent poles has to be carried along to the summer pastures; when a sled runner breaks, the necessary repair can only be make-shift; if possible, driftwood from the coast of the Arctic Ocean is used for heating. Until late into the nineteen-nineties some herder communities used an open fire with a cooking stand instead of the stove during the summer months; the stove was left behind in a shed about halfway between the winter and summer pastures. Except for the type of cooking/heating source, there are few changes throughout the year; the interior of the tent remains largely the same, whereas the natural environment shifts with every change of location. The individual perception of the tent as a fully fledged home or as temporary accommodation depends on family conditioning, to an extent also on cultural patterns; from the Komi point of view, reindeer husbandry requires the herders to work in the tundra, a landscape perceived as being rather hostile; from the point of view of the Nenets, the tundra is a place where they feel at home, but owing to the settlement policy they have another home in one of the settlements that were created during the Soviet era.

Endnotes
All photos of the author were taken during field research conducted over several months with the Komi reindeer herders in 1999.

Bibliography
The Anatolian-Turkish House

Önder Küçükerman

For centuries, the traditional Turkish house with its unique space concept predominated in Anatolia. Its cultural roots can be found in the customs and traditional way of life in Central Asia. Some of the Turkic tribes in that region had adopted a nomadic lifestyle, breeding and herding sheep, goats, and horses, and practicing agriculture based on animal husbandry. In this context nomadic life does not refer to accidental migration, but is the result of a well-developed economic system that was determined by very sensitive laws and essentially was adapted to the biannual seasonal migration between summer and winter pastures that was necessary to find fresh grass for the animals.

Principle of Space Arrangement in the Nomadic Tent

The main products of this nomadic lifestyle were milk, meat, leather, and wool. Wool was processed into products for home use and also into thread, fabric, felt, and straps for trading. These were also the basic materials available for building dwellings. Wool products were used to cover the extremely lightweight and yet strong timber frame of the tent that was easy to carry and easy to erect, and to secure its joints as well as to make the interior into a habitable space. It only took 20 minutes to knock down such a tent, pack it up in individual loads, and load it onto horses. It became a sustainable and familiar home for its inhabitants, with a unique immaterial identity of space. Consequently the term home was no longer attached to the land.

In some way it was this lack of attachment that led to the creation of an independent inner order within the nomadic unit. A fire was maintained in the middle of the tent and used to cook food. Chests and saddlebags stood opposite the entrance, the goat-leather bag with the kumis (soured mare’s milk) was placed behind...
a reed wall on the right-hand side that created space for storage. The wooden bedstead of the owner of the tent is placed in front of this screen. To the right of the bed is a metal bar with hooks used to hang up valuables, clothing, and other objects. Weapons are deposited within reach, saddles and harnesses to the left of the entrance. All tents had looms for making carpets and wall hangings. The motifs used were essentially the damga — the tribal symbols of the various Turkish clans. The carpets are the most important objects; the original meaning of the word hali (carpet) is “something that lasts” or, in contemporary parlance, a “document.”

The Influence of the Nomadic Tent on Anatolia’s Vernacular Architecture

From about 1050 AD various Turkic peoples from Central Asia settled in Anatolia. Through the melding of the local culture with the Islam-based tradition of the immigrants, new architectural ideas and space concepts developed. Some of the new arrivals retained their semi-nomadic lifestyle; other tribes who had previously been settled in Central Asia practiced agriculture by cultivating the fields in their new homeland. The clans organized themselves into small groups and finally created tribal settlements around urban spaces, squares, public wells, or mosques. They arranged their dwellings along dead-end streets that were connected with the important interfaces of urban life. In this way they created what at first sight seems to be a random circulation network, but which in fact is based on very rational ideas. The structural order that had been developed over centuries of nomadic lifestyle evolved into some unique spatial and construction concepts with the key elements being load-bearing roofs, a movable support, and flexibility in the interior organization.

The essential steps required to make a tent into a habitable home only consist of erecting roof, floor, and side wall elements on a suitable piece of ground. In this simple way the natural environment becomes a suitable place for living. The prerequisite for this minimalist approach is that the inhabitants embrace nature, that is, that they accept life in nature, with the earth beneath them and the sky above.

For the space, the following characteristics resulted: It is practical and minimalistic. It is characterized by flexibility. In the tent, every patch is used for different functions in the course of the day. That is made possible with laid-out carpets, cushions on the floor, movable folding tables, and beds that can be rolled up and put to one side during the day.

The geometry of the room is changeable. In the transition from the mobile tent to the fixed building, the natural form of the tent gives way to the structural requirements of rather formally designed houses; the circular floor plan is replaced by rectangular rooms.

The relationship with the environment is flexible. Even though the external conditions can vary, a tent remains unchanged. By contrast, the floor plan of fixed buildings can respond to its environment, for example with the help of access via a garden or inner courtyard or providing a view of a square or mosque. In view of the fact that the traditional Turkish house was normally constructed directly on an available plot without changing the surroundings, the floor plan on the first floor normally reflected the accidental character of the terrain.

The Development of Archetypal Architectural Design Standards in Anatolia

From the form of the tents that were usually put up in groups during migratory movement, the concept of individual rooms developed, which are grouped around a central shared room, with each room having its own access to this central space. Every family member has a different position within the household. The head of the family as the most privileged person in a typically patriarchal family claims the main hall (başoda), which is appointed in accordance with his status and has the possibility of a separate access for guests and servants. Every male member of the house, every guest and servant, has access to certain areas within the house.

The patriarch’s spouse is the second most important member of the household. She spends most of the day within the house. In larger dwellings in which the internal space organization makes it possible to have separate quarters for men (selamlik) and women (harem), she spends the entire time in this area.

The Influence of the Natural Ambiance and the Basic House Types

Every civilization of necessity is influenced by the surroundings out of which it develops. Thus the natural features of Anatolia determine the form, appearance, and construction of its traditional buildings. The large variety of vernacular Turkish architecture in Anatolia results from the diversity of its regions. In many areas, people spend the summer and winter months in different houses, with those used in the hot season having to be open and cool and those more enclosed in order to preserve the heat. As a rule, the houses in the north of Anatolia were built in timber; those in Central Anatolia were built with clay bricks and natural stone; in the west, brick masonry was predominant; and in the south, a mixed construction using wood and stone.

The archetypal Turkish house originally had one story. Where there were several stories, the top level was always designed more carefully than those beneath in accordance with the hierarchy of space. In rural areas this main level tends to be closer to the ground, whereas in the more densely populated urban context it is arranged as high as possible above the narrow urban space.

The space concept of the Turkish house is based on the relationship between the individual rooms and the sofa, the shared room in between. The rooms had to fulfill all basic functions that have to be dealt with in a household every day. The residents sit, take their meals, work, and sleep in them. The sofa, which is surrounded by these rooms, is the shared living and congregation room. This floor plan concept remains the same irrespective of whether the house is built of timber, masonry, or clay bricks.

Essentially, the vernacular architecture of Anatolia has produced four basic types of house that were influenced as much by the
cultural, economic, and regional given as by the available building materials and construction methods.

Houses in the country and villages were mostly very simple, single-story, and only had few rooms. Likewise, single-room houses were not unusual, the regional diversity was extensive. Houses in the small towns are plain, with relatively few stories; they are carefully built but modest. They also reflect the regional characteristics.

Houses in the large cities are built with the greatest design intent in accordance with the local cultural legacy and tradition. Generally speaking they are extensive, large, and extravagant.

The Topkapı Palace in Istanbul is the most impressive representative of the fourth category: a prestigious state building with detectable references to the nomadic tent. Other examples of this category are the glamorous palaces of high civil servants, the villas of rich families, and the pavilions of the Sultan.

Basic Elements of Interior Design

Whatever materials are used for the construction of a house, certain elements have a specific meaning. Such an element is the continuous timber lintel above doors, windows, and cabinets. This is essentially used as a shelf and is designed such that it is at a functional height but at the same time also creates a visual separating line in the interior. The placement of this horizontal element influences the design of doors, windows, cabinets, and the entire interior fit-out. The area beneath this horizontal room divider is suitable for the daily human activities; the area above it is either fitted with clerestory windows or with cabinets.

In Turkish houses, the passage, that is, the transition into a room, is very important. Doors opened toward the inside and their inner faces are important elements of the room. By contrast with the much plainer outside faces, these are expensively designed. The door frame, the door lining, and the cabinets form a complete unit; they are designed as an integrated system.

The design of the floor is of key importance in Turkish houses because it is constantly used. It is used for sitting, working, and sleeping, as well as a whole range of other activities. Nomads erect their yurts directly on the ground, which they then cover carefully with felt mats and carpets. This principle is replicated in the Turkish house, where standardized reed mats are laid out even on wooden floors, which are then covered with carpets — also in a grid. This results in the basic form of the lower level. The carpet is the most important item of interior fittings; each one has its own name in accordance with its function in the building: there is a chamber carpet, a sofa carpet, a writing carpet, a chimney carpet, and a staircase carpet. The standardized dimensions of the carpets led to the development of the modular system for the house. In the Ottoman period the different carpet sizes are determined by law, and compliance with this law is strictly monitored.

Access to the main room is via a corridor or a room with a ceiling that is up to 20 cm lower. This difference in height symbolically emphasizes the importance of the main room. Other elements are lattice grids, railings or balustrades, arches, and columns, which are placed at the entrance in order to emphasize the boundary between the rooms. Raised seating elements (sedir) are integral parts of the floor and are visually emphasized accordingly. The counterpart to the floor is the ceiling. Together they form a congruent unit.

One of the most unusual characteristics in traditional Turkish houses is the design of the windows. Even though the lower row of windows may be quite plain, the casements of the upper row are much more elaborate. High windows — positioned beyond the reach of people — gave a symbolic meaning to the upper reaches of the room. Similarly, cabinets are some of the most important components in interior design. They line the walls of the room and are used for storing equipment and objects that are needed in that particular room, for example linen or smoking utensils, turbans, water jugs, table linen, lamps, coffee-making utensils, crockery, or foodstuffs. The top level of the cabinet is never higher than a person could reach; this principle is always adhered to irrespective of the variation in the form or function of the cabinet.

The Cantilever

Based on the tradition, there is a strong desire to relate the interior to the surroundings. The architectural solution for this is to create openings in cantilevering spaces. This led to the formation of oriels in which it is possible to directly integrate seating (sedir). Window sills are created outside the footprint of the house and relating directly to the exterior. These cantilevers are made technically
possible by using more lightweight construction materials and a large proportion of window area. Whereas the size of the windows on the lower floor became increasingly smaller, the size and number of openings on the top floor increased, which allows more light to come into the room and improves the view from the inside. Another important function of the cantilever is that it provides shade and cooling in summer.

A Uniform House and Room Concept Expressed in a Multitude of Designs

The development of the Turkish house in Anatolia resulted from the structural requirements as well as from the necessity of the “room” to be created. This led to the archetypal rooms of vernacular Turkish architecture. Even though the natural climate conditions vary a great deal in the different regions of Anatolia and hence result in different building designs, each house has the same types of room, even though the floor plans, their design, and construction can be very different. Economic factors barely influence the design of the Turkish house. This can be illustrated using three examples: a simple building in Bursa, which—even though of modest size—displays the key principles of the Turkish room, an elaborate house in Kutahya, and an aristocratic house in Bursa, which are both also built to the same rules. In conclusion, we can state that the basic underlying space design and the structural principles of all types of houses follow the same clearly defined concept. Ultimately, the traditional houses all over Anatolia all share this approach, irrespective of the otherwise extensive diversity.

Bibliography


17 Historical city house in Istanbul (photo: ca. 1960).

18 Karadeniz House in Ordu (photo: ca. 1970).

19 Buildings close together in Bursa: the upper floor clearly projects beyond the first floor (photo: ca. 1960).

20 Floor plan and section through a traditional Turkish house in Bursa, built on flat terrain.

21 Floor plan and section through a traditional Turkish house in Safranbolu, built on a slope.
The Islamic House
Hans Munk Hansen

With a fleeting look at the externally different residential buildings in different parts of the Islamic world, one might obtain the impression that there is no common building culture. However, the opposite is the case: on closer examination we can see how much a similar lifestyle unifies these countries and the design of their houses. In particular this is evident in the organization of the interior, where the courtyard house is the dominant style in all its variations, ensuring undisturbed family life shielded from the eyes of strangers. All rooms of the house face the courtyard, with the entrance door usually being the only opening in the external walls. Even though this determines the typical floor plan, a wide variety of styles can be found in the external appearance of the architecture. This results from the different climate conditions, the building materials used, as well as from pre-Islamic building traditions. Most of the people with an Islamic culture in the Middle East and North Africa live in low-precipitation areas, which means that clay dominates as a building material: rammed in timber shuttering, used as sun-dried bricks or as fired bricks, with and without glazed surfaces, clay mixed with shredded straw on flat roofs, and as plaster. This creates the predominant khaki-colored image of countless villages and towns (in Persian, khak means “earth, clay”). Below, we take a closer look at three examples of traditional Islamic houses.

House in Isfahan

When in 1960 I arrived as a visitor at the modest house of a craftsman in an old residential quarter to the west of the Friday mosque, I had to wait awhile until all women and children had left the courtyard, which was referred to as a garden. In the middle, a square water basin cooled the air and a flowering pomegranate tree in
3 Section of layout of a typical Islamic city: a dead-end alley gives access to the courtyard houses, a Public road, b Access to the residential street, c Inner courtyard

4 Traditional living quarters in Isfahan: the closely arranged courtyard houses have flat roofs made of clay (photo 1959)
In parts of this residential quarter, the typical structure of a traditional Islamic city can still be experienced today. A few narrow and angled lanes lead to dead-end alleys on both sides. The latter can be likened to a grapevine, to which the individual houses are attached like grapes. Most of the time they are built so closely together that only the entrance facade faces the alley—sometimes not even over its full length. Residents of neighboring dead-end alleys often carry out the same trade and, at the same time, are also related to each other. They were able to protect themselves against raids by locking heavy gates that enclosed their territory. When visiting this part of the city, one can see not much more than poorly maintained clay walls dotted with entrance doors. Only when taking a look from a raised vantage point, for example the roof of the Friday mosque, can one guess at the contrast between the modest facades that face the city and the often very elaborate courtyards inside the houses. This represents a strong contrast to Western culture, where the main focus is usually on presenting a certain image with one’s buildings.

Daily life in traditional Islamic homes is distinctly different to that in European households. In this culture, the home is the domain of the woman, whereas the man spends most of his time in the public realm. However, even in Isfahan, one important craft is also practiced inside the home: the women in poorer families contribute to the family income by knotting carpets.

When, fifty years later, I again visited a family in Isfahan, the number of inhabitants of the city had risen from about 250,000 to 2,000,000. Now the apartment and its furnishings were very similar to those in the West, with the television at the center. In contrast to the densely developed cities and villages in large parts of the Islamic world, on Djerba one can see many freestanding courtyard houses spread throughout palm groves. A small piece of land around the house provides the inhabitants with a frugal livelihood. Each square meter in the gardens is made use of at three levels: at the very top the date palms, beneath them smaller fruit trees, and on the ground various vegetables. The houses consist of irregular blocks of coral rock that have been cut at the coast. This is finished inside and out with plaster, which is whitewashed, creating a beautiful contrast between the white houses and the surrounding greenery.

The floor plan follows the tradition of the Islamic world and impressively shows how flexibly a house can be used. Since the house will very rarely be inhabited by one generation only, it is possible to accommodate three families, providing three independent living quarters with the associated storage rooms. As in other Islamic houses, hardly any furniture is needed: during the day one sits on the cushions on the floor, and for the night the bedding and blankets are taken out of the storage cabinet. Eating takes place either inside or outside, depending on the weather; the food is spread out on a tablecloth on the floor. The design of the three living units determines the external appearance of the house, in particular the cupolas which, at the end of the living room, cover a somewhat higher area, and the barrel vaults at the opposite end that top off the storage rooms. The latter have two levels, with the lower one often being used as a washroom. The shared space where the family meets, where the children play, and where the food is prepared for the entire family is...
the courtyard, because the actual kitchen is too small to accommodate all inhabitants. In the entrance area the door is the only opening in the external wall and, as is common in Islamic houses, the lobby behind this area has doors arranged in such a way that no stranger entering the house can see into the family area in the courtyard. This links directly with the reception room for male visitors. Where houses do not have such a room, the tea meetings of the men take place in the street in front of the entrance door. Sadly, many of the traditional houses on Djerba have been abandoned in recent times.

Bayt Al-Suhaymi – Residential Palace in the Old City of Cairo

Even though Bayt Al-Suhaymi is a large complex of buildings, or a small palace, on close examination one can detect many similarities with the simple houses such as the two described above. This is particularly evident from the division into several living units within the building complex. As far as has been established, the oldest parts of the palace date from the seventeenth century. The first thing a visitor notices is the three-story facade facing the narrow alley. Only the lowest part is devoid of all openings, with the exception of the entrance door. The stories above provide much more visual interest due to their various projections and cantilevers. Many of the windows there feature what are known as mashrabiyas – latticework made of turned wooden elements – that prevent outsiders seeing into the rooms behind but which allow a view of the street from inside.

Through the angled entrance area, visitors reach a magnificent courtyard. Surprisingly, here too most openings are covered by mashrabiyas, a sign that the courtyard was not exclusively used for private purposes; male visitors could see the courtyard from the open terrace on the second floor. From the courtyard one enters a garden, which today is of an irregular layout. The interior of the palace includes independent units, the most important of which consists of a three-story-tall room covered by a cupola. On both sides of the richly patterned marble floor with a sunken water basin one enters the actual reception rooms, the floors of which were formerly covered with precious carpets. These and other reception rooms of the building are magnificently appointed, featuring some colorful wood paneling, embellished with precious marquetry.

During past centuries the building complex was converted several times for the purpose of enlarging or reducing its size and adapting it to the various requirements of its owners. Nevertheless, the overall impression is one of harmony. The original owners of the palace moved out a long time ago, and probably now live in a modern villa in one of Cairo’s suburbs. For this reason, over a long period, Bayt Al-Suhaymi fell into disrepair until, some years ago, the Egyptian authorities carried out a comprehensive restoration. Today the palace is used as a museum.

Bibliography

Dome Houses in Syria

Karin Pütt

The dome house style, which once could be found in many parts of Syria, is rapidly falling into disuse – and only few of those houses are still inhabited. This process has been going on for decades. Today, most dome houses are empty and subject to decay; inhabitants have left or replaced their dome houses with modern, flat-roofed buildings. From the seventeenth century onward, European travelers had often mentioned this special form of housing, which is also characteristic of the suburbs of Aleppo. This typical form of construction is achieved by continually cantilevering building blocks toward the center of the room. The special feature of the Syrian dome buildings is that they are built using clay as a building material.

The Distribution of the Dome House

The distribution of dome houses reaches in a south-to-north direction from the western part of central Syria to the southeast of Turkey; the area has shrunk significantly over the course of more than 100 years. Today, dome houses can still be found in the following areas:

- The northern dome house areas: from Suruç (Turkey) via Kobani / Ain al-Arab toward the east near Ain Issa / from Harran (Turkey) toward the south along the Balikh contributory to the Euphrates / at the upper section of the Khabur contributory to the Euphrates.
- The middle areas: southeast of Aleppo through to the Euphrates and the Jabul salt lake / the Jabal al-Hoss mountain range.
- The southern areas: in central Syria to the east of the line from Hama to Homs to the edge of the desert.

These geographic regions belong to the transition zone between the rain-fed agriculture areas and dry areas (rainfall limit 200–250 mm/year) and mark the boundary between nomadic lands.
and settled agricultural areas. These steppes do not allow any significant natural tree growth, which means that construction timber has to be obtained from more distant regions. In these steppes the border between settled inhabitants and Bedouins has been shifting over the centuries. The Ottoman Empire did not succeed in stopping the attacks from the strong camel-nomad tribes on villages. Sheep-nomad tribes with a semi-nomadic lifestyle however did settle down and occupied the fertile steppes around the cities. For some of today’s inhabitants, the time of nomadic migration is only a few generations ago. In the central Syrian dome house region, former nomads mix with settled Ismaelites, Alawites, Christian, and Kurdish groups. In the more northerly regions, the individual groups remain rather separate: the Suruç-Kobani region is inhabited by an almost exclusively Kurdish population; the Harran region is Arabic, and the Khabur region was used by the French Mandate administration to settle Christian refugees. The administration had sent builders from Aleppo, who put up cheap housing for the refugees.*

Construction Principles and Basic Shape

The basic unit of a dome house is a square room with clear measurements of between 2.5 × 2.5 m and a maximum 3.2 × 3.2 m. The vertical part of the walls consists of a natural stone plinth in order to prevent moisture from rising, and masonry consisting of locally produced air-dried clay bricks made lighter with chaff. To carry the load of the dome, a wall thickness of at least 60 cm is necessary. The bond used in the walls consists of one-and-a-half clay bricks. Common sizes of clay bricks vary between 38 × 19 × 9.5 cm and 50 × 25 × 10 cm.

* As opposed to other dwelling types the auxiliary buildings are also illustrated here. In the case of the single access configuration, they are a component of the dwelling to a stronger degree than in other building configurations.
The construction of the dome is always carried out using a stretcher bond, which means the wall thickness is mostly about 40 cm. The local builders lay the bricks with a cantilever of approximately two fingers’ width in every course toward the inside. They do not use any aid for the rounding of the dome, but rely only on their visual judgment.

Two different methods are used for achieving the transition between the square floor plan and the circular form: in the first method clay bricks are laid diagonally across the corners with every course projecting further toward the inside, thus creating pendentives. In the second method short wooden sticks are laid diagonally across the room corners as the base for a pendentive that comprises only a few courses of masonry. The first method is mostly used where the vertical part of the walls is kept relatively low. The rounding of the dome shape can start from a height of 80 cm. In order to ensure that the corners can still be used for sitting, the pendentive is as steep as possible. Pendentives are constructed with sticks only when the vertical part of the wall is at least 1.8 m tall. The height of a door also determines the height at which the dome starts to curve if this is located at the corner of the room. Occasionally it is necessary to include special door oriels so as to be able to fit vertical door frames. The amount by which the individual bricks project toward the inside determines the height and form of the dome. This is decided by the master craftsman. From the outside the domes can appear semispherical, conically pointed, or parabolic. The latter can reach a clear height inside of up to 6 m. The stones inserted in the domes, which appear to be decorative elements, are needed for the practical purpose of stepping onto the domes in order to renew the exterior plaster on a regular basis.

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In the past, doors were the main source of light and ventilation. Instead of windows, the glass for which would have been too expensive, small openings were left in the walls (a maximum of 18 × 18 cm) in order to allow for cross ventilation. These were often positioned toward the west in order to benefit from the predominant cooling westerly winds coming from the Mediterranean.

As a building material, clay has good insulating properties; the interior climate of these dwellings is further enhanced by the solid material of the domes and the great height. The round shape of the dome is always carried out using a stretcher bond, which means the wall thickness is mostly about 40 cm. The local builders lay the bricks with a cantilever of approximately two fingers’ width in every course toward the inside. They do not use any aid for the rounding of the dome, but rely only on their visual judgment.

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dome is particularly effective at reflecting solar radiation. During the hot summer months the interiors heat up so slowly during the day that people prefer to be and sleep outside only from the afternoon. In the course of the night the walls give off the stored heat.

In order to increase the interior size of a dome dwelling, one or several walls with adjoining rooms are supported by vaults, thus increasing the floor area. These vaults are constructed with the help of a template. Dwellings involving two domes are common, but homes involving three or four domes are very rare.

Floor Plans and Forms of Courtyard

The layout of farmsteads that are often used for agricultural functions is based on dome units with a square plinth: – the additive principle, which is the most popular, additional constructions is based on dome units with a square plinth: – in the two northerly distribution groups we find floor plans in the upper Balikh Valley in particular, dome houses with a central hall (iwan) and two or four laterally adjoining rooms became popular from the nineteen-fifties. In spite of the different floor plan arrangements, all houses have their associated outside area on the south side of the main living space. The tendency to form an inner courtyard is common throughout the Middle East. However, even an open courtyard without marking represents a protected area for the family. The floor plan itself depends largely on local wind conditions. In most cases, the living rooms are located on the northern side of the farmstead with windows facing west, because strong westerly winds bring cooling during the hot summers. Kitchen and storerooms are located on the east and south sides in order to prevent strong odors from the kitchen or animal areas from drifting into the living spaces.

History and Future of Dome Houses

No evidence exists as to the time at which the dome house in the Middle East was first created; however, it certainly appeared in the Levant and in Northern Mesopotamia during the Bronze Age at the latest, as was established from digs in Syria. One image of dome houses in a relief from the Palace of Sennacherib in Niniveh in modern-day Iraq dates from the first millennium before Christ. Whereas formerly it was relatively cheap to build a dome house – clay pits were available at the road from Damascus to Palmyra; in Turkey the dome houses in Harran are formed into an open-air museum to attract tourists, and in the central Syrian village of Shaykh Hillah, local initiative has upgraded dilapidated dome houses to create guest houses. In Lebanon, initiatives have just started that want to make the building of dome houses again an attractive proposition to refugees. The idea is to facilitate the return of the war-impoverished population to their villages in the future; to this end, young Syrians are learning again how to build dome houses and to combine the cost-effective and sustainable building method of their ancestors with a little bit of modern comfort.

Why do dome buildings appeal to people so much? Domed spaces can also be found as tombs of saints, mosques, and churches. Is it possible that the rounded form, in a particular way, conveys a sense of nurture and protection?
Tower Houses in the Old City of Sana’a

Jan Martin Klessing

For visitors from the West, a tour around the Old City of Sana’a seems like taking a step into the medieval past. The visitor will be fascinated by the pulsating Oriental hustle and bustle in the markets and tradesmen’s streets and, at the same time, will marvel at the uniquely structured, soaring tower houses – some of which date back hundreds of years – that dominate the urban scene. Owing to the lack of maintenance and the threat of dilapidation, the historic Old City of Sana’a, together with its entire urban structure and the traditional architecture with its decorated brick facades, was declared an UNESCO World Heritage Site in the nineteen-eighties.

From 1986, many international cooperation projects for the preservation of this unique architectural ensemble were initiated in cooperation with the Yemeni Preservation Authority, GOPHCY.

As early as the beginning of the nineteen-nineties, the positive response to the extensive salvation measures in the Old City of Sana’a resulted in a previously lost and now revived interest of the population in its preservation. Through the systematic modernization of the urban infrastructure and the repair of examples of traditional tower houses it was possible to halt the decline of the Old City and to allow for the development of a functional and sociological improvement and revitalization of the medina.

In this context, the German-Yemeni restoration project for the preservation of the Samsarat Al Mansurah agreed in 1993 made an important contribution; this was supported by German and Yemeni architects and conservationists working together as partners. Taking this project as an example, the characteristic features of the traditional building and construction methods will be explained, as well the application of inherited craft skills as a necessary method for successful preservation.
The Structure

The approximately 250-year-old trading house in the Suq al Enab on the edge of the market precinct is a typical example of Yemeni tower house architecture. It has been built of lava basalt and tuff rock in the lower stories and of fired bricks in the two stories above. Above a nearly square footprint with a side width of approximately 12.3 m and a low retail floor, four main stories arise in which a number of small rooms are placed in the form of a ring around a central hall. Two columns in the middle support the decks above the central halls via rows of arches, with the halls on the second and third floors connected at the center via a gallery; the fourth central level has been designed in the form of an open courtyard.

Typical of tower houses, a pillared stairwell on three sides accesses the different levels, with the solid masonry pillar – Umm al Bayt (mother of the house) – playing an important structural function as a bracing anchor element, whereas the surrounding ring of small rooms has the effect of stabilizing the building through four stories in the manner of a tube (bamboo principle). This construction principle, which is important for the structural stability of the building, is a response to the frequent – usually weak – earthquakes in the region, which have also influenced the use of the available building materials. The relatively soft masonry of bricks and clay mortar makes it possible for the walls to absorb any tremors hitting the building without serious damage. Likewise, shock-absorbing timber beams are placed as a buffer between the stone columns and the base of the vaults. Furthermore, this device is used at critical points in the brickwork, such as at lintels over windows. In order to stabilize the building circumferentially, wooden anchor beams are inserted in the external walls at each floor level and are joined at the corners using dowels and scarf joints.

It is therefore not permissible, when carrying out repair work, to install modern rigid building components, or hard materials, which, in the case of tremors, would result in critical interference with the soft building fabric and cause considerable damage. It makes much more sense to rely on traditional methods of repair: in the stone walls of the lower floors, structural integrity is achieved by replacing damaged parts with sound blocks of stone, whereas in the upper floors damaged parts of the brick walls are repaired by rebuilding. This work is carried out without any scaffolding. Masons are used to laying bricks at the top of the wall without protection, moving barefoot backward and sideways.

Any parts of the ceiling structure that have rotted due to moisture ingress are replaced with newly inserted irregular round sticks, with the bark left in place. This is followed by the different layers of the intermediate floor: on the closely packed layer of sticks is placed a strong layer of moist clay, which in turn supports another layer of dry building rubble that has been obtained by way of recycling.

The Decorative Design of the Facade

The facade design in Yemen is typified, on the one hand, by the function of the stories and the placement of the windows and, on the other, by the creation of independent projecting brick patterns, usually in diamond- or zigzag-shaped bands all around the building.
or as a way of framing window openings. Emphasized by an application of white lime slurry, the ornamental brick bands, which project by half a brick’s width, stand out visually and determine the appearance of the facade. With its small, deeply set rectangular window openings, the first lava-stone-built story displays a fortress character that is typical also of inner city locations; this story is traditionally used as storage for various household goods, whereas the second floor, with its tuff stone facade and larger openings, contains rooms for trade or other business activities. All windows on this floor are fitted on the outside with qamariyas, lattice gypsum panels in a variety of patterns, with the upper windows being fixed-glazed and the lower ones featuring a glazed casement that can be opened inward. The structure of the two elaborately decorated upper brick stories is similar; these are designed as dwelling spaces, probably to provide accommodation for traveling traders or as permanent apartments. The qamariyas, with their geometric or floral patterns, are produced in different sizes by trained artisans, either as one-off pieces to order or in serial production for the market. To do this the artisan will first of all cast approximately 2- to 4-cm-thick gypsum panels of the appropriate size into which – while the panel is still damp – he will score the intended pattern using a compass and a short ruler. He then proceeds to cut out the openings using a special knife. Thereafter the panel is backed with a pane of glass, which is attached to the remaining bits of plasterwork using damp gypsum. In the Al Mansurah, only colorless transparent glass is used. However, the use of colored glass is characteristic of residential buildings in particular which, especially at night, results in the upper lit window openings’ creating a colorful, almost mystical atmosphere in the streets. The wooden doors are often artfully decorated with carvings and feature richly decorated metal fittings. The entrance door of the Al Mansurah, for example, illustrates the artistic decorations as well as the complex timber joints that were used to guarantee a robust and long-lasting function.

Qadath: A Waterproof Floor Covering

Water penetrating a building that has been constructed with clay as a binder can cause considerable damage; to prevent such, an elaborate craft system is traditionally used for sealing flat roofs and floors in wet rooms with qadath, a screed-type layer. In view of the fact that making qadath flooring is very labor-intensive and hence expensive, many attempts have been made over time to make any repairs with simpler means, that is, with materials using cement as a binding agent, as a rule, however, this has not been successful. Unfortunately, the knowledge of how to produce this traditional flooring has almost been lost and today the craft is only practiced by a few older master craftsmen. In view of this situation – when it came to repairing damaged areas in the roof and other sensitive areas of the Al Mansurah – a successful effort was made to revive the traditional technology for producing qadath. To this end, it was insisted that the contractor for the project employ experienced bona-fide master tradesmen at specified wages to carry out the repair work.
Apart from a small quantity of water, the raw materials consist of approximately 40 percent locally slaked lime and – especially in Sana’a – approximately 60 percent black volcanic stone rubble of basalt lava. The labor-intensive process of producing the mixture alone involves six to eight workers who, squatting in rows and sitting opposite one another in pairs, use the lime and basalt lava rubble to produce a coarse mixture as the first step. In subsequent steps, the next pairs of workers – singing along as they work – continue to crush and mix the coarse source material using heavy pear-shaped club hammers made of hard stone, adding carefully measured quantities of water until the mixture turns into a viscous but still relatively dry slurry that is ready for application. To produce just one bucketful of the finished slurry requires about two hours’ work. The finished slurry is applied to the floor area, which has been covered with wetted round pebbles; again this work requires several workers who, in a kneeling position, use sharp-edged blade-like stones to compact the layer by heavy beating, producing semicircular patterns while splashing on a little water with a straw hand brush. This compacting process alone, with a craftsman beating the slurry, takes about two hours per square meter. After a drying time of two to three days the process is repeated with a second layer, which is smoothed with a trowel. In order to prevent the formation of air cracks, the lime slurry is brushed on again and again with a hand brush for seven to ten days during the process. Finally, the surface is polished smooth with special hand-sized stones and then oiled using fabric that has been soaked in hot plant oil. The floor finish obtained with this very laborious work process is highly water- and abrasion-resistant; in addition it is slightly elastic, which means that even with heavy use a service life of far more than 100 years can be achieved.
After its refurbishment the Samsarat Al Mansurah was used by artists as a center for work, meetings, and exhibitions and was successfully operated for a long time before it was closed due to the political upheavals of recent years; it is now rapidly falling into disrepair. As a result of the civil war, air attacks have wreaked havoc in the Old City of Sana’a, causing light damage to several thousands of buildings and serious damage to several hundred; 50 houses have been completely destroyed.1

1 Information provided by a Yemeni colleague, summer 2018.

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Traditional Construction in Nuristan

Max Klimburg

Nuristan is the name of that partly high mountainous and predominantly still forested area in the Hindu Kush in the northeast of Afghanistan which, until the late nineteenth century, was known, denigrated, and also feared as Kafiristan (land of the Kafirs), meaning “land of the infidels” from the Islamic point of view. For this reason, few eyewitness reports exist before the forced conversion to Islam of the Kafirs in the winter of 1895–96. At that time, the Afghan army of the authoritarian ruler Abd-al Rahman occupied the many valleys in the area and destroyed almost everything resembling an “un-Islamic” object, such as temples and statues of deities and ancestors. Thereafter, the area was renamed and given the honorable name of Nuristan: land of (Islamic) light.1

To this day, when talking about the Kafirs or Nuristani, reference is generally made to the Kati Kafirs in the east because the only more comprehensive eyewitness report, that of G. S. Robertson following his one-year stay (1890–91) in Kamdesh in the Bashgal Valley, almost exclusively refers to this area. He was not able to gain a lot of information from the other ethnic Kafir groups with their partly profound linguistic and cultural differences. His once-famous book *The Kafirs of the Hindu-Kush* (London, 1896) with many drawings based on his photos (which have not been found), and the photos obtained by a short British expedition into the upper Bashgal Valley in 1885 impressively illustrate, among other things, the once-great importance of statues of ancestors close to cemeteries and of triumphal poles near the settlements; however, hardly any information can be gleaned about the numerous temples and shrines with their effigies of deities.

Today we know that Nuristan comprises three cultural landscapes that can be distinguished primarily by the language of their inhabitants. The largest is that of the Kati speakers, who live in the east in the Bashgal Valley, to the west of the Parun Valley in the
Kantiwo Valley, and in the northwest on the upper section of the Ailingar River. The two other cultural landscapes are those of the Waigali and Askhum speakers in the south and southwest and those of the numerically small Paruni (or Prasun) speakers, living in six villages (their number has increased recently) in the Prun Valley located to the north thereof between the two blocks of the Kati speakers. With respect to their language and culture, they differ significantly from the other inhabitants of Nuristan.

Forms of Settlement

In the narrow valleys and higher up, the most common form of settlement in Nuristan consists of mountainside villages, such as that of the large Kandesh community in the east and that of the large Wama village in the Pech Valley. Cluster villages with houses with a central courtyard are only found in the upper sections of the valleys with their often wide valley floors. Their defense walls consisted of the external walls of the houses that were built close up to each other. As a rule, these villages also had defense towers and underground passages that, in the case of a siege, allowed for communication, obtaining water and, as a last resort, served as escape routes.

Generally speaking, social and ethnic criteria determined the location of houses in the settlements, with their inhabitants belonging to different clans. The location of individual dwellings is largely determined by membership in the clan and other social criteria; as a rule, impoverished families are forced to move to lower positions in the village. Ethnic criteria stipulate that the bari, the “higher” craftsmen (blacksmiths, carpenters) and shuwala, the “lower” craftsmen (basket-makers, potters, laborers), who are classed as ethnically foreign and “impure” (being the descendants of groups that once were slaves), are permitted to live only in the bottom-most part of the village. Due to their “impurity” they are only allowed to enter the proper zone of the village for special tasks; when doing so they may only enter the very front part of the houses of the “genuine” Nuristani or once Kafirs. During festivals they may only take part as helpers; they—like women in general—are only given food with little or no meat and have to eat this away from the main festivities. No bari lived in the Prun Valley, which was praised as being especially “pure” in terms of the cult, but some of them—particularly blacksmiths—were exceptionally permitted to briefly enter the valley for certain tasks; hailing from Kati-speaking villages. Since some time several bari families live in Pashki, the lowest village in Prun.

Houses and Their Construction

Construction timber comes from the very straight-growing Himalayan cedar, which can easily be split and was once widely available. As late as in the early nineteen-seventies, saws were virtually unknown anywhere, and the men doing the construction work (bari) worked with axes, felling the often mighty trees and parting them with axes, wedges and bars in order to split off sections of tree trunk, tearing them apart, and finally working the timber with adzes, pry bars, and knives.
View of the village Nishegram in the Waigal Valley at about 1,850 m altitude seen from the mountain slope opposite (photo 1972).
The ama (dwellings) are all detached single-room houses with a lower story, a cellar, with four pillars around the central fireplace (nowadays mostly a metal stove), with one entrance door, usually a small door leading to a rear storeroom, and with a trap-door into the lower story. Similarly, houses next to each other, which are connected via a platform, terrace, or veranda, are only accessed via their entrance doors. Generally speaking, the buildings are more or less square, each side measuring about 5.2 to 5.5 m – except in Parun the amoq, the mostly rectangular religious cult houses of the clans in Kafir times which can be up to 8 m long. The inside height of the dwelling is about 2.4 to 2.6 m. The lower story is used for storage, primarily food. The plinth is constructed of stone or stone with timber and, on steep slopes, can be very tall.

In the case of mountainside villages with flat-roofed houses, one often has the impression that the roof of the building below is used as a terrace by the inhabitants of the house above. Sometimes the routes to and between the houses may lead across the roofs for a short distance, but anyone walking along that route may cause some earth to fall down from the ceiling of the respective house. Roofs are used by inhabitants for drying food, such as cobs of corn, walnuts, and stone fruits; the roofs are also frequently used during festivities.

The construction of the dwellings – except the stone buildings in the upper Parun Valley – shows similarities with log building. In order to save timber, logs are stacked at the corners only; in between they are separated with stones or wood blocks by about 15 to 20 cm, and the gap created is filled with stones and clay soil. Only in the valleys occupied by Kati speakers are houses built with every layer of the well-hewn logs pegged together at the corners using simple joints. In all other instances, the logs – which are usually unhewn – are held together using thin vertical poles pushed through holes in horizontally inserted boards on both sides of the wall. This method of construction, called piku-nakara in Waigali/Ashkun, ensures the strength of the walls, but braces them only to a limited extent, which means that the houses occasionally look to have slanting walls, as if blown by the wind. Both types of construction are earthquake-proof.
not found in the piku­nakara houses in the mountainside villages in the lower Parun Valley. This is partly due to the fact that, until very recently, bari craftsmen were not called in to build houses, or only exceptionally. The work was carried out by the building owners and their relatives and neighbors only. Unsurprisingly, the result sometimes looks a bit higgledy­piggledy.

Sunken Houses in the upper Parun Valley

The stone­and­clay­soil­built houses in the cluster villages on the floor of the upper Parun Valley are unique in that they are sunk into the ground. Aboveground, one can only see a small low building with an entrance door, from which the inhabitants reach the dwelling by climbing down a tree trunk ladder. The interior of this entrance structure is dominated by a mighty, square, box­like container that serves as a smoke­retainer: the idea is to capture the smoke with its inherent heat, which is particularly profusely created when burning shrubs and softwood in the house. Smoke can eventually escape through a smoke hole in the flat roof, which can be covered with a stone.

Amol, the former clan temples of the Parun culture, of which there were several in every village, are somewhat larger rectangular buildings with more than four upright supports. In the upper Parun Valley they are reached by climbing down an incline, and their large, square smoke retainers are placed on the roof.

In all regions, with the exception of the upper Parun Valley, a platform, terrace (as the roof of an extension of the lower floor), or enclosed veranda is located in front of a dwelling and is supported by often up to 3 m long poles. Platforms are primarily common in the Ashkun area in the southwest as well as in the villages of Wama and Achenu in the Pech Valley, whereas terraces dominate in the Waigal Valley because almost all houses there feature extensions, which are often supported by long poles. Enclosed verandas, which are indicative of the higher social standing of their owners, are frequently used by Kati speakers in the Bashgal Valley but are rare elsewhere. Railings on these platforms and terraces are standard, but may also be lacking.

Extensions, enclosed with vertical boards, are accessed from the lower floor via an opening the size of a door and can be accessed from the outside by removing or sliding certain boards. They are usually used for the storage of hay, straw, and firewood; they are also the place with the hole for the drop toilet.

The roof bears on two main beams which, each supported by two uprights, are placed either at right angles to or in parallel with the façade, depending on the region. These beams carry a layer of closely spaced thin poles so that short boards can form the ceiling...
The living space is generally dominated by the four, often richly carved, pillars around a fireplace and, below the smoke hole, in the upper Parun Valley, the large smoke retainer. The social right to have decoratively carved pillars, facades, entrance doors, and other items—-at one time almost everywhere—literally had to be earned (organization of large feasts and martial successes). The interior of the houses was/is covered in a thick layer of soot; today, the formation of soot is much reduced due to the widely spread use of very simple stoves.4 Above the fireplace/stove, anchored to the four pillars, thin horizontal poles are fitted for drying items such as animal pelts, which are sewn into bags for carrying things. At the back wall a long, deep board is used as a shelf for all kinds of objects, and in one of the side walls—inserted at half height—may be a small storage box with a sliding door. Storage chests exist only rarely in the living space. Often are bees kept in a short length of hollow tree trunk inserted at a low height in the facade.

Endnotes

1 A small area inhabited by the somewhat culturally related Kalasha-Kafirs directly to the east of the border with today’s northwest Pakistan, in the Chitral district, was beyond the reach of the Afghan army and escaped all conversion to Islam. Its inhabitants lead a life that is increasingly threatened by Islamists, and the people are referred to as the “Kafirs of Pakistan”; however, this is not discussed further in this article.

2 Little is known of the Kafirs there, because they had been forced into exile for a whole generation.

3 In the nineteen-fifties there were still towers standing in Parun, in Pashki, Dewa, Pronz, and Ishtewi. The last of these, in Ishtewi, was taken down in the nineteen-eighties.

4 Simple water mills with a horizontal waterwheel exist everywhere, but the way down to them is often arduous, and during dry periods operation is limited.

5 In the simple metal stoves with a stovepipe leading through the smoke hole, it is not possible to burn wood slowly, as can be done in an open fireplace by pushing branches slowly into the fire. Furthermore, they provide hardly any light.

Bibliography


There has been little change in the life of the nomadic herders of Central Asia throughout the centuries. They have been driving their herds through the endless steppes since time immemorial. They undertake their annual migrations following a sophisticated system in order to make best use of the sparse pastures available throughout the year. Their mobile dwellings consist of two basic types: the yurt and the black tent. The two types of buildings are described below using the Kyrgyz yurt and the black tent of the Tibetans as examples. Even though the lifestyles of the nomadic herders of the two peoples are similar in many ways, their tents are nevertheless very different.

The Yurt

The yurt of the Central Asian nomadic peoples belongs to the archetypical form of building that is almost perfectly adapted to the conditions of its environment and, for this reason, has remained almost unchanged in terms of construction and appearance over many centuries. Its origin is likely to date from the time before Christ. In the cold and arid high steppes, the yurt not only offers excellent protection from the cold, snow, and rain but is also well suited to resist wind due to its round and aerodynamic shape. Its spacious circular interior receives an even amount of light from an opening at the top and generally is a high-quality space. Another important factor is that the construction of the yurt requires only a few small sections of timber, a material that is scarce in this region. Likewise, only few simple tools are required for its construction. The geographic distribution of the yurt — the term comes from the Turkic language and originally referred not to the tent but to the camp site — stretches from Iran via Afghanistan and Kazakhstan to

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Christian Schittich
Mongolia. In spite of all similarities, two basic types can be distinguished: the Mongolian ger, as used by the Mongols, Kalmyks, Tartars, and other ethnic peoples with a language derived from Mongolian, and the yurt of the Turkic peoples, which include the Kyrgyz, Kazakhs, Uzbeks, and Turkmen, among others.

The essential difference between the two types is that the Mongols use straight poles for the roof and a flatter roof ring, which results in a more cone-shaped roof, whereas the Turkic tribes use roof poles that are bent at their lower end and a heavier bent crown, creating a more cupola-shaped top. The yurts described below are from Kyrgyz peoples from the region of the Karakul Lake on the Pamir Plateau in the extreme west of China.

In contrast to the former Soviet Union, most nomadic peoples in China were largely able to continue their traditional way of life during and after the Cultural Revolution. Even though the majority of them were no longer allowed to carry on working on their own account but instead were organized in work units, they continued to migrate with their livestock to pastures and to live there in their traditional tents. For this reason, quite a few traditions have survived better in China.

The herding nomads who live at Karakul Lake change pastures with their herds three to four times a year, with each family always going to the same precisely defined locations. Whereas in the summer camps at the higher altitudes yurts are the only form of dwelling still in use, simple houses built of rough stonework can be found more and more often in the winter camps at the lake at an altitude of about 3,650 m; these are also used for the storage of provisions and hay.

A yurt can be put up by four people in about two hours; it takes one-and-a-half hours to take it down and package it into easily transportable loads that can be carried by two to three camels. It is a masterpiece of prefabrication and standardization. Its frame is self-supporting and usually consists of willow shoots of 2 to 4 cm diameter. Often the wooden parts are finished with a matte protective coating of red earth and sheep’s blood.
Construction and Structural System

The characteristic feature of the yurt is the kerege (lattice grate), which commonly consists of four (in larger tents up to six) kanat (parts) of equal size. Whereas each kanat can be moved individually and pushed together for transport, they form a stable wall when they are placed in a circle and tied together with straps. This is usually carried out in a fixed sequence: at first the door frame is assembled, as it is important for the stability of the structure during the construction process. Then the kereges are attached to that and placed in the form of a circle. Each kanat consists of a specific number of split willow shoots, which are placed on top of each other in crosswise fashion and are traditionally tied together with leather straps that are threaded through holes at the joints and knotted on both sides. During assembly the leather straps are wet, and as they dry out they contract so that the slats are firmly pressed together; nevertheless, the joint remains flexible. Lately, nylon cord or metal hinges are increasingly used instead of leather straps. The yurt’s 50 to 60 roof poles are bent at their lower ends at an oblique angle. They are tied at their lower ends to the uppermost crossover points of the diagonal members of the lattice grate; the other ends are inserted into the prepared holes of the cupola ring. In parallel, a strap of woven material is applied all around the structure in the upper third of the lattice grate and secured tightly; this counteracts the outward pressure of the roof structure. As soon as the load-bearing structure has been erected, it is covered with overlapping felt mats, which are tied to the structure using camel hair ropes tensioned in a crosswise pattern. A common practice is to use rectangular mats on the sides and two trapezoidal mats for the roof. In winter it is also common to apply two such layers on top of each other. The opening in the cupola is covered by a square tarpaulin. During the day this is pulled back in order to allow light and air to enter, and in the evening it is closed to protect against the cold. Since about three decades ago, it has become more and more common to place a white linen canvas sheet in the place of the second layer of felt in order to provide additional rain protection for the yurt.

The Interior of the Yurt

A yurt is the microcosm of its inhabitants and is viewed as their home – independent of its location. It consists of a single room about 5 m in diameter, which is laid out with woven carpets and provides excellent protection against wind, cold, and rain. However, it does not have any tensile strength and is therefore not suitable for tensioned tent constructions such as those used by other nomadic peoples. It was probably the supposed disadvantage of felt as a covering material that led to the development of an ingenious, tried-and-tested type of dwelling such as the yurt.1

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Kyrgyz yurt at Karakul Lake, Xinjiang, China (photos 1988)

5, 6 In September the nomads move from the higher pastures to their winter camp at the lake. Then the meadows are mown and the hay is kept in storage for the cold season.

7, 8 Simple woven carpets are used in the yurt as floor coverings and wall hangings. They are produced by women and girls in the open using narrow looms that can easily be transported.

9 In the winter camp, the yurts are placed relatively close together.

The second important characteristic of the yurt, in addition to the kerege, is felt as a covering material. It is produced by the women in a simple process using the wool of their animals — primarily sheep and camels but sometimes also goats and yaks —
provides space for a whole family, sometimes up to 12 persons. Occasionally some parts are separated with suspended carpets. As a matter of principle, everything has its definite place. The area to the right of the door is reserved for women, the area to the left for men. The area furthest away from the entrance is the place of honor. In the middle is the fireplace, which, since a few decades ago, has been replaced by a cast iron round stove, which is used for heating as well as for cooking. On the basis of this layout, all objects are arranged in accordance with a rigid scheme that is based on the gender and status of the family members. This means that the saddles, harnesses, and weapons are placed on the side of the men, and the cooking equipment and household items on the side of the women. Wooden chests and the paniers for transport are opposite the entrance behind the place of honor. The central circular opening in the roof is more than just a smoke vent and roof light – it is seen as a window to the heavens, and hence as a connection between the material and immaterial worlds.

**Black Tents on the Changtang in Tibet**

It is assumed that the black tent originates from Mesopotamia and spread along a geographic belt stretching from Mauritania on the Atlantic to the east of the high-altitude Tibetan Plateau. In this process, people from very different cultural backgrounds have adapted it to their needs. All the regions covered by this belt of distribution are characterized by a dry climate, whereas the temperatures run the entire spectrum from extreme heat to arctic cold. The nomadic herders on the Changtang live in one of the world’s most inhospitable areas, at altitudes not inhabited by any other people on Earth. Winter temperatures of -40°C are not uncommon. Here too, seasonal migration is carried out in a well-planned, tried-and-tested system. Over the course of a year, camps may be moved between three and eight times. In the endless expanse of the Changtang it is not possible to relocate to lower altitudes in winter. Even so, every family has a permanent main camp for this season. In former times this normally consisted of a tent, but today – similar to the Kyrgyz and other nomadic peoples in China – consists of a stone-built house in a village. The nomads engage in extensive trade with agriculturalists in the lower-altitude regions of Tibet. They barter meat, wool, leather, and sometimes also salt for vegetables, grain, and tea, as well as simple industrially produced products such as cooking utensils. For this purpose, the men with their yak caravans are often away for several weeks. The tents described below can be found in the regions around Lake Nam, about 130 km north-west of Lhasa. In that region, pastures are at an altitude of about 4,700 to 5,200 m.

**Construction and Tent Skin**

In contrast to the yurt, the black tent is based on a tensile structure. Its roof skin is supported by just a few wooden poles and is tensioned using ropes. This tensioning is at a relatively shallow angle, with the tensioning rope having a length of up to 6 m. The timber construction usually consists of two uprights inside the tent with their ends slightly sunk into the ground, they support the ridge beam and the slightly slanting tent poles outside the tent.
skin that are also driven into the ground. In this tent, even less timber is needed than in a yurt, although the cross sections needed for the uprights and the ridge purlin are significantly thicker. The floor plan of the tent is rectangular, the length of its sides varies between 5 m and – in extreme cases – 10 m, and the ridge is between 2 and 2.5 m high.

The name of the black tent derives from its dark color, which is the color of the animal hair used for the roof skin. In most regions this is goat’s hair, but in Tibet it is mostly yak wool. Yak hair has similarly favorable properties to that of the goat; it is very tear-resistant and swells when exposed to moisture, which means that when it rains the fine holes in the fabric close and the water drains off the surface of the tent. In addition, the natural fat in the wool is water-repellent. In spite of all this, however, the tent skin will not resist rain for longer than half a day. But to date, long rainfall events have been very rare on the Changtang. Instead, the overall relatively dry climate (except in the far east of the high plateau, the annual precipitation is less than 500 mm) is characterized by frequently changing snowstorms, rain, hail, and much sunshine. Owing to the high altitude, solar irradiation is of such strength that the tent will immediately dry out again.

The tent fabric is manufactured by the nomads using simple looms that lie on the ground and are easy to transport, producing fabric of a maximum width of 50 cm. The woven pieces are then sewn together. Whereas the weaving is purely women’s work – there is strict division of labor between the genders – men take care of the sewing. In the end, the tent skin consists of two symmetrical halves, each of which can be carried by one yak. When the tent is put up, the two halves are pinned together using bone needles.

Many families own several tents, for example a smaller one with a thicker fabric for winter and a larger one with a thinner skin for summer. The fabric of the summer tents is often thin enough for light to shine through. This reduces the transport weight, the interior is brighter, and the tent is more stable because it offers less resistance to the wind. Furthermore, nomads use particularly lightweight tents for their travels with caravans or for their remote camps, which today often consist of linen.

**The Interior of the Black Tent**

As with other nomadic tribes, everything has its firm place in the black tent of the Tibetans. Here the side to the right of the entrance is that of the men, where saddles, harnesses for horses, furs, and blankets are stored. The left-hand side is reserved for the women. This side is also used for storing household items and the equipment for processing milk, because after milking the animals in the morning the women and girls spend a large part of the day processing the highly perishable milk into butter and cheese which – sewn into sheep’s stomachs – will keep well for more than a year. With the Tibetans too, the area furthest from the entrance is the place of honor for guests. This is also where the family altar stands and where butter is stored. The tent is not subdivided, and at its
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Outlook

Over the last three decades, nomadic life has been increasingly abandoned in Tibet and other regions of China. Using various means of pressurizing, as well as financial incentives and the provision of apartments and houses, the Chinese government is trying to make the nomads adopt a settled lifestyle. The balance between the available pastures and size of herds, which had been functioning for hundreds of years, is increasingly knocked out of kilter. The reason for this is not only the increase in population density due to better medical care and higher life expectancy but, primarily, worldwide climate change. The increase in the Earth’s temperature leads to the grass’s drying out more and more frequently on the high steppes with their dry climate, and to rain events being increasingly more common than snowfall. This would lead to the conclusion that the last remaining yak-wool tents, which are not made for long periods of rain, will soon become unsustainable.

Endnote


Bibliography


The Tulou Buildings in Fujian

Qinghua Guo

Tulou (“house of earth,” more or less) refers to a type of building for the communal living of an entire clan (a group of families that share the same surname or an extended large family) in Fujian Province in southeast China. The floor plan of a tulou is either square (or approximately square) or round; the building consists of a peripheral fortification wall made of rammed earth and a several-story-high timber structure that leans against the wall and is oriented toward an inner courtyard. The timber structure—based on the construction grid—provides living units of equal size, which makes for a fair allocation of space. The living units are accessed via the courtyard. Most tulou only had a single entrance to the inner courtyard.

Tulou were mainly built by the ethnic group of the Hakka (meaning guest families), whose ancestors were from the north of China. Since about the tenth century, the Hakka undertook various migration moves toward the south, where they finally settled. In their new homeland they developed the tulou for defense purposes, to protect themselves from hostile local tribes as well as robbers. Tulou exist in many different versions, thus indicating both the change as well as the constancy of certain forms of living. More than 3,000 tulou that were constructed between the fifteenth and twentieth centuries have survived in Fujian, among them almost as many square forms as round ones.

Type 1: Vertical Dwelling Units, Horizontal Covered Corridors

The oldest tulou in Fujian, the origins of which date back to the twelfth century, is Gufeng Lou. The four-story building, with a footprint area of 31.8 × 29.6 m, accommodates 22 family units that are communally owned. Both the exterior and the

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**Region**  
Southeast China

**Material**  
Clay, wood

**Clima**  
Temperate, hot and humid

1–3 Tulou in Nanjing County, Fujian: a rustic timber construction with courtyard is hidden behind the solid external rammed-earth wall.
The Tulou Buildings in Fujian

The interior walls consist of rammed earth. Toward the inside is a secondary timber construction built to form access corridors and ancillary rooms, such as kitchens. The courtyard (13.5 × 11.4 m), which is only accessible via a single entrance, has a well and is the main stage for daily activities. Internal access from story to story is via communally used staircases. These can generally be located at various different places in the building: in the entrance area and directly opposite, in the corners of the tulou, and in the covered corridors themselves. The family units are vertically organized and relatively similar. Food is prepared on the first floor, directly in the courtyard area; above that is a storeroom for grain, and the upper stories contain the rooms for sleeping. Most often, the corridors are cantilevered and open in order to let light come into the rooms. In technical terminology this type is referred to as a “corridor type.”

The solution with vertically organized dwelling units and a central courtyard has a positive effect on both family life and community life. The courtyard surface slopes toward the center to allow for good rainwater drainage. Owing to their durability, and for fire protection reasons, clay tiles are used as roofing material.

The largest round tulou in Fujian is Chengqi Lou, with 288 rooms; it dates from 1709 (rebuilt in 1929) and consists of four concentric rings. From the middle toward the outside edge these contain the ancestral hall (also used as a school), storage and learning rooms, guest rooms, and dwelling units. The two inner rings have only one story throughout, the third ring has two stories in parts, and the outer ring – with a diameter of about 73 m – has four stories. This tulou has three entrances: one main gate and two secondary gates. For security reasons the windows facing the outside are very narrow and found only on the upper floors. The openings have slightly tapered frames and are a little wider on the inside. The strong earth walls protect the inhabitants – Fujian has a moderate subtropical climate – from heat and cold. The rooms are lit and ventilated via the courtyard. The roof overhang is large and the space beneath it is used for storing household items.

**Type 2: Courtyard within a Courtyard**

Eryi Lou (1770, rebuilt in 1904) has a different arrangement. It consists of two circular buildings and a central courtyard. The inner ring has one story only, the outer ring – with a diameter of 71.2 m – has four stories. At intervals of three segments, the two rings are connected by roofed structures. The spaces between these roofs create twelve inner courtyards, one for each family. Each of these consists of a front building consisting of three circle segments, a four-story back building consisting of four segments, as well as two side wings and a private courtyard. The tulou has four entrances to the central courtyard, which in turn provides access to the twelve family units.

The front building accommodates the access area with kitchen and storeroom. In one of the two side wings is a staircase that is only used by the respective family. In contrast to Chengqi Lou described above, Eryi Lou has no shared ancestral hall but rather a private room for ancestor worship above each family unit. The external enclosing wall of rammed earth is stepped in order to create bearings for the floors, at the very bottom it measures 2.5 m and at the top 0.8 m, which means that there is space for a roughly 1 m-wide passageway behind the ancestral rooms, which is accessible to all families.

**Type 3: Private Staircases**

The Jiqing Lou tulou is characterized by vertically arranged family units, communal covered corridors, and private staircases. The round building has a diameter of 66 m and, with its four stories, includes a large central courtyard. The courtyard is used for outdoor living by the entire clan; in its center it features an ancestral hall in which all communal activities take place. The history of this tulou can be traced back to the year 1419. At some stage in the course of time numerous staircases were built from the courtyard leading upstairs, which now provides access to the private dwelling units. In the covered walkways, these are all designed differently.

**Construction and Building Process**

Tulou consist of earth walls and a post-and-beam construction in timber, usually air-dried Chinese fir. The ceiling joints span from beam to beam, and at the ends rest directly on the earth wall. Once...
10 The monumental Chengqi Lou consists of four concentric circles. The innermost one holds the ancestral hall.
13 Floor plan of first Chengqi Lou (drawing after Wang Qijun, Vernacular Dwellings: Earth Dwellings, Cave Dwellings and Siheyuan Compound, Beijing, 2012).
the load-bearing structure had been put up, the roof is covered. The lower stories of the building were soon occupied, whereas those at the top sometimes remained unfinished for years. This meant that the timber construction of the tulou was sometimes exposed to the weather for long periods and as a result often suffered distortion. But thanks to the construction using a combination of earth and timber, the movements were absorbed.

Generally speaking, the buildings require regular maintenance; especially following typhoons or other disasters, the roofs, parts of the earth walls, or timber beams have to be renewed. On the whole, however, a tulou lasts a very long time. When the extended family grows, a new tulou is built, where possible in the direct neighborhood.

First the outer wall is constructed using earth, which for defense purposes has to be tall. The earth was rammed layer by layer using a sliding formwork and, immediately after removing the formwork, was compacted by hitting with wooden shovels to make it firmer. The construction of the wall did not require scaffolding. Several teams were able to work on the same layer, which guaranteed fast progress and meant that the clay dried out evenly. In order to absorb tensile stress, layers of bamboo strips are inserted in the rammed earth. The strong tiled roof with its wide overhang (more than 2 m) protects the outside wall. External plaster was not applied.

Tulou are built with natural stone foundations sunk into the ground; the width of these foundations is about twice that of the wall and the foundations of a three-story building is built into the ground by about 0.3 to 0.6 m. Above that, a stone plinth is built measuring 0.6 to 1 m in order to prevent damp from rising; this is then covered by a layer of tree bark. The earth wall constructed on top of that is stepped back at each story. When the desired height is reached, the ceiling joists are placed on the ledges and then construction of the wall continues. Finally the roof purlins are placed directly on the wall. In all instances, the outer ring is built first and an inner ring is possibly added at a later date.

Final Observation

Two different forms of tulou can be found in Fujian: round and square. Apart from the shape, they are very similar with regard to the organization of space, the building materials, and the construction technology. With regard to the orientation of the dwelling units, the round tulou has the advantage of a more even, and hence fairer allocation of units because the angular form always has one main side that is more prestigious. The organization of identical family units illustrates that the architectural design tends to emphasize the communal family grouping rather than social hierarchies.

Generally speaking, two different forms of organization can be found in the tulou: vertical family units with horizontal access corridors; and the model of “courtyard within a courtyard.” The first type of model is older and functionally well suited to large families in a direct line of descent. By contrast, the second model is preferred by people related to one another in a looser network of relationships. In both cases it is not possible to marry an inhabitant from the same tulou. In Fujian, square and round tulou coexist in many places side by side. It is impossible to say whether one of the two forms is older than the other. Archaeology tells us that in the Neolithic era China
already had round and square buildings. Earth houses in Erdaojingzi (lower Xiajadian culture, ca. 2000 to 1500 BC) in Chifeng in Inner Mongolia, are built in a variety of different construction technologies, including layered reed and clay rolls, adobe bricks, and rammed earth. Even if there is no indication that Erdaojingzi is in any way connected with the tulou, the example nevertheless shows that similar earth construction methods were already in use 2,000 years before the first tulou.

**Bibliography**


Weiwu of the Hakka in Fujian
Qinghua Guo and Christian Schittich

The Hakka is a group of Han Chinese. Owing to political unrest, they migrated in different waves from a thousand years ago from the Yellow River (Huang He) region to the south and settled in various provinces. A significant proportion arrived in Fujian. In their new homeland the Hakka were faced with hostility from the local population and ambushes by marauding brigands. Their buildings thus feature a distinctive fortress-like character. The best known among these are the mighty tulou (see page 172). Where the need for defense was less pronounced but nevertheless existed, the Hakka created weiwu, enclosed houses built for an extended family or a clan with the same surname. Even though the weiwu differs significantly in layout, footprint, and size, they are largely similar to tulou in principle. Nevertheless, exterior appearances of the weiwu can differ widely depending on location, date, and family. The expressive weiwu shown below are located in Youxi County in central Fujian, and date to the nineteenth century.

Location and Structure

In accordance with the precepts of feng shui, the Taoist teaching of harmony of wind and water, the weiwu are always placed on a more or less sloping site, with the back to the hill and the entrance toward the water. The water can be a natural stream or an artificially created pond, ideally in the form of a semicircle. Likewise, the defensive rear toward the hill is arranged in a round shape for symbolic reasons.

The warm and humid subtropical monsoon climate in Fujian has hot summers and moderate winters with high rainfall. For this reason, good ventilation of the interior and an efficient drainage system are essential elements in building a weiwu. Channels run-
The hierarchical complex of courtyard houses and longhouses is based on a strict grid with repeating dimensions in accordance with Confucian rules. Its center is occupied by the ancestral hall. It is the highest and most extensively decorated building and is used for venerating ancestors as well as for congregations and celebrations, weddings, and funeral ceremonies. To both sides of it are the rooms of the various nuclear families in longhouses, usually with a kitchen at the end. The parallel longhouses are linked by small bridge structures crossing the channels running between them, making it possible for the inhabitants to go from one house to the next. In the roofed-over bridge pavilions it is common to have a bench as a seat, which can be used to take a rest or as a meeting point. Owing to the position on sloping terrain, the open areas and courtyards are built in the form of terraces; the defense structure rises toward the hill. Its heavy, tile-covered roof follows the layout with vertical offsets, resulting in a staggered overall image. Often the defense structure is flanked by one or several guard towers made of rammed earth.

**Construction**

The construction of the weiwu consists of timber framing in the chuan dou system, which is widely used in southern China and features precisely fashioned and rigid push-fit connections. In this system, horizontal transoms are connected via peg joints to the continuous posts, which are spaced at about 2 m. All elements are based on standardized sizes, prefabricated in the workshop, and precisely joined on-site. The facades facing the courtyard are primarily built of wood and have openings for ventilation and daylight. The outward-facing facades are without openings and consist of rammed earth or timber framing with wattle and daub. The exterior walls of the defense structure frequently consist of natural stone or rammed earth. As is common in many parts of China, the timber skeleton that supports the roof is kept separate from the solid wall. All roofs are uniformly covered with dark gray tiles.

**The Weiwu in Dafuzhen**

This weiwu in the Pingzhai municipality was built between 1870 and 1885 by four half-brothers of the Xiao family. In its heyday it was home to 36 nuclear families with up to 170 people. Today, after an interruption during and after the Cultural Revolution, about 25 inhabitants remain.

The complex stands on a relatively shallow incline with the different levels connected by steps; it consists of six parallel residential longhouses, the central community area with the ancestral hall, a private school, as well as workshops and guard towers. The commonly used area has been designed in accordance with the traditional principle of courtyard architecture and comprises two courtyards that are bounded by the entrance building to the southwest, a central hall, the large ancestral hall, and secondary buildings. In the area of these courtyards the timber structure is richly embellished with carvings, whereas the timbers in the living areas are kept relatively plain. The two halls and the longhouses are built on a platform; the living areas also have a raised floor, which helps with additional ventilation.

Apart from the weiwu in Dafuzhen, a handful of similar complexes still exist in the region around the city of Youxi, such as Shujing, Guangyu, and Shiba.
11  Elevation of the main hall
12  Section through the central yards
13–16 The two central courtyards in the weiwu of Dafuzhen; left the upper courtyard with ancestral hall, right the lower courtyard.
The geographic area inhabited by the Tibetan peoples stretches across four countries and a distance of more than 2,500 km, from Ladakh in northern India in the west to the Hengduan Mountains in the Chinese province of Sichuan in the east. It comprises the arid Tibetan Plateau, which is protected from the monsoon rain by the Himalaya mountain range, deep, densely wooded valleys in the east, and the wide, gently rolling grassland in the northeast. But it also includes parts along the northern border of Nepal and the wooded southern slopes of the Himalayas in Bhutan that are exposed to the monsoon.

A complicated history full of changes determined by the major powers of Central Asia and China, the wide distribution of Tibetan culture, and topographic- and climate-related diversity were contributing factors to the development of the wide range of autochthonous forms of dwellings and construction methods, which, particularly in the remote parts of the region, have been preserved into the twenty-first century. Typical of these buildings are a nearly symbiotic embedding in local resource cycles and a subtle adaptation to local climate conditions. The shared cultural background is Tibetan Buddhism, which has remained alive over the centuries until today in four main schools and numerous subdivisions. This forms the religious and sociocultural bond that connects the different ethnic groups and is expressed in numerous aspects of traditional rural architecture. For example, every house has prayer flags and a room for worship; many elements and colors have a religious meaning. The following four examples from the eastern and southern parts of ethnocultural Tibet demonstrate the diversity of these dwellings as well as their adaptation to local climate conditions and the use of local resources as building materials. Interestingly, the houses employ very diverse construction principles, even when the same building materials are used.
Clay and Timber Construction in the Kandze Highlands

The high plateau of Kandze lies in the east of the Tibetan Plateau in the Chinese province of Sichuan. The extensive valley of the Nyag Chu River and its contributories forms the largest part of the area inhabited by the farmers settled here, whereas the adjoining hilly steppes are used by nomads and seminomads as pasture for their yaks. On the terraced fields of the river basins the farmers grow highland barley in crop rotation with green peas and potatoes. The region’s climate favors agriculture. It is cold and temperate, and the majority of the average annual precipitation of 638 mm falls in the warm summer months between June and August, while the winter months are dry and cold.

As a rule, the farmhouses have two floors and a flat roof. They are constructed of a combination of clay and timber typical for the region, which demonstrates the efficient use of the local resources of timber and clay as building materials. The example shown is typical of the region in terms of construction and use of the floor areas and open spaces. In accordance with the predominant local practice, the first floor is built in rammed-earth construction. This is primarily used for storage and as stables, whereas the upper floor consists entirely of timber. The inhabitants use this as a multifunctional living space, which is extended by a large south-facing terrace that is primarily used for drying grain.

The soil in this area is rich in clay, which is optimally suited to the construction of the rugged rammed-earth walls of the first floor. In most cases the clay is dug directly from a pit on the plot of land, where it is used for the building. The construction of the walls involves a specific regional shuttering system consisting of high vertical posts that hold long wooden planks; the clay is laid and compacted in layers between these planks along the entire length.
of the wall. By successively tying the posts together, the thickness of the wall is reduced toward the top. Traditionally, the ramming work for a house is carried out manually and shared by all members of the community. The same clay is used to cover the timber beam floors and the roof, and—with the addition of shredded straw—as plaster.

The construction timber usually comes from the adjoining wooded regions of Drango and Nyarong. The upper floor generally consists of two diagonally placed log cabins, which provide rigidity to a post-and-beam construction between them. These log cabins are built with single-skin walls using round logs cut in half. They accommodate the most important rooms of the house: the room for worship and the reception room. Additional rooms are created within the grid of posts using wooden panel walls. The construction of such a house generally takes about two years. The earth walls are constructed in the winter months with their low precipitation; they will dry out by the following summer, when the timber building is erected.
Earth Walls, Wooden Oriels, and Flying Roof: The Phobjikha Valley, Bhutan

The Phobjikha Valley lies in the Wangdue Phodrang District in central Bhutan and has an average altitude of 3,000 m. Owing to its mild winters, the wide and in parts boggy valley floor, from November to March, serves as the winter habitat of the black-necked cranes that fly in from Tibet. The house shown here is not inhabited throughout the year. The users spend the winter in a village located at an altitude of about 1,000 m lower and is about one day’s hike away. The annual migration with the numerous yaks, which spend the summer in the hills above the valley, is associated with special rites.

The valley’s houses are clustered in groups on the gently rising slopes. Around these building clusters lie the fields, which are primarily used to grow potatoes for sale. As a rule, houses have three stories and consist of clay and timber, the locally available building materials. Owing to the high precipitation in the region, all houses are fitted with a type of flying roof, a roof supported on posts and detached from the building. Traditionally these roofs were covered with larch shingles; today corrugated iron is the preferred material, partly for reasons of resource protection. The solid walls of the lower two floors are built in rammed-earth construction; the top floor, which houses the main living room, is added on top of these in timber-frame construction. The oriel-like structure that projects on three sides and provides an element of prestige is a rabsel, a name that also refers to the room enclosed by the structure. It features wood windows and carvings and, irrespective of the cardinal direction, faces downhill. If the rear of the house faces south, this elevation will also have large windows.
In contrast to the example of Kandze, the rammed earthwork in Phobjikha is not carried out in layers around the entire building, but in blocks. A type of sliding shuttering is used for this that is closed with boards on all four sides and held together with wooden clamps. Once a block has been completed, the shuttering is used directly for the next block. The frames of doors and windows are inserted early on during the ramming process. The cantilevered rabsel frame is filled with bamboo wattle panels that are plastered with clay. The regular framework of the rabsel and its windows is the most notable characteristic of the traditional houses in Bhutan.

**Stone Walls and Timber: Dabpa, Sichuan, China**

The hilly region of Dabpa, with its relatively low mountain ranges, extends to the south of the grasslands of Litang in the east of Sichuan. With an average altitude of over 4,000 m, it is one of the highest settlement areas in the east of the Tibetan Plateau. Rainy summers and cold, dry winters characterize the climate and vegetation, as well as the material culture of the inhabitants. People make their living based on yak herds in the mountains and a modest agriculture, in addition to trade in Matsutake mushrooms and yartsa gunbu, a caterpillar fungus popular in Chinese medicine. While the grass landscape further to the north was traditionally more populated by nomadic groups, a special type of stone house developed in the area of Dabpa that uses the wealth of timber available from the slopes of the valley as well as various kinds of natural stone. The predominant building materials are fir and spruce, as well as various forms of granite.

The house shown here is located in the village of Sumdu, roughly 120 km to the south of the small town of Litang, at the crossing...
of two provincial roads. The loose, widely spread settlement stretches across a wide valley floor at an altitude of 3,900 m. As is common practice throughout the region, the first floor of the house accommodates the stables while the upper floor is used as living accommodation. In terms of its construction, the house is typical of the building method in the area. A post-and-beam construction that is not attached to the external walls is placed within the external natural stone walls with a thickness of roughly 80 cm. The posts are placed in a 3 × 3 m grid and, on the first floor, are not stripped of their bark; on the living floor they are fluted and have the considerable cross section of about 40 × 40 cm. With a width of 18 cm, the main beams supported from the posts are significantly narrower. These in turn support the actual closely spaced floor joists. Complex timber construction is also used for the entrance to the house and the windows, with the projecting lintel details that are typical of large areas of ethnocultural Tibet. The windows are protected from rain and snow by a frieze of slate slabs that surrounds the entire building. The dark color of the interior spaces is due to the treatment of the wooden surfaces with a mixture of charcoal, yogurt, and water, which is considered to be both a means of preventing insect attack and a moisture repellent. Whereas the interior of the house is subdivided into different zones and rooms using simple paneled mullion/transom construction, the approximately 80 cm-thick external wall consists of roughly hewn granite blocks that are laid using locally available clay as mortar. The joints of the external layer are plugged with small stones, thereby creating a characteristic appearance.
First floor

- a) Entrance with grain storage
- b) Raga / dura (du ra), stable for horses and pig sty
- c) Bara (ba ra), stall for cows, yaks, and dzo
- d) Pekhang (pe khang), area for newborn yaks
- e) Dienkhang (zan khang), toilet
- f) Tago (ta nago), equipment store

Second floor

- g) Hallway with toilet and firewood storage
- h) Nachen (ne chari), kitchen
- i) Baka tsang (baka tshang), bedroom
- j) Dozhe (rngo shu), large multipurpose room with open fireplace, called toka (to kha)
- k) grain storage bangsa (bang sa), tool storage, zona (dong ma)
- l) Jenka (ji nga lu), bedroom
- m) Zo (dzong), storeroom
- n) Chukhang (chos khang), sacred room

Large multipurpose room on the second floor of the stone house in Sumdu village: a mixture of charcoal, yogurt and salt is used to dye the wood dark.

Floor plan of first floor

Floor plan of second floor

Exploded view of the post-and-beam construction and roof structure

Southwest and southeast view of the stone house in Sumdu village, Sichuan, China
Stone House with Double-pitch Roof in Kongpo, Autonomous Region of Tibet, China

In spite of the short distance from Lhasa, the climate conditions in the Kongpo region are completely different. About 150 km to the east of Lhasa, beyond the Mila Pass, one leaves the dry and cold landscape of the Tibetan Plateau, with its very sparse vegetation, and reaches the warmer and green valley of the Yarlung Tsango, the slopes of which are covered with subalpine pine forests, rhododendrons, hemlock spruce, and juniper. As temperatures do not fall below freezing even in winter and there is plentiful precipitation in summer, the land can be used to cultivate barley, wheat, potatoes, beans, etc. Houses in the area of Kongpo reflect these favorable natural conditions.

The house presented here is part of a small cluster of houses called Tashi Gang. Narrow lanes wind between the enclosed courtyard spaces with their stone-built walls. The courtyards are used to keep pigs and cows in separate wooden buildings, whereas the yaks belonging to the household graze on nearby mountain slopes. A richly decorated wooden gate leads to the courtyard. The houses themselves are conspicuous due to their size of up to 16 × 25 m and their shallow double-pitch roofs covered with wooden shingles. A wide staircase leads directly from the ground to a type of hall on the second floor, from where one can reach the various rooms.

The approximately 1 m-thick exterior walls of natural stone enclose a biaxial system of beams that rests on a grid-like system of timber posts. In this manner, a type of platform framing is created which is not attached to the surrounding stone walls. The interior walls consist of lightweight infill panels between the posts and beams. In contrast to most houses on the Tibetan Plateau, the flat roof above the top floor is topped by a wide purlin roof, the loads of which are transferred via timber posts and the two gable walls. The roof is covered by several layers of wooden shingles that are weighed down with stones. A special feature of the roof construction is the rooflight placed at the ridge, which not only provides light to the central hall on the living floor, but also ensures good ventilation to the loft space, which is used for storage. The black color of the wood and walls inside is the result of soot-based surface treatment that acts as an insect repellent. The windows of the house shown consist of delicate wooden lattice panels, which today are quite rare.

This contribution is based on the results of a five-year research project on vernacular architecture in ethno-cultural Tibet, which received funding from Deutsche Forschungsgemeinschaft. See Peter Herrle and Anna Wozniak, Tibetan Houses: Vernacular Architecture of the Himalayas and Environs. Basel, 2017.
First Floor
a. Entrance hall with staircase to second floor
b. Kartse (khar rtse), store for horse equipment such as saddles and harnesses
c. Drokhang (gru khang), corn store with large wooden boxes for storing the grain
d. Storeroom for household equipment
e. Private storage area for the head of the household

Second Floor
f. Ma dzokhang (mar mdzong khang), butter store that is connected to the tsampa store
G. Tsampa dzokhang (rtsam pa mdzong khang), tsampa store
h. Tapsang (thap tshang), kitchen
i. Storeroom for tools
j. Zin khang (zin khang), bedroom
k. Shar tsomchen (shar tshom chen), east-facing parlor
l. Chos khang (chos khang), sacred room
m. Nub tsomchen (nub tshom chen), west-facing parlor for the reception of guests and for special events
n. Central hall. A toilet used to be attached on the exterior.
o. Staircase to the loft story
p. Dziar dzo (lcags mdzong), store

Loft story
q. Tshogias sang (thog kha sang), left loft

40, 41. East and south view of stone house in Kongpo, Tibet, China
42. Floor plan of loft story
43. Floor plan of second floor
44. Floor plan of first floor
45. The section through the stone house in Kongpo shows the purlin construction of the shallow double-pitch roof
46, 47. Connection detail of the biaxial beam system supported on timber posts
48. Interior view
Writing about Indian vernacular architecture requires a differentiated vision. The contexts of climate, sociocultural and political administrations, and economic and regional material resources are quite diverse. The material evidence is as ancient as humanity itself. As a result the subcontinent is a memory bank dotted with three-dimensional forms that have been interpreted differently and periodically and not always linearly, by voyagers, merchants, invaders, and colonists and in turn have influenced subsequent narratives. The last decade of the seventy years of independent India has witnessed a multidisciplinary inquiry into its past of continued existence from 3000 BC and beyond. A scientific and holistic engagement ensued by archaeologists, historians, architects, scientists, and scholars of the scripts has renewed the debate, but a unified thesis may take time before summation.

The earliest presence of humans on the Indian subcontinent appears in a multidimensional record dating back more than 100,000 years at the Bhimbetka cave dwellings (now a World Heritage Site), whose real significance was discovered only in the nineteen-seventies. Per the UNESCO citation, “The Rock-Shelters of Bhimbetka are in the foothills of the Vindhyan Mountains on the southern edge of the central Indian plateau. Within massive sandstone outcrops, above comparatively dense forest, are five clusters of natural rock shelters, displaying paintings that appear to date from the Mesolithic Period right through to the historical period. The cultural traditions of the inhabitants of the twenty-one villages adjacent to the site bear a strong resemblance to those represented in the rock paintings.” This cultural continuity confounds the world. The visionary government of Madhya Pradesh commissioned the Museum of Tribal Heritage at Bhopal in 2004, since more than 30 percent of the population of the state is tribal. Care has been taken that the venue and building are designed such...
that the tribal communities can identify with, extend, and evolve, to represent themselves and express their own ideas and way of life with ease and spontaneity. The ancient civilization of the Indus Valley dating to 5000 BC remains an enigma, as the script of that era is still not deciphered. Archaeological excavations suggest, however, that there was a highly developed water management and storage system. No grand dwellings have been unearthed nor anything specifically religious, which suggests that there were no social hierarchies. All building footprints have a sense of proportion, and the relationship of width and length is observed in a simple ratio.

**Vastu Shastra: The Science of Dwelling**

The Vedic period (ca. 1500 – ca. 500 BC) of Indian culture took place between the end of the urban Indus Valley Civilization and second urbanization in the central Gangetic Plain. The later Vedic period (1100 – ca. 500 BC) is credited with the development of the Sanskrit language used in scripts and treatises for planning, social governing systems, and spiritual and physical health along with ritualistic Hinduism. Many treatises were part of an oral tradition prior to the writing of the Vedas. Rājaśāla is considered to be the oldest of the four Vedas, and many scholars have traced the development and recording of mathematics, astrology, astronomy, and building/planning guidelines – the Vāstu śīlpa shāstra – to this period through the treatise. Vāstu Shastra (science of dwelling) are ancient Sanskrit manuals of architecture. These contain the Vastu Vidya (knowledge of dwelling). Several Vāstu Shastras on the art of building houses, temples, towns, and cities were discovered in Rajasthan, the Gangetic Plains, the Himalaya, and the southern state of Tamil Nadu. These ancient Vāstu Shastras often discuss and describe the principles of a Hindu temple as a holistic part of its community and give various principles and a diversity of alternative designs for home, village, and city layout along with the temple, gardens, water bodies, and nature. For example, Mānasāra, a treatise from South India, puts forward that a house should have a width-to-length ratio of 9:4, 3:2, 7/4, 2:1, 5:2, 11:4, or 5:3. East is the holiest direction from time immemorial and observed throughout the subcontinent regardless of the ruler or subjects. Vāstu Purusha Mandala, a grid system of 8 × 8 squares for religious buildings and 9 × 9 squares for domestic and related buildings, dictates the planning. Together, these principles have led to myriad creations that dot the country with riches in articulation and materiality along with regional craftsmanship throughout the era that is called the Classical period. Remarkably, from the Harappan culture to the Vedic period 3,500 years later and on to the end of the Gupta era around 550 AD, there seems to have been a continuity in the sensibility of creation of spaces with many articulations, which has kept the intrigue alive. The adven of Islam and the Delhi Sultanate that influenced Delhi, Gujarat, Bengal, Kashmir, Jammu, Malwa, and the Deccan began in 1206 and lasted until 1526, followed by the Mughal Empire (1526–1857). But parallel to these were the rising of Vijayanagara Empire (1356–1646) in South India. Then the colonial era began in the early sixteenth century and each of the foreign powers—Portuguese, British, Dutch, Danish, and French—left an indelible mark on the subcontinent that are an amalgamation of many design sensibilities, emancipated and limited by the availability of materials and knowledge systems. This temporal linearity in the evolution of architecture in the subcontinent demonstrates that in precolonial India, political boundaries were incomplete and permeable for both trade and knowledge systems. The adherence to Vastu Shastra principles in design and construction of temples from Himachal to Rajasthan, Kerala, Tamilnadu, and Bengal establish the treatise to be rigorous that encouraged regional thought, materiality prowess with its genesis in the symbiotic relationship of built and unbuilt. The diversity in styling the template is credited to the ingenuity of the indigenous community.

### Principles of Passive Climate Control in Rajasthan and Gujarat

The study of the only medieval living fort at Jaisalmer (1156 AD) reveals that the width of roads is less than the height of buildings and they run parallel to the prevalent east-west wind direction, shaded by buildings, buildings shaded by other buildings and the courtyard houses. Data on temperatures in summer and winter within the walled city compared with the temperatures outside revealed that city was lower by 3 degrees in day and higher by 3 degrees at night as compared to meteorological recorded temperatures. Further, in winter, the city was warmer by 3 to 4 degrees during day and night compared with meteorological temperatures. This is thus an example of traditional passive cooling characterized by the use of thermal mass, controlled openings in the building, sun shading of building surfaces and openings, a flexible building envelope, controlled ventilation, night radiation cooling, and flexible space use. Special attention is paid to radiant temperatures that the body feels. From shade to sun it is the radiant temperature that changes, not the air temperature. Thus, managing radiant temperature makes traditional buildings more effective. Furthermore, it was found that different sizes of openings, in accordance with the orientations at different levels, are one of the keys to achieving thermal comfort. Openings at the top and bottom allow better ventilation by letting warm air to rise and escape and cool air from the bottom fenestrations to rush in, which also creates a draft. The courtyard design facilitates effective air movement, which is the key to comfort. Warm air rises up and is replaced by cool air from the shaded areas, which helps control the ambient temperature. When ambient air is cool, like during the winter, the air movement inside the building is negligible. Also in a desert climate, slow air movement through different sizes of courtyards and smaller windows aids in dust control. A general practice of shutting the windows in peak hot hours and opening them at sundown during the summer while doing the reverse in winter is a traditional practice that also contributes toward comfortable living. The surface treatment of buildings in Jaisalmer is characterized by jalis (louvered screens), though not all are perforated. The shadows created by the carvings on the surface keep their surface...
temperature lower than that of a smooth stone surface, which in turn reduces the radiant heat from the thermal mass. Smaller-sized openings were preferred in the whole of Rajasthan and Gujarat; air flow through small openings cools the air due to compression and subsequent rapid expansion. Cultural aspects of the purdah system and segregation of the sexes are often cited for the development of the jaalis. But it is the climate-control aspects that made the jaalis popular and also led to its evolution into lattice in stone and brick, and to the louver system in timber.

Water Systems

Systems for the collection and storage of water are necessary to maintain life in the arid areas of Rajasthan and Gujarat. Houses in the walled city collect water and store it in a tank belowground in the courtyard. Other systems include a man-made reservoirs maintained by communities or individuals as water was itself considered sacred.

To get back to climate controls in the traditional architecture of India, water channels, water wells, and wind shafts with water-doused screens were some of the employed techniques to humidify the dry air in arid regions. The control of heat through the roof too was resolved by use of inverted earthenware cups creating an air gap, placed on the stone slabs and layered with smaller stone in lime mortar finished with lime concrete. The air-gap insulation delays the penetration of radiant heat into the building.

A Courtyard House Typology

Not surprisingly, the courtyard house typology became ubiquitous in the subcontinent albeit with variations in accordance to the climate, which also influenced the use of spaces. In the hot, dry climate of northwest India in summer, the terrace cools first at night and hence is used for sleeping. In winter, terraces and courtyards become work spaces. The cool night air is retained in the courtyard for a longer period, controlling also the temperatures in the surrounding rooms. The size of the courtyard remains small to allow for the work space in inclement weather.

Vernacular Buildings in the Indian Himalayas

In the upper Himalayas, the timber-frame structure with rubble stone infill walls in lime mortar, cantilevered balconies on the second floor (and sometimes more than two floors), and with timber floorings and sloping roofs in timber and slate present highly evolved hill architecture with craftsmanship in timber that evokes the spirits of the local deities and their link with community. Harsh, long winters, snow and rains and dependency on animal, forest, and agricultural produce have led to larger community spaces from which households could be accessed by individual flights of stairs as per the plinth of the house. The principle of minimum intervention in the terrain and working with nature, as espoused in the Vastu Shastra, appears to be the guiding line here.

The walled city of Jaipur was founded in 1727 and developed consistently following the principles of and providing the most coherent presentation of the Vastu Shastra. The hierarchy of roads by width forms a grid with the north-south axis and a central axis in the east-west direction that favors the prevailing winds. The courtyard house form has been further developed into haveli, a system with several courtyards that supports a mixed use of commerce and residence. Wide streets have the commercial facades of the buildings, while the narrower roads at the rear give access to homes with interior stairs to upper floors. The master plan of the city, the building plans, and the infrastructural needs of water and waste management have been developed holistically along with the provision for the social needs of a multicultural and crafts-based economic society.

The haveli architecture dots the whole of the Gangetic Plain with variation of materials from stone to bricks, both exposed and with lime plaster. In the lower Himalayas, the paved courtyard is in front of the house and may have more than one unit on its edge in a C- or L-shape. The long side of the building is oriented to the south for optimal sunlight utilization, and the walls between units are set apart so that they are not shaded. The roof design also changes from a flat terrace to a sloping roof made of slate, now being replaced by corrugated metal sheets. It is noteworthy that the ground-floor walls remain thick with low ceiling height, mostly used for animal husbandry and storage while the upper floor is used for living. The room heights are lower and window openings are smaller. The bulk form is thus adapted to the long cold months and brief summers with moderate rainfall.
more crucial. It is also a work space, to dry the produce before storage for consumption in winter. Terraces are also used to collect the sparse rainfall and snow; once again, rainwater collecting basins are a common feature in courtyards. Shading of walls is minimal and is made of rubble with smooth lime-earth plasters to maximize the solar gains. And while use of spaces is much like lower Himalayas, the courtyard on the first floor becomes the common circulation space as the room sizes are further reduced to ensure against heat loss. This open space is also for radiating heat to the walls of rooms that surround it on three sides. Thick, tapering smooth walls, thick roof terraces, small windows, low to no parapets, cobbled courtyards, and once again closely located houses (although intentionally staggered on the access road to break the high velocity of the cold dry winds) characterize the Ladhaki villages. Their building typology has not changed in centuries. The courtyard house received a makeover to mitigate exactly the opposite challenges in coastal India. The west coast of India has a tropical wet climate while the East has a tropical semiarid steppe climate. In both areas, temperatures do not fall below 18°C; the difference is in average rainfall, with the humid west receiving more than 2,000 mm per annum while the semiarid steppe receives 400 to 700 mm per annum, depending on proximity to the coast.

The Coastal Courtyard House

The coastal courtyard house has been given both an outer veranda and an inner veranda that opens into onto the courtyard to shield the walls against the lashing monsoon rains; the sloped roof is covered in terra-cotta tiles whose shape and size have evolved over the centuries and are still in use today. High roofs and plinths characterize the western coastal courtyard houses as the rainfall is many times greater than on the eastern coast. Projecting cornices, door and window architraves, and plinth moldings are common measures to interrupt the rainwater runoff over the walls to curb both weathering and saturation due to absorption, which leads to wear and tear due to leaching. Large roof overhangs and sun-shading devices for all window openings are also widely used to master the hot, humid tropical climate. Living is mostly done in the inner and outer verandas while the closed rooms are used for storage and sleeping. The walls consist of rammed earth or laterite given a thin shell lime render to check the absorption of water, unlike in Rajasthan where plaster renders can be 5 to 8 cm thick to slow the penetration of heat to the stone; timber (hardwood or coconut) is used for the load-bearing roof structure, and timber or laterite posts for the covered verandas. Earthen floors were later replaced by lime floors and then by cement slurry finished in vibrant colors. Stone floors are rare as they would retain and radiate the heat more and were limited to the courtyards and in temples. The courtyard sizes too vary; they are smaller in Malabar and bigger in Tamil Nadu, where the rainfall is relatively much less but cyclones are more prevalent. The variation in roofs between Konkan and Kerala can be seen in their height and the expression of their craftsmanship.

The same typology was given an attic in the higher altitude regions of the Western Ghats where temperatures would drop in winters and thus the timber-earth attic floor kept the rooms warm while aiding in preserving the agricultural produce stored in attics during the long monsoon months. The courtyard typology that has traditionally served the subcontinent’s housing needs is rooted in the principle of Vastu-Purusha-Mandala, a 9 × 9 grid system that is also an anthropomorphic and orientation tool with directional guidelines for regional implementations. The treatise addresses three primary principles—function, aesthetics, and harmony— which together form the all-encompassing principle for the individual house as well as the for the city as a whole. Climate and terrain are the starting point, as site selection is the first step. Traditionally one does not fight against the climate but instead works with it to achieve a higher comfort level. The value systems were stable, though they show regional differences and an evolution process in which both performance and aesthetics are dynamic in nature, using geometry, solid and voids, and fractals; but rooted in the fundamental quest of achieving the sacred in the mundane.
Vernacular Building Tradition of India

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Endnotes
3 The Sutradhara Mandana’s Prasastamandana (Manual for planning and building a temple), with chapters on town building was discovered in Rajasthan. Mana­sana Shilpa and Mayamata are guidebooks on South Indian Vastu design and construction, estimated to be in circulation by the fifth to seventh century AD. L-SAAML-SEKHI Padhali is yet another Sanskrit text from the ninth century AD describing the art of building in central India. Brhat Samhita by Varahamihira is the widely cited ancient Sanskrit manual from the sixth and seventh century AD describing the design and construction of the Nagara style of Hindu temples.
5 By Prof. Vinod Gupta, School of Architecture and Planning, New Delhi, nineteen nineties.
6 In Jaipur, the maximum summer temperature is around 48°C (120°F) while the minimum is 25°C (77°F). The maximum winter temperature is usually around 23.6°C (74.5°F) and the minimum is 5°C (41°F). The average rainfall is 259.9 mm (10.25 in).
7 The climate of India comprises a wide range of weather conditions across a vast geographic scale and varied biomes, making generalizations difficult. Based on the Köppen system, India hosts six major climatic subtypes, ranging from arid and desert in the west, to mountains and glaciers in the north, and humid tropical regions supporting rainforests in the southeast and the island territories. Many regions have starkly different microclimates. The country’s meteorological department follows the international standard of four climatological seasons with some local adjustments: winter (December to February), summer (March to May), a monsoon rainy season (June to September), and a post-monsoon period (October to November).
8 Daytime temperatures may range between 27 and 49°C (nighttime may fall to 22°C), with moderate to low humidity and minimal rainfall.
9 A range of mountains running approximately 632 km (435 mi) in a southwest direction, starting in northern India from Delhi and passing through southern Haryana to western India across the states of Rajasthan and ending in Gujarat.
10 Laterite is a rock formed by natural weathering, which has been mined for centuries in the form of brick-shaped blocks cut directly from the ground.
11 The Western Ghats, also known as the Sahyadri (Benevolent Mountains), is a mountain range that runs parallel to the western coast of the Indian peninsula, located entirely in India. It is a UNESCO World Heritage Site and is one of the eight hot spots of biological diversity in the world.
12 For example, in the proportionate scaling of model as repetition of forms to achieve the part of a whole as in pyramidal shikharas of temples.

13, 14 Courtyard houses in Kerala with the typical steep, tiled roofs with wide overhangs.
15 Courtyard house in Ladakh: the flat roof above the first floor is used for harnessing solar energy, for collecting rainwater, and as a work area.
Urban Architecture

The traditional dwellings within the old city walls of Jaipur, the capital of the Indian state of Rajasthan, create an extremely homogeneous urban image due to their uniformity. The first of these buildings was built by Maharaja Jai Singh II, who in 1728 founded the city close to his former capital, Amber. They all follow the same architectural concept, from the most modest to the most luxurious buildings, including the large havelis, the Indian equivalent of western well-to-do citizens’ houses. In spite of the continuing development of building styles and construction technology up until the early twentieth century, the buildings did not change significantly in their basic type.

In spite of contemporary differences in material, lack of maintenance, and the dilapidation of some facades, we can quickly detect – behind the external appearance of the buildings – some characteristic architectural principles that have formed over the course of more than two centuries. These include in particular the orthogonality of the buildings which, at a smaller scale, replicates the rational urban layout. The buildings almost always consist of a simple cuboid one- to three-story building arranged around one or two, and more rarely three, courtyards. Another characteristic is the regularity of this architecture that becomes immediately apparent when looking at the floor plans. The geometry of all habitable rooms is based on a rectangular grid, which is centered on the usually square inner courtyard (Fig. 3). This hierarchically divided grid results in oblong spaces, whereas smaller square modules remain at the corners of the buildings. This is reflected in the allocation of functions. The main activities always take place in the axes perpendicular to the inner courtyard, while the spaces in the corners are used as utility rooms or for staircases.

1 Decorative pavilion (chattri) on the terrace of a haveli in the Ghat Darwaza district
2 Jharokha (balcony oriel) in the center of Jaipur

Urban Dwellings in Jaipur, Rajasthan

Alain Borie
A Vernacular Construction

The houses of Jaipur are not built in marble or sandstone, in spite of their relationship with the famous Mogul architecture. Behind their elaborate facades they mostly consist of modest materials that can be found in the local quarries. The load-bearing walls consist of thick stone masonry that is clad afterward. This architecture has preserved elements of the regional tradition, which is characterized by its rustic construction and use of low-performance materials.

Richness of Spaces

The imaginative design of Jaipur’s dwellings is particularly remarkable as they all follow the same architectural concept by combining just a few simple elements. The floor plan is based on a geometric grid, which can be used to create different architectural interpretations and variations, thus leading to the creation of three types of room: the kamra, an enclosed, roofed-over room with door and window openings; the tibara, a covered room featuring arched openings along a column-lined exterior wall and the chandni, a laterally enclosed room/courtyard that is open at the top.

This is particularly evident in the ceiling and floor systems. By contrast to other cities in Rajasthan – such as Jodhpur, where timber can often be found – here only rows of slate slabs are used for the ceilings of the habitable rooms. This considerably reduces the span (only 2.2 to 2.5 m) and requires more intermediate supporting walls. The most common solution for increasing these spans is the use of horizontal arch buttresses, which at the same time subdivides rooms into several small corners. Another, much more sophisticated, method for gaining space is the extension of the interior with the help of a projecting oriel. This is created by placing a second, very thin envelope (approximately 12 cm) of vertically arranged sandstone slabs on sandstone brackets that are anchored in the masonry. The additional space created in this way is a kind of roofed-over balcony/oriel, usually located on the second floor and providing a direct view of the public space. Similar to a podium, this creates a raised, privileged area that is usually reserved for women. In this way, the jharokha could be seen as a type of Indian mashrabiya.

As can be seen in Jaipur the jharokha is a development of older models, which were also projecting balconies, albeit open. These can still be found, for example, in some havelis in Amber. In the eighteenth century this was closed in and became an independent living space. The jharokha, originally an isolated and irregularly used element, in the course of time was used more profusely and in several stories, finally stretching across the entire width of the facade, and thereby completely hiding the original load-bearing structure behind a decorative envelope. In Jaipur these oriel are an impressive element of a homogenous urban facade that can be seen especially along the bazaars. Ultimately it is these features that give the city its characteristic appearance.

Strictly speaking, we are not here dealing with vernacular architecture because the house styles reflect elements of the palace architecture4 and the cenotaphs of Rajasthan, such as the dome-covered decorative pavilions (chattri), widely projecting sloping eaves (chajja), or oriel (jharokha). Furthermore, there is also clear evidence of elements of the Mogul style. The decoration of the houses involves typical motifs of that style, such as the multifoil arches that can be seen everywhere in the roofed-over galleries (tibara). Similar to Mogul monuments, buildings feature facades that are divided into series of rectangular fields. Generally speaking, the impression of planned architecture is conveyed by the quality of the composition, the rigid geometry of the floor plans, and the careful proportions of the facade.
In spite of the rigid structure and the ubiquitous grid, a great variety of rooms can be generated to accommodate different functions. In addition to the main courtyard or courtyards (chowk), which is located on the first floor, the courtyards on the upper floor (chandni, literally “the place where the moonlight can be enjoyed”), are a unique feature of Jaipur houses. The architectural achievement is that the interior rooms are extended by numerous exterior spaces, which is particularly necessary in view of the extremely small plots and the high density of the urban fabric. Originally these small inserted terraces made it possible for each of the wives or each member of an extended family to establish independent dwelling units in each house. In this way families managed to divide their houses in Jaipur and allocate the available space so that family living was possible within a uniform framework. As a result, it is nowadays possible to accommodate many tenants in these houses without extensive conversion work (for example, no fewer than eight families in the Kashliwalji ki haveli), which, in all other types of courtyard houses, would present an awkward and difficult-to-resolve problem.

A hasty visitor cannot begin to guess at the spatial complexity of the houses in Jaipur. At first sight it is never possible to know what is behind a wall: a room or an inner courtyard? In addition, during our field study we were able to note that some rooms had originally been internal or external spaces before they were modified by the residents. For example, at Narendra Mohan Paliwal haveli we were surprised to find that the living room on the third floor was a former chandni which had just recently been closed by adding a ceiling slab. Conversely, in the Joshi haveli, after checking the construction details, the small terrace on the second floor turned out to previously have been a roofed-over baithak (living room). All this conveys an impression of the flexibility of the floor grid.

Among the traditional courtyard houses, the houses of Jaipur follow a very uniform yet paradoxically not-at-all-repetitive typology. There is a wide range of different architectural forms.
Urban Dwellings in Jaipur, Rajasthan

Endnotes

1 For the history of the city, see Vibhuti Sachdev and Giles Tillotson, Building Jaipur: The Making of an Indian City (London: Reaktion Books, 2002).


3 For the city layout, see Alain Borie, Françoise Catalàa, and Rémi Papillault, Jaipur: Ville nouvelle du XVIIe siècle au Rajasthan (Paris: Thalia, 2007), Chapter 1.


5 For traditional elements of Indian architecture, see Kulbhushan Jain, Thematic Space in Indian Architecture (New Delhi: India Research Press, 2002).

6 For Mogul architecture, see Ebba Koch, Mogul Architecture (Munich: Prestel, 1991); and Andreas Volwahsen, Inde islamique (Fribourg: Office du Livre, 1971).

This article is based on the scientific research carried out in 2002 to 2005 in Jaipur and Amber headed by Alain Borie, Françoise Catalàa, and Rémi Papillault, in the context of a cooperation with l’École nationale supérieure d’architecture de Paris-Malaquais, l’École nationale supérieure d’architecture de Toulouse, and the Aayojan School of Architecture, Jaipur. The drawings are the result of a student project as part of a seminar workshop entitled “Villes comparées, Jaipur” headed by Alain Borie, who also provided the sketches and photos.
Nearly 50 percent of the Laotian population consists of members of various minorities. The turbulent history of the country in the nineteenth and twentieth centuries, the migration movements triggered by the powerful neighboring states and occupiers, in particular during the twentieth century, and the very diverse topographic and climatic conditions were bound to be reflected in people’s buildings. *L’habitation Lao* by Sophie Clément-Charpentier and Pierre Clément remains the only work on this subject; it analyzes the numerically largest section of vernacular architecture in today’s Laos after city-bound migration, but only a small part of a much greater range. The correct long form of the title is *L’habitation Lao dans les régions de Vientiane et de Louang Prabang*. Below, we present two examples that hitherto have virtually been overlooked. Thanks to their remote location, the *thub gong* houses not far from Sam Neua in Houaphan Province have survived to this day. The inhabitants belong to the Lao-Tai language family. Verbal tradition holds that their ancestors moved there from Vietnam. The rice granaries in Ban Nam Loung in Luang Namtha Province are still in existence due to their architectural quality and the awareness by their users of their uniqueness. The inhabitants of this village belong to the Khmu and until the nineteen-nineties lived in the hill country to the north-east of their current settlement.

The appearance of this architecture is largely determined by the tropical monsoon climate in Laos. This divides the year into three seasons: the rainy season, from May to October; the cool dry season, from November to February; and the hot dry season, in March and April. In the region around Sam Neua, the temperature can fall below freezing and the people there are even familiar with snow.
The Thub Gong House

The literal meaning of thub gong is “curved canopy.” This means that the distinctly curved roof projections at both gable ends of the house have given the dwelling its name. As an example, we will look here at the construction of a typical dwelling house. The houses still in existence today are found in a clearly designated area and are an impressive testament to the influence of regional identity. Mixed marriages involving members of different ethnic groups have resulted in cultural regionalization beyond ethnic boundaries. It can be heard in the dialects, seen in the weaving patterns of traditional fabrics, and found in the houses. Houses with this exterior appearance are common throughout a wide area: similar types can be found in Thailand and Vietnam. However, their construction is specific to each region. All follow a basic design: the load-bearing structural frame consists of timber, which today is typically Fokienia hodginsii (Fujian cypress) as no timber of better quality is available. The construction of the enclosing walls and floors reflects the financial means of the inhabitants. Wooden planks could only be afforded by rich people. Wall planks, previously fitted vertically in grooved base and top plates, have long been replaced by woven bamboo mats. But the temporary smaller houses in the paddy fields too were constructed by farmers in accordance with the same scheme. The curved canopies, which provide cover to the far-projecting verandas, are the first element one notices. The ridge, which slopes down from the center of the house to the gables, is less conspicuous. The elliptical floor plan of the house is not immediately apparent until one takes a closer look at the upright supports that raise the house off the ground by about 1.3 m.
Solid columns, previously embedded in the ground and later placed loosely on foundation stones, determine the orientation of the house. Three columns in the direction across the house define its depth and the height to which the living floor will be raised. The two outer ones are used by the carpenter to erect the frame, which then carries a pair of spars. The column in the middle only reaches up to the floor level. A cross-beam rests on a longitudinal one that links up the central columns. This cross-beam ties the two outer columns together. It runs through a hole in the outer columns and widely projects on both sides; this projection is needed for construction. Six such frames are placed at regular intervals in the longitudinal direction. The dimensions of the intervals determine the length of the house. In former times the houses of important families featured more than six such frames. The two outer frames are significantly narrower in the cross direction than the four inner frames. The distance in the cross direction also decreases by about 10 cm between the two innermost frames and the ones following them. This results in an elliptical floor plan. In order to stabilize the structure in the longitudinal direction, all columns in a row are linked with a beam. The columns of the central row have this beam placed in a groove, whereas the beam runs through mortise holes in the outer ones. The rectangular vertical mortise holes are directly beneath those across the columns. The outer columns present a challenge, as they are not in line with the others. They must be tied in segments.

**Floor Plan Divided into Two**

The living floor is functionally divided into two sections. A wooden partition wall placed in longitudinal direction separates the sleeping area from the living area. The proportion is around 1:2 to 1:3. On the eaves side, two staircases between the outermost columns provide access to the house on the side of the living area. Guests enter the house usually on the hong side. The staircase on the he side is reserved for friends and female relations of the woman of the house. Traditionally the house had two open fireplaces; the rising smoke acts as a preservative for the roof skin made of palm leaves. The fireplaces emphasized the functional division of the house in the cross direction. Nowadays, most houses have abandoned one fireplace. Cooking primarily takes place on the he side. Directly next to the fireplace on the hong side is a low wooden bung, which is only used by the master of the house. The hong side, or front of the house, is not only reserved for the master of the house and formal guests, but is also associated with the parents—who occupy a higher position in the hierarchy—whereas the children, who are lower in the hierarchy, use the he side. These two are held in position in the cross direction by tie beams. These tie beams are notched out and placed into slots in the head beams; the column tenons also engage in mortise holes in these beams. The cross-bracing is further enhanced by beams that tie opposite columns in parallel to the tie beams and support the floor structure. When the load-bearing structures on both gable sides are up, the two central cross frames can be erected. Once the columns are up, they are first fixed in the cross direction. To do this, the offset column tenon again penetrates the tie beam, and a parallel beam beneath the floor level fixes the distance between the pair of columns. In the next step, the two inner pairs of columns are connected with the outer ones by a head beam. This is notched out and inserted in slots of four tie beams outside the column tenons. The vertical levels of the horizontal beams above the columns indicate the sequence of the assembly. In the last step, the six columns of each longitudinal side are tied together beneath the floor level. Beneath the beams tying the frame across, similar tie beams run through the mortise holes in the columns. In view of the dimension and the length required of at least 25 m, it is not possible to fit just a single beam. Furthermore, the elliptical floor plan means that the longitudinal tie beams follow a curved line and have to be divided into three parts. Most often, the conically cut beam ends are joined at the second and fifth columns. Four pairs of spars above the central column pairs are supported from the tie beams and are joined together at their top ends. The joint at the foot of the spar features a tenon that fits into a matching hole in the tie beam on the inside of the column tenon. The spar pairs are prepared flat and then are pulled up one by one, with the tenons engaging in the prepared mortise holes. They are fixed in place temporarily and are then finally permanently secured by a ridge beam supported on top of the rafter joint. On the inside, one or two diagonal battens are added for longitudinal bracing against wind pressure. The thab gong on the gable ends also contribute to this task. What from the outside appears to be a common hipped roof proves to be an extremely unusual construction when seen from the inside. In contrast to the spar roof above the central part, the hips rest on a construction using rafters. As a rule, seven suspended round timbers are used as the main structural elements of the hips at the gable ends. These rafters are suspended from a collar beam that is fitted with a mortise and tenon joint to the outer pair of spars just beneath the ridge. The collar beam is placed at this high point in order to give the roof its shape as a hipped roof even though, strictly speaking, it is a hipped and gabled roof. Here too the sequence of erection is strictly defined. In the first step the rafters at the corners are inserted in the protruding ends of the crossing of the short outer head beam with the outer tie beam. A strong tenon is fitted at right
angles to the rafter on the inside of its foot to prevent its sliding down. The upper ends of the rafters are tied to the outside of the collar beam. Beneath the collar beam, another tenon is fitted on the inside of the rafters. The logic of this construction will not become clear until we have explained the other rafters. Between the rafters at the corners, three rafters are suspended from the collar beam. In view of the fact that they rest on the outside of the collar beam, the tenons from which they are suspended are fitted to the inside. At their lower ends the rafters are supported on short struts. These struts have notches at the top ends to provide a secure base to the rafters; at their lower ends they are joined and inserted in a matching hole in the outer tie beam. The carpenter can use the length of these struts to determine the shape of the rounded gable. The struts are tied to the rafters. Another rafter is suspended on each side between the outer rafter and the rafter at the corner. At the bottom ends, these rafters are supported by struts which, similar to those of the three rafters in the middle, are joined to the head beam. At their top ends they are suspended from the inside of the collar beam, the jointing detail again being mortise and tenon. These tenons at the rafters look like enormous hooks. At first sight the hooks at the top end of the rafters at the corners appear out of place because they are fitted on the underside of the collar beam. The shape of the hipped roof provides good longitudinal bracing. Nevertheless, the overall height, the steep slope, the few construction elements, and the suspended rafters at the gable sides make the building vulnerable to strong wind forces. This explains the function of the hooks at the main rafters at the corners, which we questioned above: they are designed to absorb the pressure resulting from extreme wind loads that act on one gable side and are transferred to the opposite side. Once the rafters are in place horizontal poles are tied to them, which in turn support the roof skin, which generally consists of thatch-like material tied to these poles. On the gables, the poles supporting the roof skin consist of a special type of bamboo that lends itself to bending. Even so, these poles cannot be very thick and are therefore also used in the form of bundles. The horizontal tie beams between the columns are too widely spaced to be suitable as support for the floor structure. Therefore round beams are placed in between the tie beams at a spacing to suit the flooring. These beams rest on the external and central longitudinal ties. They are also used to support the fireplaces. On the projection of the beams on the left and right, outside the four central columns, a plank is fitted in an upright position. These two planks are joined together by suitable cross planks using locked mortise and tenon joints. The top of these planks has a groove, which is used to insert vertical boards that form the outside skin of the frame structure. At the top of these boards, another grooved plank acts as a lintel beam that holds the external wall cladding. A door is fitted on each gable side. The interior created in this way is divided by the longitudinal partition wall mentioned above. Opposite this partition wall, windows are inserted in the external wall. The floor at the gable ends, outside the walls, appears like a roofed-over veranda. A large loom is normally placed on the he side. This side of the house is always extended by a terrace with closely laid bamboo poles. This is used to carry out all activities involving water: cooking, ablutions, and laundry.
Rice Granary in Ban Nam Loung

The second type of building we would like to present is a rice granary in Ban Nam Loung. Two examples stand out; they have been built by Kham, a carpenter living in the village. We will describe the later example, which is more modest in its detail, and in which Kham used the experience he gained from the construction of his own rice granary. The most conspicuous feature, which can be seen from afar, consists of the six columns with a diameter of 50 cm and a length of 120 cm that support the granary. The granary stands on a steep slope in the midst of an entire village of granaries. The columns do not compensate for the slope in the terrain; instead, the site of each granary has been leveled. This not only made work easier for the carpenter, but also made the granary far more user-friendly in everyday use. The columns are placed on foundation stones that have been set into the ground. Featuring a finely detailed, almost sculptural shape, the columns convey an impression of solidity and ruggedness while the narrowing toward the top gives them a certain elegance. At the top ends, the columns are finished with a rectangular tenon. These tenons engage in 8 cm-thick round timber discs with a diameter of nearly 80 cm, which serve to keep out rodents. All granaries are placed parallel to the slope. This encourages ventilation of the stored grain from below. The granary itself rests on structural members that are supported by the columns. Rectangular beams are placed parallel to the ridge in the grooved column tenons. The two beams, and by implication also the columns beneath, are held in place by roughly hewn round logs that are notched to fit. Thanks to their perfect fit to the foundation stones, the columns themselves stand very securely; nevertheless, the weight of the filled granary and very cleverly placed pegs of the granary building are needed to fix their position permanently.

Wood Frame and Bamboo Mats

The granary consists of a timber-frame construction. Directly above the basement columns, six columns are fitted between base places and head plates on all four sides, which define the size of the granary. The two longitudinal base plates support three lap-joined perpendicular plates. All base plates project significantly beyond the joint. The columns are placed directly above the joint of the base plates. At their lower ends, their very long offset tenons penetrate the lap joint of the plates; they reach all the way down to the bottom of the round load-distributing logs. Their placement to the left or right of these load-bearing logs is very clever and ensures that the granary cannot slide sideways above the columns. The configuration at the top of the uprights varies somewhat. Again, offset tenons of the columns engage in the head plates that connect the three pairs of columns at their top ends. The beams running along the building are simply threaded on to the tenon rather than being lap-joined. This makes it possible for the carpenter to keep the cross section of these beams small. Why is this detail important? The roof is supported by a spar structure. These spars are bird’s-mouthed on the longitudinal head plates. The force of their thrust is absorbed by the cross beams to which the load is transferred via the tenons of the uprights. If the cross beams were lap-joined to the longitudinal ones, the load of the roof would be transferred to those beams, which would have been reduced to half their cross section at precisely the point where the load transfer takes place.

The walls of the granary are made up with woven bamboo mats. To give these mats a degree of strength, the weaving material consists of bamboo poles that are split and then beaten flat. However, the mats are still not strong enough to withstand the enormous pressure from the weight of the stored rice. To achieve this, further elements are integrated in the load-bearing structure: two horizontal members on each side as well as two vertical members for each field of the base frame. The horizontal members run through all vertical frame elements and project significantly in order to best benefit from the strength of the base frame in resisting the pressure. The additional vertical elements have tenons engaging them in the base and head plates and are behind the horizontal members.
Due to their rigidity, the woven bamboo mats making up the wall elements can only be fitted flat, from one corner of the granary to another. On the inside, the corner joint is covered with a nailed-on arris rail to ensure that rice cannot run out at the corners.

The transitions from the floor to the wall are hidden beneath the deposited grain for most of the year and therefore only require a simpler detail. The same measure that seals the woven mats tightly is sufficient at this joint. All walls and butt joints between wall and floor are smeared on the inside with water buffalo dung. The bamboo matting of split and flattened bamboo poles is laid at right angles in several layers and projects far beyond the base plates. This ensures that the joint between floor and wall remains leak-proof.

The Roof
In terms of its construction, the roof is a spar roof. Three pairs of spars are fitted that correspond to the pairs of columns. However, the appearance of a hipped and gabled roof comes about due to the purlin roof construction. Precipitation, which at times can be very heavy, makes it imperative to provide very good protection for the walls of the granary. The roof has to be extended low down on all sides. The spar roof construction over the main part of the granary avoids the need for intermediate posts supporting the purlins. The purlins are tenon-jointed to the outer spars, but rest on the middle ones. They support the rafters. These rafters project far beyond the head plates by about the same distance as that between the purlins. This makes it necessary to fit strong foot purlins. The foot purlins are supported in a way that is as simple as it is ingenuous. Split bamboo purlins are notched at top and bottom in a semi-circular shape. The foot purlin rests in the top notch. The bottom notch sits on a round log at floor level, which is pressed against the base plate by the slanting bamboo braces. The wooden shingles are attached to roof battens fitted to the rafters. At their top ends, the shingles in each row are attached to the roof battens using wooden pegs. These pegs are covered by the next higher row of shingles.

The gable sided hipped roof part emphasizes the protective function of the roof. An opening in the gable wall makes it possible to enter the granary or to fill it. The roof over this gable end is quite different to that on the rear of the building. The hipped roof part over the closed gable side is not dissimilar to that of the ठाक गायंग.

However, the rafters are much shorter and therefore only need to be tied to a collar beam. The term collar beam is not entirely correct because this structural member is not connected to any spars. These beams are supported on purlins and in turn support the rafters. The bottom end of the rounded hip is supported by slanting braces, quite similar to the lengthwise carved‘ sides. On the entrance side there is only a little space for braces because they would encroach on the space needed for the door and entrance opening. Two braces to the left and right of the door support the flat gable sided hipped roof part, which is flatter than that at the rear and thus allows easier access to the granary. The two open spaces between the pent roof above the door and the roof overhangs at the eaves are closed by two additional pent roof spandrels fit into the irregular shape. They are given support by the roof structures adjoining on the left and right. The two openings in the gables above the hipped roof’s part are closed — like the walls of the granary — with bamboo matting. At their base, these infill panels are held by the collar beam and the construction of the hipped and gabled roof. Fixing them to the spars on the left and right only would be too weak. Further support is provided by a short column that stands on the head plate on the gable side. The ridge purlin rests in the cradle formed by the projecting spar ends. In addition, it is supported by a column at both gable ends. These two columns are also used to attach the bamboo matting in the gable triangles.

Combination of Materials
The fascination of this granary and another one similar to it lies in the combination of the materials used and in the unique, accomplished detailing. Compared to wood, bamboo has some advantages. These have been made full use of by the carpenter. As a construction material, bamboo is rather short-lived, but that is compensated for by its fast growth. Increasingly, people are no longer prepared to regard bamboo-made parts as wear material as they lack the time for the necessary regular replacement. Many farmers are taking up second jobs as commuters, and many young people are leaving the villages of their ancestors. The government forces the relocation of villagers from remote locations in the mountains to new homes adjacent to the road network. Some foresightful farmers have taken with them saplings of the bamboo species they are familiar with. Sadly, it is not possible to replicate the traditional building technology for the columns on which the granaries rest, because the trees necessary do not exist in the new settlement areas.

The two examples presented here demonstrate how the traditional construction technology makes good use of material resources based on self-sufficiency. As large swatches of virgin forest are lost as a result of deforestation and villagers earn additional incomes outside their villages, traditional construction methods are being abandoned. Large caoutchouc tree plantations have a long-term detrimental effect on the soil and drive farmers working in them into economic dependence. In spite of that, fewer and fewer people have a sense of loss with respect to the old buildings because economic progress means that they no longer fulfill people’s expectations.

Endnotes
3 Ibid.
5 It is planned to also present other solutions in a more comprehensive publication.

Granary village outside Ban Nam Louang: the arrangement of the buildings parallel to the slope enhances the ventilation of the stored goods.
Hanok in Korea
Daniel Tändler

Geographically as well as culturally, Korea occupies a position between its neighboring countries China and Japan. Its traditional dwelling architecture, called hanok, has developed from this position and reflects the conditions of climate, lifestyle, and social habits of the country. Even though this architecture is not as well known in the West as the vernacular architecture of Japan, for example, it nevertheless offers no less rich a treasure of cultural wealth and building technology that has developed over centuries, and is currently experiencing a renaissance in Korea.

Until mass housing was introduced in the nineteen-sixties as part of a political program, the hanok was the dominant form of building. In the historical sense, traditional hanoks are considered those from the Joseon dynasty (1392–1910) that lasted up until the Japanese annexation in 1910; however, almost only buildings of the aristocracy still remain from that period.

Geographically, Korea lies at about the same latitude as Greece. Owing to its position at the eastern edge of the Eurasian continent and the westerly winds that predominate in the northern hemisphere, the climate is mostly a continental one, with subtropical conditions prevailing only in the extreme south. This means that there are distinct changes of seasons, with cold and dry winters, and hot summers affected by the monsoon rains. This continental climate with its extreme fluctuations of the seasons has had a significant impact on Korea’s architecture. In the northerly areas with their cold winters, the ondol underfloor heating was created, which provides heat to the closed rooms, called bang. By contrast, in the southerly provinces, with their hot summers, the maru, a wooden floor with back-ventilation, was developed; it can be found in the daechong, an open summer room. It seems that during the Goryeo dynasty (918–1392), the two types of rooms were combined, thus creating the traditional Korean dwelling as we know it today.
In ancient Korea the teaching of the pungsu (in the West known as feng shui), which relies on the observation of nature, has a major influence on the design of cities and buildings. According to this teaching, buildings face south wherever possible; there are very few that are accessed from the north.

The Space Elements of the Hanok

Traditional Korean architecture has a courtyard at its heart, either in the form of an individual courtyard dwelling or as several buildings arranged around a courtyard. The hanok is subdivided into a series of open and introverted rooms that lead from the semipublic to the private zone. Guests enter the courtyard from the street and from there go into the main hall, the reception area of the house. In properties of the nobility, the men’s quarters are usually located at the front, toward the street, and the women’s quarters at the rear. This strict separation, however, is a characteristic that did not develop until the latter part of the Joseon dynasty.

Madang (Courtyard Garden)

Courtyard houses are ubiquitous in traditional architecture. In hanoks too, the courtyard plays a key role. It is a semipublic open space and serves as a circulation area, to provide light to the house, and as an open area for household work such as the pickling of kimchi and other vegetables for winter. Traditionally the main courtyard does not contain a decorative garden; in larger houses of the nobility, such gardens can usually be found in front of the house. Vegetable gardens are usually located at the rear, following on from the women’s quarter.

Daecheong (Main Hall)

The daecheong, or main hall, is an open reception room with exposed timber framing and open roof structure. It is mainly used in summer and almost always faces south. It is used to receive guests and carry out household work. The floor, maru, has the benefit of back ventilation. The typical Korean flooring pattern, called umul-maru, is created by placing wooden planks on load-bearing beams using a tongue-and-groove system.

Due to the climate conditions in the southern provinces, the main hall occupies the largest part of the house. In the north, with their cold winters, the hall occupies a proportionally much smaller space. Furthermore, in the south, the main hall is often completely open on the inner courtyard side and features wooden windows at the back, which can be opened in order to ensure good cross ventilation in summer. By contrast, in the colder northern provinces, the room often features ceiling-high windows toward the courtyard garden that can be folded up.

Bang (Heated Rooms)

Bang are the private rooms of the house. They are enclosed and introverted, and are heated using the ondol system; they have a suspended ceiling. The walls are covered with hanji paper, which is produced from the fibers of the mulberry tree. Hanji paper is also used to cover the floor; it is impregnated with soya oil, which gives...
it its yellowish, beige color. In the colder northern areas, these rooms occupy a larger part of the building compared to the south. In winter especially, not only sleeping but also sitting on the heated floor is a pleasant experience. That could be a reason why, in traditional Korean households, daily activities tend to take place without chairs, directly on the floor.

*Buok (Kitchen)*

In the traditional hanok, the kitchen lies lower than the other parts of the building in a side wing next to the main hall, from which it is normally separated by a room. This makes it possible to connect the air extraction ducts from the kitchen to the ondol system, which contributes to the heating of the building. Above the fireplaces, large cast-iron cooking pots are integrated into the structure. Owing to the low position of the kitchen, space is created above it for an unheated mezzanine story, the darak. This is traditionally used for the storage of foodstuffs.

**Construction System of the Hanok**

Traditional Korean architecture consists of a timber skeleton structure with posts and beams. The preferred construction timber is that of the local pine tree (*Pinus densiflora*).

The residential buildings are usually single-story – one of the main reasons being the heating system; only the kitchen and rarely other rooms have mezzanine stories above that are mostly used for storage. Buildings with several stories were reserved for palaces and temples (pagodas). The timber elements are joined using precisely fitting carpenter joints with wedges. The precision of these push-fit joints is such that they resist bending. This method of construction makes it possible to erect free-standing pavilions without bracing walls. The basic elements of this construction are the kidung (uprights), bo (beams), and dori (purline). The kidungs are placed on foundation stones without any lateral tie and, before being placed, are adjusted to the shape of these. The foundation stones rest on a raised platform (kidan) with peripheral walls of natural stone. This is necessary to protect the entire building, including the underfloor heating system, against incoming water, particularly during the monsoon season.

In the basic design the roof is constructed with round rafters (*seokgarae*). The hanok always has a very wide roof overhang, which always extends beyond the plinth slab in order to protect the feet of the uprights from water spray. As the buildings become more prestigious, for example in palace and temple architecture, the structure is further enhanced with decorative elements and features more complex construction.

The design of the roof is a special feature of Korean houses compared to those in neighboring countries. The rafters are covered with a mesh of bamboo or thick branches. On the room side this is covered with a layer of clay and, in the visible areas, is then plastered with lime. On the outside the mesh is covered by a layer of sandy soil. Tiles are bedded into this layer of soil, with the under-tiles being rather wide and flat and the over-tiles narrower and rounded. However, in secular architecture, roof tiles were originally only used in properties of the nobility and buildings of the higher merchant class. Most normal dwellings were covered in rice straw, a by-product of the rice harvest.

The layer of soil beneath the tiles has several functions: it weighs down and stabilizes the construction. The construction timbers were often used before they had completely dried out; the weight of the roof prevented any significant distortion in the construction, which might have occurred due to the shrinkage in the final drying process. Furthermore, owing to the heavy roof construction, the hanok is structurally very safe during typhoons. During the rainy season, small quantities of water always penetrate into the layer of soil; however, this is just absorbed and gradually given off again during the dry months. Apart from helping to keep out the wet, the layer of soil in the roof also has a balancing effect on the room climate.

**Ondol (Heating System)**

An outstanding characteristic of Korea’s traditional architecture is the ondol underfloor heating system, which can be compared to the hypocaust system of the Romans. Its furnaces are located in the lower plinth area, and the system is also connected with the...
fireplaces in the kitchen. From these, ducts run through the plinth area beneath the rooms to be heated. The freestanding chimneys rise up from the ground a little distance away from the building. Beneath the rooms the ducts are covered with stone slabs, which in turn are covered with a layer of clay. This is also the origin of the name ondol, which literally means “warm stone.” The floor is finished with hanji paper that is impregnated with soya oil. This ensures that no noxious fumes enter the room. Originally, the fuel used for the ondol was wood. From about the beginning of the Japanese colonial era, this was replaced with coal briquettes.

The Future of the Hanok

The term traditional architecture used in the context of the hanok may lead Western readers to misunderstand the term. Whereas the normal association with the term traditional is historical, this is not the case in Korea. The traditional construction method has not given way to modern architecture, but to this day exists in parallel with it; likewise, the most important trades are still being practiced to this day. Nevertheless, traditional architecture also absorbed technical innovations, such as glass and bricks, in the later Joseon dynasty. Nowadays it is commonplace to include modern services installations in traditional architecture; the traditional heating system is replaced by hot-water underfloor heating. In new buildings it is a challenge to comply with the legally prescribed insulation thickness, and the modern building code often presents a major problem in the refurbishment of older traditional buildings in urban areas. At the other end of the scale, stipulations imposed by the preservation authorities sometimes restrict the use of these buildings, which can make it difficult to preserve the old architecture. In spite of all these problems, this time-honored construction method exists to this day and, from the turn of the millennium, has even experienced a revival. The future will tell where the development of the hanok will lead.
The Minka in Japan
Klaus Zwerger

Minka is the Japanese term for the house of an ordinary citizen. Distinguish from the residences of the military aristocracy and the clergy, minka were the houses of the governed people – the farmers and the city-dwellers. There are some characteristics that differentiate the minka from earlier buildings: the introduction of clay walls, the change from post construction to column construction, and a clear separation of two floor levels at different heights inside the house. Ando Kunihiro, one of the best known minka researchers, is convinced that this type of house is the result of the civil war that started in 1467 with the Onin rebellion and that did not come to an end until 1600, after the battle of Sekigahara. Because wars can only be waged when the coffers are full, the warlords made great efforts to increase the revenue of their country. New developments and improvements in agricultural equipment made it possible to establish new rice fields. This went along with an astonishing economic upturn for the farmers. This success was represented in their houses, in which they copied characteristics of the upper classes.

Timber and Clay

In the fifteenth and sixteenth centuries wood was not only the primary source of energy, but also the raw material for most tools. It was nearly the only construction material and, due to its combustibility, it was extremely short-lived in times of war. When, due to commercial success, the demand for high-quality construction timber increased over a short period of time, there was increased pressure on resources. The scarcity experienced not only led to the first systematic reforestation programs worldwide, but should also be interpreted as the cause for resorting to a building material that previously had found very little use in Japan. A second reason for the introduction of plastered clay as infill for walls may have...
been its greater resistance to demolition by fire. Previously, the interwoven organic material used for filling in the panels in the walls had protected the inhabitants from wind and weather. The devastation wreaked in the period of the warring dynasties (475–221 BC) forced people to abandon houses built in a way that could not be defended. Merchants, farmers, and artisans needed more solid houses that afforded protection to them, their property, and their provisions. Large parts of the rural population left the countryside and moved to planned fortified towns. With their castles, the warlords demonstrated how timber buildings could be fitted out to be robust and fire-resistant. The outer layer of plaster was a sophisticated system involving many superimposed coats that protected the timber skeleton in the case of fire. Houses that were significantly better fitted out were also intended to have a longer service life. Construction elements buried in the ground are likely to suffer extensive damage at a time that cannot be predicted. When posts were no longer buried in the ground but placed on foundation stones, their service life was extended. However, the structural stability of the house was lost at a stroke. Whereas previously ordi-
nary citizens had built their houses themselves, they now needed professional help. But the number of experienced tradesmen could not be increased to match the rapidly increased demand. Construction, Organization, and Floor

Minka were seemingly structured into two areas using floor levels at two distinct heights. The area of naked earth floor, level with the ground, is the doma and is used for carrying out work. Alternat-
tively, it can also be used as stables. The part of the house with a floor raised above ground level is used for living. The three characteristics of a minka presented here make it necessary to involve skilled carpenters. The loose uprights have to be connected with one another and must provide a load-bearing support for the roof structure. The partially raised floor makes it necessary for uprights to be tied at their bottom ends. The clayfilled panels between the external uprights serve as vertical bracing elements. Similar infill panels above head height inside the house further enhance this effect. The most important horizontal bracing is achieved with ceiling beams fitted crosswise. The de-
tailing, the shear solid mass, and the number of layers allow con-
clusions as to the required structural effect of the construction:
typically, several-meters-thick blankets of snow, and the regular occurrence of wind gusts of more than 200 km per hour. The roof structure is built up from the beams. The type of construc-
tion ranges from purlin roofs to rafter roofs and any number of combinations. Minka inhabitants are involved in a wide variety of activities, which inevitably has led to different design versions. The function-related diversity is further affected by the need to adapt to climatic and topographic conditions, which vary a great deal within the country. For simplicity’s sake, we divide the country into two zones: in the east of Japan, for half the year, severe cold is experienced during the winter months. In spite of adopting the minka, people nevertheless retain a fireplace that is sunk into the ground; this serves as a source of heat, a place to cook, and a source of light. This means that, in this part of Japan, the compacted clay floor was retained in the minka for a long time. Some minka had clay floors as late as the Edo period (1603–1868). In winter, straw or rice husks were spread as a layer of insulation. By contrast, in the western part of Japan, there is evidence of timber floors in the minka at an early stage. The Hakogi Sennenyä, the so-called thousand-year house in Kobe, dates from the fifteenth century. About half of its footprint area is covered with wooden floorboards. This living area in turn is divided into two areas of equal size. The half facing the open flank of the house is used for receiving guests, the rear half for the family’s private living. In the Furi Sennenyä in Himeji City, Hyogo Prefecture, a minka of similar age, this division of living quarters is even more pronounced. Only the reception area is boarded. The floor in the area used by the in-
habitants is covered with closely placed bamboo rods. If we cast our eyes over the interior of the house, we can see uprights and roof beams that are conspicuously slender as well as irregular in shape. This confirms the dating of the property described above. Timber was rare, and therefore valuable and expensive. The boarded floor in the guest area is all the more surprising. The planks are of first-class quality, long and wide. This seeming contradiction demonstrates how guests were appreciated. In due course, the boarded floors of the guest area were replaced by softer tatami. Changes also occurred in the eastern part of Japan. Here the living area was also raised, featuring a wooden floor. And guests were also to be offered the comfort of rice straw mats. This meant that
The complete form of the minka had three parts: the doma (work area), the living area with wooden floorboards, and the guest area with tatami laid out on the floor.

Fireplace, Openings and Ventilation

For anthropologists, fireplaces are a key research object as they are a focus of family life. The relationship between the fireplace and lifestyle is rarely as important as when comparing the minka of the western and eastern halves of the country. In the earliest forms of dwellings, researchers assume that roofs were erected over pits in the ground. The center of this was the fireplace. The thatched roof of reed or straw ensures that there was sufficient oxygen intake and fresh air similar to this house in Enzan, Yamanashi Prefecture.

Roof of reed or straw ensures that there was sufficient oxygen intake and, at the same time, that the combustion gases could escape. For anthropologists, fireplaces are a key research object as they are a focus of family life. The relationship between the fireplace and lifestyle is rarely as important as when comparing the minka of the western and eastern halves of the country. In the earliest forms of dwellings, researchers assume that roofs were erected over pits in the ground. The center of this was the fireplace. The thatched roof of reed or straw ensures that there was sufficient oxygen intake and fresh air similar to this house in Enzan, Yamanashi Prefecture.

The biggest challenge in terms of building technology in Japan is the relative humidity during the rainy season. If timber houses were to survive these seasons without damage, they had to be ventilated as best as possible. For this reason, they were raised off the ground. The rainy season is also a difficult time for residents. Some relief is achieved through the illusion of a draft, which comes about when as many partition walls as possible are removed inside the house. This led to the development of various sliding room dividers that could be removed. To achieve this, residents were even prepared to suffer the cold in winter. Sliding room divider elements in standardized sizes can be used to create surprising flexibility. The size of the room is determined solely by its intended function and the number of existing grooves that can be used to insert or remove doors as needed. Originally, wooden doors were used internally and externally; the internal ones were gradually replaced by thin, rice-paper-covered wood frames (shoji) that allow diffuse light to shine through. Fusuma, frames with several layers of paper, were used where greater privacy was required. Amado (so-called rain doors) made entirely of wood make it possible to close the house against the weather. There was no privacy, however, behind any of these doors. Not to be seen does not mean not to be heard.

Timber Connections

Wood is an elastic material. In order to benefit from this quality in the worst-case scenario, the structural members of the construction had to be joined accordingly. Carpenters developed fascinating solutions. With their timber joints they tried to absorb any shock impact on the construction rather than trying to make inflexible joints using rigid triangulation. Coming from our cultural background we are fascinated to discover that in most of the joints the end-grain is concealed. We wrongly tend to interpret this as an aesthetic characteristic. Commonly, in each joint the end-grain of the wood is exposed. The end-grain, however, is the most vulnerable part of a piece of wood; it is particularly susceptible when heavily exposed to moisture and when it cannot dry out for longer periods. The most effective protection therefore is to construct joints in such a way that the end-grain is fully concealed. In turn this means that where two timbers have to be joined in line, they are butt-jointed, with the functional part of the joint being on the inside of the timber. One such example shown here is the construction detail of a veranda. However, first of all it is necessary to introduce the veranda itself.

The Veranda

With the help of very restrictive laws, the Tokugawa dynasty created a period of peace that lasted for centuries. During this time of the Edo period, the citizens succeeded in softening the principle...
of built security that had been developed during the era of civil war. Step by step the houses were opened up in order to benefit from stronger contact between the interior and exterior. One of the most effective steps in this direction was the development of the veranda. The spacious extension of the floor and ceiling beyond the interior defined by shoji and fusuma into the exterior created a place for receiving guests and/or made it possible to offer visitors a separate entrance. The floor area laid out with tatami was extended to the outside using wooden boards. The roof overhang was extended to protect the newly gained space from rain and solar irradiation. The wall of the house too benefited from additional protection. The veranda was a transition area between inside and outside, possibly attributable to one or the other. Much more important however was the emotional effect, the intense sense of a close relationship between house and surrounding nature. The wall openings—in the west sliding doors were introduced early on, in the east inward-opening folding shutters and horizontal boards fitted in grooves persisted for much longer—made it possible to control this relationship. The characteristic of the veranda of being on the edge was overcome by opening doors/walls. The veranda has a kind of bridge function, and by softening the boundary between interior and exterior it creates fluidity between these areas and makes the minka a more pleasant place to live. The development of the veranda in the minka was subject to a process involving several stages. It is very closely associated with the successive replacement of solid clay wall infills with sliding elements that can be moved in a variety of ways. Initially, the
uprights used for the external walls were placed at intervals of one ken (approx. 1.8 m, the length of a tatami mat). Between these uprights, half of the panel was a fixed wall. Behind this it was possible to slide a wooden door or a transparent shoji panel and a wooden door. With these elements the unplastered half of the facade between the uprights could be closed or opened.

When we consider the next step under purely functional aspects, we will be surprised by the effort involved in this solution. The place of the solid wall area was taken up by a wooden sliding door. Two wooden sliding doors and one paper-covered door require three parallel grooves in the threshold beam and in the lintel beam—a true challenge for the carpenter considering the tools available at the time. The arrangement meant that one half always remained closed. However, the psychological effect must have been compelling. Minka residents were able to choose which half to open.

This restriction was not lifted until the groove for the amado (rain door) was inserted in front of the row of uprights. Now it was possible to fill the panels of the amado with glass, even storm and rain were no problem. Even with closed doors it was possible to witness the drama of nature—in particular its constantly changing play of light. More opening was hardly possible. Verandas were so popular that they gradually spread around the house. Whereas originally they were designed as a place of honor for guests, their multifunctionality was appreciated to such an extent that they were no longer seen as optional. The larger and more prestigious some minka are, the fewer sides of the house remain without the extension of a veranda.

Some town houses had gardens at the back of the house or enclosed by walls. These gardens were intended to further improve the quality of life and the ventilation of the house. The view of the garden, an oasis of nature, was meant to entice the guest to remain on the veranda. The host offered the opportunity to just take a few steps onto the veranda in order to escape the hustle and bustle of the street and enter an secluded world. The amado close a room toward the outside which, in front of the veranda, includes a doma area. This creates an open space that conveys the sense that residents could leave the house even in conditions of thick snow cover. Depending on the depth of snow, protective boards could be inserted in the grooves between the uprights that define the boundary to the street. In towns, such verandas are often extended such that houses next to each other are connected. In the resulting covered walkways between the row of houses and the street, it is possible to walk from house to house along the streets protected from the weather.

Expression of Social Change

The basic characteristics of the minka developed as a reaction to the existential needs of the population. Specific local conditions relating to the topography, climate, and economy formed a huge variety of different designs in terms of size, shape, and internal organization, appearance of the wall linings, and detailing of the roof skin. This diversity was again modified by historical events; there were forced upon residents by climate conditions. On Okinawa there are two amado, one behind each other, because typhoons on that island mean extra protection is needed. The development of the earth veranda was motivated by similar considerations. Even in areas with enormous amounts of snow, people do not want to totally lose contact with the outside for months on end. Therefore the roof is constructed with a large overhang and the eaves placed on uprights that are a considerable distance in front of the veranda. The amado close a room toward the outside which, in front of the veranda, includes a doma area. This creates an open space that conveys the sense that residents could leave the house even in conditions of thick snow cover. Depending on the depth of snow, protective boards could be inserted in the grooves between the uprights that define the boundary to the street. In towns, such verandas are often extended such that houses next to each other are connected. In the resulting covered walkways between the row of houses and the street, it is possible to walk from house to house along the streets protected from the weather.
was the transition from an era of war, in which the respective citizens could only think of surviving, to a peaceful society that spread in the context of a rigid system of laws and regulations and was not allowed to continue its development. The economic upturn experienced by farmers, artisans, and merchants occurred in parallel with the loss of prestige of the warrior class; on the other hand, society became defined by a social hierarchy that was legally prescribed and incapable of adaptation. An exclusive, aristocratic culture that was opposed to change virtually forced the development of a citizen’s culture. Protection against any influence from the outside was meant to underpin the political status quo and power of the Tokugawa rulers. Under these conditions the minka developed into an architectural expression of social change. Its design became one of the main pillars of artisan activity, which found its expression in more and more refined details as well as in cleverly hidden transgressions of class-specific building limitations. Expensively built houses were maintained and extended over generations. Timber buildings need constant upkeep and maintenance. Carpenters developed incredible skill and knowledge in the development of construction details that made it easier to replace building elements when required at a later date. One such element was the threshold beam at the outside periphery of the veranda. These beams are inserted in uprights on the left and right so that they are raised above the ground. They have grooves for guiding the amado. When these are closed because of heavy rain, the water runs down and remains in the grooves of this threshold beam. Over a long period of time this is bound to cause trouble, which is why these beams have to be regularly renewed. Carpenters devised a joint that made the interference with the construction as minimal as possible. Both the uprights and the monopitch roof above do not have to be interfered with.
People can be suppressed, but not their desires and fantasies. At times, the combination of the clients’ needs to display the economic position they had achieved and those of the artisans to be able to draw on influences from abroad led to peculiar excesses. In this context, one of the most interesting of these developments must be the advent of the kesen carpenters. With nearly no moral inhibition, they transferred building elements of the temple carpenters to the minka. Construction details appeared that had never been used before. They introduced double eaves and inverted their customary arrangement. They played with the volume of spaces in a similar way as Adolf Loos postulated for his buildings. They deliberately transgressed customary limits and thereby unconsciously took the minka beyond its original clear functional forms. Minka are houses that owe their diversity in design not only to an optimal adaptation to climatic and geographic conditions. Their size and form reflect conditions of living and working. Both have undergone substantial change in towns as well as in the countryside. Minka are not compatible with today’s expectations of a dwelling. Maintaining a minka is very time-consuming and costly, which means that only a few enthusiasts embark on the onerous project of attempting an adaptation with all its shortcomings. Few of the buildings that once determined and defined Japan’s domestic architecture remain as prestige objects. Some survive as museums and, with the help of tax funds or donations, can continue to exist as cultural treasures that once defined an architectural identity.

Bibliography

The island world of Oceania consists of about 7,500 islands distributed over 250,000 km². They are located in the Pacific, the largest contiguous body of water on Earth, covering about 30 percent of its surface. Oceania’s chains of islands are commonly divided into three distinct regions: Micronesia, Melanesia, and Polynesia. This division is primarily based on the varying forms of social organization and the physical appearance of the respective population. However, in terms of culture many overlaps occur since these are not isolated island worlds. In early times, oceanic seafarers already forged networks based on economic and cultural exchange, which at times was peaceful and at times also war-like. Whereas New Zealand is part of the Polynesian Triangle formed by Hawaii, New Zealand, and Easter Island, Australia is only rarely considered part of Oceania. In this contribution, the traditional building forms of Australia will not be dealt with because they had little influence on the development of the architectural forms in Oceania. At the beginning of the British colonial era (1788) there were about 300,000 indigenous inhabitants in Australia. In the main these were hunters and gatherers whose buildings mostly consisted of simple protective shelters covered with bark or grass.

**History**

The inhabitants of Oceania have in common that they originate from either Southeast Asia or Asia. The first people to migrate to Oceania arrived there approximately 40,000 to 60,000 years ago. The people of what is called the Lapita culture, a relatively homogeneous culture complex in the first millennium BC, can be considered ancestors of those seafarers who—step by step—settled in the most remote corners of Oceania. Even though only few...
archaeological pointers exist on the building method of the Lapita culture, we can nevertheless assume that the different building traditions of the islands origin from there. The Lapita settlers already practiced shifting cultivation; initially they settled along the coasts (stilt houses) and then proceeded to penetrate deeper into the interior of the islands (change from stilt houses to houses on posts/platforms). Due to the large distances between the islands, independent building cultures developed, which nevertheless are very similar in many aspects owing to similar requirements and climatic conditions. In some places there was also lively contact, and mutual exchanges of building culture took place. The contemporary Polynesian word for “house” stems from the Proto-Oceanic balay (open structure) – Fijian: vale, Samoan: fale, Hawaiian: hale.\(^1\)

### The House in Its Socio-cultural Context

On the one hand, forms of dwellings can be seen as a response to the prevailing climate conditions and the availability of building materials; on the other, they always also reflect the social forms of relationships as well as men’s houses. To this day, family and social relationships are the key to survival in many cases.

#### Typologies

##### Wall Houses

Wall houses can be found all over Oceania. In Micronesia, the high-quality wall houses on Yap, Palau, Pohnpei, and Kosrae must be mentioned, which are characterized by rich decoration and wood carvings, whereas the other wall houses in Micronesia are of a rather lower standard. In Melanesia on the other hand, wall houses are mostly found on the island groups around New Guinea. In Polynesia, more important buildings always have walls. However, they are not always closed. In particularly hot regions the walls are left open to improve ventilation or are closed temporarily with mats, for example during heavy rainfall. Such open buildings can be found on Samoa, Niue, Futuna, Tokelau, Tuvalu, and Wallis.

By contrast, buildings of the Māori on New Zealand feature solid walls consisting of several layers of planks, which provide excellent protection also during the cold winters. Buildings used for con­gregation (where null), often also called carved houses (where whakairo), not only fulfill a protective function but, with their unique symbols and the rich decoration with anthropomorphic images, also fulfill an important ritual role. The congregation building is seen to personify the founding ancestor of a clan. The koruru (main gable) represents the head, the tabahu (ridge purlin) forms the backbone, and the heke (rafters) the ribs, while carved and painted wall studs inside the building represent other ancestors. During congregations, the head of the clan will speak not only to the members, but also to the building itself and hence to the ancestors.\(^4\)

##### Roof Houses

The roof house type does not need walls because the rafters reach all the way to the ground. Roof houses are much less common in Oceania than wall houses, and are used primarily for secondary functions. High-status roof houses are very much the exception, for example in Melanesia, especially on Vanuatu, the Solomon Islands, and in the New Guinea region, where roof houses are built as men’s houses or congregation buildings. An interesting feature of roof houses is that they are often built with bent elements for Belmont. For example, curved rafters are used in boathouses where there is a clear affinity with the inverted hull of a boat. A unique example among the roof houses is the diagl (dance house) on Palau. The double-pitch roof is similar in construction to those of the boathouses in which the rafters are also anchored in the ground. However, one of the roof surfaces of the diagl is movable and can be folded open during performances and turned into a mono-pitch roof, thus creating a stage for the female dancers. Roof houses with an oval footprint (hare paenga) are unique to Oceania, where they can only be found on Vanuatu and Easter Island. They can be constructed using lower-grade timber, and are particularly resistant to tropical storms because they offer little resistance to the frequently occurring Passat winds. Today, on Easter Island only the foundations of processed tuff-stone tiles are evident of the existence of these buildings, which were up to 8 m long and 2 m wide. The stone tiles have holes on the top, which were used for anchoring the curved rafters while also protecting them from the weather. The roofed-over entrance was located in the middle of one of the long sides.\(^6\)

##### Stilt Buildings

Stilt buildings are found in particularly damp regions that are susceptible to seasonal flooding, as well as in lagoons. Building houses on stilts provides protection from hostile attack, as well as raising the houses beyond the reach of the Anopheles mosquito, which transmits malaria. The location of these houses is important as they are close to an important source of nutrition: fish and seafood.

Particularly impressive examples of stilt houses can be found in Melanesia. So-called boath houses with up to 200 stilts were created at the upper course of the Sepik River in the highlands of Papua New Guinea, which strongly resemble the stilt buildings of Southeast Asia. A special type of stilt building in Micronesia is found on the Mariana Islands. The base of these buildings does not consist of wood but of limestone columns (latte columns) that supported the actual timber skeleton building. Other special forms of stilt buildings are the sacrifice platforms, oracle towers, and corpse huts that are found in Polynesia (Hawaii, French Polynesia, and New Zealand). A worldwide unique building is the fale poutasi (single-post house) on Tuvalu, which can be turned.\(^5\)

#### Footprint Forms

##### Rectangular Buildings

The footprint form most frequently found in Oceania, and particularly found everywhere, is the rectangle. Prestigious buildings with a rectangular footprint and rich decoration are found more commonly in the west of Oceania than in the east. This allows the conclusion that the solid features of these constructions were heavily influenced by the building culture of Southeast Asia. This influence can also be seen in the shape of the roof of the rectangular buildings. Double-pitch roofs with an elaborate projecting
gable, known as the show gable, which can be found from Palau via New Guinea and Vanuatu through to New Zealand, have strong similarities with the gables on the Indonesian islands of Sumatra (Batak and Minangkabau) and Sulawesi (Toraja). Such gables were mostly used in prestigious buildings, such as men’s houses and buildings for congregations and/or ceremonies, and are frequently associated with the anthropomorphization of the building, in which the gables have a symbolic front (face/mouth) and back (anus).

The most impressive rectangular buildings in terms of the height of the gables and the overall size are found in the Sepik and Golf regions of New Guinea, which indicates that good-quality building timber can be found in these regions that is suitable for generously dimensioned construction elements. The ngaigo (ceremony houses) of the Itamul are up to 35 m long, up to 11 m wide, and up to 25 m tall, and are some of the largest and most imposing traditional timber skeleton buildings in Oceania. For the soaring gable construction, a separate, slightly outward-leaning gable pole is erected with the help of extensive construction scaffolding; this pole stabilizes the cantilevering cone-shaped roof and has a very important function in terms of both construction and ritual. At the point of the cone-shaped roof is the flèche faîtière, a depiction of the ancestral founder of the clan in the form of a carved human body. Other ancestors of the clan are placed as guardian figures on both sides of the entrance and as decorated wall studs on the inside of the structure. While cone-shaped roofs are widely used for the round buildings in Melanesia, they are rare in Polynesia and practically absent in Micronesia.

Double-Apsis Buildings

Double-apsis buildings are most common in Central Polynesia, where Samoa, Tonga, and Fiji are notable for their extremely accomplished buildings. The most impressive examples of this type of building are the fale tele (congregation building) and the fale alofa (community building) on Samoa. Whereas the fale alofa consists of an elongated middle part built in timber framing and adjoining apsides (tafsa), the even more complex fale tele has an extremely short middle part, which means that its footprint is close to that of a round house. The three central uprights have to support enormous forces that come together here. The roof is built from the top down; this means that during the construction phase the huge roof structure is completely suspended from the central uprights, supported only by temporary scaffolding. The wall studs are not inserted until a later date and are of secondary importance in terms of structural stability. This means that this building is unique in its form of construction. The high-quality timber, the quality of the detailing, and the very sophisticated geometric decorative joints make the fale tele one of the most important prestigious buildings in the Samoan village.

Construction and Material

Timber Construction

Aside from the stilt buildings, the timber constructions in Oceania can be roughly divided into buildings with central uprights, with four uprights and framed construction, and buildings with central rows of uprights. Notably, round buildings with central uprights are mostly found in the region where Lapita ceramic objects have been produced for more than 4,000 years, that is, in New Caledonia, on the Santa Cruz Islands, as well as on Samoa and Fiji. The system with four uprights lends itself to simple framed constructions, which are mainly used in rectangular buildings and occasionally also in round buildings. Timber-frame construction is very common and can be considered a development from the system with four
uprights; it can be found all over Oceania in various versions and qualities. In the construction system with rows of uprights, the uprights are usually used to support the ridge purlin of the roof in rectangular or double-apsis houses with large spans. This form of construction is popular in Melanesia, particularly in the extremely large buildings in the Sepik region, on Vanuatu, and the Solomon Islands, where up to ten central uprights are erected. A special form of the building with rows of uprights can be seen in the Māori congregation buildings (whare nui) in New Zealand, since these structures have to support solid roof coverings due to the cooler climate conditions, which increases the weight and hence necessitates additional uprights.10

Stone Buildings
Pure stone constructions are very rare in Oceania; where they can be found they mostly serve ritual purposes and rarely as domestic dwellings. Exceptions are the tupa (dwellings) on Easter Island, which are built completely in stone; this form of construction is largely due to the fact that timber was a scarce resource, not least because it had been used for the construction of the moai (huge stone sculptures). Stone buildings are much more frequently used for cultic and religious activities, for example the unique basalt stone buildings of Nan Madol/Pohnpei and Lelu/Kosrae in Micronesia, the walls of which are laid with stretcher and header courses without mortar. Of similar importance are the prominent stone-built cult buildings of Polynesia in Hawaii, French Polynesia, the Cook Islands, and on Tonga. Beyond these, stone is used as a construction material in fortifications (for example, korowaiwai on Fiji), in agriculture (such as terraces on Grande Terre), in the form of dams in the lagoons, in platforms for usually more prestigious buildings (for example the youth house on Yap), or in various stone pillars such as in the Mariana Islands, where timber buildings were placed on up to 6.5 m-tall limestone columns (Lattice columns).11

In some parts of Oceania the vernacular building culture is still alive (for example, on the Trobriand Islands in Papua New Guinea and on the smaller atoll islands of Tikopia and Futuna in the Solomon Islands); in many other parts, however, it has already disappeared and been replaced by imported forms of architecture. The humid climate and perishable nature of the construction materials contribute to the rapid disappearance of the legacy of the building culture, as does the generally rather low awareness of the population of the value of its own architecture. Apart from maintaining a few individual buildings as museums or what are called model villages, comprehensive documentation of these outstanding forms of building is often the only possibility for preserving the knowledge of this important aspect of human history for subsequent generations.

2. See Zámolyi, Traditionelle Fidschianische Architektur (see note 1).


Bibliography


Māori Architecture
Deidre Brown and Jeremy Treadwell

Māori builders are inheritors of a long tradition of architectural knowledge first brought to Aotearoa (New Zealand) by their Polynesian ancestors. The techniques and tools have their origins in the maritime and architectural technologies developed to inhabit the islands and navigate the seas of Oceania. Confronted with a new environment, ranging from the subtropics in the north and alpine regions of the south, Māori builders developed new construction materials, techniques, and tools that were socially and climatically responsive. This chapter will describe this knowledge and innovation, and demonstrate how they were both a tectonic solution to environmental constraints and an expression of Māori cosmologies and spirituality.

History
The first people to settle in Aotearoa (the Indigenous name for New Zealand) arrived from eastern Polynesia, in the central Pacific Ocean, around 1200 AD, and their landfall marked the end of human inhabitation of the world, apart from the polar icecaps. These earliest of migrants were seafaring people, their adeptness at living from the sea as they were from the land evident in customary concepts that still relate buildings to boats. Thus, the intricate openwork spirals on pare (carved wooden door lintels) are the same as those found on the tauhunga (prows) of war canoes and are associated with the entry of light and enlightenment into the world after the separation of the primal parents Ranginui and Papatūānuku by their children at the dawn of the world’s creation. The kowhaiwhai scroll patterns painted on hoe (canoe paddles), collected by European explorers in 1769 on the east coast of the country’s North Island, are the same patterns that Māori were painting on the heke (rafters) of wharenui, or meetinghouses.

1 The elaborately carved figures of the te hau ki kāranga represent ancestral lines. The following generations depicted on the heke (rafters) are carried by the main ancestors shown on the poupou (posts) (photo 1976).
in the region seventy years later, a practice that has since spread throughout Aotearoa. These sequential patterns are considered by some Māori artists to represent genealogical descent lines. Furthermore, the same protective chants are used to accompany the hauling of tāhuhu (ridgepoles) into place and waka (watercraft) across land portages. Apparent in these relationships between buildings and boats are important, longstanding customary values that have their basis in cosmological thought. The cosmological foundations of Māori architecture extend well beyond representational meaning and the translation of practices, by informing the way in which buildings were constructed and engineered.

**Technique and Construction**

Archaeology has revealed that while Māori brought with them the tools and technological capability to construct large oceangoing canoes, its architecture varied in its scale and use of technology. Excavations have shown that Māori continued to build one category of houses that utilizes round section unprocessed poles arranged very much as was known to have been built in Eastern Polynesia. These houses continued to be built in Aoteoroa until the twentieth century. While the pole and thatch house was a small-scale domestic building, another typology developed that was both large and technically sophisticated and that drew upon Māori understanding of the post-tensioning technology implicit in maritime construction and rigging. It was this technology that enabled Māori to build very large single-cell, wide-span buildings, which are known worldwide not for their technology but for their complex carving and painting.

Since the Gothic Revival, Western architecture conceptualized ornament as distinct from essential structure. In Māori architecture, carving and painting are intrinsic to both the social and structural dimensions of the house and extend beyond the concept of applied ornament. The carvings and the structure are conflated in the Māori house to enact the relationships that the house depends on for its social and structural stability. The genealogical relationships depicted between the carved figures and the sinuous scroll patterning of the rafters are paralleled by the development of specific structural junctions that direct the forces between the components.

At the center of the house, in both structural and cosmological terms, is a longitudinal post-and-beam structure involving, in very large whare (buildings), three posts and one continuous tāhuhu. It is in the erection of this part of the house structure that Māori demonstrate an engineering capacity which the West has struggled to accept. In the largest of the nineteenth-century houses, the tāhuhu are up to 25 m in length and weigh approximately 1,000 kg. It is clear from literature and contemporary investigations that Māori were able, through their own techniques involving trestles, ropes, lubricants, and coordinated collective manpower to raise these huge beams in excess of 7 m high.

While colonial thinking tends to simplify Māori architecture as post-and-beam structures, in fact the large houses, composed of crafted componentry, are more akin to a sequence of post-stressed structural arches formed across opposing pairs of wallposts and their associated rafters. In this structural system the junctions between the participating components such as between ground and wallpost, wallpost and rafter, and rafter and ridgebeam, are crafted to operate in conformity with the geometry and forces implicit in the stressed archform. The wallposts, or poupou, were both relatively short and wide. While the width (often about 600 mm) supports the development of the ancestral carving, it also resists the outward thrust of the stressed arch against the undisturbed outside face of the relatively shallow hole excavated for it. Important too, the post holes were excavated at an angle so the post slopes slightly inward at the top. The composition of these components contradicts the understanding of the house as a simple post-and-beam structure.

By the second half of the nineteenth century, the heke are both semi-circular in cross section and precambered longitudinally. They are fitted between the poupou and the tāhuhu with two specifically crafted compression joints. The lower joint of the heke with the poupou has become known as a whakaruawheta joint, literally “toward the space of the stars,” recalling both the house’s voyaging origins in the transverse rotations of the night sky over the voyaging waka and now in the usual north-south orientation of the tāhuhu.
This junction links the inclined slab of the poupo with the semi-circular section heke in a joint that both resists rotation and transmits the in-line force that is generated by the imposition of cross-sectional post tensioning. The post-tensioning process is known from early twentieth-century descriptions and from subsequent physical modeling. In the process the tauwhenua (tensioning rope) is tensioned with levers across the house and secured to lashing holes on the back of the poupo.

At the top of the heke a rebate on the underside butted against the squared edge of the triangular section tāhuhu. In this situation the curved heke was compressed between the resistance of the poupo against the ground and, in the largest houses, the massive weight of the tāhuhu. Buried in the literature concerning house construction is the information that the central kaho (purlin) is thicker than those above and below. The significance of this seems to be that when the cross-sectional tensioning is applied, the thicker kaho forces tauwhenua away from the heke at midspan. Large-scale modeling has shown that the resulting right-angle force resulting from the deviation of the tauwhenua slightly flattens the precambered heke, thereby subtly increasing its straight-line length and increasing the pressure on the top and bottom joints. The benefit of this technology is increased resistance to the lateral forces of Aotearoa’s well-known wind and earthquakes as well as conferring an increase in the spanning capacity of the rafters.

Tradition

The technologies of customary Māori buildings are an outcome of the profound cultural, spiritual, environmental, and physical forces that have shaped Māori culture. Maritime traditions are evident in the formalism, decoration, and construction of the whare, the post tensioning of its members a technique shared with that of boat construction and rigging. Genealogical relationships maintain social cohesiveness within Māori society, and the connections between generations is expressed in the interdependent jointing systems between heke (sometimes representing ancestral descent lines) and poupo (representing more recent ancestors). Centuries of building practice have resulted in increasingly sophisticated responses to the particular demands made on structures by the moderate climate and actively tectonic environment. The arrival of European settlers, from the early nineteenth century onward added new environmental and cultural conditions, as appropriate timber and fiber resources became difficult to access through land alienation and wetland destruction, respectively. However, it was these same pressures, and others associated with colonization and mission Christianity, which caused Māori to gather in greater numbers, enhancing the size of their communal buildings and the technology needed to create these large, voluminous spaces.
The northeastern area of the Asmat region in the Indonesian part of New Guinea consists of marshland that, to this day, is largely covered by primary rainforest and features a true labyrinth of rivers. The rivers have their source in the Central Mountains and can carry huge quantities of water depending on the weather and the tides. In view of the fact that the jungle – with its over 40 m-tall trees, climbers, and several layers of undergrowth – in some parts is almost impenetrable, life takes place primarily close to the rivers. Exceptions are small groups of people, some of whom are settled hunters, gatherers, and sago palm users in the transitional area between the forest and the mountains, also known as the tree people.

During an expedition in the nineteen-eighties from the central highland down to the Asmat lowland at the Upper Brazza River, I saw some tree and stilt houses that were about 8 to 12 m high; however, only one year later these were no longer inhabited and were decaying due to the influence of missionaries and Indonesian loggers. By comparison, until thirty-five years ago, the subdistrict Kecamatan Kouh, adjoining in the northeast and belonging to Merauke Province – the area between the Eilanden, the Upper Becking, and Dairam Kabur rivers – was considered terra incognita even by ethnologists owing to its assumed absence of mineral resources and its war-like aboriginal inhabitants. From missionaries it was known that this is the homeland of the Korowai and the Kombai tribes, with their related cultures and languages, with a total population estimated at 4,000. They are subdivided into several dozen family clans, most of them very hostile to one another. For this reason, individuals define themselves by their membership in a clan rather than by the tribe with its shared language or culture. To this day these people are considered the last genuine tree house people of New Guinea. A few Korowai, and in particular Kombai, are still...
officially considered to be out of contact to this day owing to their extremely inaccessible habitat and the absence of Indonesia’s commercial interest. Furthermore, many clans strictly refuse contact with other people, both whites and Indonesians, as well as neighboring tribes and other clans, and vigorously defend their area using bows and arrows against intruders and uninvited guests. All clans live in precisely defined areas. These so-called bolüp coincide with the land-use rights the clans have inherited from their forefathers over generations. The boundaries of these areas may not be apparent to us, and can be marked with bunches of leaves, broken twigs, fallen trees, and by riverbeds. Every time we entered the area of another clan, our porters took to loud singing, because somebody who sings comes with peaceful intent. Only the so-called laleo-bolüp, the spirit places, are not claimed directly by individual clans. Traditionally the Korowai identify so strongly with their clan territory that they consider any entry by unannounced guests as an attack and try to kill the intruder immediately in the belief that they have to defend themselves. In terms of their body size, they are much smaller and slimmer than the erstwhile tree house inhabitants in the neighboring Brazza area, and therefore are probably a type of intermediate ethnic group between those groups living in the lowland to the south and those in the Central Mountains. Owing to the poor availability of protein in this rainforest, there are no big or fat people found here — characteristics that are not optimal for climbing trees and living in the treetops. In spite of some conspicuous physical and physiognomic differences distinguishing them from their northern neighbors, the pygmy Papuans who live in the mountains in small round huts at ground level (Kimny, Mek, Eipo), they share some cultural similarities. This suggests that there were very ancient trade relationships between them and a resulting cultural exchange. In the sparse inland area, at the edge of the first foothills, the Korowai and Kombai practice a limited form of horticulture (sago palm, tobacco, bananas) and also on occasion keep pigs. All other food is derived from the fruit of the jungle and from hunting.
The area of the Korowai is only sparsely settled. Small family units usually live in 8 to 12 m high stilts-and-tree houses in small clearings, surrounded by their gardens and pigsties. These small settlements usually comprise two to three houses, and sometimes also palm leaf huts at ground level. One cause of the strictly isolated way of life is the deep-seated fear of other hostile clans, and the continual confrontations due to the so-called khkhaus witchcraft, in which the death of every clan member – even those who die of old age or illness – is blamed on somebody who is then punished in cannibalistic fashion.

Owing to the extreme natural conditions, the Korowai very often die early. Very few people live past the age of 45, and likewise infant mortality is extremely high due to infectious diseases. The inhabited areas are usually on dry, sandy ground at higher levels, between the large areas of wetland where the Korowai cultivate their sago palms. Sometimes they also live on higher sandhills in the rivers. The Korowai call the tree house cheim or kcham. They also have tree-shaped longhouses at ground level that are used for accommodating visitors or for festivities, but these are relatively rare; they are called cha-ke or khai.

### The Tree House: Construction and Building Process

In the treetops the air is fresher. There are fewer mosquitoes, no ground insects, poisonous spiders, or snakes, and up here people feel relatively safe from actual attack from enemies and from hostile witchcraft. For the Korowai the tree house is like a micro-cosmos, their small, confined family habitat, where they eat, sleep, and live, and from where they can keep a close eye on their surroundings. The larger tree houses have separate sections that are hardly discernible to us; enclosures and ladders are strictly separated for men and women. The up to 1 m think central man always consists of the relatively straight and strong tree trunk of a living jungle giant, usually a wambo or banyan tree with large, widely spread and well ventilated branches that can be drawn up and that have, down the sides, cutouts exactly the size of a foot. The same applies to the last step of a giant tree house. These yafin are attached to the platform using rattan and twisted bast fiber, and can be pulled in as a security measure. The lower ends of the plant ropes usually hang loosely down toward the forest floor as a kind of warning device, because any movement can be detected by the inhabitants of the house.

The tree ladder can only be used by stepping sideways and preferably without shoes, otherwise one is likely to slip. Following an old custom, the Korowai apply pig fat or sago larvae fat to this ladder. The canopy of leaves of the tree can continue to grow and provide shade, cooling and – with its fruit – also sustenance. The tree house person with smoke pipe in the men’s segment

### Life in the Tree House

As a rule, the interior of a family tree house consists of three rooms that are assigned to and lived in by the different genders. Women and children have their own living room and their own fireplace. Work on the construction is organized in a strictly divided manner. Whereas the older men with experience in climbing and building tie the base plate together in the crown of the tree, the younger men form chains for transporting all materials to the respective platforms. Even though the women and girls help collect sago leaves, clay, and other material, they are forbidden to participate directly in the construction process. On the top platform the side walls, which are about 1.5 m tall, are plaited from the stems of the sago palm leaves and covered with wide pieces of tree bark. Before placing additional supporting posts into the ground, the Korowai line the holes in the earth with the blades of a certain type of grass – as protection against demons or evil spirits that could climb up to the house using these posts. The structure of the house, the footprint of which is no larger than 5 × 8 m, consists of main and secondary beams as well as rafters, which are only tied together with lianas. The roof, the ridge of which is about 3 m above the floor, is covered exclusively with sago leaves. The canopy of leaves of the tree can continue to grow and provide shade, cooling and – with its fruit – also sustenance. Whereas the lower steps of the higher houses are built in the form of ladders, the access to the lower houses consists of individual tree trunks that can be drawn up and that have, down the sides, cutouts exactly the size of a foot. The same applies to the last step of a giant tree house. These yafin are attached to the platform using rattan and twisted bast fiber, and can be pulled in as a security measure. The lower ends of the plant ropes usually hang loosely down toward the forest floor as a kind of warning device, because any movement can be detected by the inhabitants of the house.

When the men are present in the evening, entering the room used for sleeping and gathering or using the men’s fireplace is strictly taboo for the women. Sometimes even pets such as dogs, pigs, or cockatoos are taken all the way up to this enormous height to live. The fireplaces are used to prepare food, which is then distributed fairly; when it rains and the weather is colder, people sleep and keep warm. When there is an excess of men, the older boys and as yet unmarried men live in separate tree house where the space is not divided into rooms. 8 Giant tree house (photo 2002) 9 Tree house person with smoke pipe in the men’s segment 10 Women’s segment 11 Beneath the roof hang trophy bones, such as pigs’ jaws or kangaroo skulls, and nets, snake skeletons, and empty cassowary eggs.
With the onset of dusk, lively and busy family activities take place among the tree house people. The men sit chatting around their fireplace. Smoke pipes are passed around. In the hot ash between heated stones, sago bread, snake meat, and insect larvae are cooked wrapped up in banana leaves. The soot-blackened ceiling is crowded with suspended pigs’ jaws, kangaroo skulls, nets, snake skeletons, and empty cassowary eggs. The Korowai fear the night and only rarely leave their tree house during the hours of darkness. Even ablutions are performed from high up.

The End of the Traditional Lifestyle

Over the last three decades the life of the Korowai has changed considerably in line with the advance of civilization. The area between Yaniruma and Yafufla has been considered pacified for some time. Many consumer goods and the monetary system have been accepted, and more recently international travel companies are even taking well-paying adventure tourists to this area. For this purpose new tree houses are even sometimes put up, in which foreigners — for a hefty price — can get a taste of the “original life” of the tree people. But in spite of all efforts to date, the Indonesian government has not succeeded in luring the Korowai out of their tree houses to settle in Yaniruma or other kampongs.

This essay is largely based on the observations and notes made on location by the author at the end of the nineteen-eighties and during the nineteen-nineties, as well as between 2011 and 2016; it is also based on experience gained during several weeks of filming on expeditions in 2001, 2002, and 2003 in the Korowai area and, in particular, on anthropological research findings from Dutch missionaries (Van Enk and De Vries, The Korowai of Irian Jaya).
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Traditional Forms of Construction in the South of Morocco

Jürgen Adam and Sophie Karst

The development of dwelling types is determined by geographic, climate, and historic factors. The land of the ksour, tigermatin, and igoudar reaches from the southern slopes of the High Atlas Mountains to the Sahara. Its altitude is between 2,000 and 700 m above sea level. The average rainfall is less than 200 mm per annum, in the southern section it is less than 100 mm. The average temperature is between 5°C in January and 39°C in August. At the banks of the River Dadès, temperatures below freezing are just as common as maximum temperatures above 50°C in the Draa Valley. Daily fluctuations of more than 20°C are regular occurrences. For centuries, the land between the High Atlas Mountains and the Sahara was the destination of Arabic and Berber tribes’ migration. The nomadic tribes were lured by the paradise of the river oases: water, greens, grain, fruit, vegetables, food for the animals, and shade. They always saw these oases, which however did not belong to them. Other tribes had lived there and managed them for a very long time. As nomads they were free people, but this freedom was not that of paradise. In front of their eyes they saw what they did not have. Why should they not take a piece of it?

Settled Life in the Ksar and the Tigermatin

Settled people were tied to their land. They lived in fortified settlements next to their fields at the edge of the river oases. They had learned how to irrigate these, how to farm them, how to store and conserve fruit until the next harvest and, if possible, beyond. The readiness to defend their crops, their fields, their settlements, and dwellings was an absolute necessity. It was not always possible to defend themselves against attacks from nomadic or settled tribes. Often it was not even enough for individual tribes to join together in confederations. Attempts to make contracts with the nomads that were to provide protection in exchange for part of the harvest...
failed again and again. The result was the development of tiger-martin (dwelling castles) in marginal defense areas and occasionally also in the midst of ksour.

Fortifications

The ksar consists of a wall, some towers for monitoring the wall flanks, and a gate building often combined with a walled-in forecourt where domestic animals can take refuge in the case of danger. The gate building is fitted with an outer and an inner gate, and it has a shaded space in between. This is the door guardian’s abode, and there is room for itinerants; it is protected by the outer gate and yet distant from the interior. It is possible to grant hospitality without neglecting safety and security. Many men have to occupy the defense walls and defend the ksar when it is attacked. This means the ksar is extremely densely built and there is an almost oppressive lack of space. The pressure from the outside has to be balanced with the pressure of social closeness inside; this is accepted as long as it is the lesser evil. When pressure from the outside abates, houses are built outside the fortified walls of the ksar, sometimes still attached to it but somewhat removed from the extremely high density inside.

Circulation in the Ksar

Starting from the only gate, which is also a meeting place, ksar houses are laid out in a comb or ring system or a combination of both, connected via semidark, mostly roofed-over alleys. Cul-de-sac streets become open space for an extended family, often separated from life in the ksar by a gate. A loaded donkey can reach every point in the ksar. Behind the gate is often a small square, from where it is possible to reach communal facilities such as the hamam, the mosque, or storerooms.

The Ksar House

Houses are built back-to-back, creating an extremely dense development. Rooms receive air and light from a courtyard, with the average annual amount of precipitation in the south of Morocco is only 100–200 mm. Nomad women in the street of the kasbah (photo: 1971) Rich vegetation in the Dra Valley between Agdz and Zagora (photo: 1971).
light opening being variably adjustable. The courtyard has rooms on one or several sides. Every house has a roof terrace. This is an important living space used at certain times of the day and during certain seasons. In summer, people spend the day in the cool shade of the house. The nights are spent sleeping on the terrace. Cooling winds help to reduce the heat. In winter the day is spent in the warming sun on the terrace, and the night inside the house protected from the cold. Houses are too small to have rooms for specialized functions, therefore it is an appropriate response to the daily and seasonal changes in the climate to arrange life in this flexible way. An exception is the kitchen, which can often be found inside the house as well as on the roof terrace. The first floor is reserved for domestic animals and storerooms.

Tigermatin

As armed conflict became less of a threat, the inhabitants of the ksour started to build their houses outside the protection of the ksar – initially accessed from the ksar, but later as freestanding buildings with their own defensive appearance. These dwelling castles are called tigermatin.

In her book about living at the Dadès dating from the nineteen-fifties, Djin Jacques-Meunié describes the ksar and tigermatin of Amridil in Skoura, which for a long time was still accessed from inside the ksar. The oasis of Skoura has many tigermatin – dwellings of extended families – that are organized around light-admitting courtyards. When the family grows, the tigermatin is extended with low buildings.

From the nineteen-sixties, the tigermatin of Ait Mouro was deserted and fell into disrepair. For some years now it has been renovated, changed in parts, and is used as a hotel. In Ait Ben Hadou, which enjoys classification as a world cultural heritage site, dwellings could not be defended for long. Ruins indicate that, in former times, an agadir (storage castle) was available. The tigermatin demonstrated more power than it possessed.

A long time ago, the Ait Sedratte were nomads. Could it be that the division of the tigermatin into four households was to do with the desire for freedom of nomadic Berbers, which resulted in the independence of the four households? By contrast, is the courtyard type, with shared living for the entire extended family under the rule of the family patriarch – as in the riads in the cities – more the expression of the Arabic lifestyle?

Relocation of the Tigermatin out of the Ksour

The example of the Amridil dwelling castle in Skoura is evidence of the first attempt of its inhabitants to liberate themselves from the social pressure of the ksar. Pressure from outside had decreased, and thus it was possible to dare to escape this social pressure, initially still with the ksar at the back; the oppressive closeness in the ksar was left behind as the family moved outside the fortified wall. The first step of individualization had started, which was 200 years old. This tigermatin is quite archaic and impressively beautiful, standing as it does in front of a grand rock face. In contrast to the tigermatin in Skoura, it does not have a courtyard. Lights enter through small windows in the facade. These are placed quite far up to stop any intruders’ entering the tigermatin through them. The tigermatin of Ait Hamid also served as the dwelling of an extended family, with four separate households, each with its own fireplace; you could call it a four-family house. Each quarter belonged to a nuclear family of the same clan. There is a clear distinction, which can be seen in the spatial arrangement. Partially open rooms are typical of the courtyard type, which contrast with a sequence of rooms in the closed type. In Ait el Arbi it is significantly cooler than in the Draa Valley. There are no palms here, and it snows in winter. In this case, courtyard developments would be inappropriate. In the closed type, there are no water draw-off points in the house. Dwellings could not be defended for long. Ruins indicate that, in former times, an agadir (storage castle) was available. The tigermatin demonstrated more power than it possessed.
followed by a dwelling that was completely detached from the social community. This process continued apace in the twentieth century, and is still continuing. More and more people are leaving the ksour – although some are still partially inhabited. In the nineteen-sixties, this was illustrated by Jean Hensens using the Boukhlal ksar in the Draa Valley as an example. Windows were inserted in the fortification walls, several exits from the ksar were opened up, and new houses were constructed in front of the wall. These days the houses are mostly freestanding and can be extended. Distance to the neighbors allows for more individuality and creates an undisturbed space. The fact that the houses have fewer floors means that housework is made easier. The houses can now be reached by car. Transport from and to the house is simpler. There are many pragmatic reasons in favor of this development. However, when looking at the completely undifferentiated sprawling agglomerations, such as that of Boumalne du Dadès to Kelaa M’Gouna, one cannot but wonder whether this form of liberation from the confined building space and social pressure has been successful. The social order has lost its structure, and the urban development lacks any discernible organization. Frequently, the new houses consist of reinforced concrete skeletons of dubious stability with panels filled in with stone and a mixture of clay and cement, featuring a cement-based screed as finished floor, steel gates, and synthetic carpets. The urban organization has virtually been turned on its head. Where formerly, based on their ksar, clearly distinguished social groups appeared as strong communities, today we see disjointed ribbon developments. The divisional structure of the tightly confined ksour has changed into an additive agglomeration of individual buildings. Where formerly people stood up for one another in critical situations, even if this was perhaps not entirely voluntarily, they now live side by side, often also as adversaries, without any significant social cohesion. The main reason for people leaving traditional settlements and dwellings seems to be that they have the idea that their own culture – measured against what they see on television – is backward.

Agadir

In addition to settlements and dwellings, other traditional fortified buildings in the south of Morocco include the agadir (storage castle; plural: igoudar). Storing and keeping goods always was and still is a basic human need. It is not surprising therefore that the corn store or collective store is the most important building in a settlement in many different cultures, and is also often the place where fertility rites and cult activities are practiced. Dwellings and stores are some of the oldest solid building structures. The igoudar in Morocco are important cultural monuments of the Berber tradition. This type of building can be found in the mountainous regions of Morocco, especially in the High and Middle Atlas Mountains, in the Anti-Atlas and in the Atlas foothills, and also in some adjoining river valleys. Grain store, collective store, and storage castle are different terms referring to the same facility. In Morocco’s Berber language, two different terms are in use. In the central and eastern High Atlas,
19 Cross section of the tirhermt of Ait Harred, Ait el Arbi: a Entrance, b Stable, c Living, d Bedroom, e Collapsed ceiling, f Gallery, g Roof courtyard, h Tamesrit, i Animals, j Roof terrace.

20 Floor plans of the tigermatin of Ait Amr and Ait Khoali, Ait el Arbi: a Passage, b Yard, c Stable, d Ait Khoali, e Ait Amr.

21 Tigermatin of Ait Amr and Ait Khoali at the upper course of the Dadès in front of a spectacular rock backdrop (photo 1971).

22 Spaces interconnecting in the tigermatin of Ait Mouro: Courtyard type.

23 Tigermatin of Ait Harred, Ait Amr, and Ait Khoali in Ait el Arbi (photo 1969).

24 Sequence of rooms in the tigermatin of Ait Harred: Closed type.
the Middle Atlas, and in the Tafilalet, the term used is ighor. In the Anti-Atlas however, the term is agadir. It is likely that the word agadir stems from the Phoenician gadir (Hebrew: gader), which means wall, fence, or fortress.

These impressive building structures, some of which are up to 1,000 years old, surely are the result of the seminomadic lifestyle practiced by the Berbers for centuries, and in part still is today. Many villages or tribes were inhabited for only part of the year, mostly in the winter months from November to April. During this settled period, people also practice agriculture. However, in the summer months the various families and tribes adopt a nomadic lifestyle, moving with their sheep and goats herds, to move to the higher mountain regions. During that time villages and settlements are unguarded, and a safe place of storage for their possessions is a prerequisite of a functioning social life in the winter months. That said, the history of the storage buildings also allows the conclusion that there were rivalries and tribal feuds between the different villages, and even armed robberies by nomads. The igoudar or agadir are intended to provide safe storage of the harvest and of other valuable objects during the absence of the village people, as well as places of refuge in the case of an armed attack from the outside. This explains why most igoudar have a fortress-like character. In their architectural design, these buildings are shaped in response to the predominant climate, the geographic/topographic situation, and the social structure.

Generally, each family of a village or tribe possesses one chamber in the agadir in which its valuable objects, especially grain stocks, can be stored. The principle is similar to that of safe deposit boxes in a bank. Each agadir is locked after by one or several guardians, referred to as an andif (plural: idafen), who often live directly in the agadir. Sometimes these guardians take turns in a daily, weekly, or monthly cycle; occasionally there is even a special night guard. Each chamber is locked by a different key, which is retained by its owner. The key to the agadir is held by the guardian. The chambers in an agadir are stacked above one another, resulting in two- to four-story developments, occasionally even a six-story extension building. Occasionally, the agadir is oriented like a fortress with its own entrance door and lock. When a villager wanted to build a chamber, he had to obtain permission from the administrative council. The construction material was supplied by the user. It was also possible to buy, sell, or exchange chambers for goods. In addition to wheat, other valuables were also stored in the chambers, such as weapons, jewelry, or silver. Horses and donkeys were used to transport the harvest into the courtyards, from where it was stored in the chambers. Timber beams were fitted in the wall at several places in the inner courtyards and used for hoisting loads up.

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In former times, the agadir was continually guarded by six men, one permanent guardian (andif or lami), and five other men who took turns. When faced with an attack, the men withdrew into the agadir to defend their property; the women remained in the villages. The permanent guardian made sure the facility was used in the proper way. He knew the owner of each cell. He remained continually in the agadir, where his family was able to visit him. In 1999, the agadir of Tvasgant was once again plundered, and in 2001 the last guardian finally died. Since then this agadir has remained closed.

The first part of the agadir (courtyards 4 and 5), which is built completely of natural stone masonry, is about 940 years old; the other parts (courtyards 1, 2, and 3) are about 630 years old. From a forecourt, corridors lead to a total of five inner courtyards around which the compartments of the various families are arranged, up to five stories high. The cells, 175 in total, are accessed via daringly projecting stone slabs integrated in the masonry bond. The size of the rooms varies considerably. There are also chambers that consist of several rooms; however, the average size is between 5 and 10 m². The wooden doors of the chambers, some of which are decorated with diamond patterns, have a hole in the middle or to one side through which the doors are locked or opened using a wooden key. Small openings in the external and internal walls ensure ventilation.

Three cisterns, one of them on the inside of the agadir, provide necessary drinking water in case of a siege. The two cisterns outside the building are still in use today. The agadir also contains a kitchen, a prayer room, and a room for the guardian. The stepped structures of the various parts of the building are placed at different levels connected via steps, which means that it is possible to walk across all roof surfaces. The ceilings consist of a main layer of round joints, mostly almond wood, and a secondary layer of round and split timbers. This is followed by a layer of natural stone slabs covered by a screed. The roofs are covered by a layer of clay and small stones which may be up to 50 cm thick. In recent times, some areas have been covered with screed. Throughout the building, vertical joints indicate the completion of sections of the store. The size of the units in the natural stone masonry varies a great deal; stones may be between 4 and 10 cm wide and roughly 2 to 20 cm tall. The external walls of some cells were plastered with clay or mortar.
Material and Construction of Dwellings and Storage Buildings

Clay from the immediate neighborhood is used in the form of rammed earth or air-dried bricks. The house and the landscape have the same color. The shuttering of the rammed earth can be moved several times a day. With air-dried bricks it is possible to form geometric ornaments in the facades and courtyards. At higher altitudes, in Magdaz and Tamtatouchte, walls are built in natural stone. Owing to the flexibility of palm wood, only small rooms in the river oases can be covered with beams of this material. At higher altitudes however, such as in Ait el Arbi, the timber used is walnut. Above the joists, layers of twigs, short bamboo sticks, boards, or flat natural stones complete the ceiling. A finish is applied in the form of puddling clay. Bamboo sticks are artistically placed and sometimes decorated in a notable fashion. Doors are made of wood. From the middle of the twentieth century they have been lined with recycled sheet metal from tins.

Nowadays only metal doors are fitted, which sometimes have a certain aesthetic quality owing to their artistic paint finish.

Outlook

It is a hurtful experience if you have to see – at every visit – that another piece of unique architecture has been lost or is in the process of being lost. At best we can assume that some of these wonderful settlements and architectures can be preserved for the future. A glimmer of hope lies in the fact that a few architects in the country recognize the value of their own building culture and are starting to refurbish and maintain some ksour, tigermatin, and igoudar. Much remains to be done, and most Moroccans currently have a poor view of building with natural stone and clay, and hence of their indigenous culture. Traditionally, only few materials were available for most buildings; these came from the immediate vicinity, within walking distance, and long-distance transport was nearly impossible. These local
Traditional Forms of Construction in the South of Morocco

Materials could do everything, but only to a modest standard, and nothing really good. The relevant question in this respect was how clay, natural stone, and timber had to be used in order to make best use of their qualities and prevent damage to the building. Clay used in walls has many qualities: it is load-bearing, it shields, it absorbs heat from the outside slowly and releases it again slowly. However, it is not well suited to protect from rain and snow. For example, the clay screed of the flat roofs in the Atlas has to be renewed every year; the coping of the parapet has to be replenished—involving continuous building maintenance. When the owner of the house has a job in one of the industrial centers of Morocco or elsewhere, he will not be at home for large parts of the year. This means that he cannot carry out building maintenance.

Today, a wide range of different materials are joined in building components and used in construction; they come from far away, from different parts of the world, and have their own specific purpose. These different materials have to be joined together wherever they come from and wherever they are used, and we should not forget that they also need to blend visually with their new environment. My many years of cooperation with architectural students from L’École Nationale d’Architecture in Rabat, among others, have shown me that new, outstanding solutions involving appropriate, functional, and attractive designs are found again and again for the changing tasks in urban design and architecture.

Endnotes

1 Fortified dwelling castles: tirhermt, tighremt, figuernoo (all singular), tigermatin (plural).
2 Fortified villages: ksar (singular), ksour (plural).
3 The information on the architecture of the Tazgaent agadir was collected in 2003 as part of a survey with the IEK (Institut für Entwerfen und Konstruieren) of Stuttgart University. The notes on its history and use are based on conversations with the caid of Ait Abdallah and the elders of the villages of Amzrou and Bakou.

40, 42 Ornament made of air-dried mud bricks
41 Building components made of loam and subject to erosion disintegrate into their original components and merge with the surrounding environment.
43 Color of the earth within a circle with a radius of 200 m surrounding the Tirhermt of Ait Hamdi in Ait el Ait.
44 A rich mural adorns this ceiling.
Ever since people left their caves to organize their lives on the expanse of the land, the earth has been the basis and the material from which all life arises and is sustained. From it grows plants, the fruit of which nourish people and the fibers of which — woven into blankets and mats — provide protection from the rain and cold. But the earth is also the place of the dead, it is always populated by the souls of the ancestors and numerous metaphysical beings. It is both a material and a spiritual reality that everyone can get hold of, the indispensable existence of which is the basis of religious and profane activities. People experience the earth via their senses: when they sleep on it, when they dig it up to find water, or when they stamp the clay with their bare feet in order to form it into containers and bricks.

Earth is also a building material that people have learned to appreciate. But they also fear the power it has of triggering earthquakes when the enraged gods grumble underground. The ground embodies a holistic and axiomatic worldview in which the earth, on a par with the destructive forces of existence, is seen as Mother Earth. It is therefore not by chance that, among the Jews, Christians, and other religious groups, humankind is understood to be a product of the earth. In many creation stories, God made man of clay, and in many non-European countries priests and shamans have a knowledge of the esoteric nature of the earth.

There is a vast range of different clay buildings with different underlying concepts; therefore, it would seem sensible to limit our consideration to a few ethnic groups. In doing so, we will find that in spite of all differences in geographic conditions and worldviews, shared similarities and parallels predominate. In the past, this factor has been explained by the migration of people who in prehistoric times migrated beyond the boundaries of continents via now sunken parts of land. On the other hand, however, there is...
the fact that people of all races and regions have faced the same problems and therefore often have found similar solutions. It is nature that they perceive as hostile. There are droughts, earthquakes and floods, and the death of people and their animals. There were sicknesses and natural disasters, which they could not overcome with their own strength. This is where magic and religion came into play; they pervaded everyday life, including houses built by the people, and the caves they inhabited. Wall paintings were intended to avert evil and, for this reason, architectural concepts followed metaphysical laws that took shape through dreams, states of trance, and the pronouncements of oracles. This means that the purely functional design evolved to take account of gods and spirits.

The examples described below come from Africa, where fascinating forms of building can be found in the Sahel zone and to the south of it. Even though these are based on strict religious concepts, they do not lack a certain functionality in response to the climate and lifestyle requirements.

With the Somba/Tamberma, the Gurunsi, and the Dogon, a notable feature are the small entrances that make it easier to defend the compound and are also a way of ensuring a balanced climate inside the homestead. Clay, with its fantastic thermal properties, is capable of balancing the heat of the day with the cold of the night.

The reason why building with clay is so widespread in the Sahel zone and the adjoining dry savannah areas is the fact that the low precipitation climate has a less destructive effect on this material, which is susceptible to water damage. In Mali, which is famous for its grand clay buildings, it is the rain that causes problems. Hundreds of people congregate at festival-like events in order to renovate the water-damaged facades of their prayer houses. An integrated scaffolding makes this work easier. Thick wooden sticks projecting from the facade allow the placing of boards. Helpers stand in long rows, passing pounded clay up to the building site. There it is applied by hand, with fingers leaving a typical structure. This creates an aesthetic that has its origin in the method, seemingly without the repair crew’s intending a design.

Pounded clay is also used for the construction of the roof terraces. This is applied on a base of thick wooden sticks to a thickness of 20 cm. In order to improve its durability, it is mixed with additives ranging from goat’s urine to cattle blood, but also with plant fibers that increase its tensile strength. At the corners, wooden reinforcements are fitted because although clay has a high compressive strength, its tensile strength is limited. Furthermore, the material is weakened by cracks resulting from drying; this is why plant fiber or straw is added when the material is mixed. Whereas clay houses in the Yemen are up to six stories high, African buildings are usually shorter. On the one hand there are two-story dwelling houses and, on the other, monumental buildings such as the Great Mosque of Djenné, the minarets of which are several stories tall. In Mali, along the Niger River, clay buildings can be seen in their full splendor. This is facilitated by the abundant availability of the materials water and earth – the substance the houses are built of.

The Buildings of the Gurunsi

The main distribution areas of the Gurunsi people are the south of Burkina Faso and the northern part of Ghana. The name is applied

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3, 4 Houses in a village of the Gurunsi in the north of Ghana; the clay facades have been impregnated with red plant sap and decorated with magical patterns; the windows are particularly small.
to a number of Gur-speaking peoples, of whom the Kassena and the Nuna are the largest groups. Owing to their exposed position, the Gurunsi were decimated at an early stage by Mossi slave hunters. To this day they suffer from infiltration by their neighbors the Bobo, Yarse, Dagara, and Sissala, leading to integration. If you travel into the Sirigu area today you will mainly find new buildings that emulate the style of the traditional homesteads; these latter have now disappeared, having collapsed due to flooding and heavy rainfall. In parts, villages have been renovated and rebuilt for touristic reasons, but the difference remains visible. The images accompanying this report were taken between 1968 and 1975 and show the original buildings with their terraces, which were used for drying harvests and for resting during the hot season. The short walls that interrupt the alleys between the buildings and can be found everywhere are effective means of keeping the domestic animals from eating the stocks of food. The houses of the Gurunsi are richly decorated with ornaments and zoomorphic figures. Mostly these are reliefs, but there are also figurative images that are scratched in the outside facade or that protrude from the walls as semireliefs. The ever recurring colors are black, red, and white. Like the symbolic figures and reliefs, they are considered to provide protection but also are deemed to enhance fertility, including that of people, animals, and fields. As breeders, they focus on small livestock; chickens, goats, and sheep provide meat and are used for trading.

The Dogon live to the south of the bend in the Niger, along the Bandiagara plateau. The bizarre landscape of the Falaise, a 200 km-long and 400 m-deep escarpment, is the settlement area for a population of around 250,000. The Dogon make their living mostly by cultivating the land, growing maize, indigo, sorghum, onions, and tobacco. As breeders, they focus on small livestock; chickens, goats, and sheep provide meat and are used for trading. Until the arrival of the French, they built their houses in clay and stone, placing them in the inaccessible rocks of the Falaise and in the scree that could not be reached by the Mossi horsemen, their enemies. Centuries before, this land had been inhabited by a different people. “The small red people,” as the Dogon refer to their ancestors, left cult objects in the rock niches, some of which are up to 1,000 years old. The design of the entire Dogon architecture is based on mythological concepts and, furthermore, explains these concepts and incorporates them. Marcel Griaule is considered to be the most important interpreter of Dogon architecture who has received his detailed information from high-ranking dignitaries. In a short report like this it is only possible to provide a cursory description that allows a fleeting insight into the complex world of a unique building culture.

“The design of a Dogon village, like that of a house, resembles a human figure lying on its back. This is characterized by eight stones, with a ninth marking the head. The eight stones represent the descendants of the ancient ancestors lying on the ground, four women and four men. This model also characterizes the social life. It demonstrates the social order and family relationships.”

Worldview and Architecture of the Dogon

“According to Griaule, the figure lying on the ground is divided into its main components. Accordingly, the smith’s hearth, the toguna (town hall), and the village square to the north form the head of the figure. The women’s houses are positioned in the east and west: they are the hands. The gúná (family houses) in the middle of the site represent the breasts; the oil stone and the foundation altar symbolize the male and female genitalia; and the altars in the south are considered to be the feet.”

“The family house, the gina sala, also features a rich symbolism. In its concept it is comparable to a person lying on their back. Through the entrance hall one reaches an inner courtyard that is flanked by stable and storerooms and the living tract. The building itself, with its columns supporting the roof, is interpreted as anthropomorphous: the floor of the first floor symbolizes the earth and the lebe (forbeart) that have arisen from it. The terrace, which is rectangular like that of the floating granary, represents the sky, and the floor between the first floor and the second floor is the space between earth and heaven. Around the main terrace the four small rectangular terraces and the fireplace point to the four cardinal directions. If the house has the right orientation, which means that it is open toward the north, the bowl set above the flame indicates this point. The stones point toward the east and west. The wall, the third support of the vessel, points toward the south. The interior of the house and the various rooms are the caves of this world inhabited by people. The antechamber, that is, the owner’s room, represents the man in the pair; the external door is his entrance. Rooms and storerooms symbolize the woman who, with open arms, is lying on her back ready for union. The room behind these, where the fireplace is, represents the breathing of the woman who is covered by the ceiling, the symbol of the man, the beams of which are his skeleton. The pair’s breath escapes through the opening at the top. The four posts are the arms of the pair, and those of the woman carry the man, who supports himself with his own arms on the ground. The raised earth platforms that are used as bedsteads lie in a north–south direction; the pair rests
Griaule’s descriptions are so extensive and full of detail that the passages quoted here only provide a cursory insight. In conclusion, we can look upon Africa’s clay architecture as a challenge that may appear strange to our systems that are built on rationality and functionality, but nevertheless demonstrates how poorly our society designs its buildings with respect to sociocultural and spiritual structures. These days, traditional values have been lost and the determining criteria are municipal town plans, plot sizes, and the market value of the site, as well as the individual wishes of the building owners. The preservation of historical buildings and one’s neighbor’s objections have shaped Europe’s contemporary architecture. They have condemned the historical city centers to relics of the past. The disjointedness of suburban architecture reflects the economic and political conditions of the time of its creation. The longing for the building styles of the past confirms their quality and is the expression of a dissatisfaction that manifests most clearly in Europe’s satellite cities and in social housing. Stimuli such as those inspired by African clay construction could also fall on fertile ground in other climate zones and continents.

Endnote
1 Marcel Griaule, Schwarze Genesis: Ein afrikanischer Schöpfungsbericht (Frankfurt am Main: Suhrkamp, 1980).

Bibliography
Mosques along the Niger to the north of the city of Mopti are characterized by their sharp-edged facades. The horizontal timber elements in the facade are used to stand on during maintenance work.
The Architecture of the Dogon in Mali and Burkina Faso

Oliver Heiss, Wolfgang Lauber, Bamadio Kodio

The more challenging the climate conditions, the harder it is for people to permanently occupy a piece of land. This is particularly apparent in places on Earth where nomadic life intermingles with settled life – at the edges of deserts. This is the precise meaning of the Arabic word el ahil (Sahel). Where the sand deserts of the Sahara begin to merge into the at least partially fertile regions of the semiarid dry savannah of the sub-Saharan Sahel, we can find extraordinary forms of vernacular architecture.

The traditional homeland of the Dogon lies between the 13.6 and 15 northern lines of latitude and the 1.6 and 3.9 western lines of longitude, at an altitude of 300 to 600 m, with average temperatures between 21°C (January) and 32°C (May) and an average precipitation between 0 mm (January) and 172 mm (August), in today’s Mali and Burkina Faso.

It has been proven that this region was populated by pre-Dogon cultures (Tolloy, Tellem) for more than 2,000 years and by the Dogon for approximately 900 years. The Dogon are an indigenous, autochthonous ethnic group of about 400,000 people who live in about 300 villages on the Falaise du Bandiagara (also called the Dogon plateau), a 300 km-long high plateau that breaks off steeply toward the south.

It is assumed that, as a result of forced Islamization, the Dogon settled in this area in two waves of migration between the thirteenth and fifteenth centuries and mixed with local ethnic groups. The Dogon believe in a holistic cosmology, a belief that largely continues to this day.

Culture

As an ethnic group whose origin is strongly associated with flight, the Dogon took refuge on the high plateau and the escarpment of...
Mali, Burkina Faso

The Architecture of the Dogon in Mali and Burkina Faso

the Falaise, and essentially organized their life on the basis of subsistence farming. At the beginning of the twentieth century, French researchers described them as warfaring people who live remotely in their clay fortresses. The high plateau serves as a refuge area for its inhabitants who, in their closed villages, have had to regularly defend themselves against invaders. With their regular celebrations, migrations, and markets, the Dogon are in regular contact with other ethnic groups in the Sahel; markets take place at a different location on every day of their five-day week.

Material

Construction materials are exclusively sourced from what is available locally. Foundations, base walls, and pillars usually consist of natural stone. The main building material is the soil with its high clay content which, mixed with sorghum grass remains, is used in construction using either the banco technique or air-dried bricks. After every rainy season, inhabitants will manually renew their clay-plastered dwellings. The material, which is reinforced with straw – and, if necessary, also with acacia wood – has excellent temperature and humidity balancing properties and considerable tensile strength (3,100 – 5,500 kPa). Pillars, uprights, beams, ladders, and doors are mostly made of acacia wood which, owing to its growth and size, cannot be used for spans of more than approximately 3.5 m. The roofs are often covered with sorghum grass.

Settlement Patterns and Geometric Forms

According to the findings of French researcher Marcel Griaule, the structure of traditional settlements resembles that of a prostrate person. The anthropological comparison provides an ordering system for quarters as well as for individual buildings. Extensions to the settlement connect with the existing structures via women’s houses – linking joints likened to the image of interlinked hands. These are then used by the women of adjoining quarters. There is no fortification of the settlement as a whole. It stabilizes itself as individual buildings grow together to form bigger units. In settlements with farmsteads, it is their fortifications that form an interlinking structural unit.

Even though the dwelling types are comparable throughout the Dogon homeland, there are also significant variations. Whereas in the west and northwest amorphous and round forms predominate, dwellings in the southern and southeastern part feature stricter geometric patterns.

Togu na, Ya punulu ginu, Smithy, and Village Square

The first building to be put up when a new settlement is started is the togu na or togo pai, the seat of the council of the village community to which access is only permitted to the initiated men. It has several functions, for example as a place for deliberation, a court of law, a guard post, and a reception room for guests. In terms of construction it is a simple roof that provides shade and customarily rests on nine uprights. These uprights may consist of

3 Dwellings in the village of Pa on the western plateau
4, 5 Old house in Pa with cellular layout and central three-story storage. Section and floor plan of entrance floor
6 Alleys in the village of Niongono on the western plateau
The Architecture of the Dogon in Mali and Burkina Faso

Timber or natural stone. The roof structure itself consists of three main beams and several wooden rafters. Every seven years a new, approximately 30 cm-thick sorghum grass layer is placed on this structure. As a rule, the togu na is placed in a north-south orientation. Its oval footprint measures about 5.5 m in length by 3 m across. The size of the central post and the dimensions of the spans make it possible to use stems and branches of the gum acacia tree.

The clear height beneath the roof is rarely more than 80 cm, which requires people to stoop deeply when entering. The relatively low height provides shade to the togu na, and also ensures good ventilation. As the structure is open, the surrounding area can be watched in all directions; the position is usually somewhat raised compared to the other parts of the village, thus ensuring that the surveillance function is not impeded. At the same time the shape of the building ensures that it can hardly be seen from a distance, and the silhouette merges with the landscape. Except for the posts, there is no embellishment in the togu na. Occasionally timber posts are embellished with carvings; uprights consisting of natural stone are plastered and shaped with clay.

When the location is considered to be suitable for a village, the next buildings to be put up are the ya punulu ginu, the “houses for women during menstruation” (women’s houses). These are the places to which women withdraw to discuss matters. Access is open to all girls and women from their first menstruation. These single-room and single-story buildings have an oval footprint and no windows. Quite often there will be a courtyard in front of the building, which is protected by a freestanding wall. The buildings themselves are of a similar size to the togu na. Inside there is space for two to four people to sleep, as well as a fireplace. Another fireplace is in the courtyard. The plinth of the solid walls is built of natural stone; the wall above consists of air-dried clay bricks or clay rolls. At a height of about 2 m, the roof is constructed of wooden main and secondary beams covered with layers of sorghum grass and finished with a layer of clay approximately 5 cm thick. At the edges of the building, this layer is formed into an upstand. Precipitation water is drained off the roof via wooden water spouts.

Access to the single room only rarely consists of a simple opening in the external wall. More often a solid, gate-like structure is placed in front of the building. Its door opening is not higher than 1.2 to 1.5 m. This design suggests that it is intended to at least make the unimpeded entry of enemies more difficult.

Close to the togu na, albeit usually outside the main part of the settlement, the smithy is built as a single-room structure. At its center it has a furnace that is operated with bellows and a stone anvil. The blacksmith, master of fire and metal, produces the necessary tools for farming as well as cult objects and weapons. As in many cultures, he is therefore considered to have special powers and skills. Within the community, he and his family can never enjoy the same status as other members.

The ginna pa(ye) or ginna banna (the “large dwelling”) is the ancestral family home, that is, the seat of the founder families, which is also the place of the family altar and frequently of ancestral graves. The building has two stories, and its floor plan is larger than that of the women’s house (approximately 7 × 6 m). The only access to the building leads to a reception room, from which the central sleeping room is entered. This is followed by the two-story cooking room, with its fireplace to the east. To the north and south of the sleeping room there are additional rooms. These are used on the one hand for storage of family items and, on the other, for the mortal remains of ancestors. The roof terrace above the central sleeping room is reached via a tree trunk ladder above the cooking space. The roof terrace is used for drying foodstuffs, which are stored in other rooms on the second floor unless they are used by children or as additional sleeping rooms. The two-story west facade is conspicuously structured horizontally and vertically. The expressive character of this structure is heightened by the extreme play of light and shadow. In addition to numerous shelf-like niches, it has two openings: the main access to the house on the first floor and an opening in the upper floor, which is reached via a tree trunk ladder. Behind this is a room with other cult items of the family, to which only the male head of the
household has access. The niches in the facade are used for storing the mortal remains of ancestors and offerings, as well as valuable objects. The access facade is particularly strong, featuring a mixture of clay-plastered wood bundles, natural stone masonry, and clay bricks/banco. Both openings can be closed with a wooden door. With a respective height of approximately 1.4 m and 1 m, they are relatively small. Again, the reason for this may be that they are easier to defend. The configuration of the ancestral family building is also based on human symbolism. The building can be cross-ventilated with the help of the entrance door to the west and the access door to the roof terrace to the east. In summer the central sleeping room is the coolest room in the house, and in winter it is also the warmest room as it is close to the fire. The ancestral family home is part of a farmstead, which also includes single-room dwellings for additional wives, one or more children’s houses, stables and, particularly, storage rooms. The farmstead is enclosed by a wall and can be shut off with a wooden door.

Ginna

Most of the buildings in the farmstead consist of single-story clay buildings, the western facades of which do not have the expressive plasticity of the ginna pa. This is inhabited by the descendants of the settlement’s founders. The arrangement creates a visible differentiation of the rooms occupied by the different members of a village community. Multistory buildings are only used where the topography prevents horizontal expansion. Here, the totality of the settlement is made up of the various farmsteads. In this case, the individual buildings do not have any open internal courtyards or fortifications.

Guyo ya and Guyo ana

Storage buildings are the most elaborate types of building of the Dogon in terms of construction, because they contain the resources necessary for survival. There are two basic types: the guyo ya (the female storage) and the guyo ana (the male storage). The latter contains the foodstuffs for the family and is managed by the head of the family. The female store contains personal belongings of the wife, her own food reserves, spices, and jewelry. The usually somewhat higher male store has two openings that are above each other and are used for filling and retrieving stored items; the inside is not subdivided and as a rule is filled with just one type of food, usually sorghum. Its footprint is square. Round male stores can also be found under protected overhangs in the Falaise. The female storage has only one retrieval opening. Below this it is subdivided into four compartments, and above there are shelf-like fitments. The openings of both stores, measuring approximately 60 × 40 cm, are closed with a wooden door, often with an artistically designed lock. When a full storage is not yet in use, the joints between the door and external wall are filled with clay; if both doors of the male storage have visibly been used, it means that this storage contains food only in the lower third. In order to protect the stores from food thieves, insects, and water, they are raised off the ground with the help of natural stone pillars. These carry a square timber grid, which in turn supports a separating layer consisting of grass and leaves. Above this, the relatively thin walls of only 3 to 8 cm are modeled to the dome-shaped roof to which is added a sorghum grass roof finish, which protects the building and its contents from heavy rain as well as extreme solar irradiation.
Farmstead

In the escarpment of the Falaise and on the table mounts, dwellings are not organized in the form of farmsteads. Rather, they are developed as a conglomeration of interwoven building structures of different owners and families. By contrast, ginnas on the high plateau, at the foot of the Falaise, and on the plain are usually farmsteads enclosed by a natural stone wall. A farmstead will at least have a dwelling, as well as a male and a female storage. If the man has two wives, the second wife will have a house and her own personal storage.

Probably owing to Islamization, the man in the Dogon culture may have up to four wives provided he is capable of providing appropriately for large families. This results in significantly larger farmsteads, often with distinct entrance buildings.

Fields

“Agriculture” says Ogotemmeli, an informant of Marcel Griaule, “is carried out in squares each side of which measures eight ells (approximately 3.6 × 3.6 m), which are surrounded by an earth wall, because the surface of the parcel unit corresponds to the terrace of the heavenly store. And the parcel is precisely aligned. Each side faces one of the four cardinal directions.”

The Situation Today

Both climate change and the armed conflict present in the north of Mali since 2012 have prompted not only families but also entire villages to leave their traditional homes in the Falaise du Bandiagara to try to build a new life in the south of the country. These developments are part of the reason that Bamako, the capital of Mali, is currently the fastest-growing city in Africa. By far most of the new arrivals live in slums and organize themselves informally. It is not possible to foretell how long the fascinating world cultural heritage of the Dogon will survive.

Endnote

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The Vernacular Architecture of Southern Africa
Franco Frescura

Over the years many visitors to southern Africa have commented upon the beauty of its indigenous architecture, the quality of life it engenders, and the ingenuity of its builders. Indeed, many of the earliest European immigrants to this land found local dwellings to be equally adapted to the heat of the summer sun and the bitter winds of winter, and chose to built their homes in the local manner. Durban, for example, for many years was a Zulu town whose English residents lived in the Zulu manner and, in some cases, married Zulu women.

In time it was also understood that indigenous settlements were built along strict lines of distribution and social hierarchy which defined the resident’s gender, social status, position within the family unit, and group affiliation. Consequently such architecture needs to be read as a text, with each part paying a role in the rich tapestry of rural life.

Indigenous Settlement

Generally speaking, the indigenous architecture of southern Africa can be divided into three distinct groupings:
– the KhoiSan, representing the earliest inhabitants of the sub-continent, whose culture today is almost extinct,
– the Venda, a small group of pastoralist farmers whose lands lie in the Limpopo valley and whose ancestors, a thousand years ago, established the trading empire of Great Zimbabwe,
– and the Nguni/Sotho/Tswana speaking group of pastoralist farmers whose descendants constitute the greater part of the population of latter-day southern Africa.

All three derive their settlement forms from their cosmological beliefs as well as the hierarchical relationships perceived to exist between husbands and wives, wife and wife, parents and children.
and different gender groups within the same polygamous family unit. Despite the fact that most rural homesteads were not polygamous, these basic values were held in common by all members of the group.

Aspect
With the exception of the Venda, all settlement in southern Africa was circular in shape and sited on a gentle slope facing east, toward the rising sun, where all warmth and nourishment was perceived to originate. Individual dwellings also faced the same direction, and because they are the domain of women and are viewed as a metaphor for the womb, each day is viewed as a rebirth and a new beginning. The Venda on the other hand, sought no such orientation and located their homesteads and villages on a well-drained north-facing hillside.

Approach
In general, the southern African homestead is approached uphill and entrance is made through a central gateway located at the bottom of the perimeter, on axis with the residence of the chief/father at the opposite and uppermost end of the circle. Approach to the Venda homestead, on the other hand, is more circuitous and reflects a local proverb that proclaims “in order to reach the mountain you must follow a zigzag path.” Thus access to a chief is only achieved via his people, represented by a high official; to the husband via his wives; and to the parents via his children.

Cattle Byres and Burial Practices
In general the cattle byre is located centrally within the settlement. This area is held to be the preserve of men, and women are only allowed into its perimeter once they have reached menopause. It is the place for the gathering of men, and in most instances it is also a place of burial, thus reinforcing the spiritual link perceived to exist between cattle, adult males, and their ancestors. Sacrifices to the ancestors, usually in the form of cattle, are also made within the byre. The Venda, on the other hand, locate their cattle byre to one side of the homestead, and it is freely accessible to all members of the family regardless of age or gender. Little spiritual significance is attached to it, and burial takes place at the back of the homestead, behind the father’s dwelling.

Social Hierarchy
In the determination of social hierarchies, virtually all domestic settlement in southern Africa is guided by a concept of left and right. Rural society holds that the right hand wields the spear and is thus dominant over the left, which holds the shield, leading to a separation of wives in a polygamous household into the right-hand house, including the first and all subsequent odd-numbered wives, and the left-hand house, which includes the second, and all subsequent even-numbered wives. The First or Chief Wife is held to bear the heir to the family and, theoretically, only male children from the right-hand house may rise to clan leadership. The concept of left and right is important not only in determining the position of the dwellings of the various wives within a polygamous homestead, but is also extended to its application to the residences for the children, the separation of sleeping areas within the dwelling unit, and even the seating hierarchy at a beer drink. Most important, it is commonly used to establish the line of inheritance, after the death of the father, when no clear successor to the clan leadership can be found. The Venda, on the other hand, only recognize the primacy of the First Wife, and the location of dwellings for second and subsequent wives is arrived at by a process of negotiation and common agreement. As a rule, the dwelling of the father will be located behind those of his wives; parents will be located behind the homesteads of their children; and the chief will be located behind and above his people. All groups however, recognize that each wife is entitled to her own cooking hut. Finally, it should also be noted that despite the fact that many of these planning principles are derived in the context of a...
polygamous society, historically few men took more than one wife, and then only for reasons of levirate, wherein the widow of a deceased brother is taken into the household of another. Such complex rules of hierarchy are made therefore for the benefit of a small ruling elite where polygamy is used as a tool of diplomacy and government.

The Khoisan

The Khoikhoi were a diverse and widely dispersed group of migrant pastoralists who, in precolonial times, inhabited the southern African region south of the Gariep. Better known by the derogatory colonial term Hottentot, the Khoi inhabited a variety of physical environments, from the well-watered western and southern Cape to the sour grasslands of the eastern Cape, to the arid semidesert scrublands of the Karroo. Despite this seemingly wide range of habitats, their dwellings were generally uniform in both shape and construction. The structure consisted of a number of saplings set into the ground in a circle and bent into a series of widely spaced arches. The hemisphere thus formed was then covered with reed matting, with an adjustable skirt of animal skins surrounding the bottom of the hut.

The structure is dismountable and easily portable and is thus highly suited to the migrant nature of their society. The reeds and saplings necessary for their matting can only be found near watercourses and in the shallow pans of the southern regions, and it is evident therefore that their annual migrations would have included a stop near a source of materials. From the mid-eighteenth century the pressures of European settlement in the southern Cape slowly eroded their land holdings and cut off their access to natural building resources. By the mid-nineteenth century their mat dwellings, known to European settlers as maanjieshuise or mat-houses, had all but disappeared, and although a few cases are recorded where the mats were replaced with industrial materials, the transition was not successful. The demise of the mat dwelling was also assisted, to a large degree, by the work of missionaries, and by the eighteen-thirties most Khoi living on mission stations were reported to be living in “neat whitewashed little cottages.”

The San, on the other hand, were scattered groups of hunter-gatherers whose territories, at one stage, covered most of southern Africa. Although modern genetic studies have shown that the San were closely related to the Khoi, the San were unable to make the transition to a more pastoral economy, and once Dutch farmers began to spread into the southern African interior, the two groups came into open conflict which reached genocidal proportions by 1800. This was only brought to an end in 1806 when the British took over colonial rule of the Cape. Because of the nature of their society, their architecture seldom manifested itself as little more than temporary shelters or at best, the use of a portable mat screen.

The Zulu

The Zulus are a Nguni-speaking group inhabiting the eastern littoral of Natal. At the beginning of the nineteenth century, the “children of heaven,” as their name translates to, were a small clan of some 2,000 persons inhabiting the northern reaches of Natal. Through a combination of coincidence and skillful leadership, by 1822 they had emerged as the dominant social, military, and political force in their region, and by the eighteen-forties their armies were ranging with little opposition as far as Botswana to the west and Zimbabwe to the north. Their dwellings are hemispherical in form, and although the Zulu follow a sedentary pastoralist lifestyle, should the need arise, their homes can also be transported over short distances. Structures usually consist of saplings set into the ground and bent into a series of interlinking arches, closely spaced to one another. This framework is thatched over with grass or a combination of grass thatch and reed matting held down with a net of grass ropes. The hemisphere is usually supported by two central posts, which carry a timber trellis, which is used more to carry the weight of the thatcher during construction than to provide additional strengthening to the structure. The average dwelling is about 4 m in diameter, but this can vary from a cooking hut 3 m in diameter with no central supports to a royal audience chamber with 16 supports capable of seating more than 100 persons. The thatch cover is usually taken down to ground level, although this leaves it vulnerable both to moisture rot and the ravages of grazing domestic animals. Consequently the lower reaches of the dwelling are usually finished with a coating of clay, applied both internally and externally, that ranges from a few centimeters in height right up to about 90 cm above ground level. The entrance, a weak
The South Ndebele dwellings point in the construction, is usually finished off with grass ropes intricately bound about the opening, while the doorway is closed with a lightweight wicker screen held in place with a crossbar. The guy ropes of the grass net come together radially at the apex of the roof where they are gathered into a decorative knot. The hearth is located centrally, while a low semicircular shelf known as the umsamo, is placed at the rear of the dwelling on axis with the doorway and the hearth. The umsamo is significant, for not only does it serve as a storage space for food and household goods, but it is also a sacred place where the father can reach out to his ancestors. Although the hemispherical beehive dwelling of the Zulu was commonly still being built throughout Natal and the Kingdom of KwaZulu right up to the nineteen-seventies, a shortage of suitable grasses as well as the increasing pressures of settlement have ensured its gradual disappearance from the rural landscape.

The South Ndebele are a Nguni-speaking group who, some 500 years ago, migrated from northern KwaZulu onto the northern highveld, bringing with them the tradition of building dwellings very similar in both form and construction to the hemispherical grass domes found in their old homeland. They continued to build these until the eighteen-eighties when, following a leadership struggle among their Pedi neighbors, they found themselves at war with the Dutch Government of the ZAR. After a siege lasting some nine months, they were eventually starved and dynamited into submission. As a result their lands were declared forfeit to the ZAR, which subdivided them into farms for Dutch settlement. The surviving members of the nation were broken up and families were allocated to the farmers to work as indentured laborers, a condition of virtual slavery.

At this point their architecture began to adopt the forms, textures, construction, and even decorations of the Pedi. It is possible that this was a conscious decision taken for political reasons, as their neighbors had never been defeated by the Dutch and had managed to steadfastly retain control of their lands in the face of white incursions.

The Ndebele dwelling consists of an inner chamber some 7 to 8 m in diameter, surmounted by a conical thatched roof. The front of the unit is faced by a narrow enclosed veranda about 1 m deep which runs about the front of the building. This is used as a storage area as well as a sleeping space for young children. The inner chamber is used by the parents as a sleeping area, with the left-hand side facing out being named the side of the woman or “the side of life,” where a woman would lie during labor. The right side of the chamber, the side of the man, was also named “the side of death,” because this is where a body might be laid out prior to burial.

At the back of the dwelling, opposite the entrance, was the umsamo, a residual feature of the dwelling from the era when the Ndebele still resided in northern KwaZulu. However, the Ndebele umsamo no longer functions as a domestic storage space but has been converted into a seat built in clay against the back wall. As a result of this change in function the hearth has been moved from the center to a position closer to the umsamo at the rear. The main dwelling is surrounded by a series of walled courtyards used by the women for a variety of social and household functions.

Additional structures used as kitchens and as sleeping quarters for older children are located off a rear courtyard, which is accessed via a side entrance.

The practice of South Ndebele women of decorating the walls of their homesteads with polychromatic designs is probably derived from a monochromatic Union Jack pattern which is applied by their Pedi neighbors as a basic form of wall decoration. By the early nineteen-fifties the Ndebele had begun to elaborate these designs into more ambitious polychromatic compositions. In the process, this art form began to fulfill a number of social functions. Wall decoration among all Southern African groups is the work of rural women, and its practice is a manifestation of women’s rights and fertility within the group. However, its practice also coincided with
the rise of White nationalism and the imposition of overtly oppressive racist legislation upon the Black people of South Africa. Given its chronology, it can be assumed therefore that Ndebele wall decoration also had a political intent, serving to reinforce their group identity and laying claim to ancestral lands stolen from them less than three generations before.

The Venda

The Venda is a group more closely associated with the Shona of southern Zimbabwe, who inhabit the area immediately south of the Limpopo River, on the northern borders of South Africa’s Limpopo Province.

Although their dwellings today are very similar in form to those built by other groups in southern Africa, they differ substantially in their method of construction. Before the nineteen-twenties, when restrictions were placed in the region upon the indiscriminate cutting of indigenous trees, their construction was timber-intensive. The conical roof, consisting of an almost solid body of timber obtained from the mopane tree, is taken radially to a central apex marked by a finial. This is then raised upon a solid drum of mopane posts placed in close order in a circle some 4 to 6 m in diameter. Additional support is given to the roof at the eaves,
where a series of timber columns is used to carry the roof frame, thus creating a sheltered veranda about 1 m deep. The inner drum is also strengthened against torque by a series of sapling hoops fixed internally and externally at roof, head, and waist height. The whole structure is plastered both internally and externally with a mix of clay and cow dung, while a grass thatch cover is laid onto the roof. The under-side of the roof cone is often plastered and painted with a series of concentric rings known locally as “the eye of the lion.” The back veranda is often enclosed and used either for storage or as the sleeping quarters of the wife.

Today a shortage of lumber has curtailed the construction of such timber-intensive structures, and although sun-dried clay bricks have now replaced the timber drum, and the roof structure has been rationalized, the veranda dwelling remains the predominant domestic form in the region.

Postscript
Much of what I have written above should be read largely in a historical context. While some older dwelling forms and building technologies may still be found, these are few and often in a poor state of repair. The end of Apartheid in 1994 brought with it new democratic rights, access to a better standard of living, and a government-sponsored housing program that has actively worked against the survival of older and more traditional methods of construction. As a result much of this architecture has quietly moved out of our countryside and into open-air museums, coldly correct but devoid of life and character. This is sad to record, but at the same time it would be unrealistic to ask people to live in dwellings made out of grass or sun-dried clay when a better quality of life is available to them.
America

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Building Forms in Indigenous North America

Christian Feest

Tipi, wigwam, igloo, and pueblo are terms for dwellings in indigenous North America that have been adopted into the English language and are often considered typical of “the Indians” or “the Eskimos.” In fact, however, these dwellings represent only a small segment of the enormous variety of traditional building forms, while in their original languages these terms mostly just mean “dwelling” of some form or other. Taking into account the cultural diversity of the peoples who inhabit the extremely diverse regions between the Arctic Ocean and the Mexican borderlands, the wide range of building forms is not really surprising. The respective environmental conditions demanded different degrees of protection from the cold, heat, wind, and precipitation and often limited the availability of building material such as wood, stone, ice, or snow.

The requirements associated with the life of nomadic hunters and gatherers were different from those of sedentary populations, not only with respect to the mobility or permanence of their residence, but also to their social organization, in particular the size of the coresidential groups.

Even within a population, a considerable diversity of building forms existed, partly resulting from a seasonal alternation between sedentism and mobility, and partly due to the different functions of non-residential structures, such as storage and other utility buildings, dance and council houses, ceremonial buildings (such as temples or sweat lodges), grave houses, fortifications, menstruation houses, and other special buildings. In addition, there are the historical shifts brought about by changing living conditions and the selective adoption of construction techniques from Euro-American immigrants (in particular the construction of now traditional log houses) and also from other indigenous groups.
The pressure of cultural assimilation predominant in the nineteenth and early twentieth centuries together with the decreasing importance of hunting and the enforced shift to nuclear families often led to traditional building forms being abandoned in favor of those used by the majority society: single-family houses built in log or timber-frame construction. In the second half of the twentieth century there was an increased interest in the revival of old building traditions even though a significant part of the knowledge required for their construction had been lost and new buildings in the old style were no longer used for residential purposes.

The following cursory overview focuses on dwellings. Generally speaking, we distinguish between temporary, often improvised lean-tos, mobile tents, and stationary houses, which nevertheless employ the same principles of construction, which reflect the existence of technological traditions with an often supraregional distribution.

Walls primarily refers to building components bridging height, roofs to those traversing floor space; both may consist of a framework covered with wall or roof skins, or be self-supporting structures. Walls without roofs – such as branches stuck into the ground next to one another or walls made of stone or blocks of snow – are found exclusively as windbreaks in temporary camps.

Igloo

The igloo is not the typical dwelling of the Eskimo and was more extensively used only by the Inuit of the Central Arctic; however, as a true vault construction, it is just as unique among the traditional building forms on North America as the use of snow as building material for this purpose. Snow houses were only used in winter and, with good care, were capable of lasting throughout the winter. Outside the Central Arctic igloos were only occasionally built as temporary dwellings.

It took two men less than an hour to build an igloo; one cut the trapezoidal blocks, measuring about 50 × 80 × 20 cm, from suitable snow (neither powdery nor too heavily iced up), using a bone or wooden snow knife, while the other laid the blocks along the predefined circular layout. The first blocks were dug out from within the later walls, resulting in a floor level lower than the surrounding surface. This increased the clear height and at the same time created space for the cold air to sink below the raised sleeping platforms.

When laying the blocks, they were cut from the inside to a perfect fit with the snow knife. Once the first course had been laid, it was partially chamfered so that the following courses could be added in the form of a spiral. After inserting the final block at the top, an air vent was cut into the ceiling, an entrance opening into one of the sides, and an aperture to accommodate a window of freshwater ice. Due to the heat from the oil lamps – the only form of heating in the igloo other than the body heat of the inhabitants – an insulating layer of ice formed on the inner surface of the roof; snow heaped against the outside and, occasionally, furs used as cladding on the inside helped protect against the cold and prevented untimely melting due to the heat build-up inside. Often, several igloos...
were built wall-to-wall and connected by door openings. Access was through a semi-subsurface tunnel leading through the storeroom and kitchen to the living and sleeping room. In the autumn, before sufficient snow was available, people in the Central Arctic also built houses with self-bearing walls consisting of rectangular slabs of ice jointed with snow. The roof was made of "hexagonal hogan" with log walls and a earth-covered corbelled vault of the Navajo. In the Canyon de Chelly, Arizona. Photo 1989. A conical, earth-covered hogan on a tripod frame, Navajo, Arizona, around 1930. Photo George Wharton James. A roof with corbelled vault of a semi-subsurface ceremonial room (kiva) of the Anasazi in Mesa Verde, Arizona, 1250-1325 AD. Drawing after Jesse W. Fewkes, "Ventilation in Ceremonial Rooms" 1908. A Buttes, 6 Joists, c Wooden sticks and bark of Loam, e Wall.

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Hogan
The only other occurrence of corbelled vaults in North America is found in the Southwest, where up until the nineteenth century the prehistoric ancestors of the Pueblo peoples built polygonal roofs consisting of rings of round logs on stone walls with the ends of these logs resting on the middle of the timbers of the next lower ring. Six hundred years later the Navajo, who by then had migrated to this area, used the same method for the construction of the roofs of their hogans and, more rarely, also of freestanding roof houses. Hogan is the general Navajo term for traditional dwellings (in contrast to the western house called kiw). Probably the oldest form, no longer in use today, was a conical roof house with a sunken floor, a tripod or tetrapod framework of forked poles interlinked at the top, cladded with wood, bark, branches, and finally loose earth, and often featuring a projecting vestibule as a windbreak. However, the term hogan is also applied to buildings with a flue or corbelled roof (later also other forms) resting on a frame resting of four or more posts or on walls built in log house construction, on palisade walls, or on stone wall.

Tipi
The tipi (from the Dakota word for house) was the mobile dwelling of the bison hunters in the steppes and grasslands of central North America (Prairies and Plains). On the Plains the tipi was inhabited throughout the year, whereas the farming peoples of the Prairies used tipis only on their seasonal hunting expeditions. Today, tipis are also used outside the Plains, primarily a symbol of Indian identity, and are only exceptionally used for residential purposes (such as during festivities). The tipi’s supporting structure consisted of a slightly backward tilted tripod or tetrapod of wooden poles measuring 5 to 12 m in length (preferably of lodgepole pine), which are tied with a long leather strap about one third below the upper ends. Additional poles were placed into the forks of this frame, the lower ends of which defined the egg-shaped (three-pole foundation) or oval (four-pole foundation) floor plan with a diameter of 6 to 10 m; they were held in place by the leather strap, which was subsequently tightened and anchored to a peg in the ground. Depending on the size of the tent, the nearly semicircular roof frame was set together from up to more than twenty tanned bison skins (replaced by canvas after the extinction of bison in the late nineteenth century) and featured semi-oval cutouts for the door opening on the straight side of the cover and, at the top, projecting rectangular smoke flaps. This cover was attached to a lifting pole, which was inserted into the fork at the back of the framework; then spread around it, and closed above and below the door opening with wooden pins. Two somewhat shorter poles were inserted into pockets attached to the smoke flaps and used for their adjustment in order to ensure unimpeded discharge of the smoke from the central hearth through the opening at the intersection of the poles, or to close it in case of rain. The bottom edge of the tent cover was fastened to the ground with wooden pegs. The door consisted of an oval or rectangular piece of rawhide or of a leather-covered frame. On the inside, a curtain reaching to the floor was attached at the lower third of the poles to reduce the intrusion of humidity and draft and enhance ventilation because the air entering along the ground would be rising behind the curtain. Tipis were the property of women and traditionally were also erected by them in significantly less than an hour.

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In view of the fact that wooden poles were precious on the nearly treeless Plains and had to be carried along together with the heavy tent cover, tipis of the size described above could only evolve after the introduction of the horse in the eighteenth century. Tipis transported by dogs inevitably were considerably smaller.

The preference for three-pole or four-pole foundations as well as other construction details was based on ethnic traditions. In addition to the usual tipis for living, smaller tepees for hunting, larger ones for councils and ceremonies, and other special forms were also found on the Plains. Conical tents with such frame-works were also found in other parts of North America; their roof skins were not custom-fit, did not have smoke flaps, and consisted of pieces of leather or bark, branches, or mats held in place by poles leaned against them from the outside. The Umatilla and their neighbors in the Plateau area to the northwest of the Plains also had larger buildings consisting of two tipi frames connected by a ridge pole.

Wigwam and Wickiup

Wigwam is a loanword from Algonquian languages of the Atlantic Coast and, as such, refers to all “Indian” dwellings. In its stricter sense, the word is used today for roof houses, formerly widely distributed in the Eastern Woodlands of North America, with a load-bearing structure consisting of crossed parallel arches. They were built by inserting long pliable poles into the ground at regular intervals along the round or oval floor plan; pairs of opposite poles were bent toward the middle and formed into parallel arched supports by tying the ends of the poles together; they were connected to a second set of arched supports set at right angles by tying them together with bark fiber at the intersections. Additional strength to the frame was provided by horizontally attached elements. In smaller round buildings the poles were sometimes tied at the center to form radially arranged cross arches.

While the construction of the frame was a men’s job, covering the wigwam was carried out by women. For this purpose were used rectangular pieces of birch bark sewn into panels and secured against warping by wooden poles attached at their ends; other materials used included twisted rush mats and later also canvas. In the absence of birch bark, elm bark served as a substitute. In addition, the inside of the wigwam was often lined with mats. For long-term use the roof skin was held in place on the outside by a construction similar to the supporting framework or by cords tied around the building, otherwise by poles leaned against the walls. Rectangular doors were made of the same material as the roof cover. The smoke from the central fireplace could escape by seeping through the gaps in the roof skin. On travels, the rolled-up mats (more rarely also the bark panels) were carried along; in the Woodlands, wooden poles were easily obtained everywhere. In addition to wigwams used as habitations with an average length of about 5 m, the ceremonial buildings of the medicine society built in the same manner could be more than 90 m long. This type of construction was also used for the significantly smaller sweat lodges that are also found far beyond the Woodlands.

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An identical frame construction found among the Apaches in the North American Southwest is curiously designated in English as wickiup (a loanword from another Algonquian language, related to the word wigwam). In the absence of bark and mats, the roof skin originally consisted of overlapping bundles of grass tied to the frame with cords of yucca fibers. Pieces of leather could be spread over the roof to protect against the rain. The doorway was also covered with leather.

Barrel Roof and Ridge Roof Houses of Eastern North America

The oldest visual representations of indigenous building forms in North America show the barrel roof houses of the Algonquian peoples of coastal North Carolina (1585–86), which are related to wigwams. Their supporting framework consisted of parallel arches connected by stringers and with horizontal and vertical braces at the gable ends to provide rigidity. The roof skin was made of mats that could be folded up during warm weather. The door opening was placed in the middle of a gable wall when raised platforms were placed inside along both side walls; it was offset to one side or placed in one of the flank walls when the sleeping platforms were only located along one flank wall or at the rear gable wall. In another illustration, building were depicted with paneless window openings. There was no smoke outlet, because cooking mostly took place outside the house. These houses provided living space for up to 20 people (probably extended families).

In their appearance these dwellings were similar to the longhouses of the Iroquois although, as the name suggests, these were longer (up to 150 m) and wider (up to 10 m). Owing to their greater width, the use of arched supports was impractical. Instead, the domed roof was placed on purlins, which in turn rested on posts along the flank walls of the house, and was further supported by two rows of posts inside the dwelling, on both sides of the central corridor. Between the outer and inner posts, platforms were placed along both flank walls and subdivided with mats into compartments. These rooms were open to the fireplaces in the central corridor, the use of which was shared by facing rooms, but could be closed with curtains. Above the sleeping platforms an intermediate floor was used as storage space. In these buildings the roof skin consisted of large rectangular pieces of elm bark held in place from the outside in a similar manner as those of bark-covered wigwams. By the nineteenth century the longhouses had changed from barrel roofs to ridge roofs with an additional ridge purlin resting on posts and supporting the rafters. What formerly served as a dwelling for a clan shrank to satisfy the needs of a nuclear family.

Ridge roof houses were widely distributed from the western Great Lakes region to the adjoining Prairies and to the Southeast. They differed in the construction of the roof structure and in the material used for walls and roof skins. In the Southeast the leaves of the Palmetto palm were popular for thatching the roof, while the wall skin often consisted of dashed wattle or (as in the choke of the Seminoles in Florida) could be missing.
In the Arctic and Subarctic in particular, ridge roofs also occurred as roof houses, that is, without distinct walls. In this case the ridge was formed by a purlin resting on two posts with forked tops or by a leather cord stretched out between two supports; the latter variant was used for tents in which one of the supports was often a tripod and the roof skin fixed to the ground with stones.

**Ridge Roof and Shed Roof Houses of the Northwest Coast**

Another area where ridge roof houses were popular was the densely forested Pacific Northwest Coast. Here the supporting framework was made up of four to eight heavy posts of different kinds of coniferous wood supporting two to four equally heavy purlins which, placed at different heights, determined the slope of the roof. The ridge purlin was not always continuous. Instead, the Tlingit and Haida on the northern coast used two shorter beams supported by boards resting on the topmost pair of purlins, between which an adjustable board-like smoke flap was fitted; the Kwakiutl of the central coast did not use these beams and the smoke flap. The supporting framework as well as four additional uprights defining the approximately square or rectangular floor plan were planked with horizontally and vertically arranged boards joined to the uprights and to boards placed on the ground along the gable ends. The purlin roof was shingled with boards and bark panels, which were protected against displacement by wooden...
poles and stones. Additional rafters and stones were used to prevent their becoming dislodged. Access was via steps leading to a rectangular or oval door in one of the gable walls. Inside the dwelling the floor was also covered with boards and was recessed into the ground in one or two tiers, with stairs leading to the central fireplace. Originally there were no windows. At the upper level, sleeping compartments—themselves often in the shape of gable roof houses—were placed along the walls. The houses, about 15 to 20 m in length, were inhabited by larger kinship groups whose inherited privileges were displayed on carved crest poles in front of the house, paintings on the walls, and other decorative elements on the building. On the southern northwest Coast, shed roof houses were predominant. Their roofs, sloping toward the back, were supported by several parallel purlins resting on uprights. In northern California, the southernmost part of this region, there were buildings whose walls of vertical wooden planks also served to support the roof.

Earth Lodges

From Alaska across the Plateau and California to the Southwest, and from the Plains to the Southeast, semi-subterranean earth-covered houses were found, which, in spite of their similarities—indicating a likely common origin—nevertheless feature a wide range of different construction methods. The sedentary and farming peoples living along the rivers of the Plains (such as the Mandan, Hidatsa, Omaha, and Pawnee) constructed round earth lodges of about 15 m in diameter in their permanent villages located in the proximity of their fields. The ground was excavated to a depth of between 30 cm and 1 m, thus creating a low wall between the living level and the lower edge of the roof. Among the Hidatsa, however, considered here as an example, the excavation of the floor had been omitted by the end of the nineteenth century. The roof was supported by two supporting constructions of different heights: Around the fireplace in the center of the house, four thick posts, approximately 4 m in height and forked at the top, supported a square of four purlins held in position by matching notches. Along the circumference of the pit (or approximately 1 m from the lower roof edge), a second ring of purlins was supported by posts of about half the height. A door with threshold and lintel was located between two of the outer posts; it was approached through a covered porch, which, in contrast to the door, was not built until the roof had been completed. The door was covered with a piece of leather or fur. Next, about 100 poles were placed as rafters on the purlins, the lower ends flush with the lower purlins and the upper ends projecting somewhat beyond the upper purlins, leaving space for a smoke hole, which later on would usually be cased. Shorter poles were placed at a steeper angle from the lower ring of purlins to the ground, without additional fastening at either end. In the next step, dried willow branches were placed all over the roof, followed...
by a 20 cm-thick layer of dried grass and another layer of the same thickness of loose earth or grass sods (with the root side up). The earth was moistened with water and smoothed manually in order to render the roof as impermeable as possible to rain. Along the steep outside wall, a railing of poles resting on forked posts was to prevent a slippage of the earth cover. Nevertheless, the roof always had to be repaired after heavy rainfalls. When it rained, the smoke hole was covered with a round bullock boat with its opening facing downward.

Along the walls there were canopy beds with leather curtains and low platforms for storing food. This was also the place where firewood and other objects of daily and ceremonial purpose were stored. A corral for horses was located near the door. In front of the central posts facing the entrance was a palisade fence extending on the left to the wall and separating the living area from the storage area. The floor consisted of tramped earth.

The earth lodges built by the Hidatsa in winter as seasonal dwellings at the wind-sheltered edge of the forest were somewhat smaller and constructed less carefully because they were not used again later, whereas the permanent houses had a lifespan of about ten years. A conical structure consisting of a ring of purlins supported on four posts and with the roof covered in the manner of the main building was often attached to winter houses.

The earth houses of the Interior Salish in the Plateau area of British Columbia were only inhabited during the coldest time of the year. They were also round and sometimes measured up to 15 m in diameter, although they could also be much smaller depending on the number of inhabitants (15 to 30 people). The pit over which the house was erected was more than 1 m in depth. Instead of uprights, four inward-leaning posts with notches at the top were inserted in the floor of the house and supported four strong rafters that were also anchored in the ground and held in place by a wrapping of willow rods. In addition, two shorter lateral braces were attached at this joint. Roof battens were tied to this framework, spaced at about half a meter below the level of the joints and laid without gaps above it. They were covered closely with wooden poles, which (like the main rafters) left a square smoke hole at the top of the building. The frame of this hole was made up of stronger pieces of timber because it was also used to support the top of the log ladder, which provided the only access to the house. Its lower end was sunk into the ground and protected by a stone plate against damage from the nearby fire.

From the Iñupiat in northern Alaska to the Yup’ik in southwestern Alaska earth houses served as winter dwellings or as men’s houses in which men and boys lived together throughout the year. Typical of these houses was the underground access tunnel that often led into the more than 1 m-deep dugout living area through an even lower cold trap (not used in summer). In contrast to other parts of the Arctic inhabited by Eskimoan peoples, driftwood was available in abundance here and was not only used for the
structural parts but also for the wall skin, for sleeping platforms, and for the floor. The lowered fireplace, which could be covered with wooden planks, received air through the cold trap. A special feature found quite frequently was a support consisting of two posts and a purlin placed diagonally in the corners of the room, which supported the pyramid-shaped stacked roof structure whose smoke hole could be closed with a gut window.

Grass Houses of the Wichita

An unusual pointed/oval silhouette distinguishes the grass houses of the Wichita and other Caddoan speakers of the southern Plains, which have not been used for habitation for more than a century. Twelve forked uprights supported a ring of purlins similar to the earth houses of the Plains, but did not support the roof; instead the main purpose of this structure was to provide a block against which the flexible poles inserted into the ground around it could be bent to the required shape; these poles were then tied into a close mesh with horizontal rows of willow rods. Overlapping rows of sedge grass bundles were sewn by the women as a roof skin to the framework built by the men. The narrow door openings were also clad with grass. In the absence of a smoke hole, smoke has to find its way through the roof skin. This same method was employed in the building of ramada shades, beneath which most of everyday life took place; except that the lower part of the building remained uncovered. The diameter of grass houses could be up to 20 m.

Pueblos

The Pueblo peoples of New Mexico and Arizona owe their Spanish name to the fact that, in contrast to nomadic groups, they lived in permanent villages consisting of masonry-built houses. In the first millennium BC the ancestral Puebloans inhabited primarily round semi-subterranean earth houses with a diameter of 3 to 7 m. After about 700 AD a transition took place to rectangular houses with flat roofs and sandstone walls, which were increasingly built wall-to-wall and finally evolved to multistoried buildings—the typical “Pueblo architecture.” However, the tradition of semi-subterranean round houses that are accessed from the top via ladders survived in the building of ceremonial rooms (kivas). Originally, the load-bearing walls of sandstone slabs were placed on a sunken foundation of rubble and clay mortar. Following the settlement of the Rio Grande Valley, where the supply of suitable stone was limited, the Puebloans began to produce crude hand-shaped, air-dried bricks of clay (adobe), which, in contrast to those later made by the Spanish colonists, were not mixed with straw and were therefore less durable. In some prehistoric buildings, walls were built up with layers of clay. The walls featured small windows or ventilation openings and sometimes also doors. The ceilings/roofs consisted of a grid of logs and thinner slats covered with branches of shrub, grass, and a layer of clay. The walls featured small windows or ventilation openings and sometimes also doors. The ceilings/roofs consisted of a grid of logs and thinner slats covered with branches of shrub, grass, and a layer of clay.
this had to be done by manpower. Roofs were surrounded by a small upstand and used as terraces. The layer of clay on the rooftop was laid with a slight incline toward this upstand, thus draining water into projecting drainage channels. Repair work, in particular to the roofs and walls, was carried out regularly once a year by the women.

Up until the twentieth century many of the buildings, which can have up to five stories, did not have doors at ground level. Access and the connection between the stories was by means of rung ladders rather than the previously used log ladders. Units inhabited by a household were primarily rooms stacked above and connected to one another. The living rooms featured brick fireplaces, chimneys, benches for sitting, and wall niches, and were located above the sleeping rooms and the storerooms at the bottom. Among the Western Pueblos (Hopi, Zuni, Acoma, Laguna) households consisted of extended families of three to four generations of women related through the female line, their husbands, and unmarried children. When the family increased in size, additional rooms could easily be added.

The second half of the twentieth century saw an increasing relocation of the residential population, especially of the Western Pueblos located on mesas, to villages at the foot of these mesas. However, the old villages continued to be used for ceremonial purposes, and in recent times have also been regaining importance as habitations.

Endnotes
Taos Pueblo, New Mexico (photo 1989)
Colonial Architecture in Colombia
Gx Samper, Ximena Samper in collaboration with Marieth Castro

The Spanish colonization of the Latin American continent had a distinct influence on its residential architecture. In the various regions, from Mexico to Argentina, a characteristic introverted architecture developed that is closed toward the outside and oriented toward the inner courtyards. This contribution analyzes the architecture of three important cities in Colombia from the colonial era: Cartagena, an important transfer port with connections to Europe; Popayán, located in a cool-climate zone in the interior of the country; and Mompox, a town that, in the sixteenth and seventeenth centuries, grew out of a trans-shipment point. These examples will also be used to describe the typological and construction aspects of the house in greater detail.

Cartagena and Popayán

The city of Cartagena formerly was an immigration port and was used for shipping South American products to Europe, mainly on Dutch vessels. This also had an effect on the residential development: instead of the usual two floors, there is an additional floor for the storage of goods that have to be protected from damp. By contrast to the houses in Popayán and owing to the heat in the city, timber canopies and balconies are a necessity.

Like all colonial houses, the courtyard houses of Popayán are purely designed as residences. The type of building again is inward-oriented, featuring a central courtyard that ensures that the private sphere of the inhabitants is safe. Characteristic of the Popayán house is a uniform external appearance; the image of the urban street is determined by the houses that link up with one another side by side.

Following the earthquake in 1983, the destroyed buildings were rebuilt. The objective was to retain the colonial structures. However,
most of the owners of the houses did not have the necessary re-
sources to fund a full refurbishment. For this reason the buildings
are mostly occupied by commercial users and the public spaces
are less populated than they were before.

Mompox

Mompox, located at the lower section of the Rio Magdalena,
used to be an important trans-shipment point for passengers and
goods that could be reached by steamboat. But, at the end of the
nineteenth century, the river changed its course, and Mompox
was left behind at a silted side arm of the river that is unsuitable
for shipping. That is the sole reason that, to this day, Mompox
has been completely preserved as a colonial city. The town
was developed in linear blocks along the river and displays charac-
teristic urban design patterns governed by the three streets
that run parallel to the river. In addition, Mompox was created
around its sacral buildings. As part of its identity, these build-
dings are focal points of orientation in the town and, today, also
key tourist attractions. The residential dwellings are mostly sin-
gle-story, with the exception of the casa alta (high house), which
has two stories.

A typical residence in Mompox is defined by a number of charac-
teristics, even though variations are possible. The main compo-
nents result from the close proximity of all houses in their urban
layout. This creates clearly defined public spaces. In the interior
of the buildings, a generous ante-hall is a common feature. The
other rooms follow on around one or several courtyards that are
surrounded by open, roofed-over galleries that provide shade
for the rooms. In a town with a very hot climate, this is essential
in order to make it possible to use the houses during the day.
In addition, there are ornamented balcony oriels facing the street:
one of them in front of the main room, which in some cases is
used as a business room or office, and one in front of the main
bedroom in order to underscore its importance. The oriels are an
expression of the social standing of the house owner, which is
why they play a big role in all buildings, from the simplest to the
more ornate.

By contrast, the family living room faces the courtyard, which also
provides access to the dining room and kitchen. A second court-
yard provides access to the secondary rooms: storeroom, room for
slaves, stables, cesspit, and well. The second access to the house
lies at the rear and is used for cars, horses, and goods. The external
walls of the house rest on foundations of shaped natural stone.
with polygonal surfaces and an irregular joint structure in the form of what is known as cyclopean masonry, without mortar. The walls themselves consist of bricks bonded with lime/sand mortar. As a rule they are 69 cm thick. The partition walls are built using the bahareque method, with a thickness of 40 cm, a construction system consisting of timber posts and panels of wattle and daub, which in former times was widespread. The widely cantilevered roofs are supported by uprights, with braces between them and the horizontal members. Sometimes these bracing members are inserted purely for decorative purposes. The rafters consist of round or sawn sections placed on purlins, and are visible from below. They support wooden close-board, which holds the roof tiles in a bed of lime mortar.

Another characteristic of the architecture in Mompox is the absence of large roof overhangs in the facades. Instead a decorative cornice forms the top of the elevation of the building. On the street side it is common to have double-pitch roofs, which continue toward the courtyard in the form of monopitch roofs. Access to the residence is emphasized by an elaborate portal. It is finished at the top by a horizontal frieze that features a combination of different classical styles. Two lateral pilasters are the only vertical elements, emphasizing the verticality.

**Bibliography**


Indigenous Architecture and Construction Technology in Mato Grosso

José Afonso Botura Portocarrero

The native Brazilian population uses timber from their local area in extremely skillful and sensible ways by empirically trying out options for using the material. They try out different forms of construction by way of trial and error. In this way they succeed in constructing incredibly lightweight, light-flooded buildings with just a few construction materials that are ideally suited to their requirements. They work like artists – thinking while proceeding with the work. They fell trees only in a very planned way, thus practicing early methods of sustainable forestry. In this way Indians preserve and retain the trees of the grass steppes and forests, securing their only source of raw material for house construction. They understand the forest to be part of their life and culture, and cultivate a respectful relationship with nature. They are aware of the fact that this coexistence is essential for their survival. Their profound knowledge of the variety of trees allows them to benefit from the properties of each type of plant, either for the construction of their houses or for medical purposes. However, the rain forest for them also has spiritual importance and is a firm component in the various ethnic groups’ view of the world.

When European explorers arrived, Indians played a key role by helping the invaders to partially decipher the codes of this “new world.” Their knowledge of plant species, minerals, the world of animals, and geography, which had been accumulated through generations and was passed on peacefully, was ruthlessly exploited by the foreign intruders in order to secure their colonial power through the introduction of a brutal regime of suppression. In particular, they paid little attention to the indigenous architecture with its climate-suited construction, considering it as inferior.

From our perspective today we can say that these buildings made the best possible use of locally available materials and local
The House and Its Technology

The houses of the Indians are considered to be simply executed albeit based on complex design — this apparent paradox practically applies to all indigenous buildings in Brazil. This essay deals with the house of the Bakairi, a tribe that lives near the Xingu River. The main and secondary structures of their buildings consist of timber covered with the leaves of various types of palm trees. At one time these materials were abundant in the region, but are now being increasingly displaced through the rapid expansion of agriculture. However, in the wider Xingu area it is still possible to find the material within the national park. Exploring the design of indigenous buildings is similar to rediscovering a forgotten genetic code. These buildings embody the cultural, symbolic, and cosmological — as well as the technological — legacy of the various tribes and, owing to their diversity, can become a source of inspiration for sustainable contemporary architecture that is committed to the environment. Houses built by the Indians have a fresh and inviting feel; they provide protection and are also capable of adapting to the needs of their inhabitants. The houses, with their pointed-arch-shaped roofs, seem to breathe through their wall claddings. The aerodynamic shape offers only a small profile to the wind and makes a critical contribution to surviving tropical storms. The unique design of these houses is still exemplary. However, most people today have a certain difficulty in accepting the achievements developed over hundreds of years as proper technology.

Claude Lévi-Strauss provides valuable observations regarding the recognition of foreign cultural inheritance; his poetic words and paradigms shall be cited here: “the houses were majestic in size in spite of their fragility, and were the result of the utilization of materials and techniques which we in the West are acquainted with in small-scale forms: they were not so much built as knotted together, plaited, woven, embroidered and mellowed by use; instead of crushing the occupants under an indifferent mass of stones, they adapted to their presence and their movements; they were the opposite of our houses in that they remained always subordinate to man. The village rose round its occupants like a light, flexible suite of armour, closer to Western women’s hats than to Western towns.”

Regarding the appreciation of the original people’s knowledge, Lúcio Costa had already pointed out the necessity and importance of paying attention to this, and had demanded “that the things that had hitherto been despised or even covert by disregard be embraced with sympathy and used as an opportunity for new research, not least as that we, the modern architects, can benefit from this knowledge.”

The Sensuous House

We will present here the atã, the Bakairi house, as an example of indigenous architecture of Mato Grosso. The Bakairi speak the language of the Carib and live in the Federal State of Mato Grosso, primarily in the Cerrado region, about 300 km to the east of the capital, Cuiabá. Their mighty longhouses, construction of which has long ceased, were described by Karl von den Steinen in 1887 during his second expedition to Xingu. His records are the only ones available on this subject: “You had the sensation of entering a huge beehive, but luckily without bees. The floor plan was almost circular with a diameter of 15 meters; two huge posts, 9 meters tall and placed at the center 3.5 meters apart, support the mighty straw dome, the substructure of which consisted of horizontal bamboo rings and rods bent perpendicular to these upward toward the opening. It was blackened by smoke, shiny like tar. […] In summary:
a family dwelling in full use, just as much disorder as is needed for comfort, everything clean and neatly arranged, everything suspended, boxed, stacked, no iron nails or screws, only threads and braiding, everything worked with a stone ax, animal tooth, and shell. The overall impression: brown the wall, the hammocks, the gourds, the people, brown in every shade but harmoniously so, very 'Knaus.' Here and there the sun shone through a gap in the straw dome, the bright daylight could be seen through the door, and the alley between the doors lay in half-shadow; through the opening, which was rather tightly locked, a few shafts of light formed flecks and circles on the floor, and mat specks of dust danced in the rising smoke.” In conclusion the German doctor and researcher wrote about his stay with the Bakairi: “I do not hesitate to look upon these days as the best I have ever experienced.”

Von den Steinen observed with much acuity: “The hammocks were tied to particularly strong posts on both sides, from the wall toward the interior, in radial fashion, which meant that the outside space was subdivided into a number of compartments, albeit open. The large central space around the main posts and beneath the opening remained clear, serving as kitchen and for stacking the food baskets, pots, earthen Beijú pans, sieves, mats, panniers, mortars, pestles, and gourds. Sticks with climbing plants were tied to the main posts and were used to hang pumpkin shells or tobacco bundles, large birds with legs and tails braided from straw were dangling from a cross beam, and looking very mysterious and serving the sole purpose of storing the cobs of corn that made up their inards and wings in a way that pleased the eye. The floor was lined with a rock-hard layer of fine white cassava flour, the pestles and mortars were white like the flour and the pots were blackened by smoke. Above the doors were baskets with gourds, creels, fishing nets, in the ‘chambers’ on the wall bows, stone axes, the colorful feathered arrows poking out of the straw of the dome, a heap of little baskets, drinking bowls and small equipment, on the floor white clay balls, small pots, stools, bits of wood, fans for the fire, and the ash of the little fire, which everybody maintains at night next to them and almost beneath their hammock, at the hammock a small bunch of colorful feathers and a comb, here and there a pyramid of rods with the frying grid, also hung up a pair of sticks that are used for starting a fire, and next to it tied a small packet of tinder.”

The size of the atã, with its oval-shaped footprint, should be roughly the same as that of the indigenous houses built to this day in Xingu. The entrances are in the middle of the longer sides. Inside visitors are greeted by a very special atmosphere of filtered light. It is a thoroughly sensuous house: lively, well ventilated, with a constant subtle play of light and shadow on the walls and an enormous variety of color nuances. Like birds build their nests, the Indians weave their houses using the materials offered by nature, which they join by bending, tying, and braiding. This creates mystical spaces such as we no longer know in our contemporary civilized world.
Endnotes


2 In areas of proper forest management, on average five trees are cut down per hectare and only the oldest trees are selected. This area will not be worked on again for about thirty years so that it can recover in the meantime.


5 The first images of the Bakairi houses are by Wilhelm von den Steinen and were produced during the two expeditions led by Karl von den Steinen in 1884 and 1887.

6 The Parque Indígena do Xingu was declared a national park in 1961 and today has an area of about 2,600,000 hectares and a population of about 5,500.

7 Eduardo N. Alves and Fernando Tuféia, “Altemativas para as tecnologias habitacionais” (Mimeo, 1984).


10 Karl von den Steinen, Unter den Naturvölkern Zentral-Brasiliens (Berlin: Reimer, 1894), 84.

11 Hed, 81.

12 Ibid., 85.

Bibliography


Adobe
Air-dried, unfired clay brick. The term, which originates from Arabic, was adopted primarily in the English language via Spanish.

Balloon-framed building
Timber frame building in which the wall studs extend through more than one story and the intermediate floors are attached to the upright members.

Banco
Term for clay in various regions of West Africa, including among the Dogon in Mali.

Black tent
Type of tent that is widely used from North Africa to Central Asia; its woven covering consists of wool of dark animal hair, usually from the goat, in Tibet also from the yak.

Brick (also tile)
Fired masonry unit or roof tile made of clay.

Byre-dwelling
A long house in which the living quarters are combined with the livestock and/or grain barn under the same roof. A central hall is accessed from the side of the house and originally also had a cooking facility.

Clan
Larger family grouping, the members of which share the same provenance.

Clay, loam, mud
Mixture of clay, silt, and quartz sands produced through erosion. It can be found almost everywhere in the ground and can be used in its natural damp form, or by adding water, to shape building components. Depending on the content of binding clay, the material is referred to as lean clay or rich clay.

Cleat
Timber section, the thickness of a beam, that is used to give additional support to a cantilevering timber member; in half-timbered buildings this is often sculpturally embellished.

Clinker brick
Brick fired at high temperatures (1100–1300°C) resulting in a particularly strong and weather-resistant product.

Collar beam
Horizontal bracing timber section fitted between the rafters in a rafter roof.

Corbelled vault (false vault)
A vault, which is formed by the layer-wise projecting of the bricks or stones.

Dampness inherent in soil
Natural dampness of soils such as clay.

Earth house
A house that is wholly or partially dug into the ground and covered with earth.

Felt
Animal wool, primarily sheep's wool, treated by felting; it is a nonwoven material that is easy to manufacture. The material is used by the nomads of the Turkic people and the Mongols, among others, as a covering material for their yurts.

Feng Shui
Taoist concept (literally meaning "wind and water") aimed at bringing about harmony between people and their environment; in ancient China it was also used to find suitable locations for building houses and for aligning the house and rooms in a harmonious way.

Gamble
Turf-covered, solid earth house of the Sami people in northern Scandinavia.

Ger/Güber
Felt-covered lattice grate tent used by the Mongols.

Grass sod
Square piece of turf cut from the natural ground. Grass sods are used in Scandinavia, among other places, as a roof covering material.

Half-timbered construction
Timber construction with uprights and braces, etc., with the open panels filled in with another material. The open panels are usually filled with wattle and daub or with masonry or brick nogging.

Haveli
Large multifamily dwelling with several courtyards in cities in India.

Igloo
Winter dwelling of the Inuit in the Central Arctic. Igloos are built as genuine vaulted constructions using blocks of snow.

Infill panel
Part of the wall between structural timbers in half-timbered buildings that is filled with wattle and daub or masonry/brick nogging.

Jali /Jaali
Building component with a lattice-like structure of natural stone, wood, or brick in India that is used for providing ventilation as well as privacy.

Ksar
Fortified village in Morocco.

Lap joint
Joint between two parts of a structure, where the upper part slightly overlaps the lower one.

Main rafters
Part of the roof structure, these timber members are suspended at the top end from a purlin, usually the ridge purlin.

Minka
Term used for the houses of ordinary citizens in Japan – both in the city and also as farmhouses in the country.

Mountainside village
Settlement whose houses are arranged like stairs on a mountain slope. The resulting roof terraces are usually used for storage and drying of food for the winter, sometimes also for development.

Oberrähm construction
Timber frame construction in which the Rähm (head plate) is placed above the rafters.

Pisé (rammed earth)
Construction using earth rammed into shuttering (from French pisé: to ram).

Platform construction
Half-timbered form of construction in which each story is completed before the next one is added on top.

Post and beam (mullion/transom)
Wall construction consisting of vertical members (often extending through several stories) and horizontal transoms between them.

Maloca
Communal dwelling house of the indigenous people in the Amazon and Xingu areas of South America. Several nuclear families of a clan live in a longhouse with barely any subdivisions, or occasionally in a round building, nevertheless mostly using their own fireplaces.

Mashrabiya
Decorative wooden grate in traditional Islamic architecture, used as a window grate to provide ventilation to rooms and to provide privacy.

Mumaya
Type of tent that is widely used from North Africa to Central Asia; its woven covering consists of wool of dark animal hair, usually from the goat, in Tibet also from the yak.

Mugal males
Large multifamily dwelling with several courtyards in cities in India.

Igloo
Winter dwelling of the Inuit in the Central Arctic. Igloos are built as genuine vaulted constructions using blocks of snow.

Infill panel
Part of the wall between structural timbers in half-timbered buildings that is filled with wattle and daub or masonry/brick nogging.
Post construction
Timber construction in which the vertical posts are sunk into the ground; this is in contrast to timber studs that are placed on a foot plate.

Pueblo
Indigenous form of settlement in the southwest of the United States, the term being derived from the Spanish word for village. Typically, a pueblo will consist of a large number of rooms joined horizontally and vertically built in clay brick construction. Vertical access is provided via ladders.

Purlin roof
Roof construction in which the rafters rest on horizontal roof beams (purlins).

Rafter roof
Roof construction consisting of pairs of rafters that are placed against each other at the top (without a purlin) and form a series of load-bearing triangles.

Rähm beam
Horizontal top timber section (top/head plate) in a frame or wall in a half-timbered building. The Rähm is joined with the uprights (studs) and often serves as a bearing for the ceiling joists.

Rammed earth (also pisé)
Construction method that uses clay for building solid components. The damp mixture of clay and stone conglomerates is compacted in usually movable shuttering.

Rattan
Climbing palm tree, the long shoots of which are used for connecting or tying timber or bamboo construction elements. The scarf joint is used in rammed-earth construction and is usually moved vertically but occasionally also horizontally.

Roshan
Latticed wooden corner window.

Scarf joint
The scarf joint is a method of joining two timber members end to end, with the joining faces cut at an oblique angle and the timber surfaces continuing flush, forming a solid joint.

Sedir
Raised seating element in the Turkish house in Anatolia.

Siheyuan
Courtyard house in China with an inner courtyard with buildings on four sides.

Silt
Sediment consisting of very fine sand.

Skim coat
Thin surface coating that traditionally is made using lime or clay.

Slash-and-burn agriculture
(also roving agriculture)
Traditional form of creating areas for agricultural cultivation, particularly in the tropics; the practice involves clearing the land and burning the natural vegetation. The resulting ash serves as a fertilizer. When the soil is exhausted after a few years, people move on to new areas, which are treated in the same way.

Silt building
Timber construction method in or close to water in which usually pointed stilts are rammed into the ground and carry the house.

Stube (living room)
In the traditional houses of Central and Eastern Europe, a heated room for daytime use. In addition to the kitchen, this was often the only room heated in winter.

Stud construction
In contrast to log construction, this form of building uses framework made up of vertical studs and horizontal beams.

Subsistence farming
Form of agriculture with the primary aim of supporting a family or small community (as opposed to commercial farming).

Tatami
A 5 to 6 cm-thick floor mat made of rice straw. The standard size of the tatami of approximately 90 × 180 cm, which varies slightly from region to region, forms the basic grid in the Japanese house.

Tipi
Cone-shaped pole tent of various indigenous peoples in North America.

Timber framing
Term used for all construction methods in which the roof is supported by a timber frame.

Tulou
Round or rectangular fortified communal dwellings of the Hakka and some other ethnic groups in southeast China; approximate translation: earth house.

Turf roof
The term turf roof applies to different methods of covering roofs, which all have in common a layer of earth that contains different types of grass and (matted) roots.

Umgebinde
In the Umgebindehaus (Upper Lusatian house), a load-bearing timber-frame structure encloses an inner self-supporting building volume built in log construction, which normally contains the living room.

Unterrähm construction
Timber-frame construction in which the Rähm (head plate) is fitted beneath the rafters.

Wattle
Warted latticework made of willow shoots, branches, or strips of bamboo as a carrier material for the clay surface material (daub). Often used in half-timbered buildings for closing open panels between the structural timbers.

Whare
House of the Maori in New Zealand.

Wind tower
Tower-shaped part of building with openings supporting natural ventilation and cooling of houses in the Arabic region and in Persia.

Yurt
Felt-covered lattice grate tent used by the Turkic people. The term originates from the Turkish language and refers to the camp site rather than the house.
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