HABITAT

Thames & Hudson

Edited by Sandra Piesik

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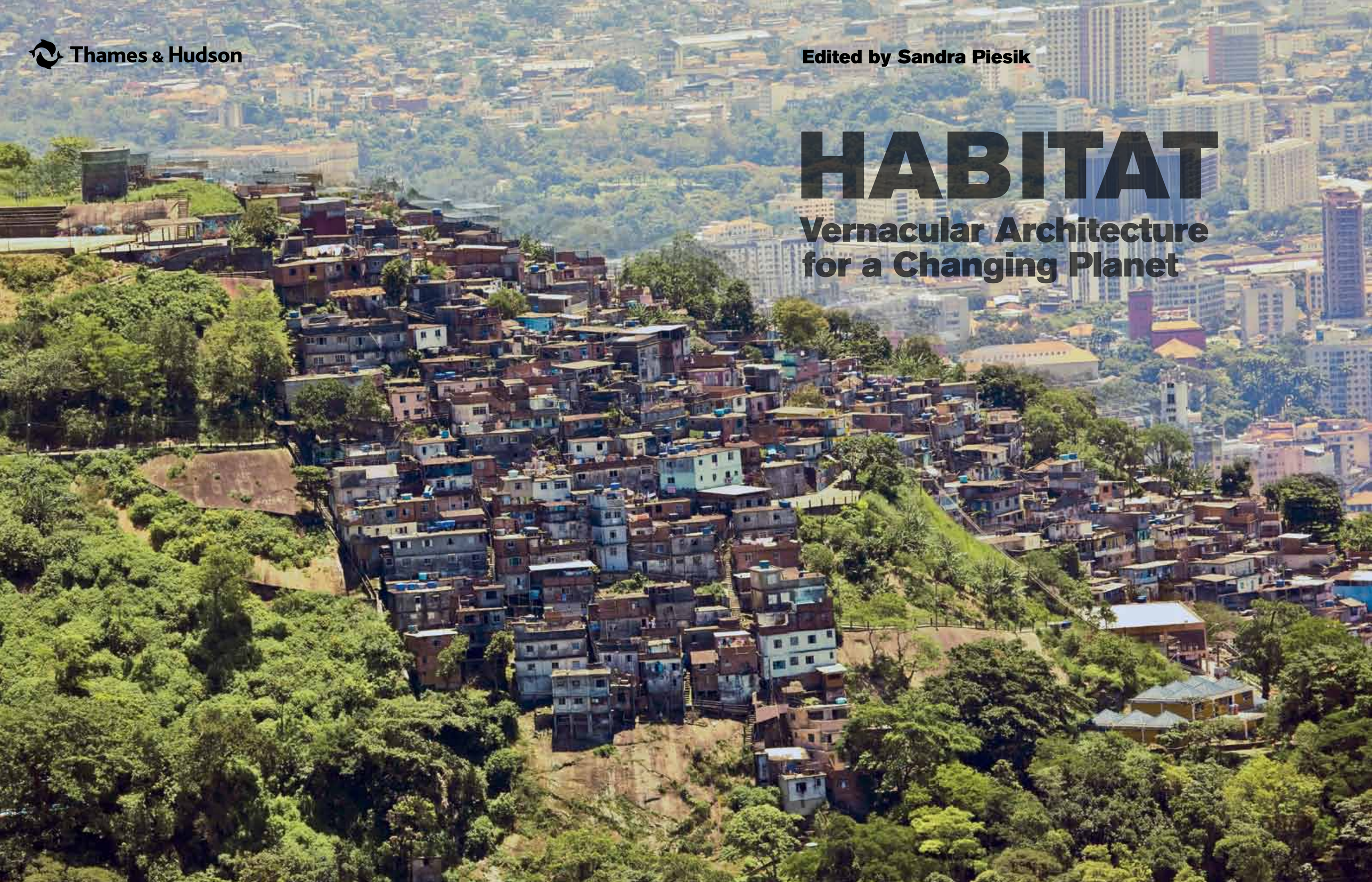
Vernacular Architecture for a Changing Planet



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Introduction

The Timeless Lessons of Human Ingenuity

Sandra Piesik

The diversity of architecture on earth is immense. While we are becoming increasingly accustomed to living and working in urban centres with 'international style' and standardized global building technologies, it is useful to remember the rich variations in the way we dwell on our planet. A vast range of factors – shifting continents, climate zones, materials, species, migration, local cultures and technologies – have been critical in shaping the way we shelter humanity. Now, more than ever, all of these elements are in flux. The necessity to understand our past and our local building cultures has never been more important for the future. *Habitat: Vernacular Architecture for a Changing Planet* is an ambitious survey that presents a breathtaking spectrum of indigenous buildings and local traditions, many of which are being lost to modernizing and globalizing forces. The book presents lessons for how we can better respond to these seismic forces.

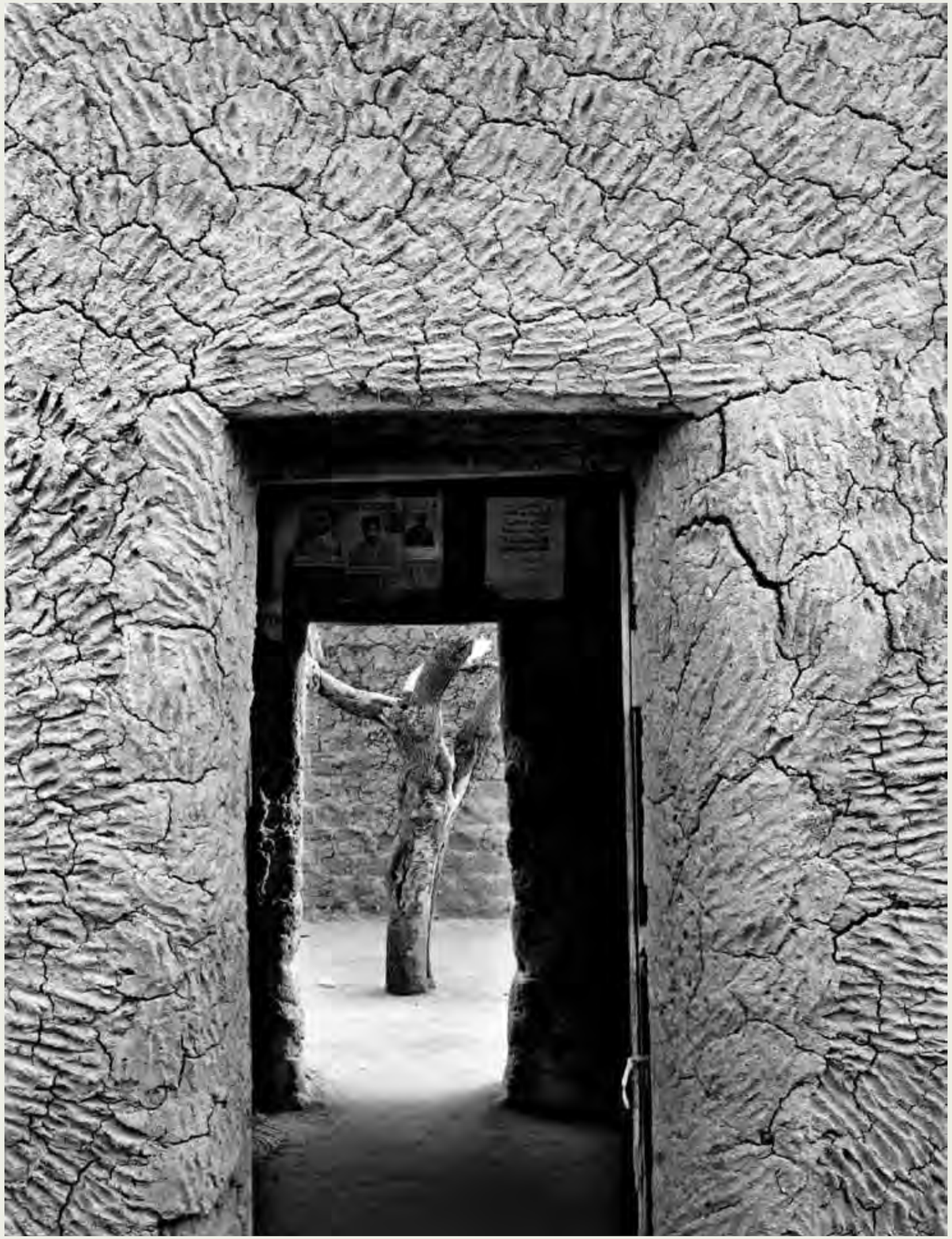
Historically, vernacular technologies have been developed specific to their context and were derived from empirical and physical experiences of climate. The fundamental aspect that unites the development of early construction technologies throughout the world is the availability of local materials: from animal skins and plants to stone and earthen bricks. As well as addressing the basic human need for shelter, these resources have been used to create magnificent structures that often served as landmarks, drawing on geometry and vision to produce striking examples of vernacular architecture at an impressive scale. The Melanesian architecture of Papua New Guinea or the communal malocas of Brazilian Amazonian nomads are just two instances of vernacular responses that illustrate great craftsmanship of buildings, comparable to Gothic cathedrals or Japanese temples.

The diversity of architectural forms created in response to a specific climate not only relates to the local materials available, but also to the particular temperatures experienced diurnally and annually. In a desert climate, for instance, high daytime and freezing nighttime temperatures are often mitigated through the use of housing with thick walls that offer thermal protection. Patterns of use and migration are equally affected by seasonal temperature changes: we are accustomed to dwelling in the same house all year round, while also occupying permanent and temporary enclosures that can accommodate seasonal diversity. Yet patterns of migration – even within an individual house – can be seen in some climates and cultures, such as in Western Asia, where inhabitants move to different areas to adapt to the changing temperature patterns of solar radiation and hot summers.

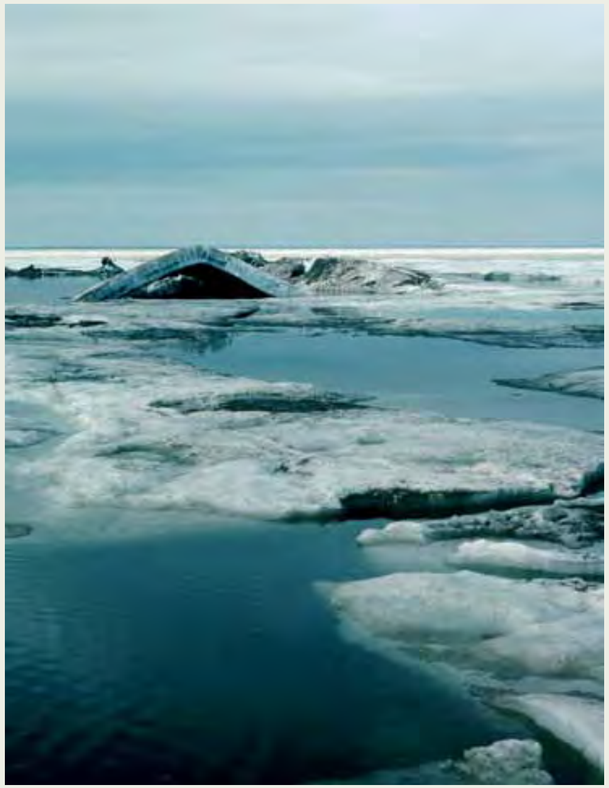
Most vernacular habitats have an extremely efficient use of natural materials, spatial functions and environmental devices that illustrate thoughtful technological innovations developed in the past. Very few materials generated by daily life remained unused, and many types of agricultural or general wastes were incorporated into building components.

Significant challenges relating to climate change, economic instability and human migration have never been more pressing. We are also confronted by population growth, the uneven distribution of food and the rise of globalized trade. How, in the face of a man-made anthropocene era where the impact of human activity on the planet has irreparably altered our environment, can these modest vernacular techniques and materials help us? Though vernacular architecture cannot save the world, it holds clues to established techniques that have allowed cultures to live in harmony with our environment while maximizing the use of regional economic resources. Some

Vernacular architecture cannot save the world, but it holds clues to established techniques that have allowed cultures to live in harmony with our environment while maximizing the use of regional economic resources.



Opposite This doorway to an inner courtyard in Agadez, Niger, is formed of sun-baked clay bricks that wear the cracks of heat gain.



Opposite, top A circular *maloca* construction of the Yekuana Maquiritare (Mayongong) in the upper Orinoco region provides a traditional multi-family dwelling.

Opposite, bottom left Folded sea ice in the Arctic. Changes in sea levels and climate change continue to affect our environment in significant ways.

Opposite, bottom right Vernacular responses to local materials shape the way in which buildings are made. In Sweden, for example, buildings were historically constructed from readily available rough-sawn planks.

Below The Köppen–Geiger map delineates climate zones of the world based on zones of vegetation and climatic patterns identified in each of the five distinct categories: Tropical (red), Dry (yellow), Warm Humid (green), Cool Humid (purple) and Polar (blue).

natural materials that have been in use for thousands of years are no longer employed or are disposed of in landfill sites, yet for many countries they remain a vital part of contemporary economies, such as agricultural, agro-forestry or quarrying industries.

Regional economic growth is closely connected to the development of traditional technologies. The building examples presented in this book have been honed over centuries to utilize renewable materials most efficiently, and yet much of the globe, particularly in rural areas, continues to face poverty. It is in these areas that the use of indigenous techniques can help alleviate poverty. Construction skills can create employment and utilize agricultural waste while local materials can be used for practical, stable building solutions.

Destitution faced by those in the inhospitable desert climates, whose condition has been worsened by climate change, is one example of where vernacular architecture can help. By observing ancient vernacular techniques in such inhospitable climates, we discover tools that could provide housing and opportunity for economic growth.

Such fundamental problems of building for survival may suggest that aesthetic issues are secondary, meaning that we face a stylistic problem of how to interpret the vernacular. There are numerous examples of contemporary architectural languages that have been derived by visually imitating the past, and new design and construction technologies have increased the complexity of stylistic variations and possibilities in architecture. And yet, these new digital tools are used in less than 5 per cent of the global construction industry. Many countries continue to construct buildings by hand, and these traditional hand-made technologies can perform perfectly well in those regions. Perhaps what is most needed is to link new technologies with a greater knowledge of traditional techniques and indigenous materials. The resulting built solutions have the capacity to perform incredibly well structurally and thermally, as well as being stylistically appropriate to their local surroundings.

Just as new and ancient technologies can influence each other, similarly, cultural boundaries are porous. For millennia cultures have affected each other and imported or exported ideas and aesthetics to different parts of the world. One such example is eighteenth-century colonial architecture, which was widely imitated around the world, with mixed results. The destruction of local buildings in the seismic zones of Latin America, where indigenous constructions were superseded by European-style architecture unadapted to earthquake zones, has had disastrous consequences.

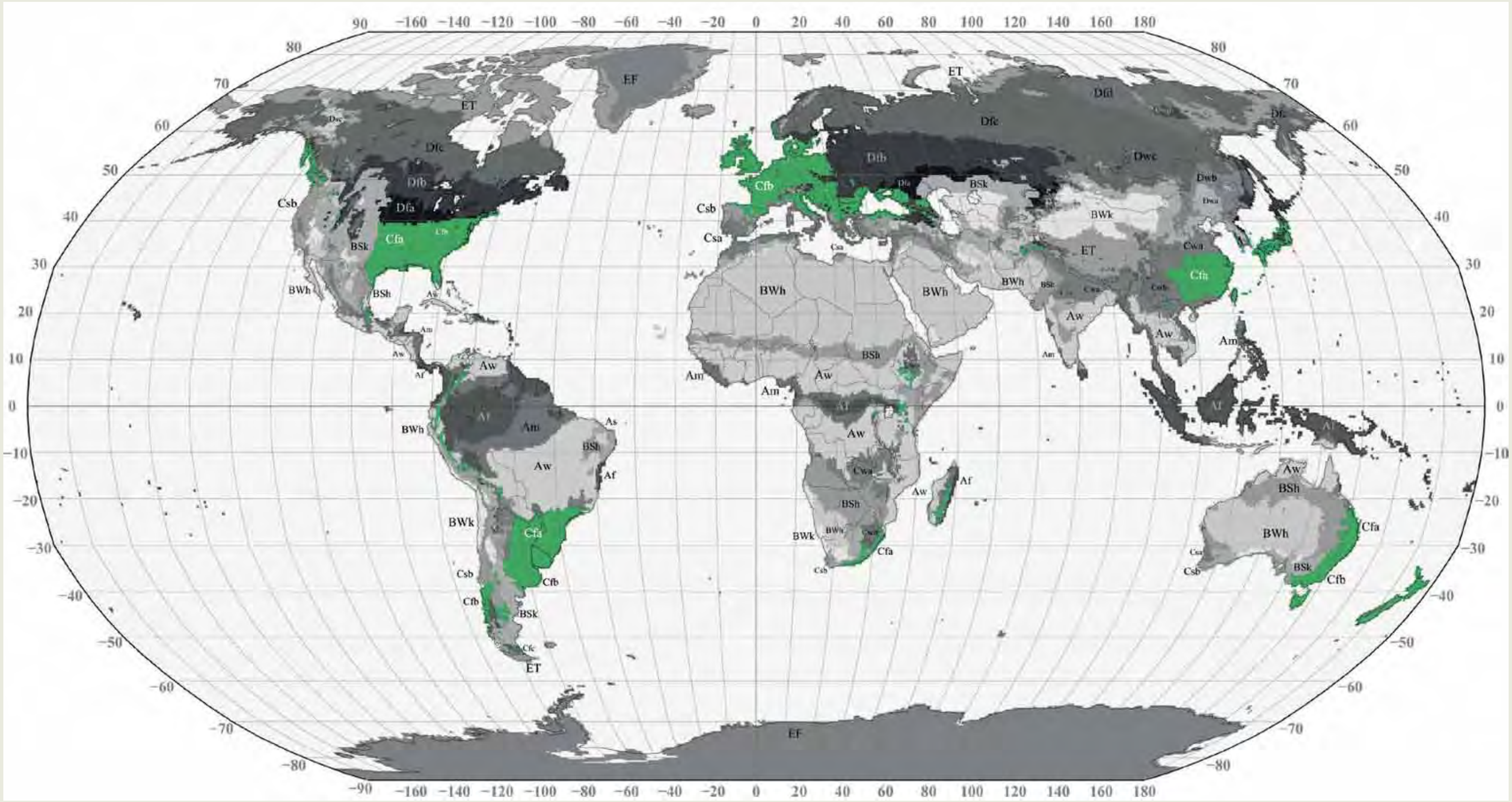
In an age of increasingly globalized style, the story of imported aesthetics has another dimension. Every tribal group expresses its identity through ornamentation and small modifications of local architectural style or technology. Buildings and interiors have been adorned and localized throughout the centuries – from Alaskan Eskimo houses to Ugandan huts and Bedouin tents in the Rub Al Khali Desert. The differences proudly displayed the distinctions between tribal groups, even in the most remote places on earth. Supplanting this visual identity of a tribe partly eradicates the cultural identity of a nation.

The phenomenal diversity from across the planet collected in this volume celebrates above all a sense of community or belonging: to a family, a place, a tribe, or a religion. Many vernacular buildings offer aspects of a spiritual dimension or cosmological understanding of the world that we are losing today at an astronomical rate. *Habitat: Vernacular Architecture for a Changing Planet* offers suggestions on how our planet can be inhabited in harmony with nature and with each other.

Perhaps what is most needed is to link new technologies with a greater knowledge of traditional techniques and indigenous materials.

WARM HUMID

The moderate temperatures of warm humid climates have shaped architectural solutions that provide cooling and shading during summer seasons, and thermal mass for autumns and winters. Hardwood, mud, brick, straw and agricultural by-products for roof thatching are among the most commonly used materials.



Materials, Buildings and Adaptations for Temperate Climates

Spread across several continents, including southeastern regions of North and Latin America, Europe, Eastern and South Eastern Asia as well as the North Pacific Islands, temperate climates are often located on geographic borders of desert and rainforest climates. Classified as 'C' in Köppen–Geiger's system, seasons and moderate temperatures of warm humid climates have shaped architectural solutions that provide cooling and shading during summer seasons and thermal mass for autumns and winters. Vegetation of temperate climates is similar across continents: hardwood, mud, brick, straw and agricultural by-products for roof thatching are among the most commonly used materials.

Architectural solutions in a temperate climate share passive methods of cooling and use of materials. However, the differences are apparent in the builders themselves – from native indigenous peoples to the later arrival of other cultures. Both North and Latin America have case studies of early constructions as well as modified colonial architecture that was adapted its to fit local conditions. In North America, the construction of an indigenous 'chickee' house originally built by Seminole tribes with cypress log structures and thatched roofs of palm fronds sits alongside colonial architecture in the form of the Charleston House and Shotgun House typologies.

The temperate climate of Latin American produced a similar pattern of indigenous and colonial architecture across Paraguay, Uruguay and Chile. Rural areas are characterized by pre-Columbian indigenous architecture that has been adapted to Hispanic and Portuguese styles. These two typologies of native and colonial architecture demonstrate porous cultural boundaries and the influence of one culture upon another while also embracing local climatic conditions and resources.

Cultural diversities could not have been more apparent than in Europe, where the presence of many diverse ethnic groups produced vernacular architecture in response to equally diverse micro-climates. Materials such as timber, stone, earth, clay, brick, mortars and wattle-and-daub have been shared across the continent. Environmental elements such as wind, rainfall, exposure or protection from the sun as well as various settlement densities from cities to rural areas shaped the European vernacular.

Eastern and South East Asia, as well as the North Pacific Islands, offer exceptional examples of timber construction and technologies; Chinese, Korean and Japanese vernacular is synonymous with this material. In China, for example, wooden courtyard houses orientated in response to climatic conditions were arranged to form compounds and uniform urban systems that also reflected the social structure of Chinese society. Round *tulou* typically seen in the Fujian Province of coastal Southern China epitomize communal architecture that may provide a solution for neighbourhoods of densely populated cities today. Kam architecture in China's Guizhou Province demonstrates another type of communal self-sustainable living based on agroforestry. The use of local timber by highly skilled carpenters has created magnificent drum towers structures that are central to Kam living.

Rare examples of South Korean ***neowa*** houses with bark-shingle roofs and predominantly red pine construction engage with rural living in mountainous areas. Different timber species were used for different ***neowa*** building elements, which demonstrate the sophisticated adaptation of architectural form in response to different plant species. The ancient history of Taiwanese vernacular is best represented in settlements that belong to one social group of a single clan. Their architectural form of settlements accommodates houses for immediate and distant families of one social group. Meanwhile, Japanese ***minka*** houses offer an archetype of 'houses for the people' and a masterclass in the diverse use of plant-based materials for both rural and urban areas.

Chickee, Charleston and Shotgun Housing in the American South

Gray Read and Larisa Marenco

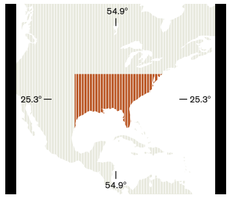
Geography/Climate
The southern vernacular of the United States comprises three main building types within three distinct cultural building traditions, which respond specifically to the warm-humid climate of the region: the palm thatch 'chickee' built by Native Americans in Florida; the Single House characteristic of Charleston, South Carolina, based on a Classical European type; and the Shotgun House, ubiquitous in the 19th century and said to have origins in Africa and Haiti.

Building Plan/Form
All three types adopt similar climate strategies, yet in strikingly different architectural forms. All include porches and shaded yards as principal areas for work and social life, creating an urban pattern that allows breezes to penetrate even compact cities. And all offer high ceilings and strategic openings to induce ventilation by drawing hot air up and out.

The 'Chickee'
Among the diverse building traditions of the native peoples of the region, an iconic example is still built as garden structures by members of the Seminole tribe of Florida using traditional, local materials. The 'chickee' consists of a structural frame of rot-resistant cypress (Cupressaceae) logs covered by a thatch roof made of palmetto (Sabal) fronds. Historically, chickees often had a raised platform of small, split cypress branches to provide working or social space – whether in a village or constructed remotely as a hunting or fishing camp in the exposed Florida Everglades.

This raised platform catches the breezes and provides some defence against insects, while the high-pitched, dense roof of the chickee shades and insulates from the sun and sheds rain while allowing heat to rise up and out. Chickees can be built quickly from common wetland trees joined or lashed together – and they can be disassembled just as rapidly, leaving behind no non-organic waste.

The Charleston Single House
The English and French settlers who arrived in the southeastern region of the United States brought with them a very different idea of architectural form from those of the indigenous population – building boxy, symmetrical houses based on Renaissance principles of proportion. The implicit model for a colonial house had a central stair hall with flanking rooms on two or three levels, and presented a formal façade to approaching visitors. In the warm, humid climates of many colonies – including those of India, South Africa and the Bahamas – wide roofs and porches surrounded a square house. In the American colonies, the manor houses of southern plantations had sweeping verandas, sometimes on two levels, supported by tall, Classical columns, creating a portico that almost engulfed the house. These elegant properties oversaw vast plantations worked by slaves brought from Africa, until the mid-19th-century Civil War abolished the



Rainfall (in/per annum)
25

Population average (per 100 mile²)
9,000

Sunshine (days per annum)
330

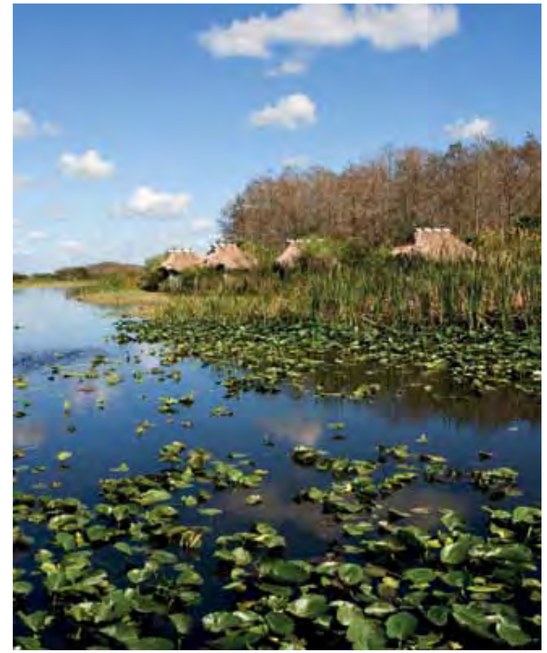
Altitude (metres above sea level)
500

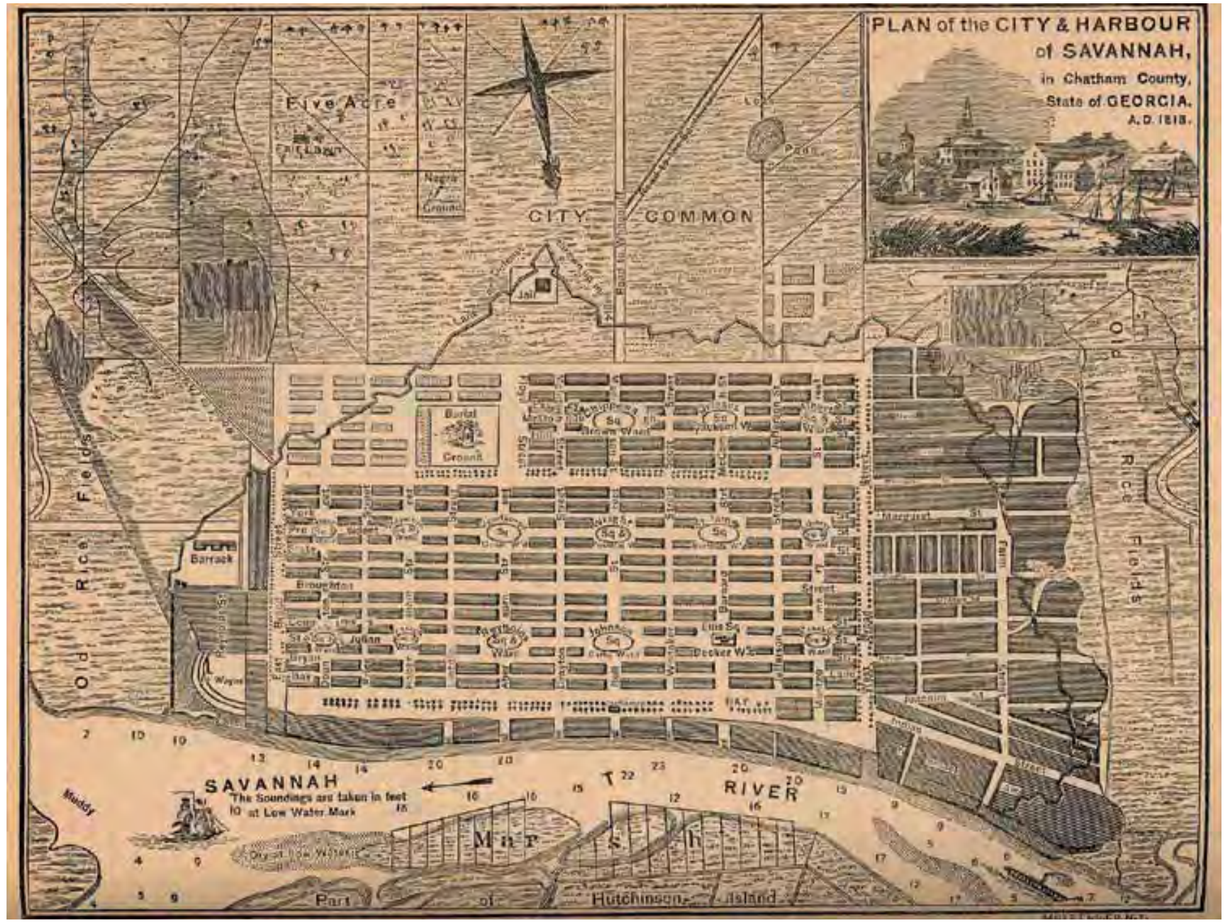
Humidity (%)
2

Below Garden structures known as 'chickees' are built in Florida by Seminole tribes and draw on readily available local materials for their construction. The raised, open-sided platforms for socializing and work admit cooling breezes that provide relief from humid climatic conditions.

Opposite, top Formed of a timber frame and thatched with palm fronds, the simple 'chickee' structure shades and insulates its inhabitants. Its breathable roof allows heat to release and it can be disassembled as quickly as it is made, leaving no inorganic waste.

Opposite, bottom In contrast to the indigenous vernacular, homes and cities of settlers in America's south were shaped by their European heritage. This 1818 map of Savannah, Georgia, illustrates the city's rectilinear urban plan designed by General Oglethorpe, based on narrow lots and streets flanking shared garden squares.



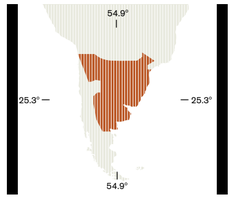


Quincha, Adobe and Stone Structures of Latin America

Natalia Jorquera Silva

Below Encompassing a range of microclimates, the warm humid regions of Latin America include areas as diverse as Brazilian jungles, the verdant plains of Uruguay, semi-desert valleys of northern Chile and Argentina, and the Mediterranean climate of central Chile.

Opposite This adobe house in Pumanque, Chile, includes a shade-giving veranda to provide relief from intense heat. Such adaptations typify colonial Spanish and Portuguese influence on vernacular buildings in Latin America.



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Geography/Climate

Within the area classified as a temperate warm-humid climate in South America, there are many variations and sub-climates. This vast territory covers almost 18 million square kilometres and its diverse geography creates many local microclimates, which supply a variety of natural resources.

The many 'micro-environments' of its temperate, warmer humid areas alone vary from the subtropical jungle in southern Brazil and parts of Paraguay to the temperate oceanic climes in the plains of Uruguay, the semi-desert valleys in the central-north of Chile and Argentina and the Mediterranean climate in central Chile. However, common features of all these environments are four well-defined seasons and precipitation, to a greater or lesser extent depending on the exact location. The presence of rainfall promoted the growth of vegetation and the use of timber as a basic element of indigenous construction. This was then supplemented by adobe, brick and stone masonry with the arrival of Spanish and Portuguese settlers from the late 13th century onwards.

Materials

Despite the existing climatic and cultural differences across this vast area, some constants remain in its vernacular architecture. This can be seen despite the many cultures from which this vernacular originates – indigenous, Spanish or Portuguese, African or mestizo (mixed race or ethnicity – often Spanish/Native American). Both the 'informal' indigenous and the 'established' colonial architecture used local materials and responded optimally to the environment in which they found themselves, serving as examples for sustainable architecture today.

Construction Techniques

Throughout the southern part of the continent, two main types of vernacular architecture can be distinguished: that of indigenous pre-Columbian origin and that of the Hispanic and Portuguese colonial period. The latter was adapted to the local environmental and cultural conditions, and its construction techniques were influenced by pre-existing technologies.

The indigenous architecture of these temperate and humid areas of the continent is characterized by its informality; its sporadic (temporary or seasonal) nature; and by the fact that it was limited to basic activities such as eating and sleeping, while the remaining domestic activities were undertaken outdoors. The houses comprised half-timbered structures, which were either left open or infilled with a mixture of light vegetable matter or raw earth mixed with vegetable matter. The wetter and warmer the climate, the more open were the dwellings in order to improve natural cross-ventilation. However, in places with a greater diurnal temperature variation, external walls made of raw earth and thatch were the preferred method of enclosing interior space. Nowadays, many examples of Latin American indigenous vernacular architecture still exist in rural and remote areas

The region's colonial 'vernacular' followed a formal well-defined architectural and constructional pattern, and therefore might not be considered as a true vernacular. However, with the passage of time this architecture was adapted to various local environmental realities: the different climates of each country and region; available natural resources; prevailing local techniques; and, in the case of Chile, seismic activity. These local differences had an impact on the otherwise uniform architectural typology – for example, on the colonial hacienda, which are widespread in Chile, Argentina, Paraguay, Uruguay and Brazil but which vary greatly in their construction techniques.

Building Plan/Form

Paraguay

Paraguay's traditional architecture retains the strong legacy of the Guaraní people, mixed with the influence of the Spanish conquest. This architecture is now most evident in rural areas, and it is characterized by the combination of a couple of enclosed spaces with one or more semi-open spaces, which ensure natural ventilation to deal with the heat and humidity. This type of building is considered a 'big roof', which is open sided and which can be adapted for different functions. The local materials used are timber, palm, straw and leather – with the straw-thatched roof being a very typical characteristic of the country's indigenous architecture.

Uruguay

In Uruguay, indigenous architecture from various ethnic groups (the Charrúas, Guenoas, Minuanes and Chaná-timbúes) also centre around the sporadically inhabited house made of wood, leather and vegetable matter. With the arrival of the first Portuguese settlers in 1680, stone began to be used as a construction material. The best-known examples of this technique are the architecture of the city of Colonia del Sacramento, now a UNESCO World Heritage Site, and some colonial buildings in the historic district of the capital, Montevideo. Rural housing, as in Paraguay, combined both indigenous and colonial traditions, and was built mainly on raw earth – especially when adopting the technique known as terron (a block cut directly from the soil) with a timber frame covered with rough straw.

Chile

The various indigenous ethnic groups that inhabited Chile's central, temperate zone left a legacy of temporary architecture built with vegetation and raw-earth elements, known locally as quincha. This technology is particularly common in the north-central region of the country known as Norte chico ('Little north'). In this area, there are still many rural towns whose architecture is a product of both adaptation to various environments and a symbiosis between indigenous traditions and the Hispanic legacy. The buildings there maintain some colonial features but the technology is indigenous, with the predominance of half-timbered and earth-daubed walls with thatched roofs.

In the central region of Chile, which has a Mediterranean climate, the most important traditional and recognized architecture is of Spanish colonial origin. It is characterized by the use of adobe as the main building technique, a product of the local abundance of clay soil. This provides thermal mass, with large, thick walls – an important response to the significant variations in diurnal temperature. This architecture is encountered in hundreds of villages throughout five regions in Chile, and its predominant features are formal, closed, introspective buildings, organized around central courtyards and closely linked to agricultural activities. However, there are many variations of this type, depending on latitude: further north, where the climate is dry and temperate, the architecture is more compact; further south, where the rains are more abundant, an exterior veranda appears as an important element. This last-named feature allows people to walk outdoors while protected from rain, and it also shields otherwise vulnerable adobe walls from rainfall.

The main challenge that the Spanish settlers faced in Chile was that of adapting their architecture to the seismic conditions of the country. Thus, original colonial architecture had to be modified – lowering heights, decreasing the slenderness of walls and incorporating timber elements in order to reinforce adobe masonry walls. All these actions constitute valuable vernacular earthquake-resistance strategies.

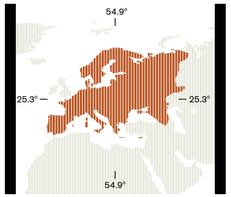
Brazil

In Brazil, as in Paraguay, there still exists Colonial-Portuguese architecture with similar characteristics to those found in the rest of Latin America. Some of the most notable examples are the vernacular buildings of the gold-mining settlements of Almas, Portos and Natividade in the northern Tocantins area of the country, and Serro, which is located along the old road of Estrada Real in the southeastern Minas Gerais region. Alongside this heritage, there exists a rich indigenous vernacular architecture – especially in the Amazon forest, which has remained intact owing to its geographical isolation.

Opposite **Thatched vegetation and timber construction are basic elements of indigenous buildings in the Latin American region. Spanish and Portuguese settlers supplemented earlier materials and methods with adobe, brick and stone masonry. The thermal mass these materials provide mitigates diurnal temperature variations.**

Vernacular Responses to Climate across the European Continent

Fernando Vegas and Camilla Mileto



Rainfall (in/per annum)
2

Population average (per 100 mile²)
9,000

Sunshine (days per annum)
330

Altitude (metres above sea level)
1000

Humidity (%)
2

Geography/Climate
The European continent has three predominant climates: the oceanic climate that covers a large part of its central territory, characterized by abundant rainfall, temperate winters and cool summers; the Mediterranean climate, on the shores of the Mediterranean Sea, characterized by mild, wet winters, dry, hot summers and variable autumns and springs, regarding both temperature and rainfall; and the continental climate, with scant rainfall and extreme temperatures and great differences between summer and winter.

The availability of traditional construction materials in each place on the European continent determines the built substance of its vernacular architecture, which – depending also on the climatology, the temperature and the rainfall – determines the configuration of floor plans, with the possible presence of an outdoor 'room' such as a patio; building shape, especially the roof; and the relationship between the interior and exterior space through the existence, dimensions and types of porches, bays, openings and filters in the façade.

Water
The presence of a larger or smaller amount of water, its state and the frequency with which it appears often determines not only the shape of dwellings but also the way in which they are grouped.

Wind
The European continent is traversed by various wind patterns. The westerlies are constant winds that blow from west to east in latitudes of between 30 and 60°; they have a moderate effect on the climate of western European coasts, which are also undeniably influenced by the Gulf Stream. They are at their strongest between 40 and 50°, latitudes known among British sailors as the 'roaring forties'. Besides this forceful current, which circulates at a great height, there are thermally generated local winds created by the difference in temperature between the variable warm and cool zones (day- and night-time breezes between the sea and the land), and those created by dynamic means due to the accumulation of air in a particular spot because of the existence of a mountain chain.

Opposite The hill town of Montilla in Spain's south typifies a response to the warm, temperate environment with its dense, central township surrounded by verdant vineyards and farm housing. Thick building walls are typically rendered in gypsum and punctuated with small openings to protect against strong summer sunlight and cooler temperatures in winter.

Right Alpine huts were devised as a strategy to protect against the roaring gales and scant sunlight that typify northern European regions. Logs were a logical building material based on the abundance of timber in the Alps.

Besides their influence on the climate, all these winds have also fashioned European vernacular architecture, generating scattered or collective urban solutions and configurations of dwellings. Indeed, the layout of many European rural settlements can still be interpreted as a strategy of sheltering from unwanted strong winds whilst, on the contrary, facilitating the circulation of pleasant breezes.

The predominant wind direction in each place also affects the interior layout of that locality's vernacular houses, wherein trial and error has been used to create a horizontal route for currents of air that permits or prevents cross-ventilation between the different rooms on each level, and a vertical route in which the staircases or the fireplace location contribute to the dwelling's internal ventilation. In cold climates, these dwellings customarily have their bedrooms placed at the rear of the interior space in order to ensure greater thermal comfort, whereas in the warmer, Mediterranean zones each room can mediate heat gain through at least one window – although this may look onto an inner courtyard, which also acts as a chimney in the building's cross-ventilation strategy. In both types of dwelling, different types of curtains were generally used. In cold-region dwellings, beds themselves often had a curtained canopy, which could be pulled closed to keep the sleeping place warm. In warm-climate dwellings, internal doors were often replaced by hanging, light curtains or lines of beads that would not stop air from circulating from room to room.

Fire

Fire is present in different ways in vernacular buildings, fulfils multiple functions and helps to configure the dwelling depending on the climate. In traditional vernacular architecture in warm European climates, fire has been used mainly for cooking and only occasionally in winter for heating, whereas in cold climates, fire has generally been used not only for cooking but also for heating and even for illuminating the rooms during the dark winter nights. The European geographic 'frontier' regarding the use of fire only for cooking or for cooking and heating lies approximately at Latitude 40° N. Since the European continent lies in a strip running from Latitude 36° N to 70° N, it is clear that only the vernacular architecture of the south of Spain, Italy and Greece – along with the majority of Mediterranean islands – could dispense with fire as a source of heat, while most vernacular European architecture traditionally depended on the presence of fire as a means of heating in order to survive. Furthermore, traditional European vernacular architecture located above Latitude 55° N, which implies six or fewer hours of light a day in winter, has especially needed fire for lighting.

The forms that fire takes in vernacular dwellings at different latitudes range from simple, traditional wood or coal fires, on which the kitchenware is placed directly, to open ranges, with tripods sitting on the fire or hanging pots, which at the same time provide heat for the room. In the transition area between Latitude 40° N and the zones immediately to the north of it, braziers are quite commonly used not only for portable heating but also as a cooking tool. In central Europe, built-in majolica-tiled stoves are common (the Russian pechka, or German Kachelofen), and are used for cooking, heating and even lighting.

It is important to point out, too, the presence of the sauna (Rauchsauna, thermae, bastu, banya or steam baths) all over the European continent, even since pre-Roman times; this device was conceived not so much as a heating system as an aid to personal hygiene, and it was usually located in constructions independent from the main dwelling.

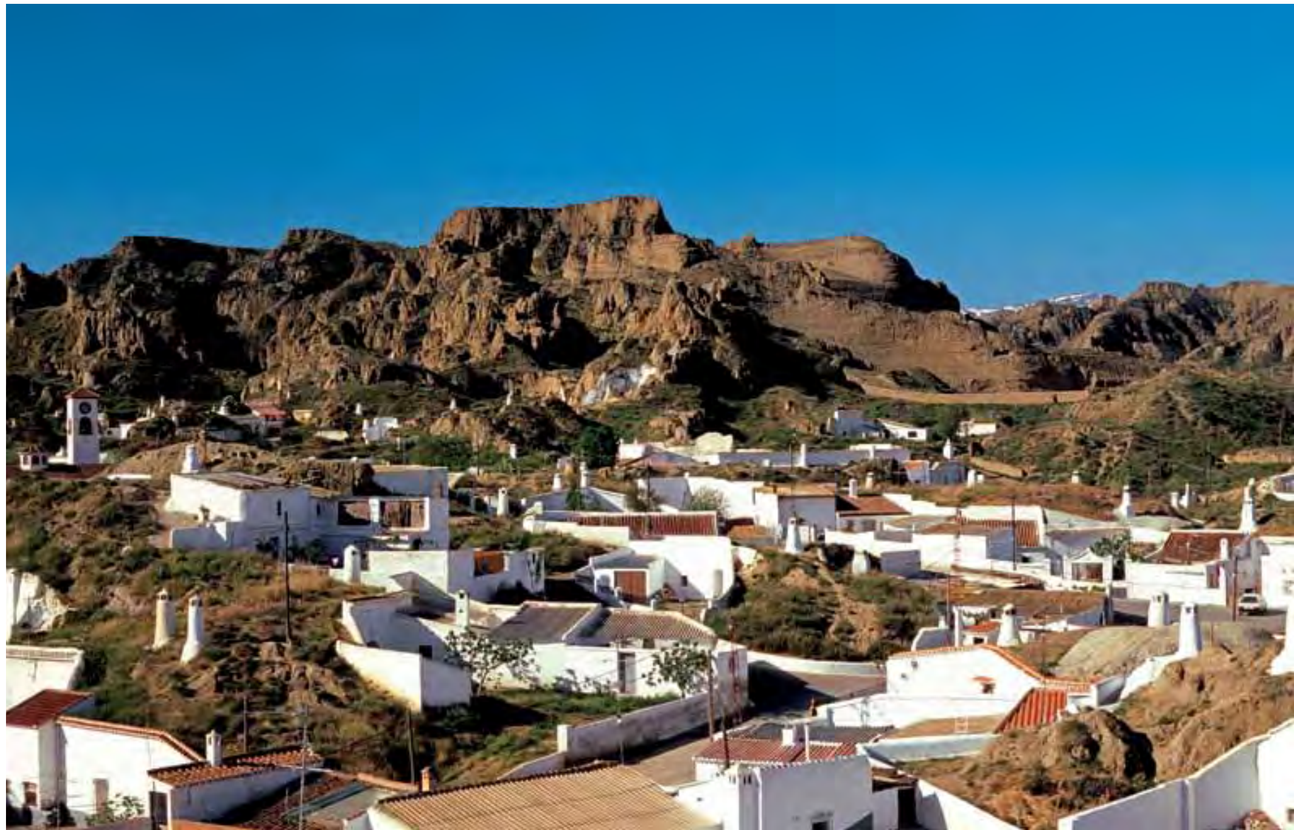
Finally, it is interesting to mention the existence of glorias, an interesting traditional vernacular subfloor heating system in the architecture of the north of Castile (Spain), probably developed from the heating mechanisms used in Roman or Arab baths. These, however, are also found in distant lands like Korea (where they are known as ondol) or China (kang), where they provide heating for dwellings in cold continental climates where no firewood is available, using straw as their only fuel.

Bottom left To manage heat gain in warmer Mediterranean zones, rooms often have at least one window that overlooks an inner courtyard, which also acts as a chimney in the building's cross-ventilation strategy.

Bottom right Cave dwellings draw on the inherent properties of the natural surroundings as a means to mediate heat in warm climates. Troglodyte homes provide an immediate respite from high summer temperatures and are occupied across southern and central Europe.

Opposite, top The form of European vernacular townships and dwellings are often configured in response to the prevailing wind direction. This Spanish village of Riglos nestles below a huge sandstone outcrop – a strategy to protect the settlement from unwanted strong winds.

Opposite, bottom In more temperate European climates, such as this township of Guadix in southern Spain, wind direction also shapes the interior plan of vernacular housing. Frequently, staircases or chimneys are positioned to enable a vertical route with which to evacuate warm internal air.



Above Differing latitudes across the European continent create varied intensities of sunlight, which directly shape the architectural responses. Characteristically, the strong solar gain in southern regions is reflected in external shading devices such as shutters, curtains, lattices and blinds. Interstitial areas between street façade and interior, such as patios, create sheltered, open areas that extend individual's living spaces.

Above Colonnades to the building exterior, and to internal courtyards, are frequently used in the Mediterranean Basin as a shield from the extreme heat that is typical of the region. Other architectural means that provide cool, shaded places to walk typically include porticoes, generous eaves, narrow streets and individual shading elements, as well as tiling or stonework underfoot.

Sun

The varying degree of sunlight that reaches all the different latitudes of the European continent has a great influence on the configuration of its vernacular architecture and especially on buildings' relationships with the exterior. The scant sunlight in the centre and north of Europe – in addition to other conditions, like the height of the location and its exposure to the wind – has traditionally given rise to very compact vernacular dwellings with bays of limited size, built close to the ground or even embedded in it, in an attempt to minimize the loss of heat from the interior of the house. More frequent sunlight in these places was always very welcome but not to the extent that large bays were inserted, because the loss of heat involved would not be compensated for. The transition between indoors and outdoors in such structures is always rather abrupt: merely through a door – or, at best, though a small hall for robing and disrobing, usually without any intermediate spaces.

The intense sunlight characteristic of the Mediterranean Basin generates a similar exterior compactness in vernacular architecture, with bays perhaps larger but still limited in size – this time in order to prevent too much heat from penetrating indoors. The indoor–outdoor relationship is richer than in northern climes, with a great variety of 'in-between' spaces or places located on the borderline between indoors and outdoors, and with an abundance of shading and cooling systems.

Such in-between spaces include terraces, porches, raised platforms, pergolas, pavilions, half-open sheds, porticoes and colonnades – i.e. places partially exposed to the open air and partially sheltered by the building. They arise when the threshold of the building expands and stretches, becoming large enough to create a space that can accommodate life. Patios deserve a special mention as they are to be found all over the Mediterranean area. The tradition of the patio dates back to the distant past, with Greek or Roman houses as prime examples although they are by no means the oldest. Patios have proved useful in many of this region's buildings, not only to provide light and ventilation but also as an element articulating communication and life within the house.

Shading systems may comprise lattices (fixed or openable), louvred shutters, net curtains, solid timber shutters, roller shutters, Roman blinds, internal or external venetian blinds, curtains or roller blinds. Blinds can also be used to hang down vertically or at an angle over the handrail of a balcony for the purpose of offering light, shade, breeze and side views, while at the same time safeguarding privacy from the front. This warm part of Europe also boasts street-shading strategies to allow people to walk along public thoroughfares protected from the sun, such as generous eaves and cornices running along narrow, winding streets; whitewash finishes that partially avoid the absorption of heat; and street porticoes offering shelter both from the sun and the rain. Other individual shading elements include parasols; awnings or textiles stretching from a street façade to the one opposite; trees with large crowns, or the shade of palms or grapevines and other climbing plants; wooden pergolas; trellised wooden roofs; and canopies intermittently scattered over the streets.

In this warm-climate European vernacular, cooling systems have traditionally been used based on height (the presence of tall rooms with draughts passing over the heads of the dwellers in order to favour convection), mass (the use of thick walls with great thermal inertia), air (the promotion of cross-ventilation between façades with different thermal gradients due to the different exposure to sunlight or the dissipation of heat in stair wells or chimney flues) and the presence of water and vegetation, which accentuate the effect of the strategies enumerated above. Apart from the overall design, which takes into account the circulation of local winds and the creation of shading systems permeable to wind, other natural cooling systems have been devised in the urban areas of these warm European regions. These include the presence of vegetation, utilizing its capacity to evaporate and hold water in its foliage, and the incorporation of water in the form of fountains, ponds and street wetting.

Materials and Construction Techniques

As is the case with traditional constructions in the rest of the world, European vernacular architecture is mainly the result of a balanced combination between the dominant climate in each place, the construction materials available in the immediate surroundings – arising partly from the climatic conditions – and the use of space and system of social relations established in a particular place – again, both partly as a result of climatic conditions. The construction techniques used to build with these materials in each climatic and social context evolved over the centuries, based on old currents of technological transference and a process of trial and error, seeking to adapt in the best possible manner to the physical conditions of each location.

Vernacular architecture is conceived on the basis of taking advantage of the resources available at a reasonable price considering the functional needs of the building. In places with an abundance of stone, it is natural to use stone for building enclosures, shelters or stepped terraces; it is also a way of clearing fields in order to facilitate ploughing and crop production. In alluvial valleys, earth is commonly used as a raw material: it is an extraordinarily cheap construction material. Where water was scarce, rammed earth was more usual because it requires a water component of only 5 per cent for construction purposes, provided that the appropriate formwork techniques were available. On the other hand, if enough water and straw was available to produce sun-dried bricks during a dry season, adobes were more commonly found. In some areas, the lack of basic means, the constant rain or even simply greater urgency led to the construction of cob walls. If timber was available too, mixed solutions were adopted, such as half-timber or post-and-beam structures with a cob or wattle-and-daub filling. Brick manufacture was much more expensive than the aforementioned methods because more fuel was consumed in the process. Brick factories therefore required a certain amount of organization and the coordination of the various crafts involved. They also depended crucially on the level of local economic development; the presence of suitable clay and timber (or scrubland) for the kilns; and the procurement of mortar, which could be made from, amongst other things, earth, lime or gypsum depending on the availability in the area and the owner's financial means.

Walls

The most common structural systems in Europe are based on loadbearing walls made of stone, brick, earth or timber, bonded variously with earth or lime or gypsum mortars – the last-named also possibly used for interior and exterior rendering. Stone is used throughout the continent, but less frequently north of the Rhine and Danube basins where it alternates with brick (commonly found all over Europe). The presence of stone and brick in these places also permits the erection of pillars, whose use endows interior spaces with greater functionality but simultaneously requires the availability of sizable timber beams to bridge the gap between pillars in order to erect joisted upper floors.

Horizontal log construction – in its three main variants of double-saddle notch log, double 'V' notch log and double square notch log – is limited to places with abundant timber, principally the Alps and the heavily forested areas of eastern and northern Europe. Log houses were exported by European migrants in several waves, beginning in the 17th century, to North America across the Atlantic Ocean, to the North American Pacific Coast across the Bering Strait, to Parana in Brazil, to Argentinian Patagonia and to Australia.

Earthen walls can be encountered all over Europe, although mainly in plains and alluvial areas. Special mention should be made of those examples located in the Iberian Peninsula, which are found both in monumental and in residential architecture, and in particular in the Pannonian Basin of east-central Europe. In the latter case, earthen architecture in more than 40 building variants and techniques became very popular following the 18th-century publication of fire edicts for the vast Austro-Hungarian Empire, which prohibited log houses and favoured earth constructions.

Rammed earth walls are to be found mainly in four specific areas of Europe: the Iberian Peninsula, the area comprising southeast France and northwest Italy, the Pannonian Basin and the Baltic countries. Adobe walls, whose production additionally needs straw and more water than rammed earth walls, were mainly spread over the northern half of the Iberian Peninsula, eastern France, the Padanian Plain (Italy) and the Pannonian Basin. Cob walls are rare, and scattered throughout the continent – mainly in humid areas with plentiful supplies of straw and water.

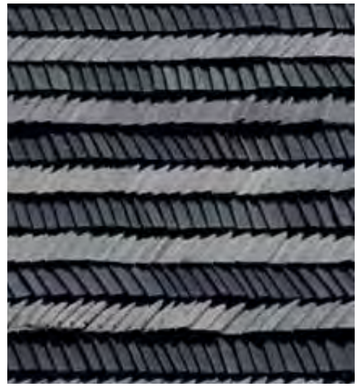
Until the 19th century, half-timbered construction – based on the combination of box-framed walling with either close studding or square panels filled with adobe, cob or wattle and daub – was a very widespread and popular traditional construction technique in areas with an oceanic climate, although it could also be found in some parts of the Mediterranean in medieval times. This type of building was exported during the 17th, 18th and 19th centuries by European migrants to the east coast of North America, Brazil and southeast Australia.

Below **Load-bearing stone, brick and earthen walls form the most consistent elements of building construction throughout the European continent. The enduring and fire-resistant qualities of these materials ensured their popular use and eventually superseded other methods, such as half-timbered construction, which declined from the 19th century.**

Opposite, top **With stone locally available, this detail of a typical wall in southern Spain illustrates how the building's solid thermal mass, its minimal and shuttered apertures, as well as its terracotta roof tiles, form a carefully considered answer to moderate the heat.**

Opposite, bottom **In cooler European regions, such as in northern Germany, more substantial and well-insulated building envelopes have always been necessary. This historic façade in Überlingen, near Lake Constance, shows architectural variation: its timber-framed wall adjacent to solid constructions of render and stone.**







Opposite Roofs and interiors of vernacular structures on the continent often draw on timber as a base element. Wood was widely available and typically used to create load-bearing structures. Upon this sturdy framework, timber or stone shingles, or thatch, enclosed the building. Inside, raw floor surfaces were laid with wooden board, flagstone paving, or tiles of ceramic or concrete, providing additional thermal protection.

Floors

Floor and roof structures in European vernacular construction are formed mainly by the use of wooden beams and joists, with bays infilled with whatever materials were freely available in the region. These could be wooden planks, bricks, stone slabs, gypsum or wattle – or a combination of earth with any of the above. Depending on the availability of timber and sawmills in the area, beams and joists could either be simple logs, without bark, or could have sawn, squared profiles. The availability of timber also dictated the infill material, and wooden planks were most commonly used in Europe – especially in relatively forested areas – with wattle being often adopted in wetlands and marshy areas. In drier, rural regions with less sophisticated means, stone slabs were often employed to bridge the (normally short) bay spans that lay between the joists.

In areas with a relatively scant amount of timber and possibly many gypsum deposits, jack-arch (or 'flat-arch') floors with either gypsum-poured or flat tile vaults were developed. These became widespread from the 16th century onwards, along the Mediterranean coast from the south of Spain, with some gaps, to the island of Sicily. At the end of the 18th century, this solution was exported to Britain and other parts of Europe, where it was often put into practice until the early 20th century. It was particularly used in dwellings and industrial plants or warehouses with metal joists and brick vaults, fundamentally because the brick vaults were fireproof – especially if the bottom part of the metal joists was protected or covered to avoid exposure in case of fire.

On this horizontal floor, composed of different materials depending on availability in the vicinity and functionality in each case, it was common to spread a layer of earth, lime mortar or gypsum in order to provide a certain amount of thermal and acoustic insulation between the various floors of the building. In the past, this layer was used directly as the surface of the floor, as in the traditional case of simple tamped earth or earth-and-lime floors found in many parts of central and eastern Europe; massetti in northern Italy; and Anhydritestrich, or anhydrite flooring, in German-speaking regions of central Europe. Alternatively, a surface of oiled gypsum might be adopted in areas with abundant gypsum deposits, for example in the east of the Iberian Peninsula. In most cases, as soon as the owners of the dwellings could afford them, these raw surfaces were limited to acting exclusively as an insulating layer and were progressively covered with a second layer of floorboards, flagstone paving or ceramic tiles (either earthenware or glazed) in ceramic-producing areas. In the late 19th century, other much cheaper options, such as colourful cement tiles, became extremely popular all over Europe.

Roofs

The supporting structure of the roof, formed by timber joists and an upper board to serve as a base for waterproofing, repeats many of the patterns described for floor solutions above – especially those made with wooden boards, stone slabs or wattle. Roofs in buildings with jack-arch floors made use of a range of constructional possibilities, comprised of an upper board made of timber, woven wattle or flat tiles. Sometimes the bare roof structure was waterproofed directly, without the help of any type of board.

Waterproofing techniques for such roof structures depended on availability of materials – employing stone slabs; slate; shingles, in timber-rich log-house areas; or ceramic tiles, which became common in large parts of Europe. Slate roofs are chiefly found in almost all regions of France and Switzerland, in the western half of the British Isles, the north of Spain, the southwest of Germany, northern Greece, Macedonia, Serbia, Montenegro and eastern Bulgaria. Shingle roofs can currently be found in eastern and central Europe, although they were once widely used in other timber-rich European regions from the Roman era onwards. Ceramic tiles, introduced into Europe also during Roman times, adopted many shapes, ranging from simple, rectangular plain tiles and Dutch S-shaped pantiles to Spanish half-truncated cones. Slates, shingles and clay tiles have also been used occasionally to clad walls, offering extra waterproofing and even (in the case of shingles) enhanced insulation – particularly in areas where walls were exposed to damp, wind and rain.

The traditional thatched roof – historically the region's most popular vernacular solution, used in every European country without exception with different local species – can still be found in many corners of the continent, although it is not used very frequently nowadays. Several types of straw and reeds in bundles, tied or nailed together, are normally applied, either directly to the roof structure or to an intermediate cane mat.

Other structural roofing and waterproofing systems, such as corbelled domes, are mainly associated with Mediterranean drystone construction methods, although they can also be found in the British Isles and Iceland. These may be used for isolated farmers' or herdsmen's cabins to shelter their occupants from inclement weather, or may even generate a whole, fascinating village, as in the case of Alberobello (Italy), Village des Bories (Gordes, France) or Cabanes du Breuil (Saint-André-d'Allas, France). A special case of corbelled domes, without any equivalent in Europe, which can only be compared to the beehive structures of Syria, are the domed huts of Castile, which are made of adobe rather than stone masonry.

Another interesting roofing system is provided by the example of excavated architecture, where the terrain itself fulfils waterproofing and run-off functions, examples of which can be found principally all over the Mediterranean region and the Rhône Valley, and which became especially popular in the 19th century with the increase of demographic density in Europe. Most of the underground architecture to be found in these European regions comprised newly excavated caves or, at least, significantly modified natural caves or cavities. Nevertheless, there are also examples of the remains of semi-subterranean winter dwellings in southeastern Europe and around the Danube Basin, made of timber poles and logs covered with wood, brush and earth.

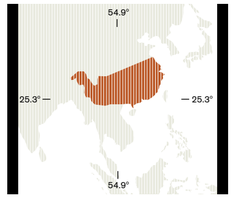
Tulou, Yangtze and Courtyard Dwellings of Southern Central China

Zhu Tan

Geography/Climate

In cultural-geography terms, China's current territory can be roughly divided into agricultural and nomadic regions. The country's eastern part includes plains and hills below 2,000 metres above sea level; with its prevailing monsoon climate, this forms the main agricultural region. China's western hinterland comprises mainly grasslands, deserts, mountains and plateaus; it forms the country's nomadic region. The bulk of ancient China's population resided – as it does today – in the agricultural zone: the central and eastern coastal areas whose northern boundary was the Great Wall. These were (and remain) the ethnic Han Chinese, who still constitute the majority (more than 90 per cent) of the Chinese population.

The central Qinling Mountains–Huaihe River line forms a natural boundary between northern and southern China. It divides the country's warm-temperate zone from its subtropical zone, its semi-humid from its humid region, the Yellow from the Yangtze River basin. To its north, the rivers generally freeze during winter months and there is mainly dry land on which to grow wheat; to its south, the rivers flow year-round, and there is mainly paddy field in which to grow rice.



Rainfall (in/per annum)
25

Population average (per 100 mile²)
9,000

Sunshine (days per annum)
330

Altitude (metres above sea level)
500

Humidity (%)
2

Below Typical of rural conditions in central and eastern coastal areas of China, the bulk of the country's population resides in courtyard houses that suit the mild climate of this agricultural zone.

Above The arrangement of courtyard villages in rural China follows an orthogonal logic that can be seen in much of China. However, they are significantly less dense than their urban counterparts, such as the traditional *hutongs* shown in this map of Beijing's historic centre.

Below Villagers usually occupy courtyard houses built of timber, with pitched roofs and broad eaves. They are arranged according to prevailing climatic conditions and are frequently organized to form a sizable compound.

Materials and Construction Techniques

China's basic construction material always was, and remains, timber. Traditionally, it was chosen not because the country was particularly rich in timber resources but because people believed that wood could form the most 'reasonable' structure. The ancient Chinese grasped the technology of these structures and could easily prepare modular, prefabricated components from cut timber. A durable structure could then be assembled very quickly, without using nails or adhesives. Therefore, building with wood, especially as a structural element, became synonymous with traditional Chinese architecture. The chosen timbers were mainly China fir (Cunninghamia), Chinese chestnut (Castanea mollissima Blume), beech (Zelkova schneideriana Hand-Mazz) and zhennan (Phoebe zhennan S. Lee).

The ancestors of the Han Chinese inhabited the Yellow River basin, in the northern, agricultural part of China, for thousands of years. Between 25 and 220 AD, they began to migrate to the southern part of Chinese territory. Entire families relocated, and spread their culture – including production technologies and living customs – to the new settlements. They also brought with them their way of constructing houses.

Building Plan and Form

The courtyard house, which forms the principal residential type of the Han, is a typical Chinese vernacular building found predominantly in central and eastern coastal areas of China and based on the agricultural economy. Its inhabitants' lives depended on their relationship to nature, and the way its single-courtyard form is arranged responds to the prevailing climatic conditions. The buildings surrounding its central yard share similar construction methods and have relatively generic, 'empty' main interior spaces; their actual functions are decided by their position and orientation. In order to take advantage of sunlight and warm winds, the key spaces are usually located on the main axis of the house and face south. Less important rooms are located at lower levels and orientated towards the north – the cooler and more shaded side of the building. The dwelling's secondary, more functional buildings are located on the courtyard's two long sides. In this way, the buildings surrounding the single, rectangular yard constitute a hierarchical unit, which mirrors the hierarchical form of traditional Han society.

At a larger scale, these single-courtyard dwellings could be easily combined to form a sizable compound, with the individual courtyard building being flexible enough to accommodate other uses – not just a residence but government offices, a school or even a temple. From a single courtyard to a compound and then to a city (or village or town), the whole system therefore resembles a large, organic, unified building. This pattern is perhaps best exemplified by the ancient city of Beijing.

As a result of the migration of the Han Chinese people, the courtyard building was diffused from the centre of the country to the surrounding regions, its form varying according to local natural conditions. Timber was chosen for the primary structure, whilst the building envelopes were generally made from other local materials. These varied according to climate and geographical conditions, but the most common ones were earth (in the form of bricks) and stone.

The central and southeastern part of China is generally held to encompass four disparate regions: the North China Plain; a loess plateau; the middle and lower reaches of the Yangtze River; and the southerly, coastal zone. In each region, the single-courtyard building unit shows distinct attributes – although they all conform to a similar basic pattern. Aside from varying local materials, different shapes of courtyard could adjust the building interiors, and the different compositions of courtyard represent different methods of social organization.

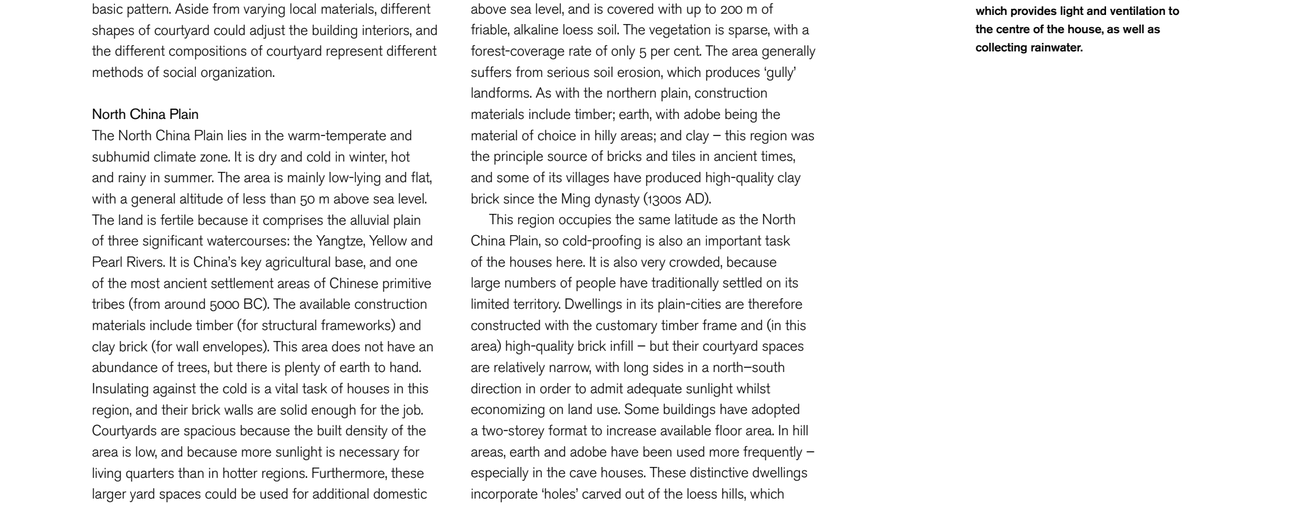
North China Plain

The North China Plain lies in the warm-temperate and subhumid climate zone. It is dry and cold in winter, hot and rainy in summer. The area is mainly low-lying and flat, with a general altitude of less than 50 m above sea level. The land is fertile because it comprises the alluvial plain of three significant watercourses: the Yangtze, Yellow and Pearl Rivers. It is China's key agricultural base, and one of the most ancient settlement areas of Chinese primitive tribes (from around 5000 BC). The available construction materials include timber (for structural frameworks) and clay brick (for wall envelopes). This area does not have an abundance of trees, but there is plenty of earth to hand. Insulating against the cold is a vital task of houses in this region, and their brick walls are solid enough for the job. Courtyards are spacious because the built density of the area is low, and because more sunlight is necessary for living quarters than in hotter regions. Furthermore, these larger yard spaces could be used for additional domestic activities, such as drying food and cultivation.

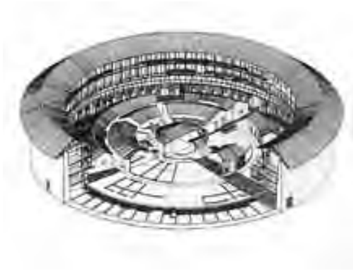
Loess Plateau

The loess-plateau region sits on the boundary of China's warm-temperate monsoon climate zone. Its winter is dry, cold and lengthy; its summer is muggy, hot and brief. The total precipitation is small, but it is concentrated in the summer months. The area lies between 1,000 and 2,000 m above sea level, and is covered with up to 200 m of friable, alkaline loess soil. The vegetation is sparse, with a forest-coverage rate of only 5 per cent. The area generally suffers from serious soil erosion, which produces 'gully' landforms. As with the northern plain, construction materials include timber; earth, with adobe being the material of choice in hilly areas; and clay – this region was the principle source of bricks and tiles in ancient times, and some of its villages have produced high-quality clay brick since the Ming dynasty (1300s AD).

This region occupies the same latitude as the North China Plain, so cold-proofing is also an important task of the houses here. It is also very crowded, because large numbers of people have traditionally settled on its limited territory. Dwellings in its plain-cities are therefore constructed with the customary timber frame and (in this area) high-quality brick infill – but their courtyard spaces are relatively narrow, with long sides in a north–south direction in order to admit adequate sunlight whilst economizing on land use. Some buildings have adopted a two-storey format to increase available floor area. In hill areas, earth and adobe have been used more frequently – especially in the cave houses. These distinctive dwellings incorporate 'holes' carved out of the loess hills, which become part of their courtyards.



Below Dwellings in the Middle and Lower Yangtze River region are usually two-storey brick or stone buildings rendered with white paint. The main architectural aim to defend against the damp climate is further moderated by the inner courtyard of this building type, which provides light and ventilation to the centre of the house, as well as collecting rainwater.



Above Principally constructed from timber and enclosed by dense compacted earth, the multi-storied *tulou* house has progressively more private spaces at upper levels, with shared common functions at ground level.

Right Distinctive for its cylindrical form the *tulou* vernacular in coastal southern China is a carefully composed response to the subtropical monsoon climate. An entire extended family can be accommodated in the fortress-like structure, which is oriented towards the central public space.

Settlements and Drum Towers of the Kam Chinese

Amy Eisenberg and John Amato

Geography/Climate and Culture

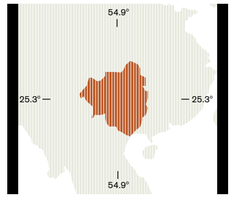
Historically, the Kam people were forcibly displaced from China's best agricultural land by the Han Chinese. Today, the Kam cultural landscape largely encompasses the provinces of Guizhou, Hunan and Guangxi, in which lie verdant riverine mountains and valleys with broadleaf and evergreen forests typical of the humid subtropical montane ecosystem. According to China's recent national census, the Kam population today is approximately 3 million, making them the eleventh largest of the 56 ethnic minorities of mainland China.

The Kam have dwelt in this diverse environment for approximately 2,000 years, developing unique livelihood strategies of harvesting fish and grain from paddy fields, integrating agroforestry and agriculture on mountain slopes, and applying specialized knowledge and skills in utilizing local natural resources. Their vernacular architecture is a cultural amalgam that reflects the spiritual and cosmological forces of Kam life.

The Kam have held fast to their heritage as a community, and in their architecture they express the significance of their past, present and future.

Materials

The Kam are primarily rice farmers, pisciculturists, agroforesters and carpenters. Professional carpentry is often intergenerational within families, and it takes many years to master it well. China-fir (Cunninghamia lanceolata [Lamb.] Hook.) and trees in the Sequoia (Taxodiaceae) family provide the most familiar wood for Kam carpenters, who are paid for their work with money, rice or labour.



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2

Left Located in the provinces of Guizhou, Hunan and Guangxi, Kam peoples have adapted and utilized materials from the mountainous and verdant humid subtropics in which they live, developing structures that are mostly built in timber.

Opposite, top Settlements within Kam villages tend to be organized as a cluster of individual groups. As seen here, in the Gao Xiu Village in Guangxi Province, the dwellings step down the hillside, with the distinctive drum tower adjacent.

Opposite, bottom Striking drum towers are present in almost all Kam villages and form the focal point for individuals to gather and talk. They were the first buildings to be completed when establishing a village and originally housed wooden drums, to warn villagers in the event of danger.

Opposite, top Mortis and tenon construction is employed in many of traditional Kam building and woodworking techniques. Iron stays are used to secure logs and beams, which are most often hewn from China-fir or Sequoia woods.

Opposite, bottom Bark used for roofing and cladding is harvested from the Cunninghamia evergreen, a fast-growing species resistant to decay. Once dry, the sheets of bark are used to seal buildings and provide robust protection for approximately five years.

Right, top While the drum towers are partly defensive structures, they are also an integral, shared community space in which to sing, dance and play the *lusheng*, a traditional Kam instrument.

Right, bottom Marked by its multi-layered roof, the drum tower is formed of an open-beam system of construction of Cunninghamia logs. Timber in newly erected towers is lighter in colour; in time, the wood becomes dark brown.

Building Plan/Form

Kam homes are arranged in individual groups within a village, and often the people living in a grouping of houses bear the same surname. These groups or clans often congregate in the 'drum tower' of their respective clan. These drum towers resemble China-fir trees, and are the highest and most outstanding architectural feature of Kam villages, which also feature schools and public buildings in self-sustainable communities. They – like all Kam building and woodwork – are constructed employing the mortice-and-tenon system, in which two pieces of wood join together securely so that nails are not required.

When establishing a village, the drum tower was the first structure to be built. It was named after the large wooden instrument that was once intrinsic to these edifices, which were originally erected with a wooden drum inside them to alert villagers in the event of an intruder. This drum was also used to gather the community, and to warn of danger or the impending approach of an enemy's army. Sounding it drew the community to the drum tower, where plans were made in response to any threatening situation.

During Mao Zedong's 'Cultural Revolution', which seriously impacted on all the ethnic-minority peoples of China, Kam cultural relics disappeared. Many drum towers and temples were destroyed in an attempt to extinguish Kam cultural heritage and identity. Since they were removable, almost all drums were burned. Fortunately, some Kam communities have repaired and rebuilt their drum towers and temples, but without assistance from the government. Today, there is a resurgence of drum towers, and Kam communities are attempting to reinvigorate the construction and use of these important historical and present-day cultural markers.

Drum towers are a focus of cultural expression and community for the Kam people. Some have a fire pit in the centre, often kept burning with coals used to light tobacco in a ceramic pipe; some have wooden floors. Most Kam houses and drum towers have clay-fired tile roofs, which are fairly easy to repair as the material is held in place by a combination of self-weight and a notch upon which the tiles catch. The multi-tiered odd number of roofs typifies the Kam's unique architectural design, and while other buildings in Kam villages resemble drum towers, they lack the distinctive tiers of the original form.

Minka Housing in Urban and Rural Japan

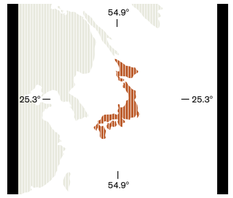
Don Kuhn-Choi

Building Plan/Form

Although Japan boasts many types of vernacular buildings, for architects the most important genre has been *minka*, meaning 'folk houses' or 'houses of the people'. The Japanese architect Wajiro Kon coined the term in the early 20th century in his pioneering study of ordinary Japanese houses; since then, *minka* have dominated studies of Japanese vernacular, becoming a major academic subject of their own. Built all over Japan in countless variations reflecting different climatic, cultural and economic conditions, *minka* were the houses of commoners – farmers, merchants and artisans – rather than nobles or elite warriors. Today, numerous outdoor museums, such as Shikokumura in Takamatsu City, display examples of *minka* from all over the country, attesting to the continuing popularity of these dwellings.

The great variety of *minka* makes it impossible to define a strict archetype, but most of these more ordinary dwellings shared several basic characteristics. Firstly, like almost all other Japanese buildings prior to the Meiji Period (1868–1912), *minka* relied on post-and-lintel timber structural frames. The universal use of wood stemmed in part from Japan's natural environment; even today, forests cover about two thirds of the country. Other plant materials provided architectural elements such as straw *tatami* mats and thatched roofs. The walls, which did not bear loads, usually consisted of mud plaster over bamboo (*Poaceae*) laths, although board-and-batten walls were not uncommon in mountainous regions. Secondly, *minka* generally included both raised-floor living spaces and earthen-floor workspaces. In houses built by more prosperous owners, *tatami* covered the floors of much of the raised area. Thirdly, doors in *minka* typically were sliding partitions such as *shōji*, which are lattice screens covered with paper (typically made from the pulp of *kozo*, a type of mulberry [*Morus*] tree); pivoted doors existed, but were less common. Fourthly, most *minka* included an *engawa*, or veranda, on at least one side of the house. This space could be used for both work and recreation, its projecting eaves providing protection from sun and rain. Finally – as in palaces, temples and other types of Japanese buildings – most activities inside *minka* were conducted while sitting on the floor, rather than on chairs. For example, women sewed on the floor, laying down the long swaths of cloth used in traditional kimono. Because each space could be used for multiple activities throughout the day, bedding and furniture were often kept in storage areas and brought out only when needed. This flexibility in the use of spaces has informed more recent efforts to create small, efficient residences in high-density cities such as Tokyo.

Minka can be broadly classified into rural and urban categories. Unfortunately, fires and redevelopment have destroyed the vast majority of urban *minka*, but examples from the Edo Period (1603–1868) survive in small numbers in many cities. One of the largest extant groups stands in the district of Imai-chō in Kashiwara City, Nara Prefecture. Imai-chō flourished as a commercial city – first as a



Rainfall (in/per annum)
25

Population average (per 100 mile²)
9,000

Sunshine (days per annum)
330

Altitude (metres above sea level)
500

Humidity (%)
2

Opposite Historical *minka* found in villages such as Shirakawa-go and Gokayama, shown here, illustrate many rural *minka* features, including thatched roofing, projecting eaves, *engawa* or verandas on at least one side of the house and mud plaster or board-and-batten walls. The pronounced sloping roofs seen in this village are a response to snowfall in the area.

Below Traditional vernacular Japanese houses or *minka* are seen throughout the country. Countless variations of the main vernacular typology of 'houses for the people' are found all over Japan. Their differences are shaped according to varying climatic, cultural and economic conditions but all are based on post-and-lintel timber structures.

Opposite, top **Connections between *minka* roof members are made with ropes and cords, allowing owners and communities to participate in roof construction and repair. Vines and saplings found locally were used for cords, and straw and linden (*Tilia*) bark for ropes.**

Opposite, bottom **Prevailing characteristics of *minka* structures and roofs demonstrate adaptations to local conditions. Thatch is a light material that provides excellent insulation and is readily harvested. Massive overhead beams retain the contours of the trees from which they are hewn. This allows builders to take advantage of 'imperfect' timber from nearby mountain pine trees. In many rural *minka*, the resulting curved beams, called *chona-bari*, create an arch-like effect as they curve upward from the exterior wall. These irregularities carry through to timber interior finishes.**

rare independent trading town from 1575 until 1679, and then as a territory controlled directly by the Tokugawa Government. The Otomura House, built for a prosperous merchant and thought to date to the second half of the 17th century, serves as a representative example of an urban *minka*. The interior comprises three zones: the wooden-floored shop area at the front, the *tatami*-floor living quarters behind the shop area and the earthen-floor workspace/kitchen. This combination of shop and dwelling was typical in the dense working-class areas of Japanese cities.

Merchant houses in Imai-chō present unpretentious but varied fronts to the street; their low eaves and relative lack of ornamentation belie the former wealth of the city. In fact, because merchants were considered to be an inferior social class, the military government of the Edo Period restricted the size and decoration of their dwellings; more generally, social conventions called for restraint rather than extravagance. In response, merchants often expressed their wealth and taste through seemingly humble architectural elements. The plastered, barred windows (*mushikomado*) of the upper floor, for instance, vary in shape and detail from house to house, as do the wooden grilles (*koshi*) of the ground floor. Used in front of the translucent *shōji*, these grilles provided privacy and protection while allowing light to penetrate to the interior.

The tile roof, which provided protection against fire, also served as decoration: the patterns on the tiles and the shaping of the plaster under the eaves distinguished the Otomura House from its neighbours. Variations in secondary elements such as tiles and grilles allowed architectural expression without violating sumptuary regulations or disrupting the cohesiveness of the street. This strategy in some ways parallels the architectural codes used in some New Urbanist developments in the United States – for instance, Seaside in Florida – which allow design freedom within strict boundaries.

Rural *minka*, like their urban counterparts, developed throughout Japan in response to their climatic, economic and social contexts. Certain elements of *minka* developed in parallel in different regions, while other aspects were unique to a given place. Two examples from mountainous areas, the Shimoki House from Tokushima Prefecture and the Murakami House from Toyama Prefecture, show both underlying similarities and distinct variations. The Shimoki House, originally built in 1781 in the village of Itchson Kijiya, is a sizable but austere example of a farmhouse from an isolated area of the island of Shikoku. In contrast, the Murakami House in the village of Kaminashi is a relatively grand example of the famous *gassho-zukuri minka* from the villages of Shirakawa-go and Gokayama in Gifu and Toyama Prefectures. The term *gassho* refers to the shape of two hands brought together for prayer; Anglophones might describe the steep gables of this style as 'A-frames'. The extreme slope of the roof is a response to the heavy snowfall of the area – while most of Japan except for Hokkaido falls under the Köppen-Geiger classification for warm temperate, fully humid, hot summer, the Gokayama region is classed as snow, fully humid, warm summer. The number of extant houses and their unique qualities prompted UNESCO to designate this area as a World Heritage Site in 1995. The Shimoki House and the Murakami House, both designated Important Cultural Properties by the Japanese Government, share certain basic principles of planning, materials and adaptation to their remote locations. At the same time, the latter house in particular shows distinctive features unique to its political and social context.

Perhaps the most striking general characteristic of the *gassho-zukuri minka* is the multistorey space beneath its steep gable roof. The Shimoki House and most other rural *minka* have only one storey, which is open to the underside of the roof. In contrast, the Murakami House and other dwellings in the area boast three to five upper floors, which were used for raising silkworms. The heavy snowfall and the scarcity of agricultural land in places like Shirakawa-go and Gokayama meant that agriculture alone was often insufficient to support a household, and residents turned to sericulture for additional income. The large scale of many of the *gassho-zukuri* dwellings demonstrates the success of this strategy – silk was traded for farming implements and other non-local goods, and even provided rare cash income. The multiple upper levels also create the most distinctive aesthetic element of *gassho-zukuri* houses – the extremely tall gable with several rows of windows that modulate light and air for the silkworms. This combination of residential, agricultural and industrial functions would seem surprising in many 21st-century settings – for instance North American suburbs, where housing tends to be segregated from other types of buildings. However, the growing population of people who work at home – whether telecommuting, running small businesses or operating workshops – suggests that the demand for multi-function dwellings may be increasing.

In terms of planning, both of these houses demonstrate similar principles, although the Murakami House is larger and more complex. Earthen-floor areas were used for cooking, agricultural work and storage, while raised-floor sections were used for living spaces. The comparative wealth of the owners of the Murakami House is indicated by the large number of rooms, the extensive use of *tatami* and the presence of a formal *shoin*-style room (drawing room). In contrast, the Shimoki House contains only two raised-floor areas, both floored in wood rather than *tatami*. In both dwellings, sliding screens separate interior rooms from each other, and sliding *shōji* and *amado* (solid wooden shutters) close openings to the exterior. Both houses also feature an *engawa*, which adjoins major interior spaces on the south side for light and warmth.

Materials and Construction Techniques

In both the Shimoki and the Murakami houses, several characteristics of the structure and roof demonstrate adaptations to local conditions. Firstly, except for the columns, many of the wooden structural members are only roughly finished. For example, the massive overhead beams retain the contours of the original trees. This reduced the need for skilled carpenters, who were scarce in remote regions, and allowed builders to take advantage of 'imperfect' timber. A pine tree growing on a mountainside will typically curve, as the trunk emerges perpendicular to the slope and then bends towards the vertical. In many rural *minka*, these curved beams, called *chona-bari*, create an arch-like effect as they curve upward from the exterior wall.

Today, the unique shape of each beam is particularly striking within the modern context of milled, standardized lumber. In fact, as designers seek ecologically sound and architecturally expressive materials, they often choose to reuse wooden beams and columns; there is a growing market for material recycled from dismantled *minka*.

In comparison with the massive *chona-bari*, the members of the steeply sloped roof structures in the Shimoki House and Murakami House are surprisingly small. In fact, in remote settlements such as Itchuson

Yurt, Adobe and Rammed Earth Homes of North China

Lijun Zhou

Geography/Climate

In regard to warm humid climates, this region of Northern China is defined as the territory running from the Great Wall to the northern borders, and mainly comprises what are known as the northeast and northwest areas along with the provinces of Inner Mongolia and Xinjiang. In this vast area reside the Han, Manchu, Mongol and Uighur peoples. Due to the varying characteristics and traditional customs of northern China, its vernacular architecture generally presents a variety of forms. However, the traditional residences of the region display many common characteristics, albeit modified by climatic adaptations to rain, wind and temperature.

Building Plan/Form and Construction Techniques

The average rainfall-distribution map of China shows that the precipitation level of the northern region is below 400 mm per year, which places it in an arid and semi-arid zone. In light of this scant rainfall, the roof treatments of the region's residential buildings include vaults, shallow monopitches and flat roofs, which are best suited to the dry drought-prone characteristics of the locality. Rammed earth or earth mixed with grass is frequently employed for these roofs, while walls are mostly adobe with little regard for waterproofing measures.

In most of region, wind speed is above 150 W/m2 according to the wind-resources distribution map shown below. In winter, northwesterly winds are prevailing and powerful. Therefore, the gently sloping or flat roof often seen in residential buildings is chosen in order to resist the impact of the cold winds. At the same time, a kind of streamlined vault is employed in Inner Mongolia in the form of the traditional yurt. In some mountainous areas, buildings are constructed on the southern sides of peaks and erected so that the northern, windward face of the dwelling is as small as possible. Openings are designed to mitigate heat loss; in addition, windows are not usually set in north walls here, and walls are built thick in order to prevent permeation by the cold winds. An alternative wind-resistance method used in northern residential buildings is

Right Despite differences due to cultural and climatic variation, one of the most common building types in northern China is low, flat-roofed homes – an adaptation to the scant rainfall.