FINAL COVER

A landmark publication that celebrates humanity's age-old ability to create buildings that are ingeniously adapted to their cultural and environmental conditions, providing enduring lessons for living today.

Habitat

Vernacular Architecture for a Changing Planet

Edited by Sandra Piesik

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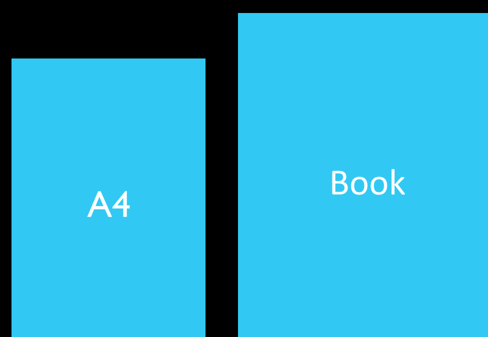

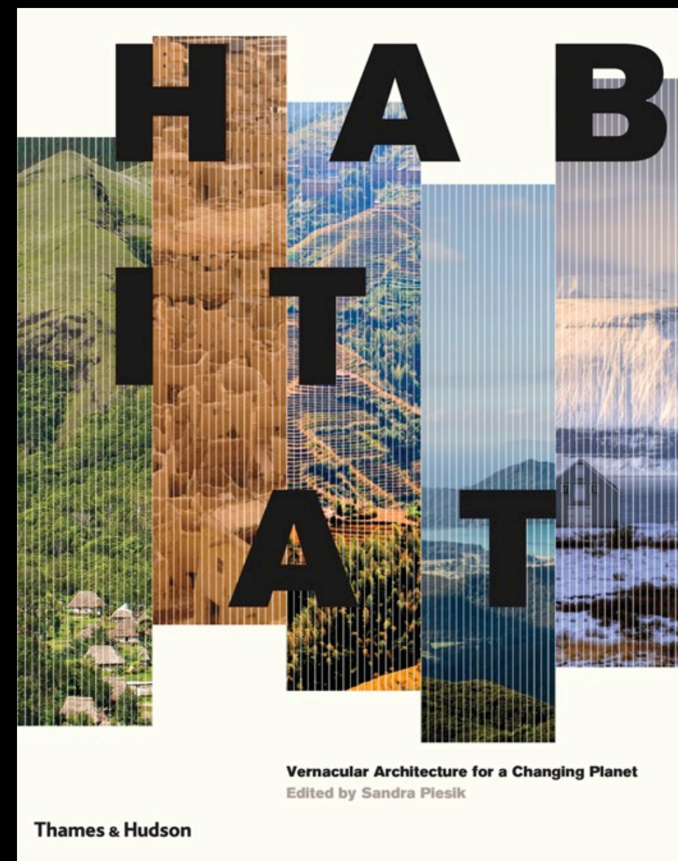

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Key Sales Points

- An ambitious and important book, created following years of research by an international multidisciplinary team comprising more than 100 academics, construction engineers, architectural historians, material scientists and climatologists
- Organized by climatic zones, an innovative new approach to the subject that provides real-world insights into sustainable buildings in the midst of global climate change and stresses the importance of preserving disappearing craftsmanship and local knowledge
- A complete reference source, packed with time-tested designs and constructions
- Large format, comprehensive and highly visual, with specially commissioned maps and climatic infographics and 1,000 illustrations


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The Value of the Vernacular

Jim Colman and Henry Fletcher

The vernacular builders of the world learn to be true to the types and conditions of the buildings that they not only construct, but also occupy. – Paul Oliver

At the heart of all the processes relating to the production of the built environment, one relationship is key – that between the occupant or user and the constructor. Buildings, cities and managed landscapes provide the most fundamental images of our communities, societies and economies. Within this enormous range of built places and their responses to the underlying natural environments (wherever these may lie on the spectrum from life-giving to hostile), the contractual distance between constructor and inhabitant goes a long way towards determining the degree of locality or regional specificity. Switches from traditional to modern methods of construction are generally accompanied by a shift: from local labour handling local materials to produce housing or other built functions for their own communities, towards non-local labour handling materials with more complex and spread-out supply chains to produce a built environment that is more modular in quality and less regionally and culturally specific. As societies move towards increasingly specialized and leveraged economic models, the accepted comfort and productivity gains from this progression are often accompanied by losses of a less monetized, more intangible nature – sometimes social, sometimes aesthetic or cultural, sometimes in terms of complex risk/comfort trade-offs. This is in addition to possible socio-economic losses associated with the decline of traditional skills and constructions knowledge, and the possible demise of associated micro-businesses.

In many ways, the creation of value through the application of human labour to raw materials (in some cases the very ground that lies below us, in others the vegetation that thrives in the water around us) can be considered the oldest manifestation of the core economic model by which economists understand the world. The losses observed as societies leave vernacular construction behind and move towards alternative procurement arrangements may be considered classic examples of market failures, whereby indirect benefits or positive externalities are not taken into account when switching from one system to another. This essay seeks to unpack the economic cases for retaining, reinstating or reinventing locally specific construction methods, or possibly finding a suitable place for them alongside modern construction methods, as well as some of the issues surrounding such initiatives to 'bring back the vernacular'.

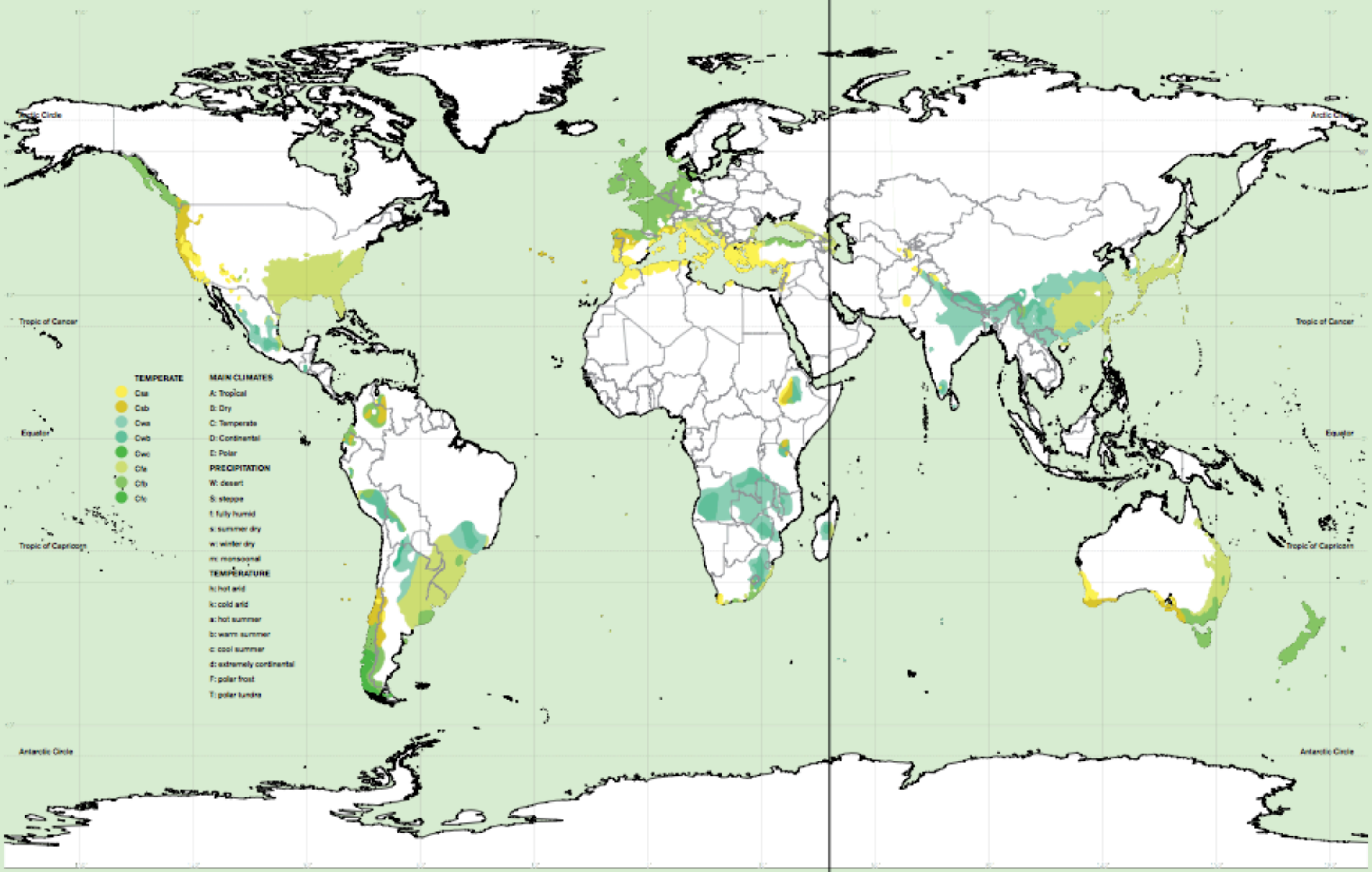
Economic justification for the protection or reinstatement of vernacular architecture, or the reintroduction of vernacular construction techniques, can be made in multiple ways at multiple levels. A global-level case can be made for the promotion of low-carbon or low-embodied-energy construction (which is frequently, but not always, a quality of regionally specific approaches), since slowing the rate of climate change is a widely acknowledged global goal. But a low carbon footprint has never been the driving rationale for techniques that emerged over millennia of development. Other global-level cases may be made for specific characteristics where their loss might be considered a loss of universal value or of a global asset.[1] However, where only a global-level case has been made, local populations may very often be sceptical of the validity of this style of argument – perceiving it, at best, as naive romanticism and at worst as deliberately anti-development.

Opposite Promoting low-carbon, often locally specific, methods of construction makes sense for economic reasons, as well as for the wider worldwide goal of slowing climate change. The grand mud mosques of Djenne, Mali, for instance, require annual maintenance using indigenous techniques to repair and restore the exterior cladding of these great structures. Their preservation is highly desirable – economically, culturally and for our climate.

In many ways, the creation of value through the application of human labour to raw materials can be considered the oldest manifestation of the core economic model by which economists understand the world.

TEMPERATE

Equirectangular projection. Scale 1: 70 000 000



The general characteristics of the moist subtropical mid-latitude climates, type C, are distinct summer and winter seasons, and humid, mild winters with average temperatures of the coldest month below 18°C but above -3°C. Such regions tend to be found on the eastern and western regions of most continents, from about 25 to 40° latitude, and can be subdivided into humid subtropical (Cwa) and dry summer subtropical, or Mediterranean (Csa).

Humid subtropical climates are found principally along the southeast coasts of continents. They dominate eastern China, the southeastern United States and South America, and the southeastern coasts of Africa and Australia, generally between latitudes 25° and 40°. A common trait is hot, humid summers as warm, humid air flows poleward in these regions from subtropical high pressure systems. This results in high temperatures and high humidity. Rainfall often shows a summer peak, especially where monsoons are well developed, as in Southeast Asia. In other regions, weak summer fronts may bring occasional relief. However, devastating heatwaves, sometimes lasting weeks, can occur if an upper-level ridge of high pressure moves over the area.

Winters tend to be relatively mild – especially in the lower latitudes, where air temperatures rarely drop below freezing. Poleward regions experience colder, harsher winters and more common frost, snow and ice storms, but heavy snowfalls are rare. Winter weather can be changeable, as mid-latitude storms bring wind and cold rain fronts through the region. However, many subtropical climates such as southeast Asia or Florida have very dry winters, with frequent brush fires and water shortages.

Humid subtropical climates experience precipitation throughout the year, with typical averages between 800 and 1,650 mm. In summertime, when thunderstorms are common, much of this precipitation falls as afternoon showers. Tropical storms entering this region can add substantially to summer and autumn totals. Winter precipitation most often occurs with eastward-moving middle-latitude storms. On the western sides of many continents, the temperatures in these regions are moderated by prevailing winds from the ocean, keeping winter substantially warmer than at locations inland. Moving equatorward of these marine climates, the influence of the subtropical highs becomes greater and the summer dry period becomes more pronounced. Gradually, the climate changes from marine (Cxx) to dry-summer subtropical, or Mediterranean (Cxx): mild to wet winters and mild to hot, dry summers.

As its name suggests, a mediterranean climate is typical of that region of the world. Characterised by dry summers and mild, moist winters, the majority of this climate zone has relatively mild winters and very warm temperatures. Commonly occurring on the west coasts of continents, these climates are experienced by much of California, parts of Western and South Australia, Central Asia, southwestern South Africa, and Chile. The seasonality of rainfall is driven by the shift of the subtropical high pressure cells north/south in response to the annual cycle of solar heating. During summer the regions are dominated by subtropical high pressure cells with dry sinking air. This makes rainfall unlikely except for occasional thunderstorms. This summer period without significant rainfall may last for 4 to 6 months. In winter, when the subtropical highs shift equatorward, the polar jet stream and associated periodic storms reach into the lower latitudes of the mediterranean climate zone bringing rain, with snow at higher elevations.

Minka Vernacular in Urban and Rural Japan

Don 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 *shoji*, which are lattice screens covered with paper (typically made from the pulp of *kozo*, a paper 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.

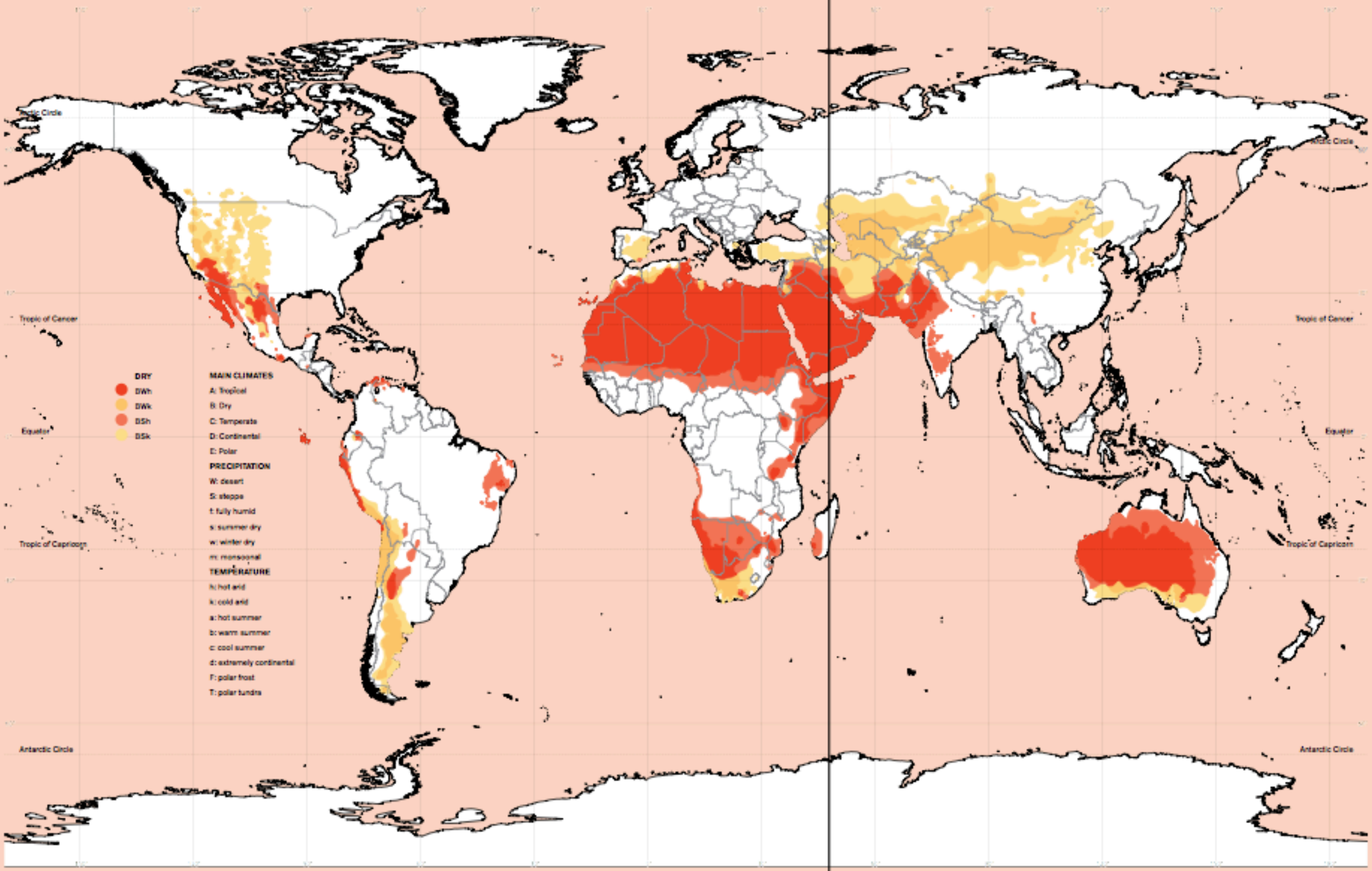
Minka can be broadly classified into rural and urban categories. Unfortunately, fires and redevelopment have destroyed the vast majority of urban *minka*, but examples from the Edo Period (1603–1868) survive in small numbers in many cities. One of the largest extant groups stands in the district of Imai-cho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

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 developed based on climatic, cultural and economic conditions, but all were based on post-and-lintel timber structures.

DRY

Equirectangular projection. Scale 1 : 70 000 000



Precipitation (water gain) in the dry climate zone is less than potential evaporation and transpiration – the amount that would occur if a sufficient water source were available (water loss). These subtropical deserts extend from roughly 20 to 30° latitude, in large continental regions, often surrounded by mountains. According to Köppen, the dry regions of the world cover more land area (about 26 per cent) than any other major climatic type. Clumps of trees are more isolated than elsewhere, and grasses dominate the landscape.

These regions depend not only on precipitation totals but also temperature, which greatly affects evapo-transpiration. Regions are more likely to be classified as dry if most of the precipitation is concentrated in warm, summer months when evapotranspiration rates are greater. Precipitation in a dry climate is both low and irregular – typically, the lower the amount, the greater the variability.

The major dry regions of the world can be divided into two primary categories. The first includes the Subtropics, between latitudes 15 and 30°, where the sinking air associated with the subtropical high-pressure zones produces generally clear skies. The second is in the continental interiors of the middle latitudes. Here, far from sources of moisture, areas are deprived of precipitation. This continental dryness is often accentuated by mountain ranges that produce a rain-shadow effect.

The Köppen system captures these two climate types based on dryness: the arid and the semi-arid, or steppe. These can be divided further, based on temperature: hot and dry, with a mean annual temperature above 18°C; or cold (in winter) and dry, with a mean annual temperature below this value.

Arid climates are found along the west coast of South America and Africa, and across much of the interior of Australia. Although meagre, vegetation that needs little water (xerophytes) exists in these regions, reliant on infrequent rains and capable of surviving long periods of drought. Such vegetation includes various forms of cacti and short-lived plants that grow during rainy periods.

In low-latitude deserts, intense sunlight and clear skies result in high daytime temperatures; maxima can exceed 50°C, although 40–45°C is more common. At night, the air's low vapour content (relatively humidity is usually less than 25 per cent) allows for rapid cooling, and minimum temperatures drop below 25°C. Arid climates have a very large daily temperature range. During the winter, temperatures are more moderate, and minima may drop below freezing. Other effects on temperature and humidity may be superimposed on this pattern – for example, those due to the effects of monsoonal circulations.

In middle-latitude deserts, average annual temperatures are lower than in their low-latitude counterparts. Summers are typically warm to hot, with afternoon temperatures frequently reaching 40°C. Winters are usually extremely cold, with minimum temperatures sometimes dropping below -35°C. Many of these deserts lie in the rain shadow of extensive mountain systems, such as the Sierra Nevada and Cascades in North America, the Himalaya in Asia and the Andes in South America. Their small amounts of precipitation tend to come from the occasional summer showers of mid-latitude storm systems.

Around the margins of these areas, where the rainfall is a little higher, the climate gradually changes to semi-arid. This steppe region typically displays short grasses and scattered low bushes, trees or sagebrush (Artemisia). More poleward regions experience colder temperatures, and rainfall is replaced by snowfall in winter. Annual precipitation is generally between 200 and 400 mm.

Syria's Villages of Earthen Domes

Saverio Mecca

Geography/Climate

The region south and east of Aleppo, from the Euphrates to Salamiya, has been inhabited since Neolithic times by both sedentary and nomadic peoples, who have alternatively dominated the area.

The so-called 'arid margins' region corresponds to the limits of Syria's steppe zone, whose extent can be estimated as covering 55 per cent of the country's territory. The diversity of habitats, in relation to the uses of the land for agriculture and stockbreeding, are linked to the dry climate and soil of the area. In these arid margins can be found a population 'mosaic' comprising varied cultural groups: Ismailis, Alawites and Christians; Kurdish or Circassian refugees; and tribal nomads. Despite this cultural and social diversity, great homogeneity exists in the architectural and building culture, based on a adaptive approach to the available materials: clay, earth, limestone and basalt – or even materials recovered from previous settlements of the Byzantine era.

Construction Techniques

Vaulting technology appears to have been quickly mastered in the ancient Near East. Domed roofing started in Tell Halaf c.5100 BC, and has been in use for centuries in traditional Syrian rural architecture. The earthen-domed house evolved over time, stemming from a willingness to apply and develop the most appropriate solutions to meet human needs in relation to the available environmental resources.

Earthen domes are superior to flat roofs because their shapes are cheaper to build in a region scarce in timber. They better resist rain leakage and they expose less surface to the summer sun, reducing solar radiation and achieving generally good climatic conditions in their interior spaces.

Opposite Domed structures in Syria are created from the strongest possible structure that can be built with readily available materials of clay, earth, limestone and basalt. The superior waterproofing and reduced radiation of this building type ensures its widespread use.

Appendix 3: Materials Science Introduction

Chris Trott

The Future of Materials Science

How best can we specify natural materials? To begin with, we must understand their benefits compared to the alternatives developed since the Industrial Revolution.

We Need to be in Charge

One certain benefit is that such materials enjoy a natural abundance – provided we treat the environment well, letting it do what it does best, which is to thrive naturally. In this way, the services that we derive from natural materials will be secured and will always regenerate.

Natural materials require stewardship, which links their use directly to the husbandry that a considerate society can bring. A fundamental re-connection between people and nature will benefit both parties. The consequences of living in a world with no understanding of the origins of the things that we need are dire. We are then, ethically, in the hands of multinational corporations – and the politicians whom they support – that set out the use of such resources. Too often, those ethics have sanctioned the exploitation of a common good – nature – that we are all entitled to by right, with little consideration for the consequences. We need to start responsible stewardship much earlier. Dr Seuss's story of *The Lorax*, a steward who 'speaks for the trees', is a poignant example of the wrong kind of thinking: it chronicles how a businessman (the Once-ler) chops down all the Truffula Trees upon which his business depends – ruining himself, the environment and his civilization, even with the plaintive pleadings of the Lorax ringing in his ears. So let's start young, with the best education, to build future capacity to engage and act responsibly.

The Mission of Business

For the rich, acts of stewardship should be relatively easy: wealth brings the luxury of choice and influence. So let's be optimistic on that front; stewardship-minded business leadership and ethical purchasing decisions are increasing, and will hopefully trickle down to the far more numerous, but less influential, poorer members of our global family. It makes good sense for business to take a stewardship-based approach, supporting both its customers and its resource base in the long term – the fundamental precept of a 'circular economy' that is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times.

Seeing those to whom business sells as customers, not consumers, is part of this mission – the objective being the service that a material provides rather than its ownership, which is only one aspect of the transaction. In fact, it is really only business and its customers (us) that can take a long-term view; our political systems currently do not appear able to plan for the future beyond their members' period of tenure.

Transparency in Materials Choices

Natural materials need to pass tests of performance, environmental impact, health and safety. However, so too should alternative man-made materials; there should be a 'level playing field'. The physical, environmental and economic performances of both material types need to be transparent and properly understood, including their impacts on the customer and the supply chain.

Opposite If demand can be created for natural materials that sustain customers, the environment and our economies, then the production of these resources can be cultivated – and will make evident the holistic performance of materials such as palms, bamboo and timber.

Natural materials require stewardship, which links their use directly to the husbandry that a considerate society can bring. A fundamental re-connection between people and nature will benefit both parties.

Building with Bamboo

Kengo Kuma

Bamboo (*Bambusoideae*) is a key element of the landscape in East and Southeast Asia, and plays an important role in the culture of the continent. The bamboo plant can be said to symbolize Asia, where it often represents nature and is frequently regarded as emblematic of an anti-urban spirit or naturalistic lifestyle. For example, in China, there is a well-known tale called 'The Seven Sages of the Bamboo Grove', in which a group of people who loathe corruption and chaos gather in an urban bamboo grove where they live a spiritual and peaceful life at one with nature.

However, bamboo is surprisingly difficult to use as a building material, and even in Asia there are few examples of such use. This is because it often cracks as it ages, and exposure to rain causes colour changes and surface weathering. Therefore, although thin bamboo is used in screens and blinds, the linear beauty of the bamboo trunk is rarely displayed architecturally other than in temporary buildings in Southeast Asia that are intended to be rebuilt after several years.

We first attempted to use 150 mm diameter bamboo in formwork for a small house in Kamakura, Japan (2001). The bamboo nodes were removed using a special drill, and two L-shaped steel rods were inserted inside the completely hollowed stems before they were filled with concrete. This meant that any cracks that might later develop in the bamboo would not affect the strength of these formwork 'columns'. In this house, we also used 60 mm diameter bamboo for all of the indoor flooring in order to create a subtle connection between the ground-floor and first-floor spaces.

In a project called the 'Great Bamboo Wall' (2002), erected beside the Great Wall of China, we used 60 mm diameter bamboo extensively in the outer walls and interior. The resultant building has been praised as being 'very Chinese' by many Chinese commentators.

By demonstrating through specific projects that bamboo can be used externally – specifically, by designing deep eaves to ward rain and direct sunlight off it when used as a wall material – we hope to expand its use as a building material. In the Shizuoka International Garden and Horticulture Exhibition main gate in Hamamatsu (2004) and the Nezu Museum in Tokyo (2009), we used large amounts of bamboo in exterior architectural details in a way that had never been attempted before even in Japan.

At the Ginzan Onsen Fujiya (2006), a boutique hotel at the bottom of a valley in the T□hoku region of Japan, we cut thin bamboo slats into 4 mm widths to create semi-transparent *sumushiko* screens that were used over the entire building. *Sumushiko* screens are a traditional detail but they are usually used only found in specific parts of a building, so our method of use was unprecedented. By combining tradition and modernity, natural materials and modern technologies, the dream is to revive the use of bamboo – a plant that has played an essential role in the culture and natural environment of Asia.

Below Despite bamboo's positive qualities of a quick-growing, relatively cheap and widely available material, it has been difficult to harness its use as a reliable building material.

Opposite top The Shizuoka International Garden and Horticulture Exhibition Pavilion designed by Kengo Kuma in 2004 was one of several of the practice's experiments in applying bamboo to external structures.

Opposite bottom Borrowing from the earlier Shizuoka design strategy of deep eaves to protect bamboo from sunlight and rain, Kuma's Nezu Museum in Tokyo of 2009 also meant that the structure could be made with large amounts of bamboo in its exterior detailing.

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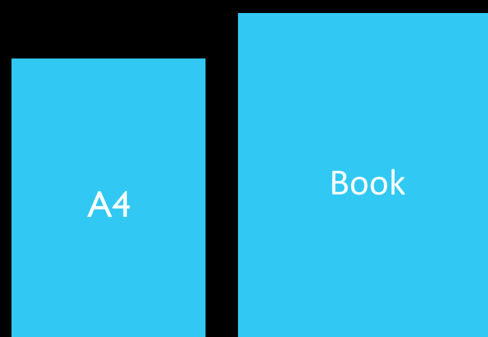

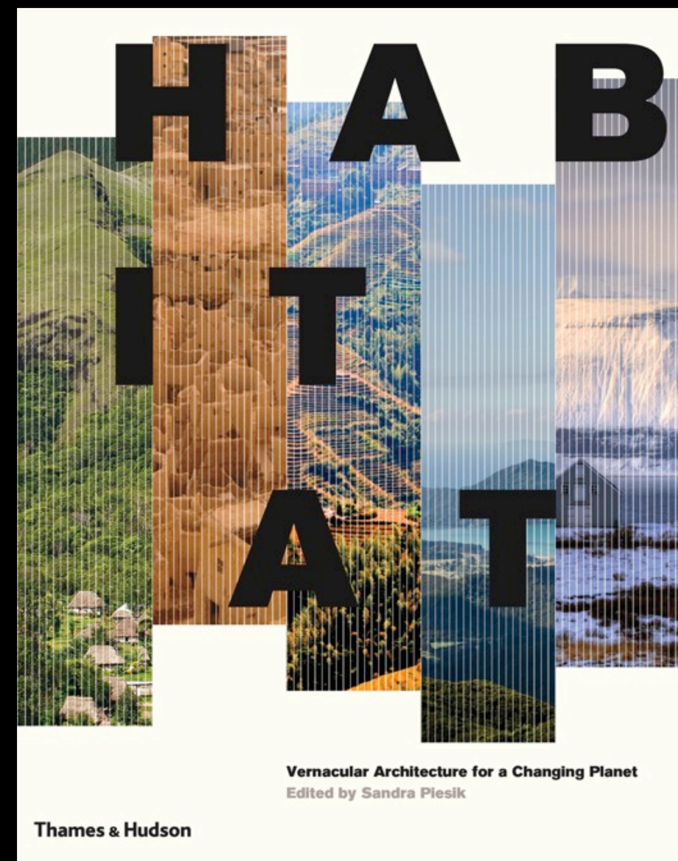

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