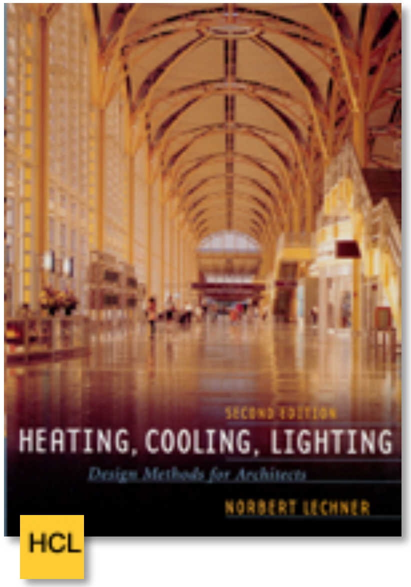
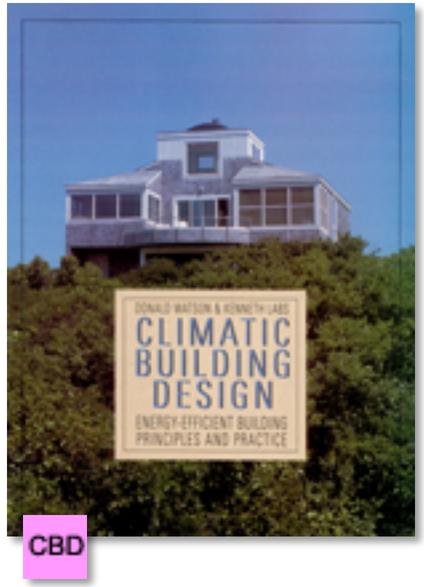
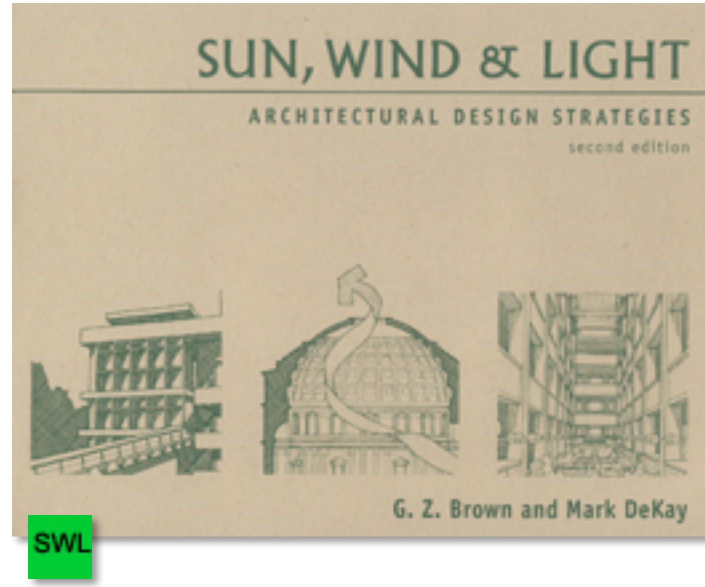
Climate, Human Comfort and Building

Arch 125: Introduction to Environmental Design

Fall 2016







Texts used in the preparation of this presentation.

Paris, Texas, Canada, Jamaica?? Can you tell which is which??

In this lecture we will learn how to make buildings that respond to their climate -- use less energy -- and that we might actually be able to tell where they come from.

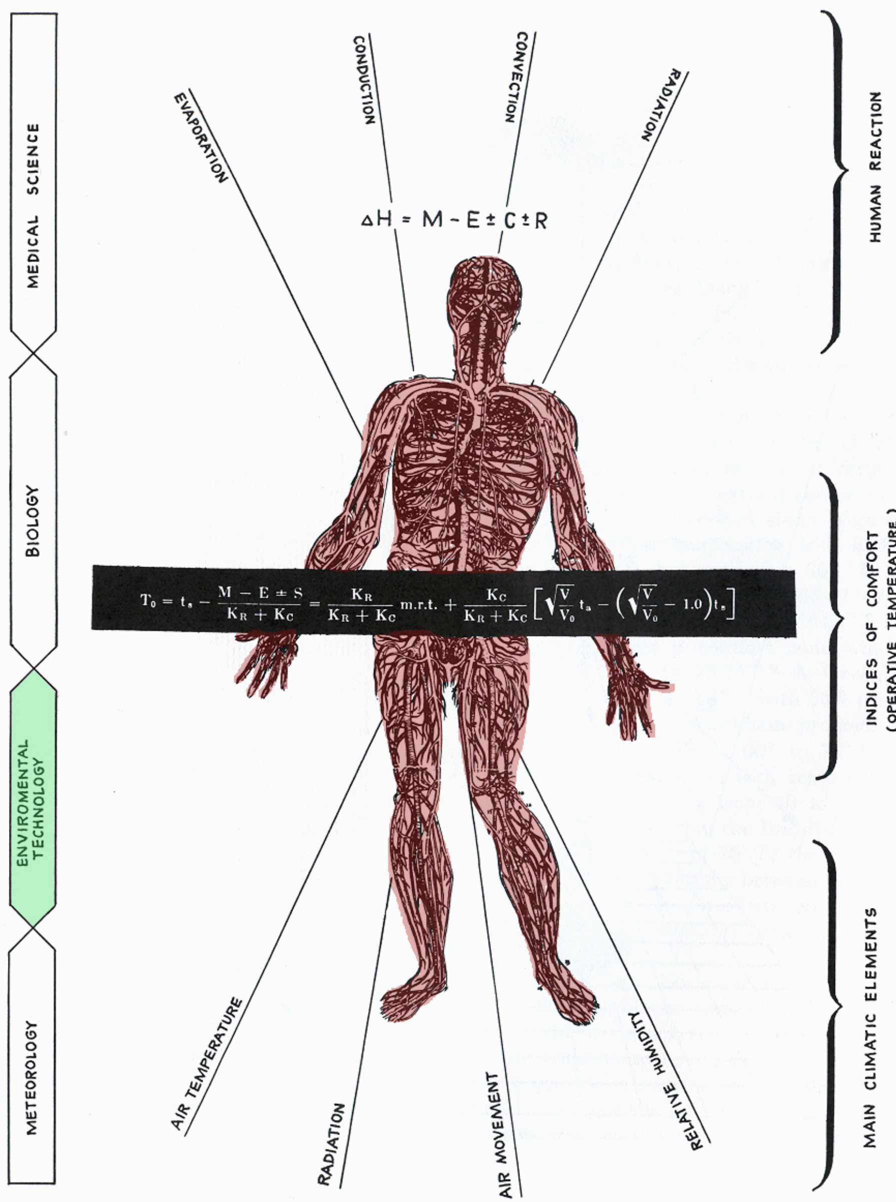

“McDonald’s” type architecture tends to distribute the same building “type” around the globe, with little recognition of the influences of climate. Before the invention of mechanical heating and cooling in the late 1800s, this would not have been possible.

Why do we build buildings???

THEN, people desired a certain minimum level of COMFORT, but would modify clothing or expectations as a function of the weather.

NOW, people people expect to be held at a constant level of COMFORT, in spite of the weather or location (in the world).

The Effects of Climate on People



36. Relation of human body to the climatic elements.

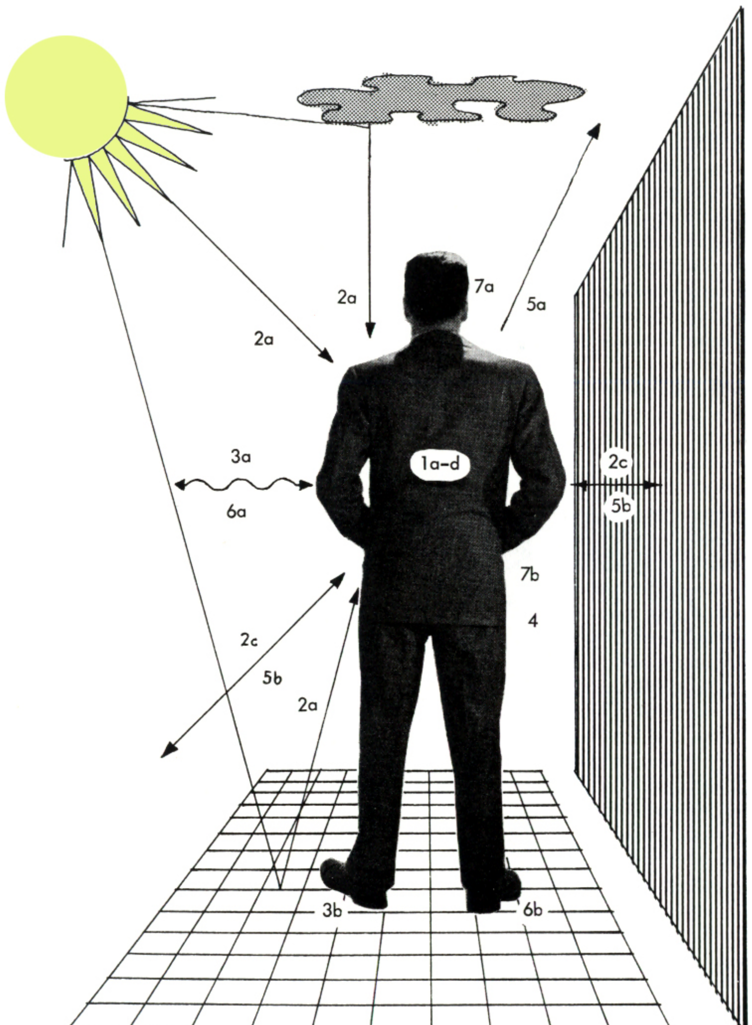
Major elements of climatic environment which affect human comfort are:

- -Air temperature
- -Radiation
- -Air movement (Wind Speed)
- -Humidity

"Thermal Comfort – that condition of mind which expresses satisfaction with the thermal environment."

ASHRAE Standard 55-66

Bodily Heat Transfer



16 37. Heat exchange between man and surroundings.

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Heat Gains:

- Metabolism (conversion of food to activity and heat)
- Absorption of Radiant Energy
- Heat Conduction Toward Body

Heat Loss Through:

- Evaporation
- Conduction
- Convection (Wind Chill Factor)
- Radiation

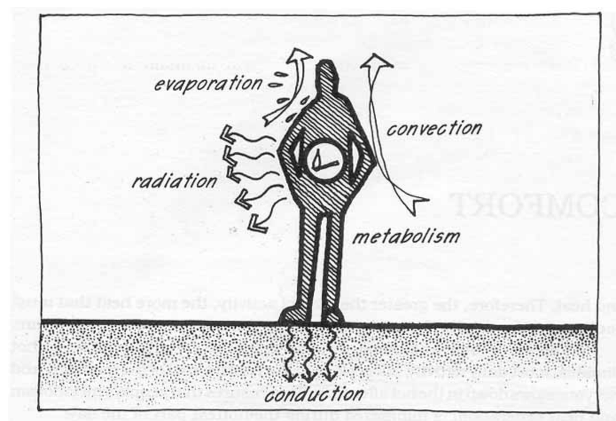

Figure 2.1: Maintaining the thermal balance by equalizing heat gain (due primarily to metabolic heat generation) and heat losses (by convection, radiation, conduction, and evaporation).

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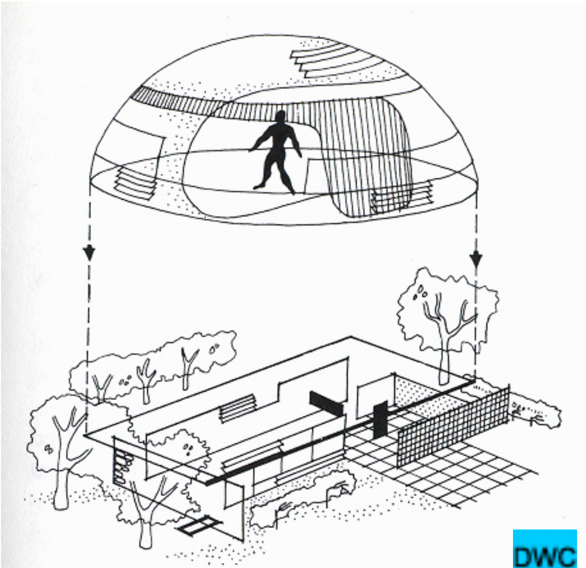
Shelter and Environment



35. Theoretical approach to balanced shelter.

•Shelter is the main instrument for fulfilling the requirements of comfort. It modifies the natural environment to approach optimum conditions of livability.

•The architect's problem is to produce an environment which will not place undue stress upon the body's heat-compensation mechanism

•*It is NOW the task of the architect to make utmost use of* ***the natural means*** *available in order to produce a more healthful and livable building, and to achieve a saving in cost by keeping to a minimum the use of mechanical aids for climate control.*

The Comfort Zone

The Comfort Zone refers to the range of temperature conditions of air movement, humidity and exposure to direct sunlight, under which a moderately clothed human feels “comfortable”.

This will be different for Indoor versus Outdoor conditions.

This will be different for different cultures and climate conditions - what are people used to??

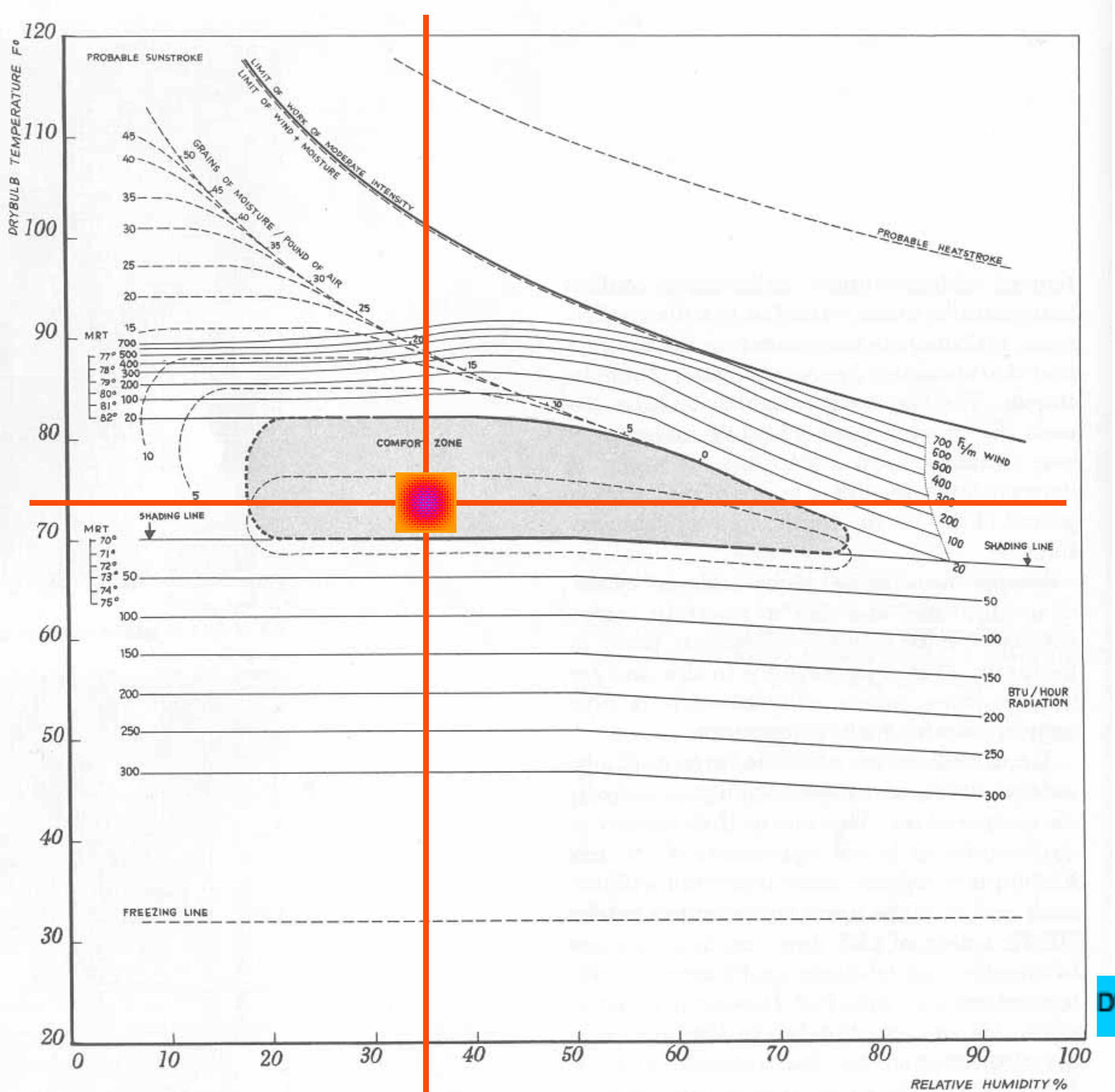
As Architects we use our buildings to not only create comfortable indoor environments, but also pleasing and useful spaces outside of our buildings.

Where do people want to sit?

The Comfort Zone

The comfort zone is the kidney shaped area that defines the range of conditions within which North Americans express no *great* objection.

However, the intersecting red lines show the temp and RH that we strive for in our *interior* environments, winter, summer, Arctic, Florida!



45. Bioclimatic Chart, for U.S. moderate zone inhabitants.

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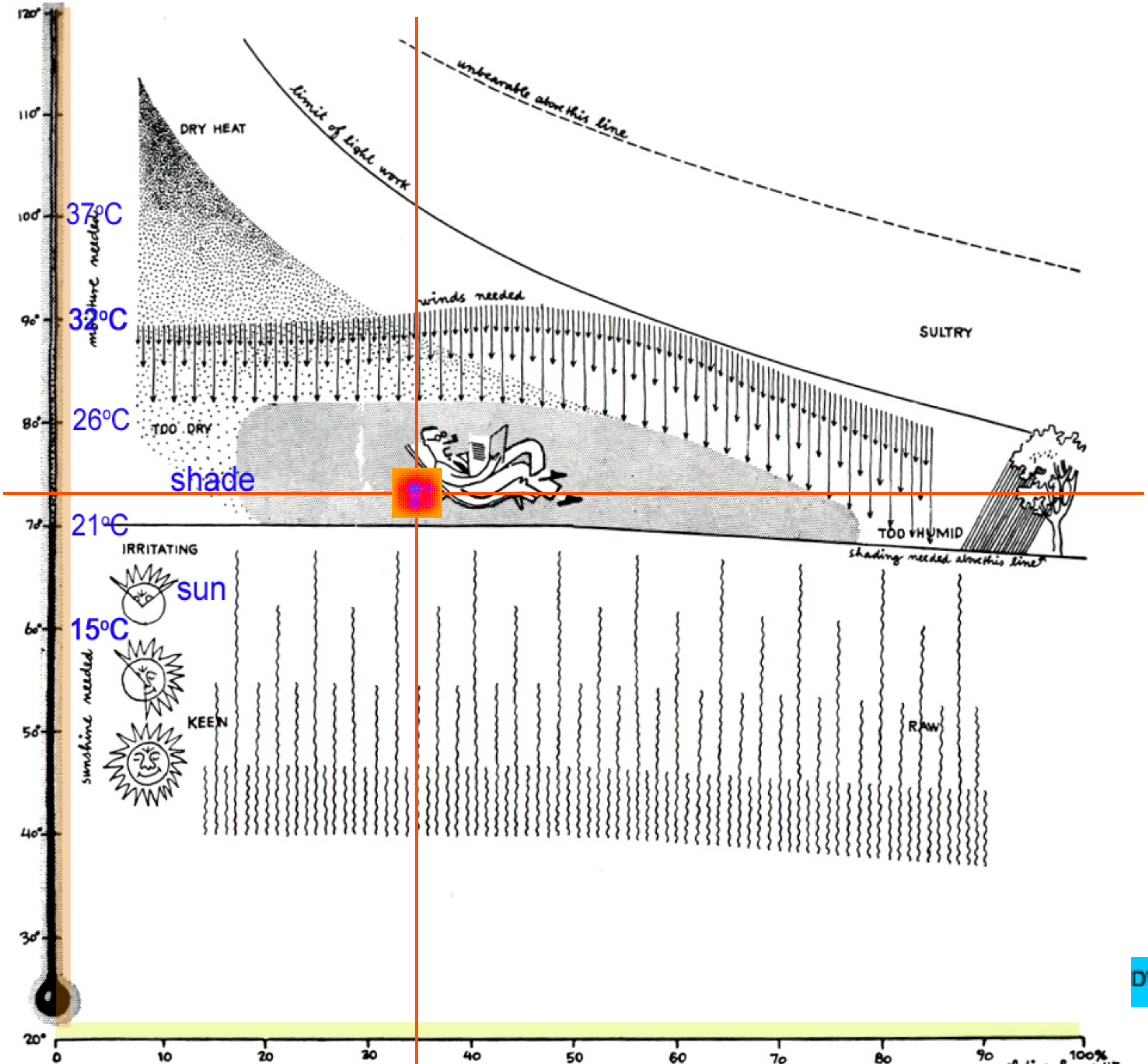
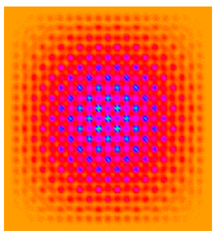


46. Schematic bioclimatic index.

This adaptation is from "Design with Climate" by Victor Olgyay, first published in 1963.

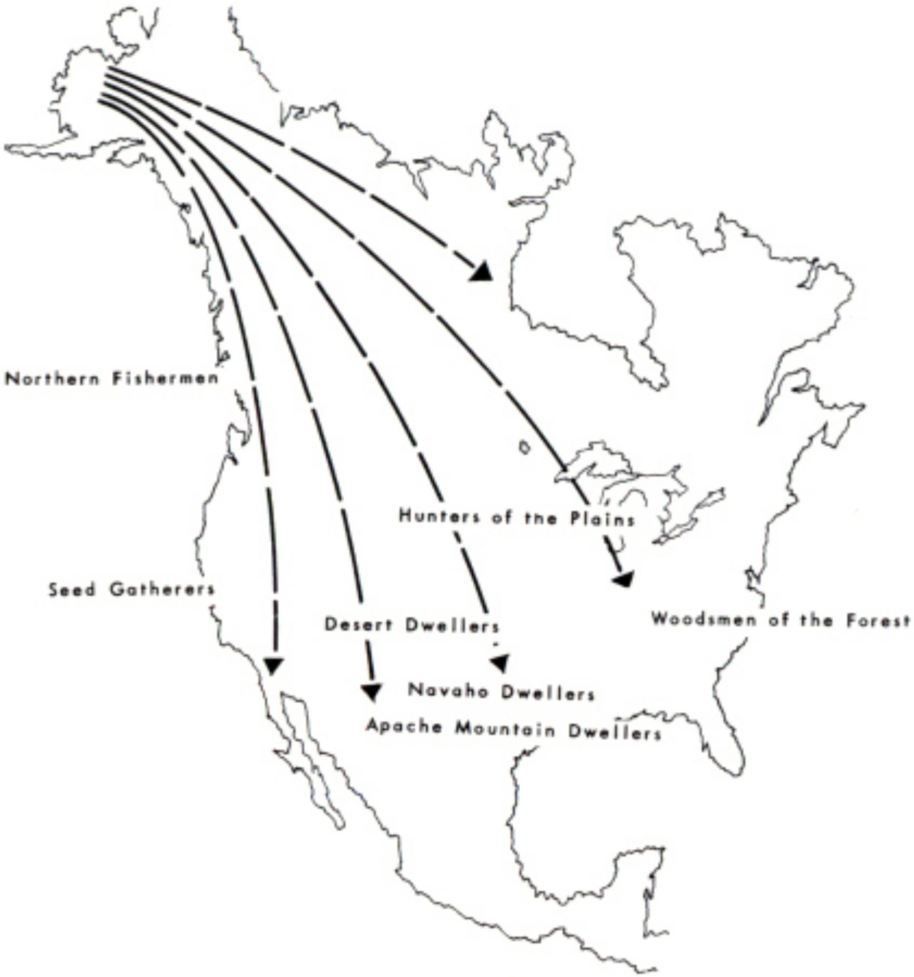
One of the biggest adjustments that must be made in trying to design buildings with less dependency on mechanical heating and cooling, is the adaptation of human expectations to have their environments held at a constant Temperature and Relative Humidity.



All indoor temp and RH that falls outside of 23C 35%RH calls for mechanical and electrical intervention!!

i.e. $$$ and fuel

Climatic Regions in North America



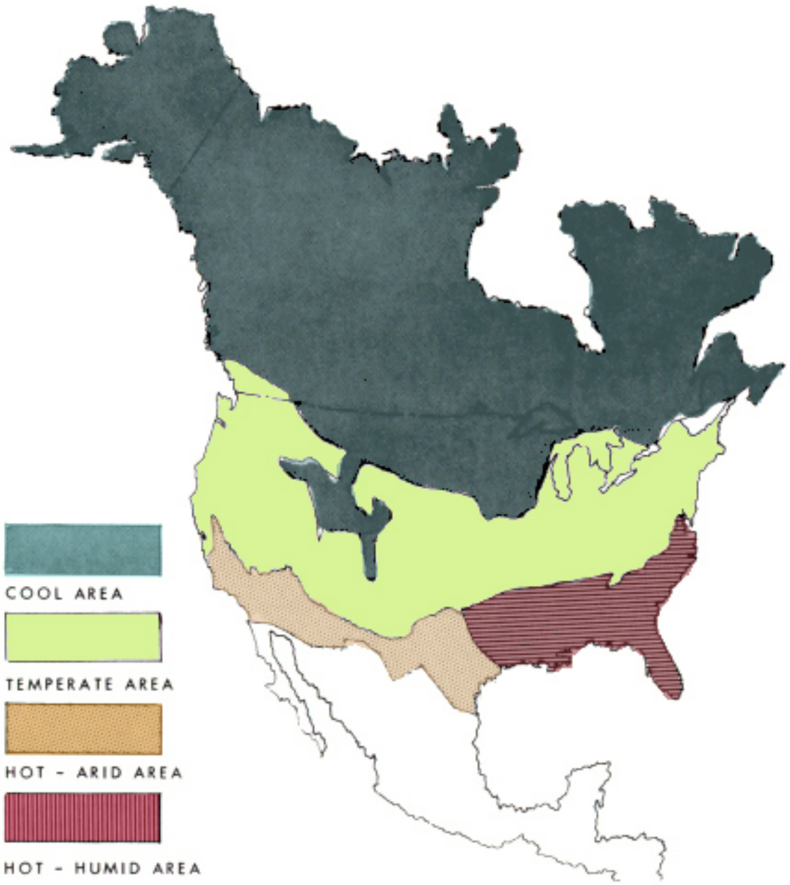
10. Diffusion of migrating Indian groups.

It is generally agreed that the American Indians stemmed from Asia and that the waves of their migration across the Bering Strait established their populations from end to end of North and South America. As they spread throughout North America, the Indians entered into a broad variation of climatic environments. These in turn impacted the type of dwellings that they created. Dwellings also reflect nomadic vs. stable settlement.

Early migration and settlement had much to do with the climate, landscape and available materials and food sources.

The availability of fresh water was also critical to these choices.

Climatic Regions in North America



11. Regional climate zones of the North American continent.

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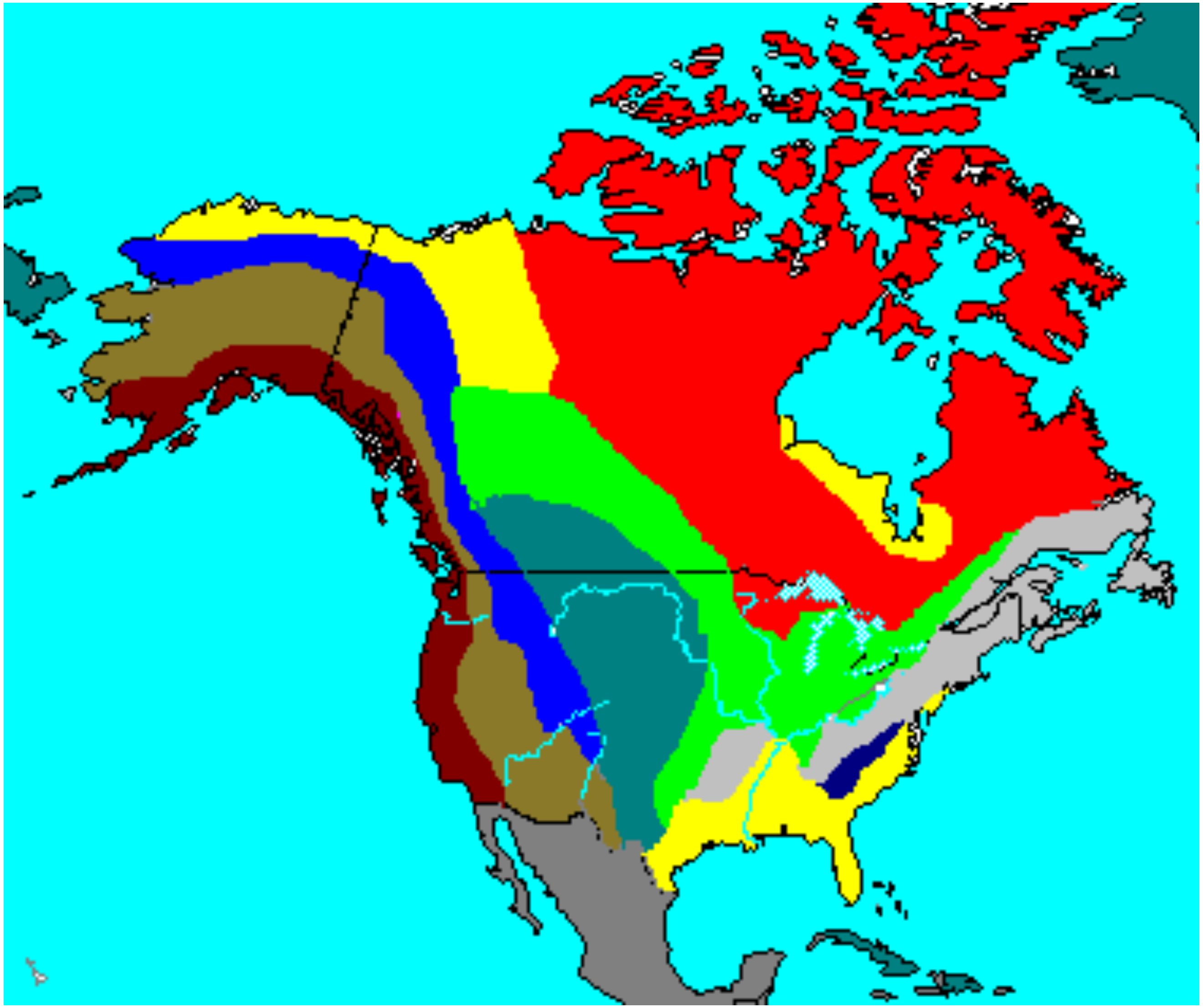
Cold -where winter is the dominant season and concerns for conserving heat predominate all other concerns.
(Eg: Minneapolis, Minnesota and Ottawa, Ontario)

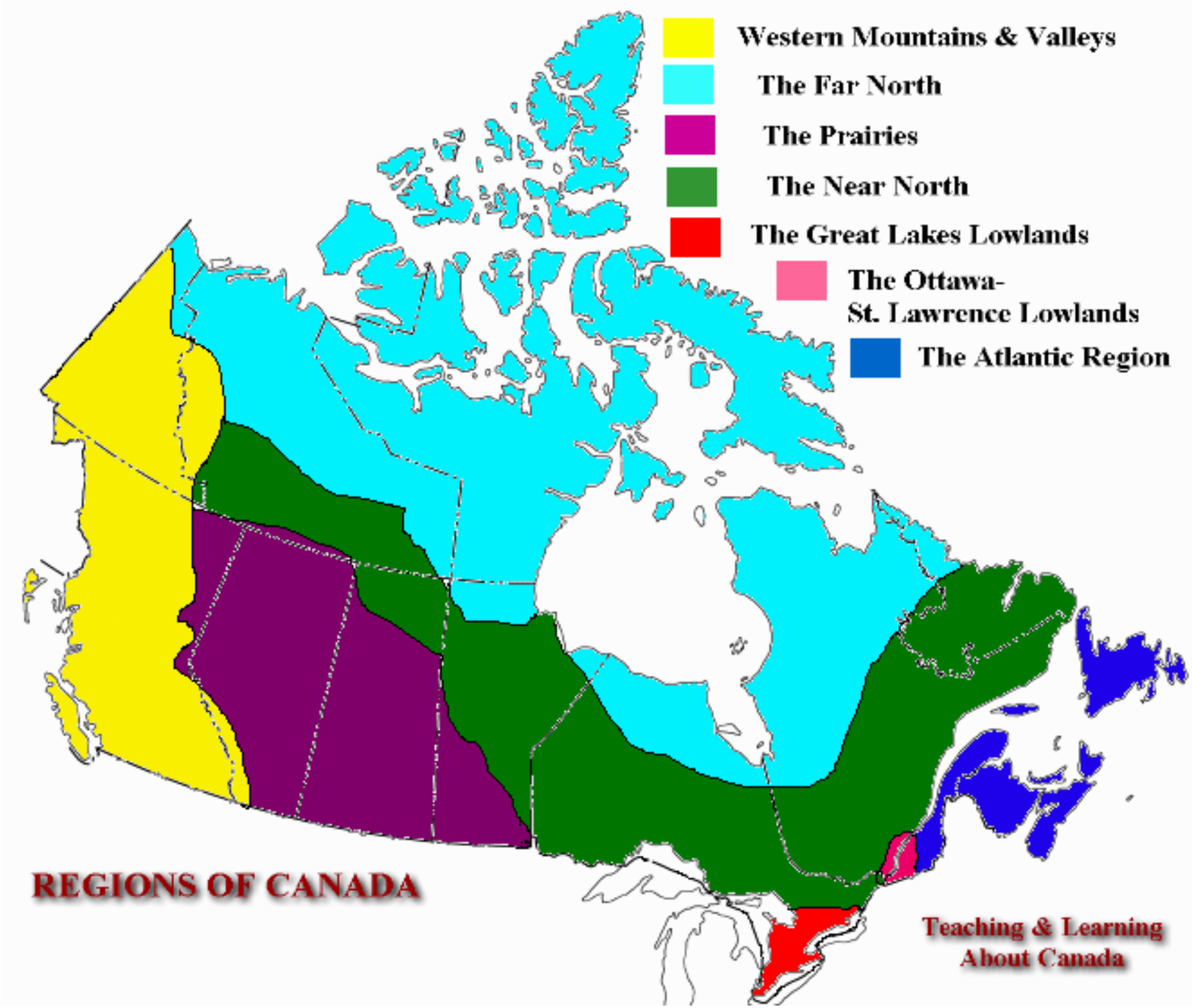
Temperate – where approximately equally severe winter and summer conditions are separated by mild transitional seasons. (i.e.: New York, NY)

Hot-Arid – where very high summer temperatures with great fluctuation predominate with dry conditions throughout the year. (i.e.: Phoenix, Arizona)

Hot-Humid – where warm stable conditions predominate with high humidity throughout the year (i.e.: Miami, Florida)

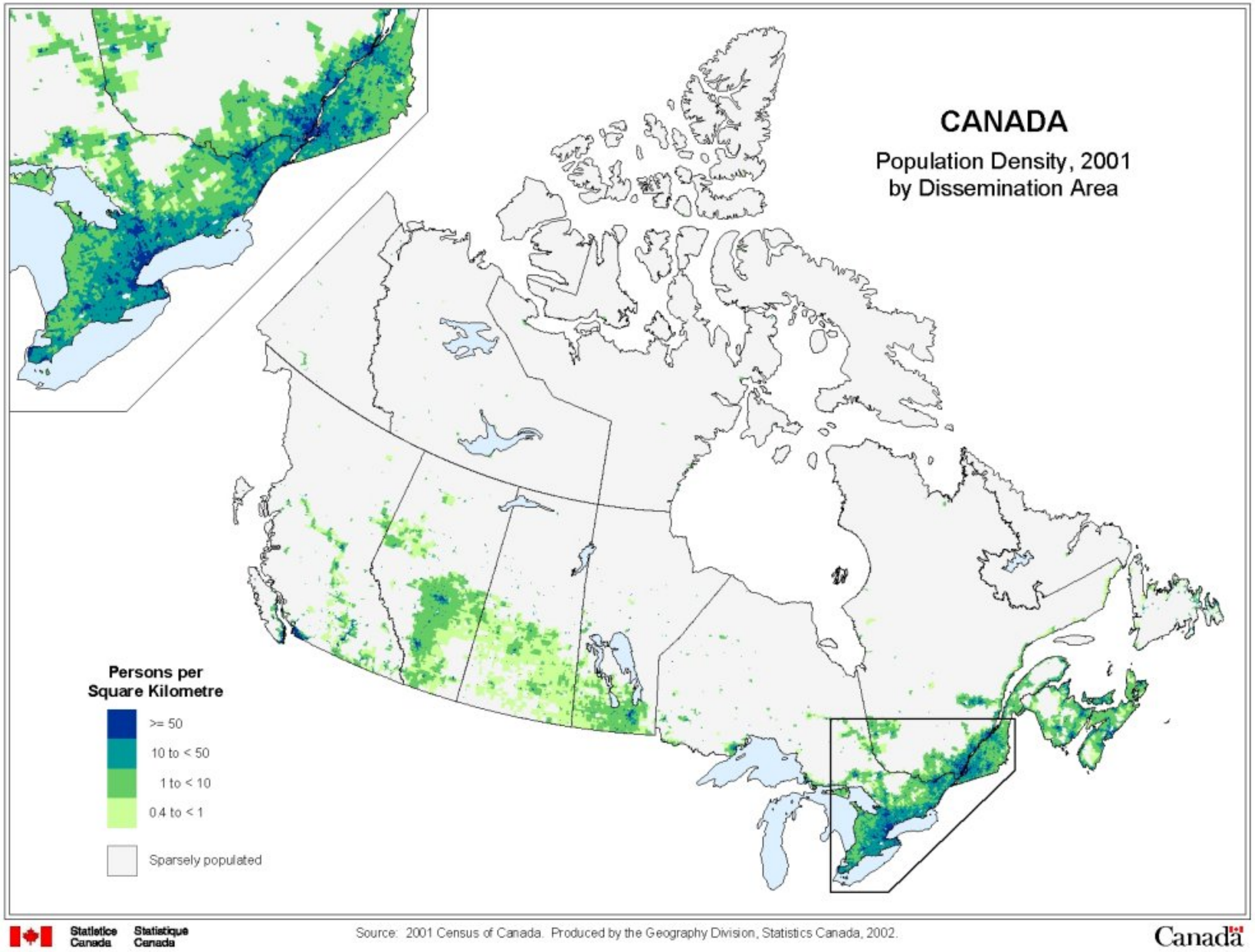


The climate regions closely align with the broad geographic regions of North America.

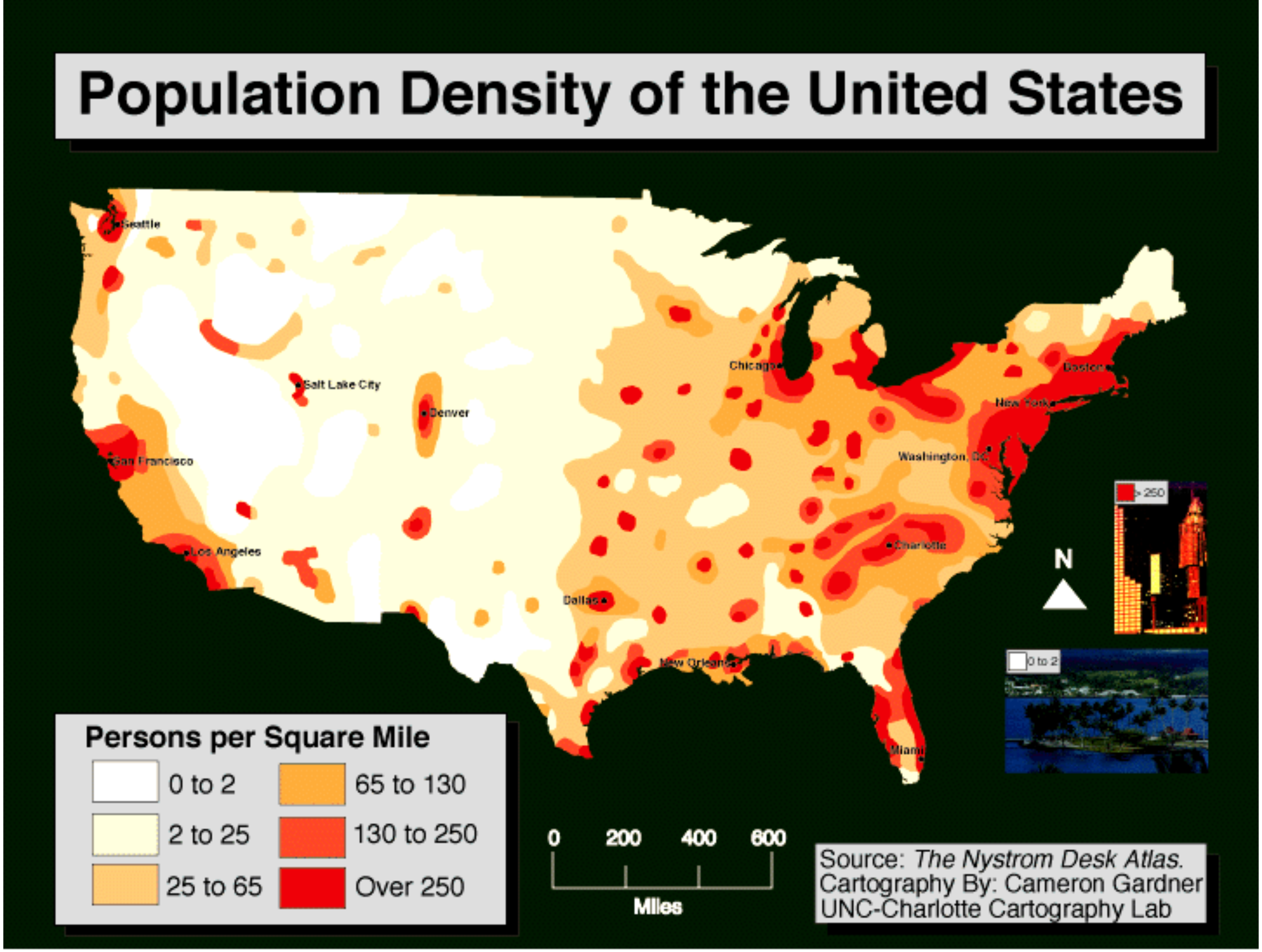


The geographic and climate regions also tend to support different cultures, ways of life, food, cooking, pace of living.

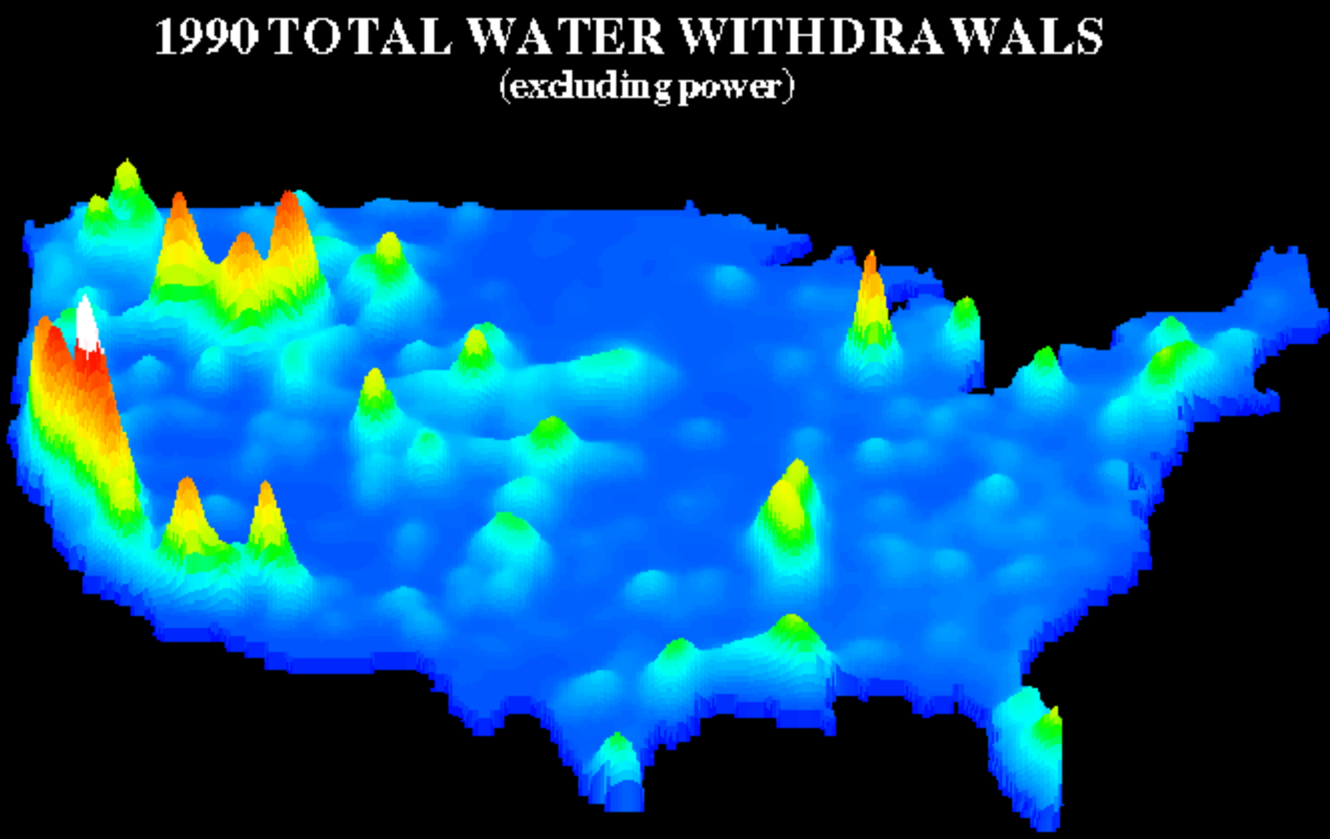
Eating fat helps if you live in a cold climate.



Population densities initially co-related to “good climate for life”, and have subsequently had less to do with this fact as modern systems have been able to ignore these issues.

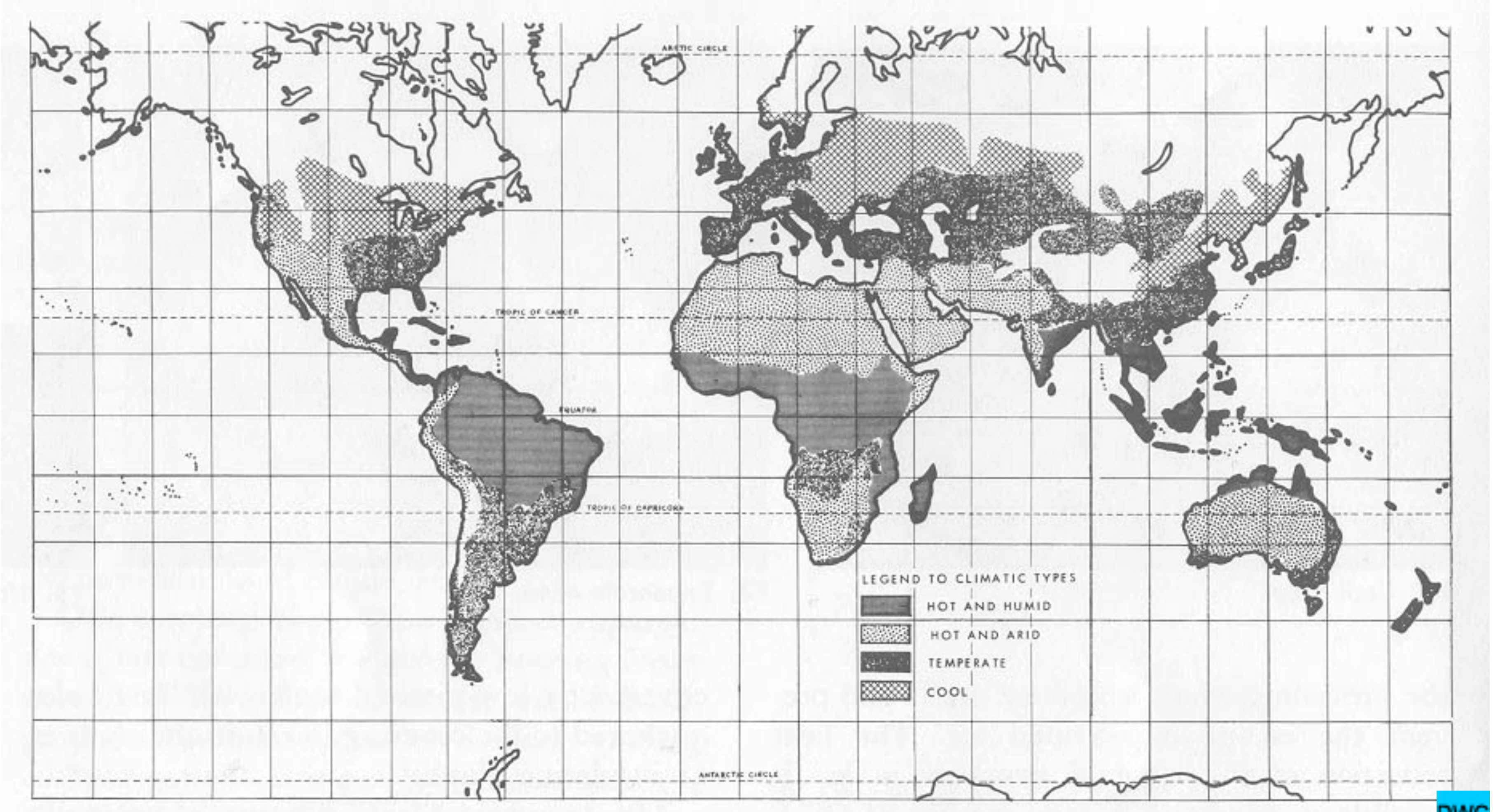


In the U.S. it is fairly easy to see geographic dependent patterns in settlement.



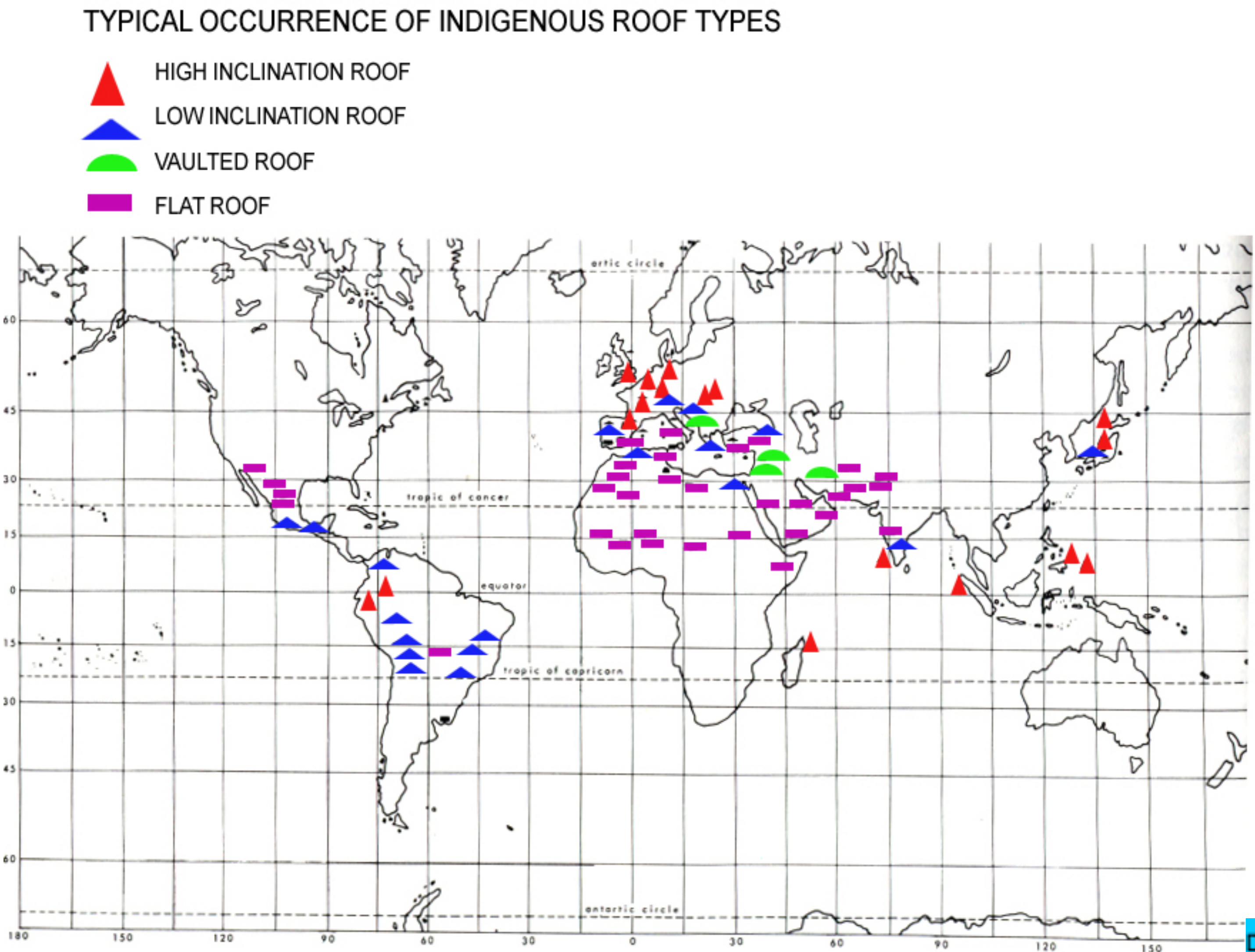
Settlement begins to conflict with geography when water consumption begins to exceed availability. This does lead to more thoughtful water use

World Climate Regions



The same climate definitions are used world-wide. Differentiated climate impacts the types of buildings that are appropriate (or not!).

Climate and Indigenous Housing



Roofs tell us a lot about housing. Flat roofs are to sleep on in hot climates. Pitched roofs shed rain. Low slope roofs hold snow….

DWC

Climate and Indigenous Housing

In its most fundamental form, housing is shelter – a system of components designed to mediate the existing environments (which is less than satisfactory in some way) into a comfortable and satisfactory environment. Historically, shelter has been built

- to reduce the range of local climatic variations;
- to avoid some of the heat of the sun in hot climates,
- to conserve heat in cold climates,
- to welcome the breezes when they can provide desired cooling,
- to avoid winds when they serve to compound the problems of an already cold environments,
- to admit light in sufficient amounts for task lighting and to keep out excessive or unnecessary light.

THERE IS A HUGE DIFFERENCE BETWEEN CLIMATE CONSCIOUS INDIGENOUS HOUSING AND "SHACKS" THAT ARE THE RESULT OF POVERTY.

…although there may remain remnants of climate effective indigenous strategies...

Poverty can result in a forced combination of old and new materials.

Cold Climate: Indigenous Housing

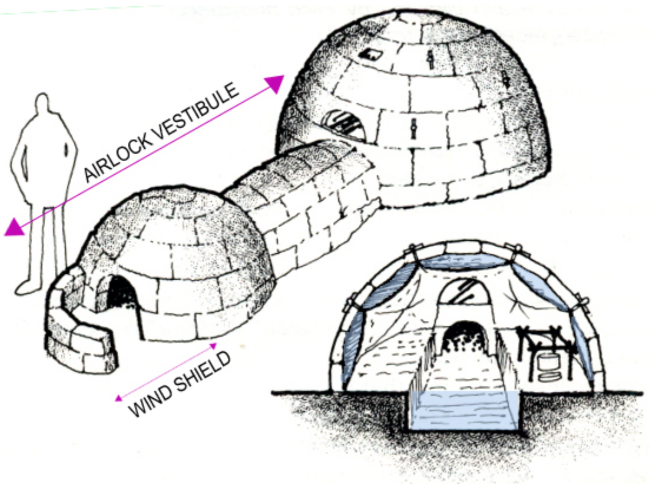


Figure 3.5: Eskimo igloo, with section showing draped animal skin insulation. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

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Cold: The severity of this climate suggests that cold temperature and wind conditions alone dictate the building sitting, form, organization and wall and window construction. Designing for all other conditions (sun, summer breezes, and humidity) are subordinated to the demands of the cold.

COLD

Also characteristic of indigenous housing is the tendency to use natural, renewable, low energy materials *(although if populations grow too quickly, materials such as wood may not be adequately replenished).* Such housing has a limited environmental impact.

COLD




This also affects the type of labour and tools that are used in construction, and typically meant inability to use "power" to assist in the building process.

COLD

Such housing does result in interior environments that would not be up to modern North American comfort standards. But perhaps we are aiming too high, making the gap between the environmental comfort level provided by indigenous solutions too far below our own expectations.

COLD

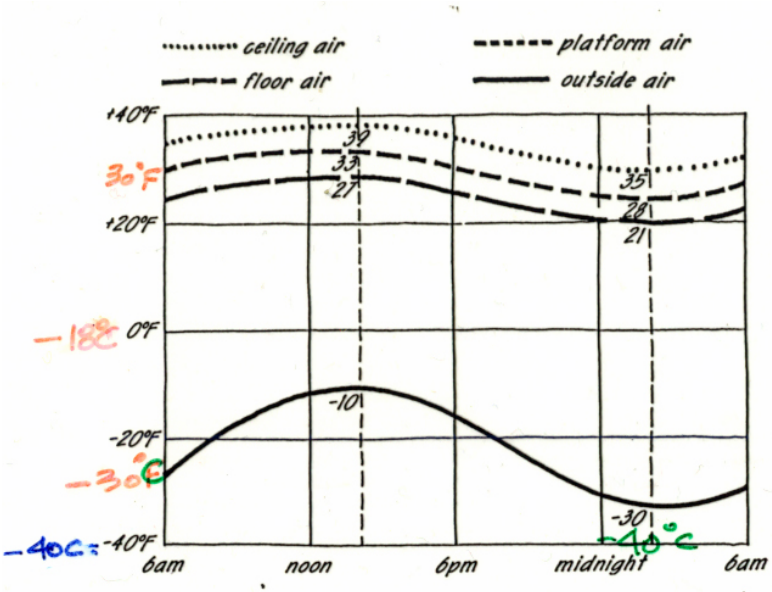

Figure 3.6: Igloo temperatures may run as much as 65°F higher than outside air temperatures using only a small oil lamp and occupant body heat. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

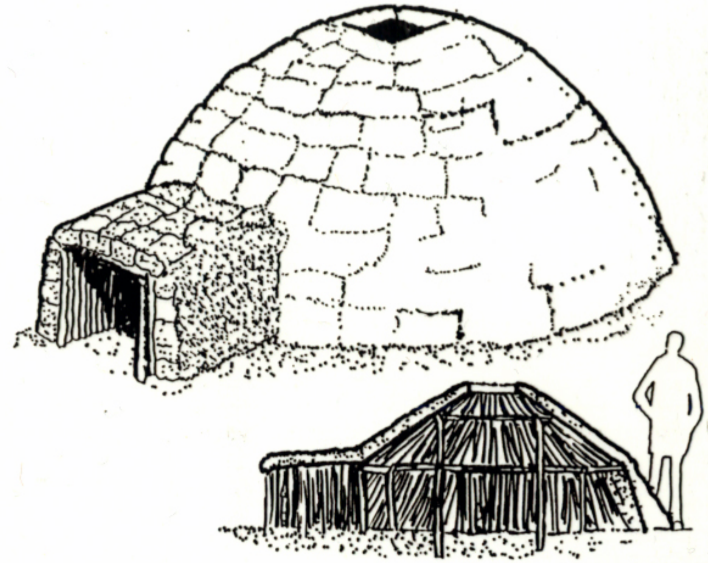

Figure 3.7: The summer house of the Nunamiut Eskimos follows the form of the igloo but is constructed using sticks covered with slabs of turf. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

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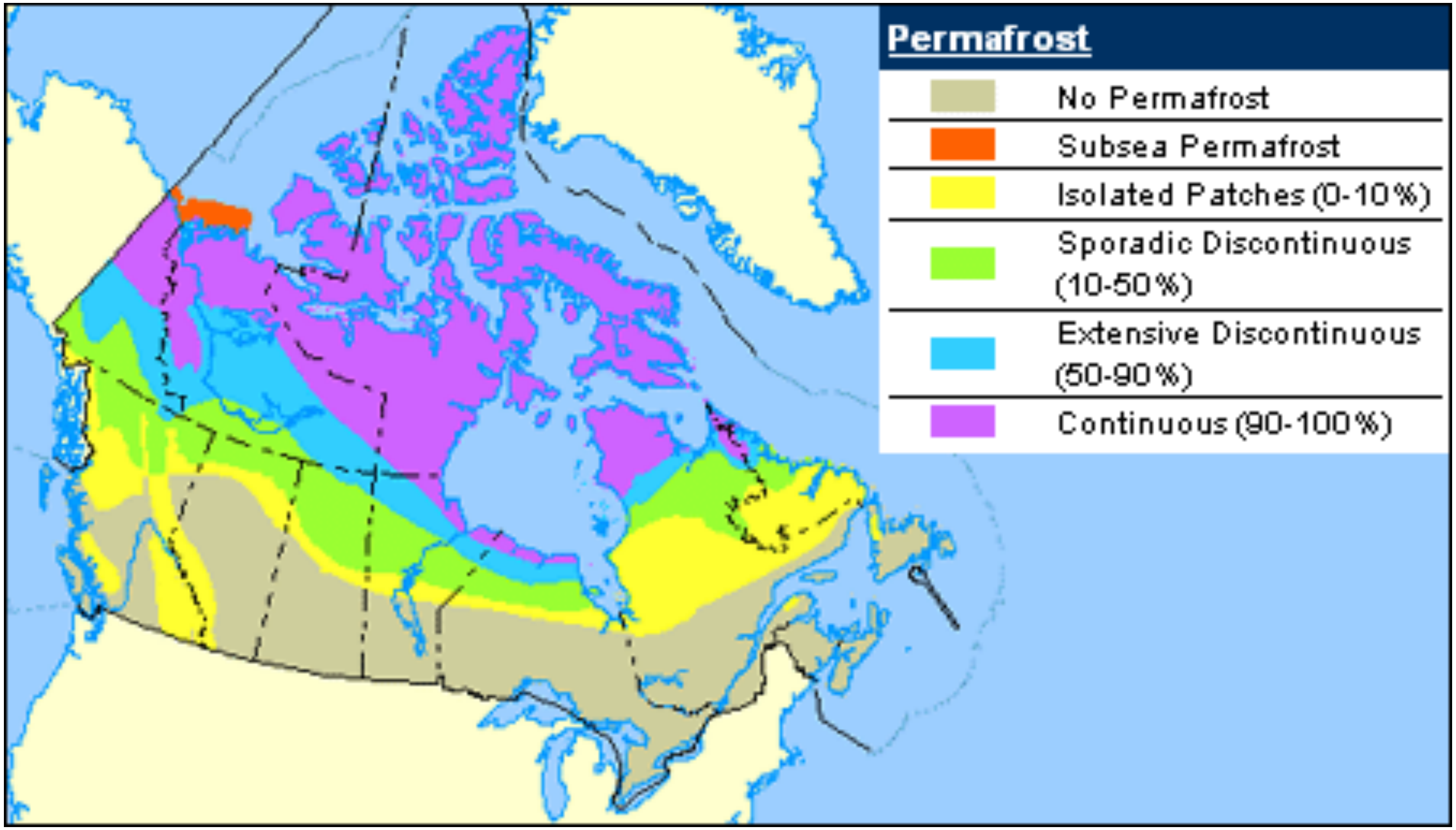
The igloo was able to keep the sleeping bench above freezing, with limited use of a lamp and the body heat of the occupants. Most modern houses are so large that occupants are quite incapable of altering the interior temperatures.

COLD

The tundra -- where are the natural building materials??

COLD



Extreme Northern building is also affected by Permafrost. Dwellings may not allow heat to escape into the ground as thawing will destroy the permanently frozen condition of the soil and the building will “sink” rather than “float” on top of the soil.

COLD

These ancient Irish buildings used a similar shape to the igloo, but in this case, stone was plentiful - so these became permanent habitations.

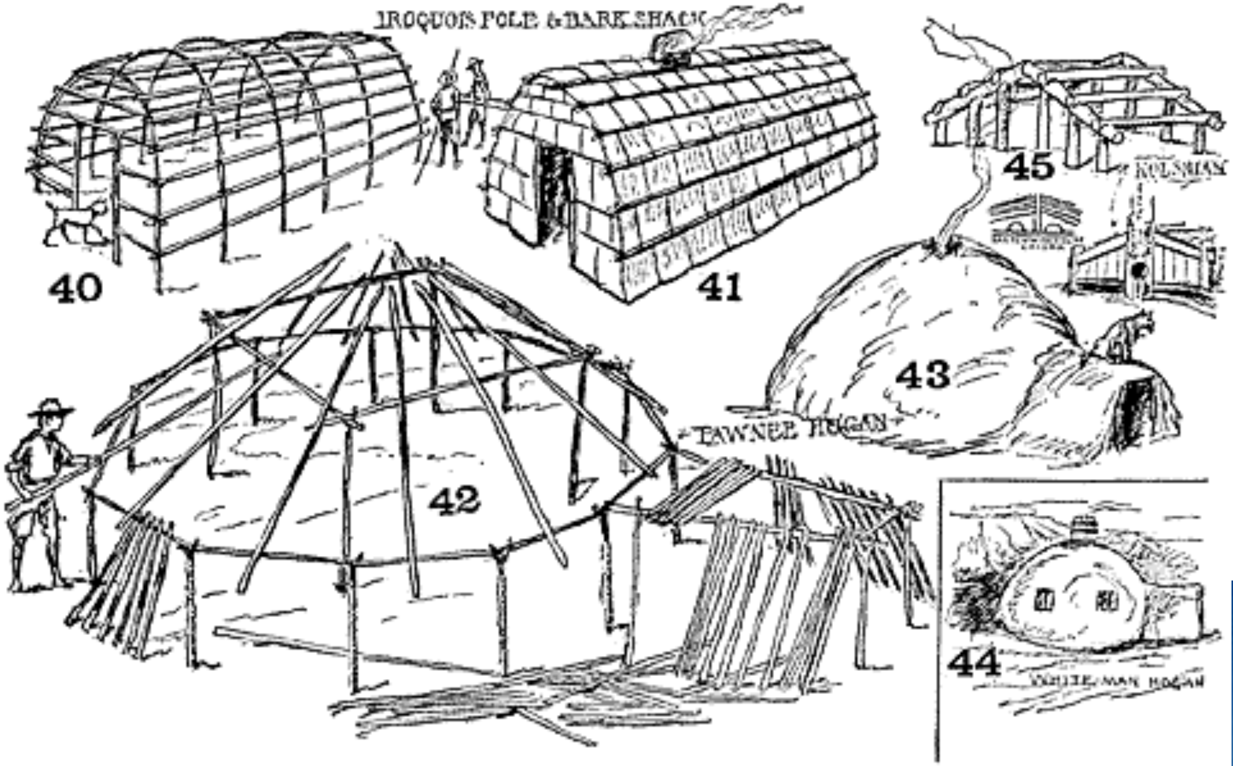
COLD

Temperate: Indigenous Housing

Temperate: The summers are hot and humid, and the winters are cold. In much of the region the topography is generally flat, allowing cold winter winds to come in form the northwest and cool summer breezes to flow in from the southwest. The four seasons are almost equally long.

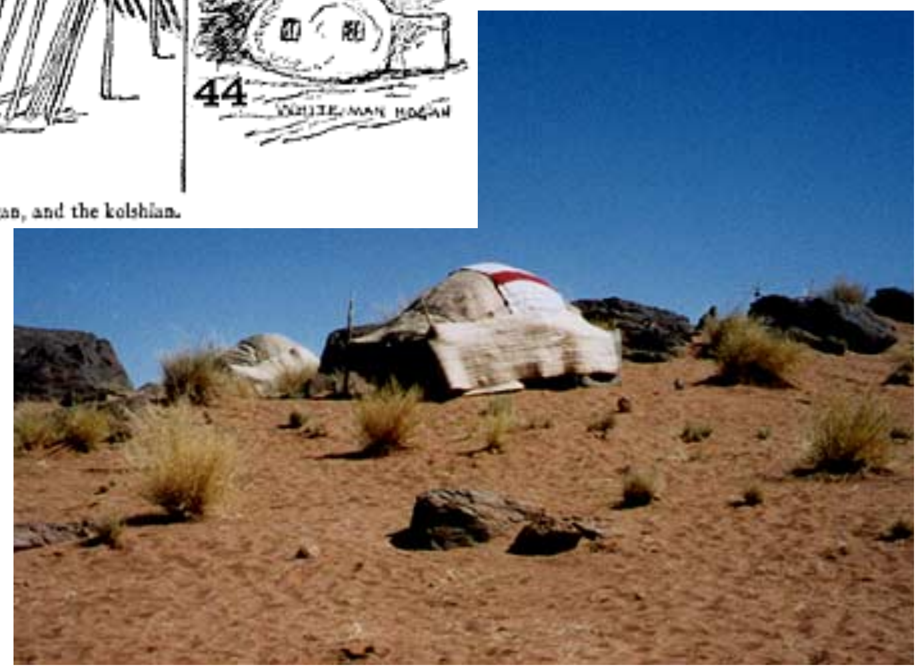
This housing maximizes flexibility in its design in order to be able to modify the envelope for varying climatic conditions.

TEMPERATE



The Iroquois, the Pawnee hogan, the white man's hogan, and the kolshian.

Similar techniques are seen in temperate buildings worldwide.



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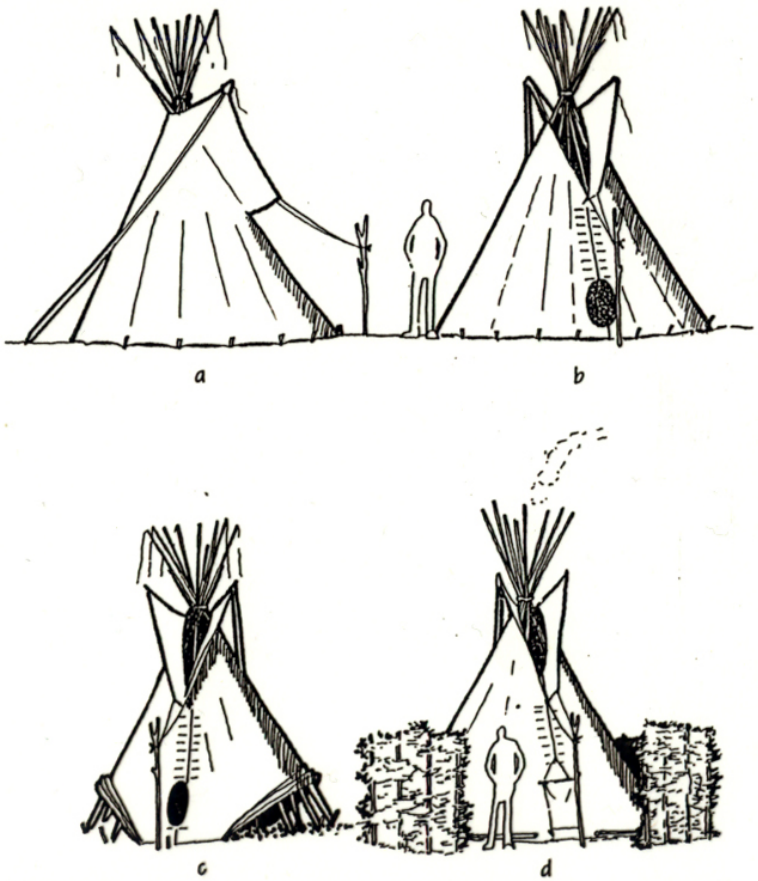

Figure 3.10: North American Indian tipi (a) side, and (b) front view; configured for (c) hot weather, and (d) cold weather. *(After Laubin and Laubin, 1977.)*

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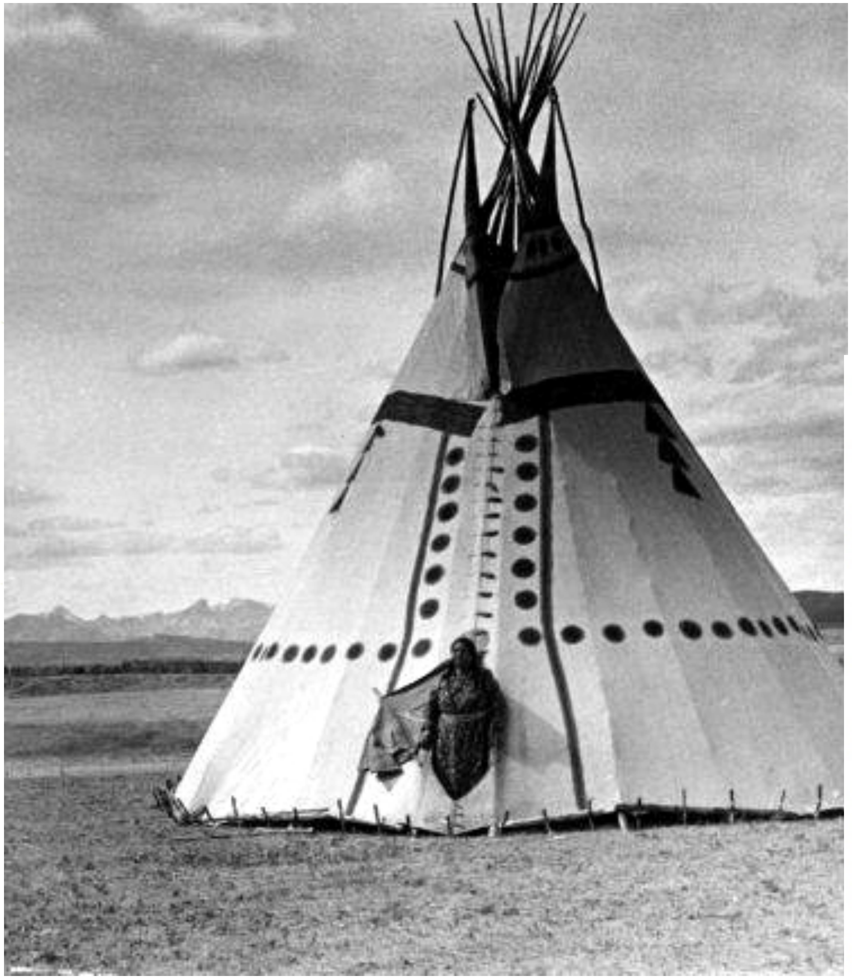

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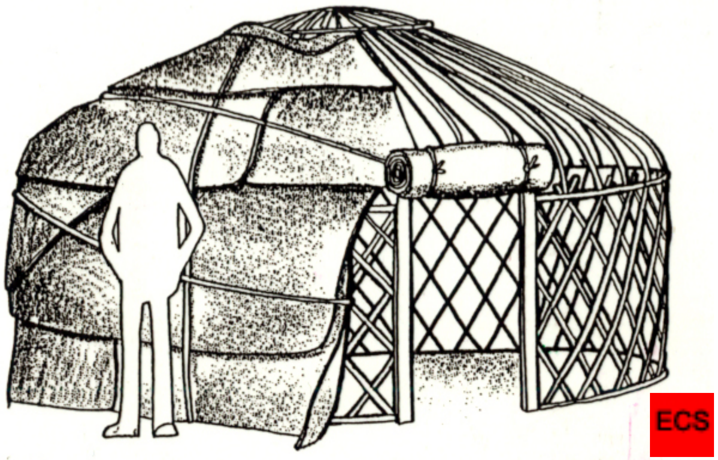

Mongolian YURT with collapsible “pantograph”side walls, and felt mat covering.

TEMPERATE

TEMPERATE

TEMPERATE

Hot-Arid: Indigenous Housing

Figure 3.17: Acoma pueblo, New Mexico, looking northeast. *(Reproduced fror Knowles, 1974, by permission.)*

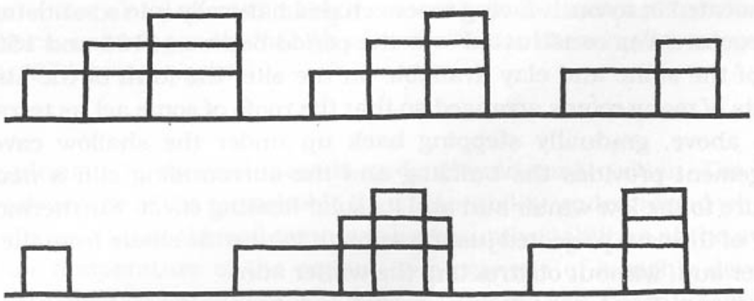

Figure 3.18: Acoma Pueblo, New Mexico. Typical sections show the critical spacin between rows of three- and two-story houses to ensure solar access. *(Redrawn fror Knowles, 1974, by permission.)*

Hot-Arid: Located in the desert region that spans California, Arizona and Nevada, the climate is characterized by extremely hot summers and moderately cold winters. The cold season lasts from November until March or April, with January temperature between 0 and 15 degrees C. A small amount of precipitation occurs during the winter. The summers are extremely hot and dry, with great temperature variations between day and night. *This "diurnal" temperature swing is used to moderate the interior building temperatures.*

HOT-ARID

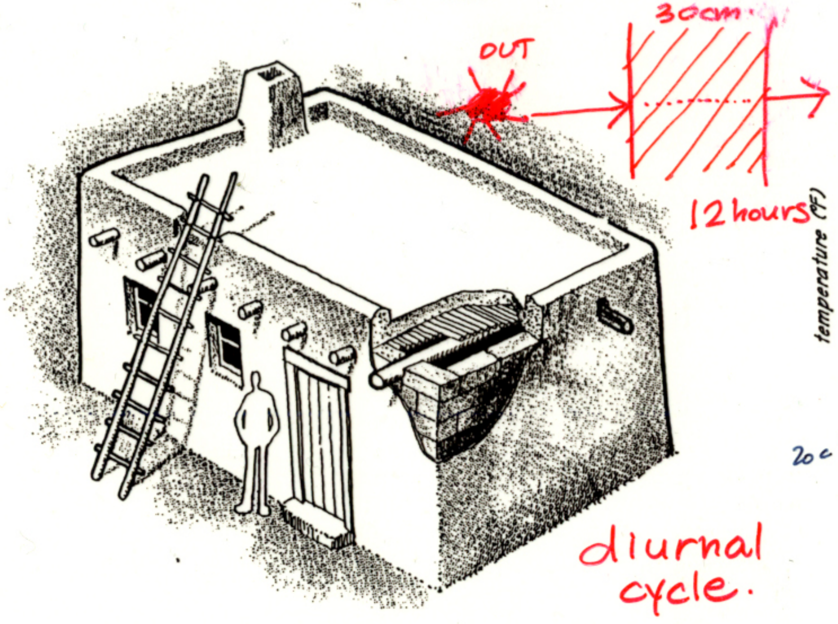

Figure 3.19: Cutaway drawing showing construction of adobe Pueblo dwelling. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

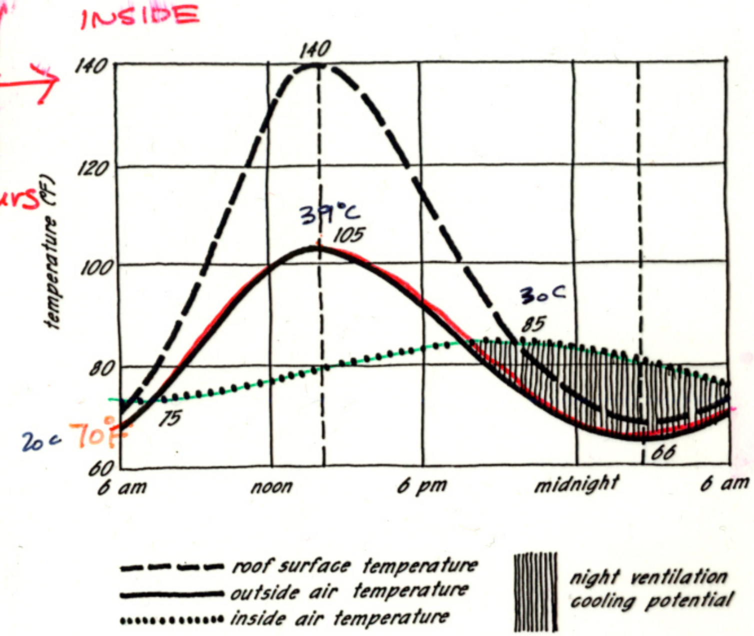

Figure 3.20: Temperatures in and around an adobe dwelling. Notice that while the average inside and outside temperature are about equal, the maximum interior temperature occurs about 10 p.m. — about eight hours after the outside peak. By this time the outside temperature has actually dropped below the inside and the window can be opened for ventilative cooling. Notice that the outside temperature swing is about 40°F wile the interior is only about 10°F. Finally, the shaded area shows the cooling effect of night ventilation. The thermal qualities of this primitive construction system are impressive indeed. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

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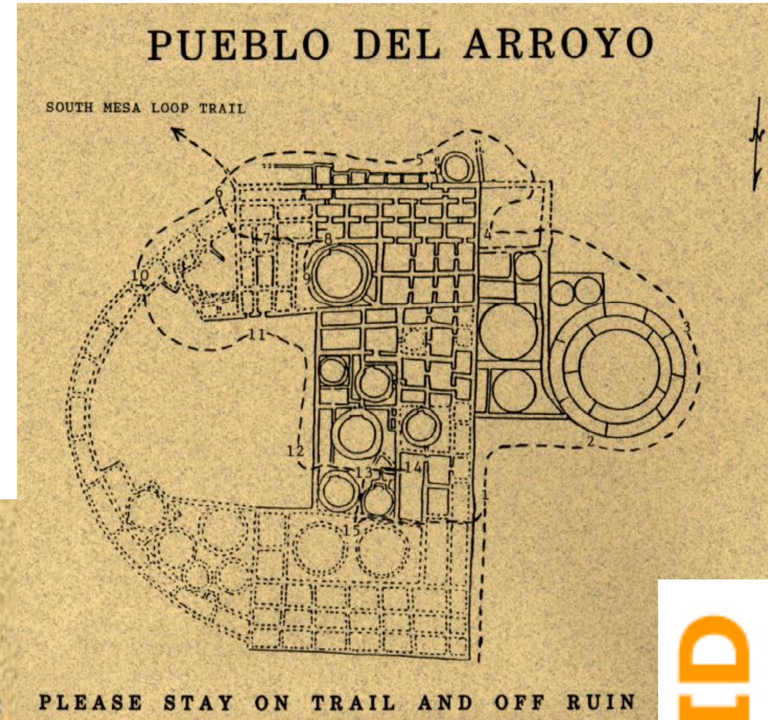
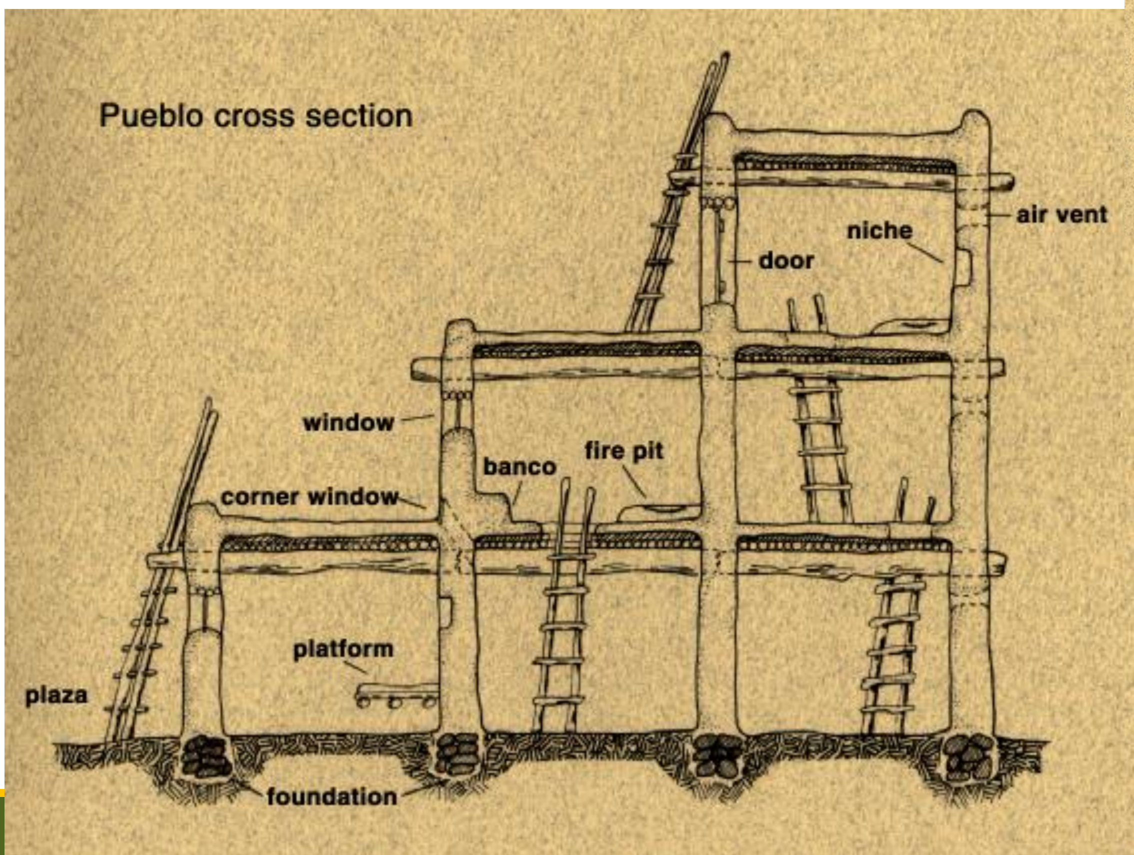
HOT-ARID

Hot arid buildings use the mass of the building to moderate the heat flow through the envelope. Occupants move out to the roof to sleep if it remains too hot indoors in the night.





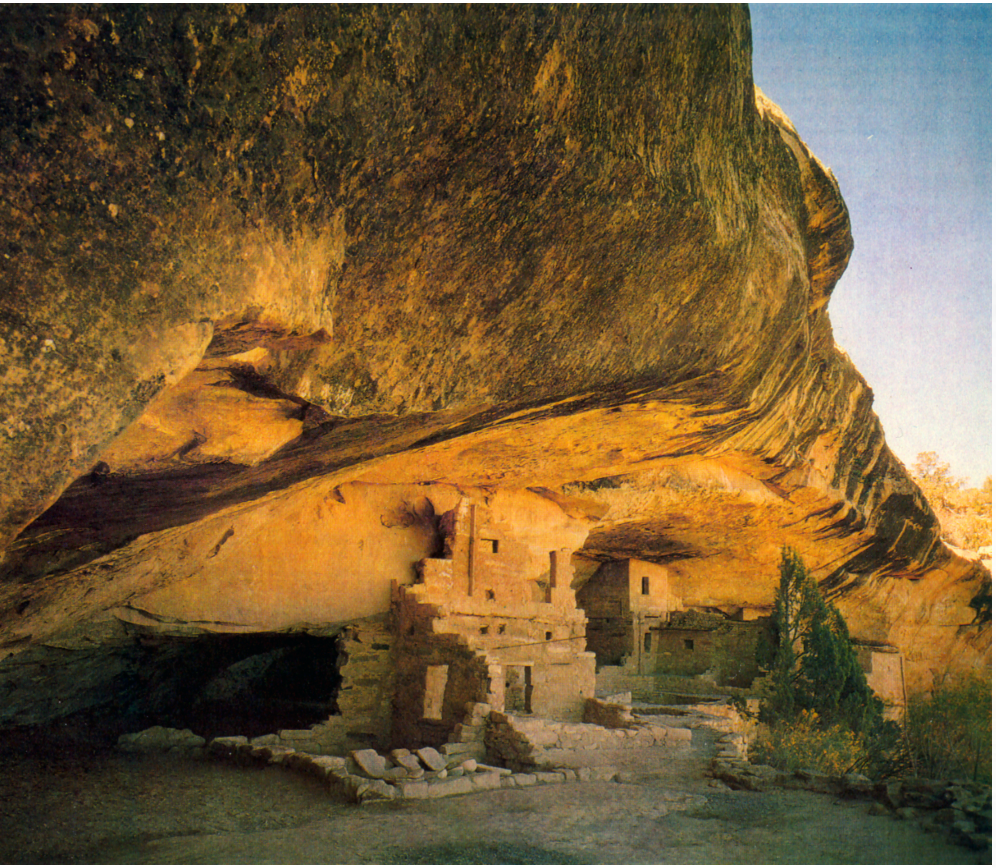
Historic pueblo type building in Chaco Canyon, New Mexico c. 1075 CE

HOT-ARID

Taos pueblos, some dating back to the 17th century and are still in use today.

HOT-ARID

These buildings do not employ “insulation” and have very limited window openings so that the sun cannot enter. They use reflective colours to keep what little light is let in. Small windows also exclude ventilation as they wish to exclude the hot daytime air from entering the building.



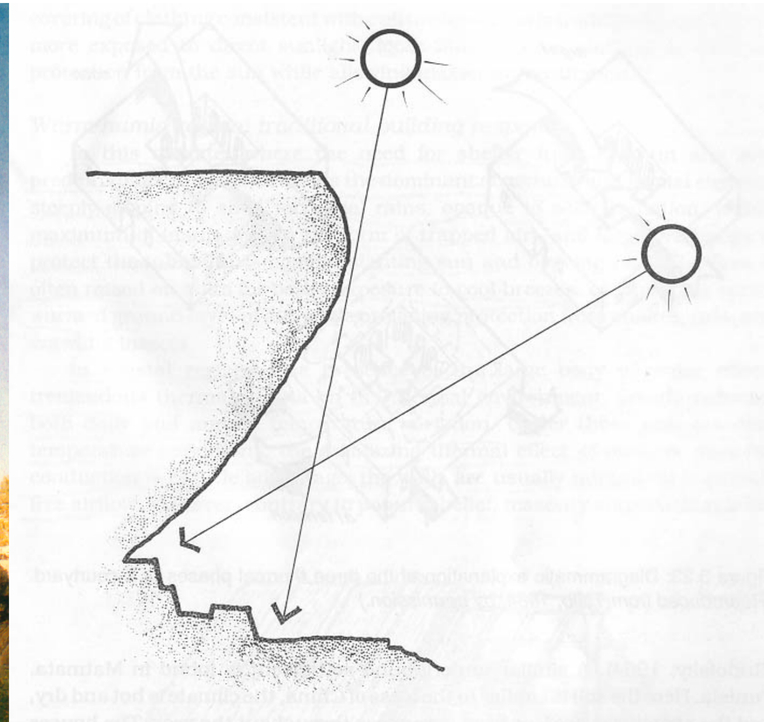


Figure 3.22: Longhouse Pueblo. Buildings were placed inside the cave in such a way that their vertical stone walls and horizontal terraces received great benefit from the low winter sun while being protected during the summer by shadow cast from the upper edge of the cave opening and by the high summer altitude of the sun. *(Reproduced from Knowles, 1974, by permission.)*

HOT-ARID

Mesa Verde used the natural landscape to take advantage of the winter and summer sun. Winter sun penetration heated up the masonry and kept the buildings warm. The cliff shaded from the summer sun, keeping things cooler.

HOT-ARID

Desert housing makes use of dense materials (stone/adobe) to store heat. It does get quite cold at night.

Not all hot-arid buildings are made from stone or adobe. Other accommodations are required when there is no stone, nor water with which to make mud bricks. Water is too scarce to be wasted in making a building… in this case, shade is optimized.

Bedouin tent

HOT-ARID

Hot-Humid: Indigenous Housing

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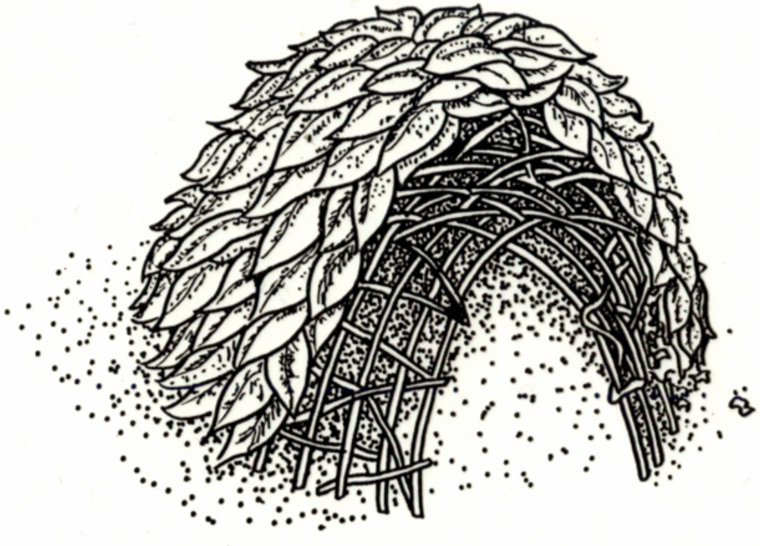

Figure 3.27: Simple dome hut of Banbuti Pygmies is a woven frame of twigs covered with large leaves. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

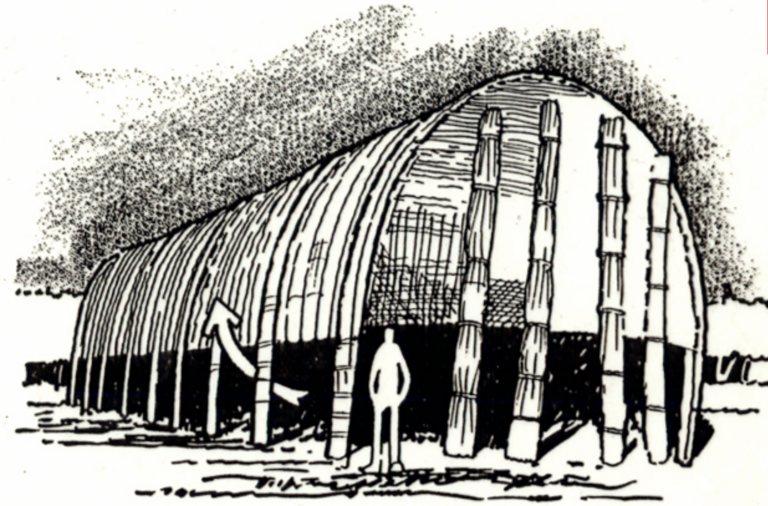

Figure 3.28: The design of this Ma'dan house (Iraq), built of 20 ft tall local reeds, ha remained unchanged for 6,000 years. The sides can be raised to maximize ventilatio *(After Grundfeld, 1975.)*

Hot-Humid: is characterized by high humidity and warm summer temperatures. Day to night temperature swings during the summer are insignificant because of the extensive humidity and cloud cover which prevents surfaces from re-radiatio to the night sky. Very mild winters make for a short heating season. Sunshine available all year. Often a lack of breeze.

HOT-HUMID

Hot-Humid: Indigenous Housing

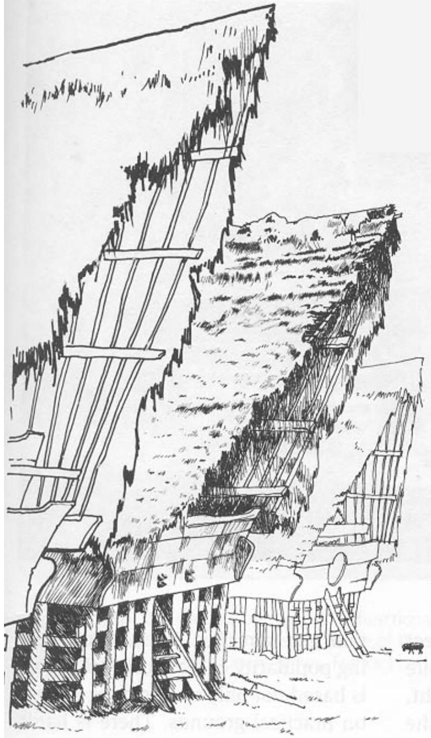

FIGURE 1.2b In hot and humid climates, natural ventilation from shaded windows is the key to thermal comfort. This Charleston, SC, house uses covered porches and balconies to shade the windows, as well as to create cool outdoor living spaces. The white color and roof monitor are also important in minimizing summer overheating.

26. Elegance in regional expression at the Hot-Humid island climates.

HOT-HUMID

Hot-Humid: Indigenous Housing

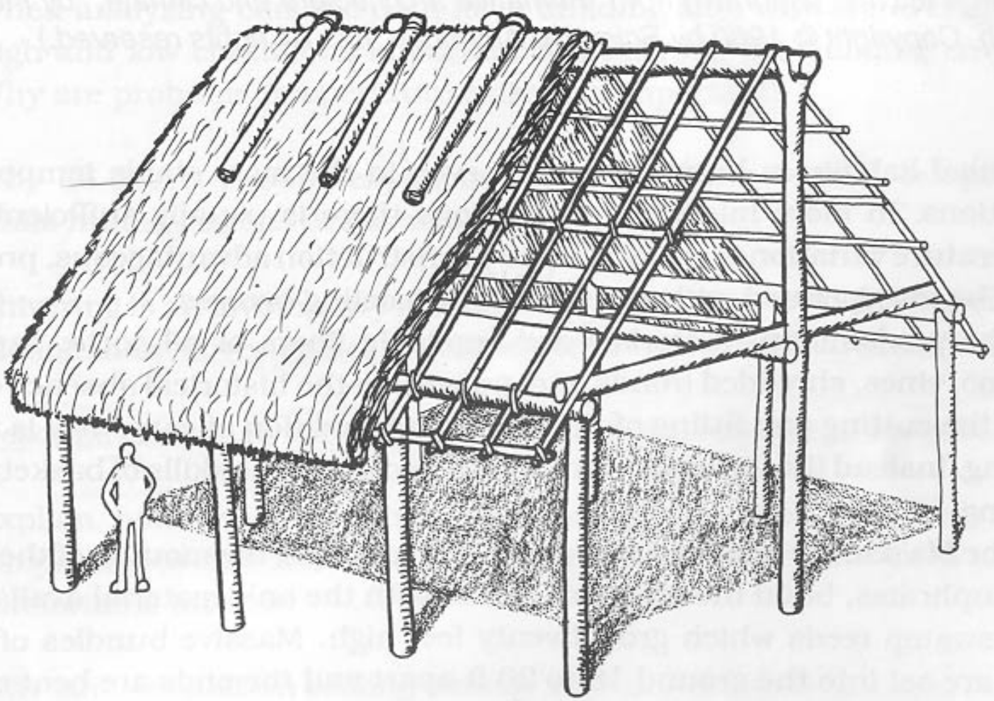

Figure 3.26: Seminole house is an open post-and-beam construction with a gable roof of thatch. *(Redrawn from "Primative architecture and climate," by Fitch and Branch. Copyright © 1960 by Scientific American, Inc. All rights reserved.)*

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HOT-HUMID

HOT-HUMID

HOT-HUMID


George Holton from Photo Researchers

bones and covered with animal hides—quite possibly kangaroo hides.

The Sakai of Malaysia still build some of their houses in trees. In the absence of lifts and cranes, building materials must be light enough to climb with. Flooring consists of bamboo bound with rattan. Walls are rattan, and the roof is made of attap leaves, which have a life expectancy of from four to ten years. Since the attap grows leaves up to ten feet long and four feet wide, one leaf sometimes does the entire roofing job.


Carl Frank from Photo Researchers

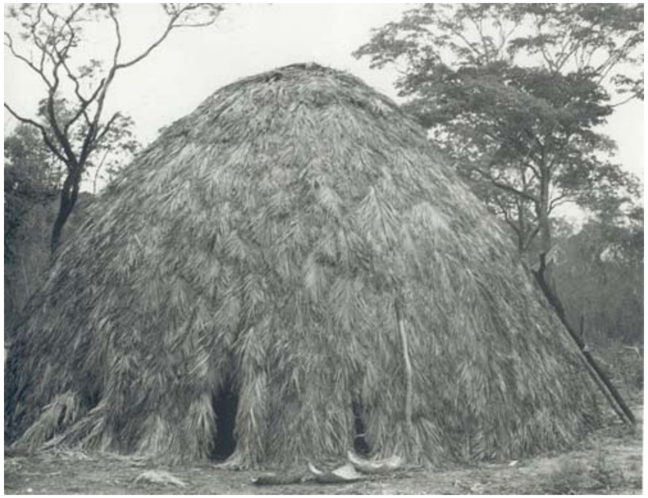
Buildings are also elevated to protect their occupants from animal predators.

HOT-HUMID

Conical thatched grass roofs top circular dwellings built with interlaced fiber siding , Village in New Guinea

HOT-HUMID

HOT-HUMID



HOT-HUMID

Plentiful materials are compromised in urban areas, as shown in the construction of these "favelas" in Brazil, which use found, cheap, modern materials - sometimes what the rich throw away. Density does not permit air circulation.

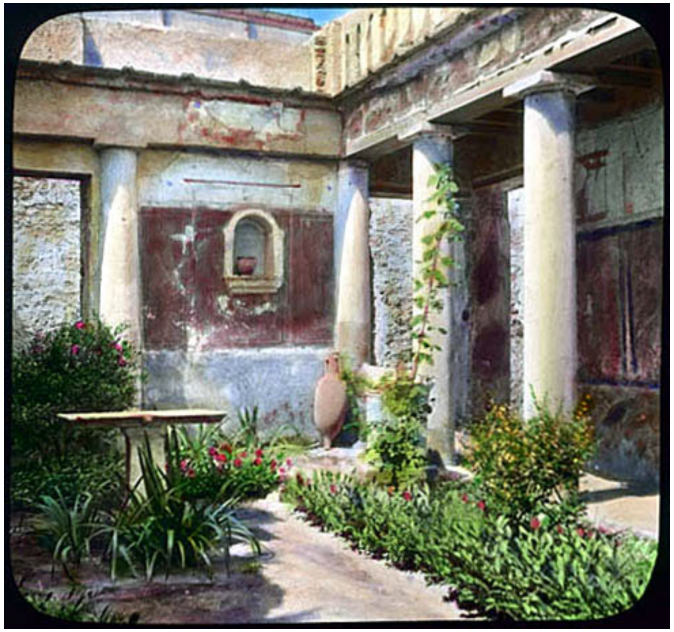
HOT-HUMID

Kandy shacks - Sri Lanka

A combination of natural and salvaged materials.

HOT-HUMID

Climate Responsive Architecture



Pompeii: House of the Vettii

Tangier: inside a Medina House

"We must begin by taking note of the countries and climates in which homes are to be built if our designs for them are to be correct. Once type of house seems appropriate for Egypt, another for Spain…one still different for Rome…It is obvious that design for homes ought to conform to diversities of climate."

Vitruvius, Architect 1st century BC

Climate Responsive Architecture

Indigenous structures are valuable subjects for study because of their ingenious use of available materials and technology to produce houses which provide a remarkably high degree of thermal comfort in sometimes hostile environments.

Vernacular architecture has grown out of simpler forms of indigenous building as done by more primitive cultures, and usually includes the same set of climate responsive parameters and similar materials but using somewhat higher technology in the construction.

Typical "modern" 20th century architecture has characteristically thrown out all of the lessons of both indigenous and vernacular building and relied on mechanical heating and cooling to moderate the interior environment with complete disregard to climate.

Indigenous:

- Originating and living or occurring naturally in an area or environment.
- Intrinsic; innate.
- Bound to its geography.
- Using traditional, typically non-mechanized construction methods.
- Almost always pre-industrial

Vernacular:

• Being *derived from* an indigenous building style using local materials and traditional methods of construction and ornament.

• Almost always post-industrial, using modern construction methods.
Ongoing cultural adaptation of a style (sometimes indigenous).

• *For example, Native American pueblos are indigenous and Mexican courtyard housing is vernacular.*

Climate Responsive Architecture

"…true regional character cannot be found throughout a sentimental or imitative approach by incorporating their old emblems or the newest local fashions which disappear as fast as they appear. But if you take…the basic difference imposed on architectural design by the climatic conditions… diversity of expression can result…if the architect will use utterly contrasting indoor-outdoor relations…as focus for design conception."

Walter Gropius

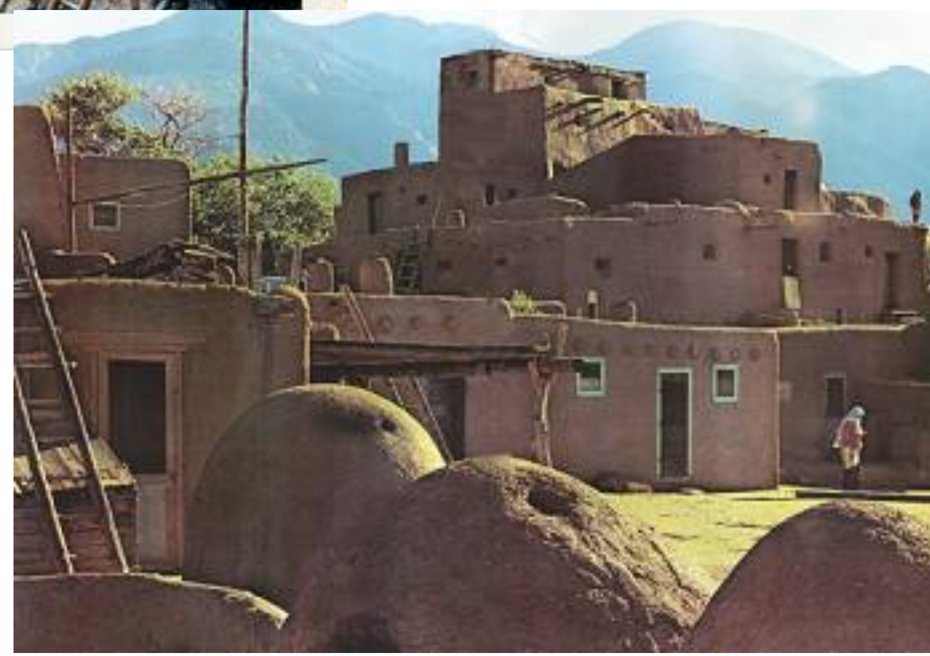
What we as architects are aiming for is to take the climate motivated, environmentally sustainable/valid ideas and practices, from both indigenous and vernacular building, and to incorporate them into a current architecture that clearly responds to issues of climate (and comfort) in the design of the building.

Actual Pueblo in use near Taos, New Mexico

(vernacular)

Early Hopi Indian Pueblo reconstruction

(indigenous)

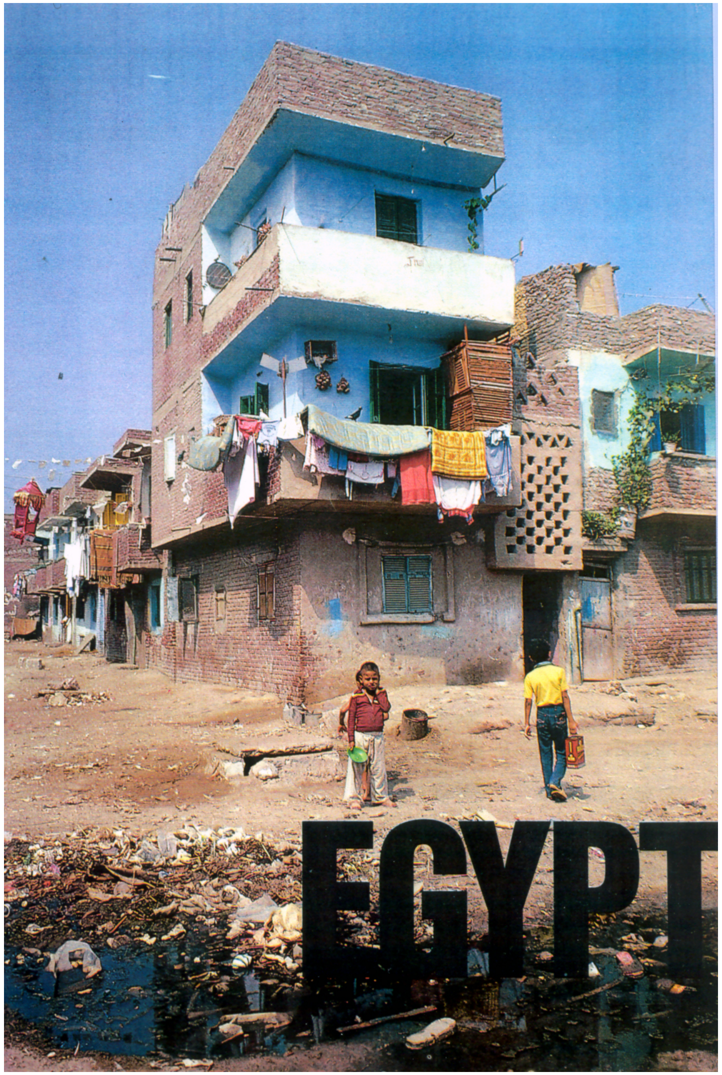


HOT-ARID

Modern building being marketed as a “pueblo” - “modern climate conscious adaptation” (how sustainable or effective not determined!)

HOT-ARID

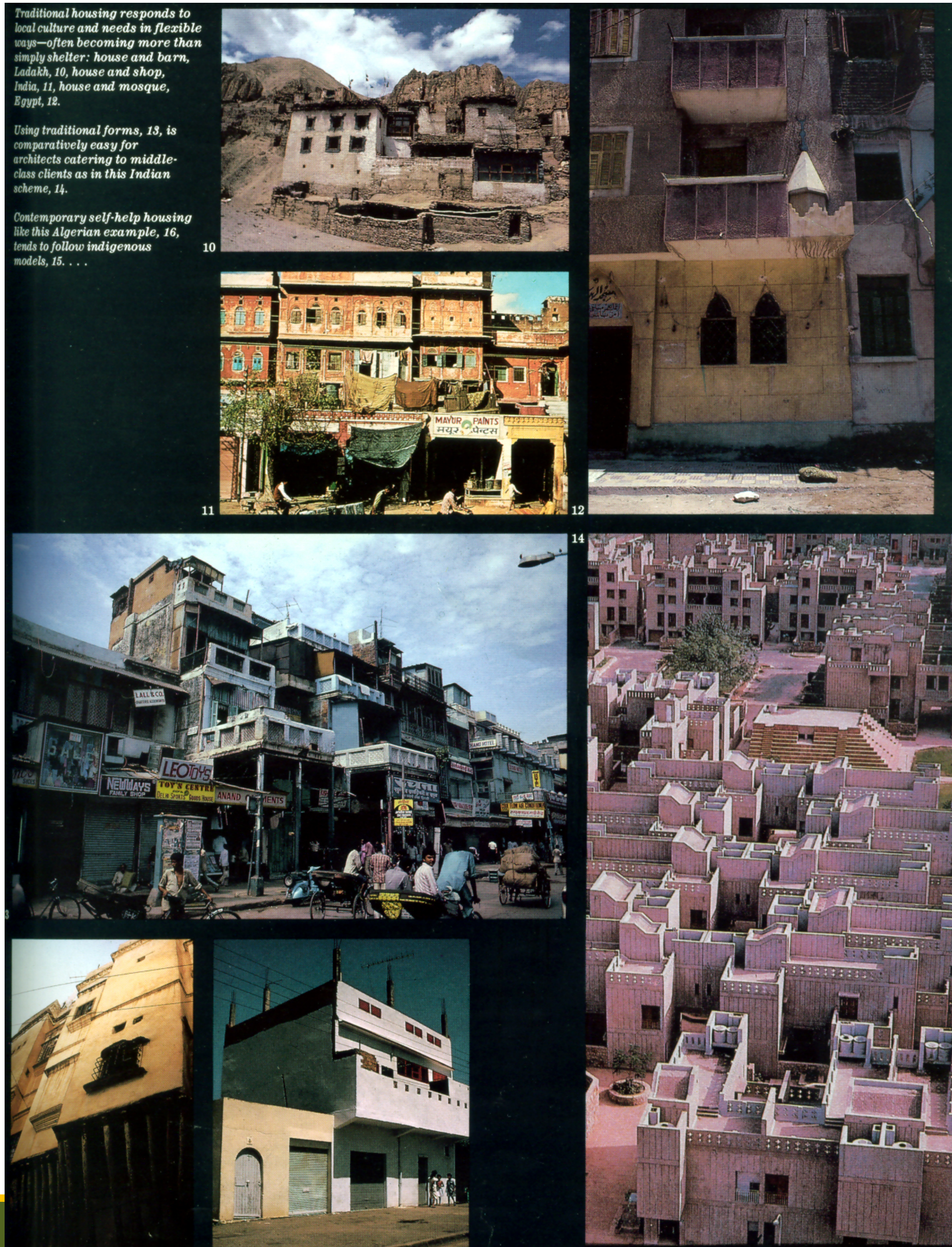
Vernacular Architecture



Vernacular architecture tends then to be building that grows out of indigenous practice and is adapted to somewhat more 20th century building.

“City of the dead” Cairo, EGYPT

HOT-ARID



In some cases urban pressures have compromised valid climate based design strategies. The “pink” town makes good use of courtyards and building shading to create a cooler place. The stacked buildings on the left retain the small windows but expose more of themselves to the sun.

HOT-ARID

TRADITIONAL HOUSE
YEMEN ARAB REPUBLIC

Adobe construction, south-facing windows provide climate-responsive design to upland mountain/desert climate. The adobe building tradition of Yemen has endured for over 300 years.
Photo: **Donald Watson**

TRADITIONAL HOUSE
PAPAGO INDIAN NATION, ARIZONA

Adobe construction, small windows, insulated roofing with shading overhangs. This modest adobe house represents a continuous tradition of building in the North American south west typical of original construction 400 years ago.
Photo: **Donald Watson**

CBD

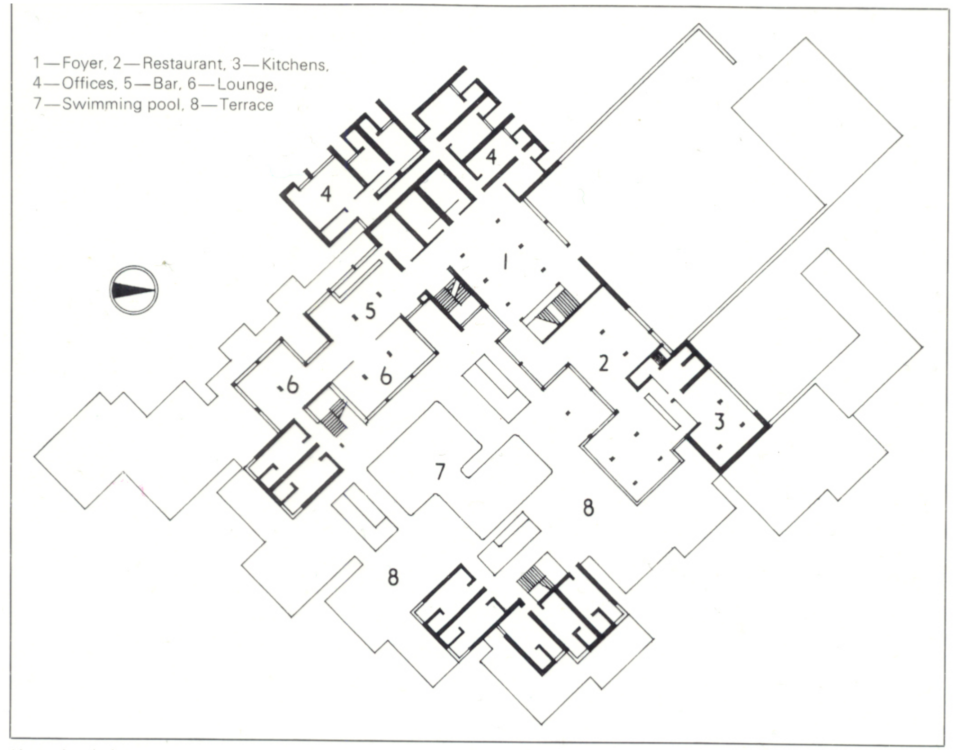
TRADITIONAL RAMADA
PAPAGO INDIAN NATION, ARIZONA

A classic shelter for desert survival, also representative of indigenous North American southwest construction, combines shading, ventilation, and insulated (earth-covered) roof design.
Photo: **Donald Watson**

Hot-arid buildings that use only nature to modify their interior environments continue to use indigenous traditions that include small windows and walls with thermal mass, and no insulation.

HOT-ARID

This modern building makes use of the hot-arid method that employs small windows and creates an “airy” interior by opening up courtyards and spaces on the inside of the building, that are constantly shaded.



Upper level plan

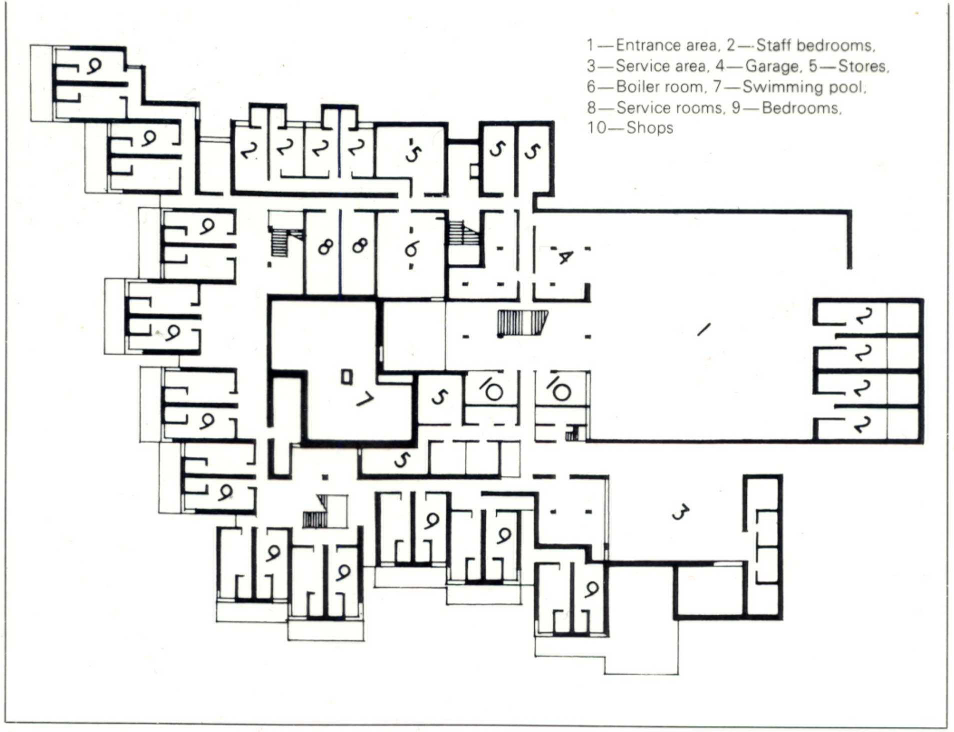
General view

HOT-ARID

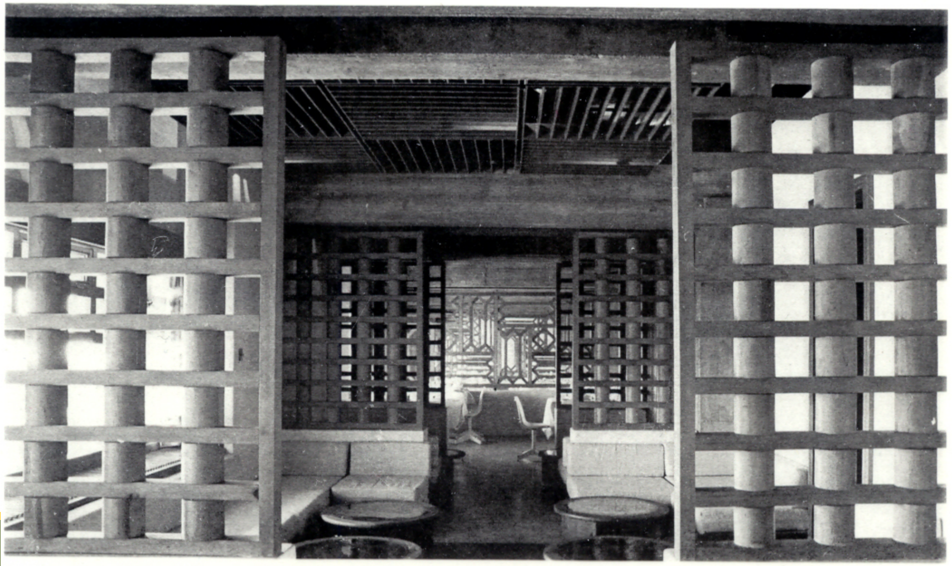
In various climatic designs, thermal mass (stone, concrete, brick, adobe) can be used as a "thermal sink". ie. The materials have a high capacity to hold heat and so the heat that comes to the interior of the space gets absorbed by the *building materials* and NOT the people.

People are 80% water, which also has a high thermal capacity.

Wood is an insulator so does not absorb heat.



Entrance level plan



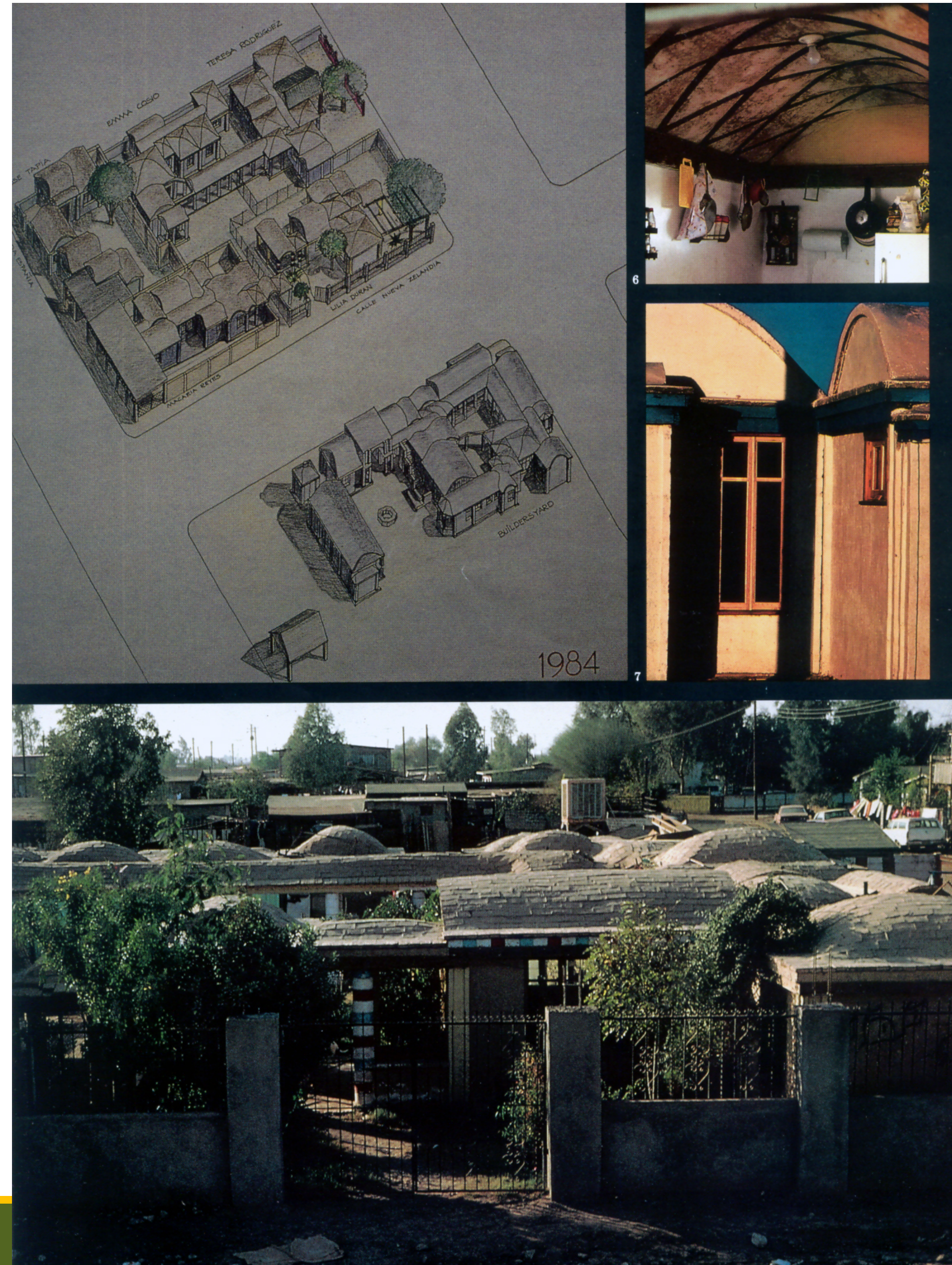
Interior view with the dining room beyond

110 THERMAL MASS - HEAT SINK.

HOT-ARID

This particular development in Mexicali had many good indigenous ideas in mind. It used local materials and building methods. But for perplexing reasons, failed to "work" or appeal to the local residents.

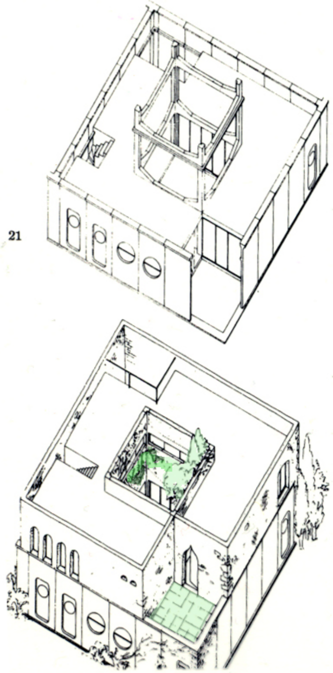
So, in spite of the best intentions, some modern adaptations of traditional building methods will not work.



8

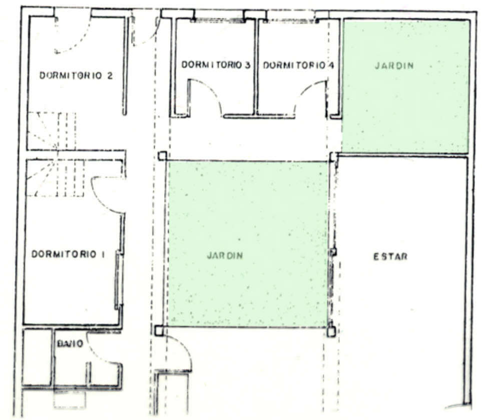
9

8, children enjoy the roofs. This house is also the local barbershop.
9, builders' yard on completion in 1976 had well-shaped courts and was most attractive, but proved too introverted and enclosed for its intended purpose. It is now abandoned.



21

23 24



19-25, scheme by James Stirling, Michael Wilford Associates.
19, 20, the houses as they are today showing a shared court, 19, and a house converted into corner shop, 20.
21, axonometric of house when completed and as expected to be extended, 22.
23, a double-storey house when complete.
24, a single-storey extended upwards.
25, plan (scale: 1:150).

These more contemporary city based hot arid houses make use of courtyards to cool the house environment. The plants not only provide physical cooling, but also "mental" cooling. This becomes highly important in architectural design.

HOT-ARID

Aldo van Eyck's cluster

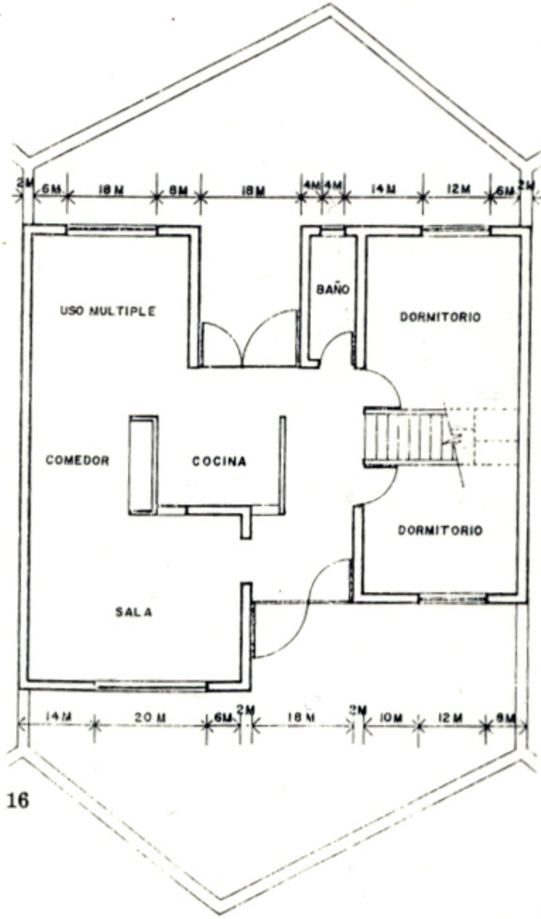
Many of the projects were conceived in pre-cast concrete, with Western floor plans. Some schemes, such as the Danish or Polish ones, had no separation between living and dining areas. Others, like Aldo van Eyck's, had the dining room as part of the living room, but tucked to one side. Van Eyck, maintained that what the dwellers may want now could change in the future: 'The question of existing norms and forms and the ways these will change confronts the architect with an apparent choice which it should not be his concern to make'.

The Dutch scheme, sharing a courtyard with Alexander's row, is easily recognisable by its hexagonal plan. The house within the walls is a more conventional shape, roughly a square. The hexagon shape, intended to discourage additions outwards, appears to work. About 35 per cent of the residents made an exterior addition such as adding one or more rooms, yet few appeared to push out against the surrounding wall or garden space. The design helped, or some might say coerced, the resident to build up instead of out.

The surrounding wall, though, did not remain untouched. Its one-storey height was perceived to be too low, and over half the homeowners extended it, a few adding broken glass as a crown.

Stirling's courts

Under the colonial style add-ons, the decorative roofs, diagonal trim, second-storey additions or colourful awnings can just barely be discerned the large round windows of Stirling's original design. Round windows worked in Runcorn New Town housing (1967), so why not Peru? Whether inspired by the



16

17

18

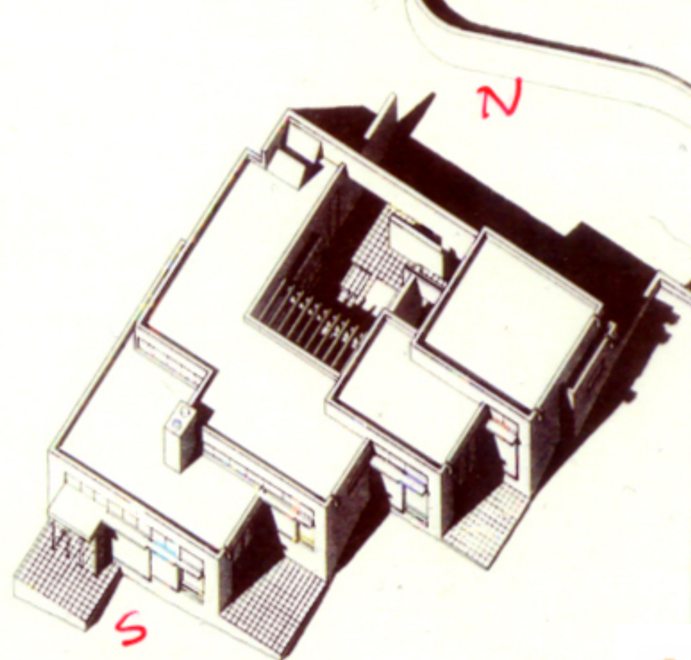
14-18, Aldo van Eyck's scheme:
14, the houses as they are today; the hexagonal garden walls were thought to be too low for security.
15, a modern kitchen in van Eyck's scheme: generally the residents are of a higher income group than was planned.
16, ground floor plan (scale: 1:150)
17, houses when completed.
18, as they are now.

In this case the courtyards are more to the exterior of the building and also provides spatial separation and "privacy".

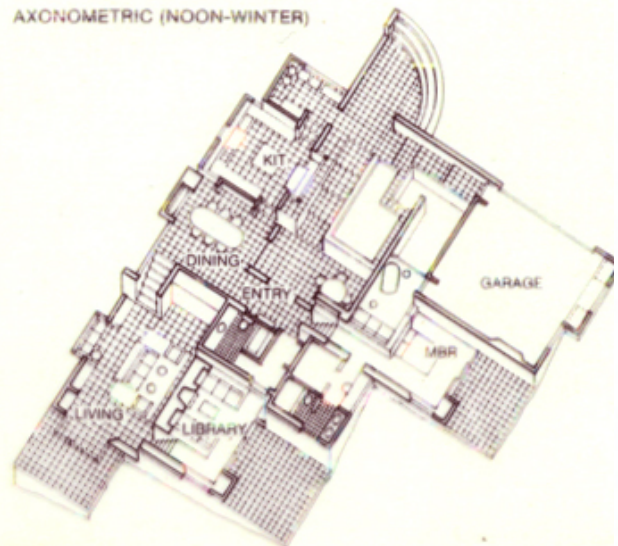
the tradition of New Mexican architecture while adopting both a new energy strategy and the inspiration of a Mexican master in Luis Barragán. Its architects are themselves transplants, Ervin Addy arriving in Albuquerque from Texas and Robert Peters coming from Minneapolis via Chicago. The firm name, Alianza Arquitectos, symbolizes, however, the firm's intent to live and work within the Southwestern heritage and seek a vocabulary appropriate to it.

When Peters came to Albuquerque from SOM, Chicago (and work on the Sears Tower

A view of the residence from the southwest (below). The non-vented trombe walls are visible on the south façade. The low winter sun strikes the trombe walls full strength (opposite).

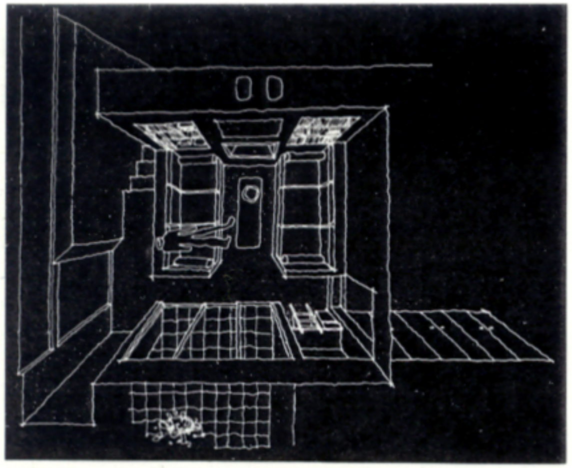


AXONOMETRIC (NOON-WINTER)

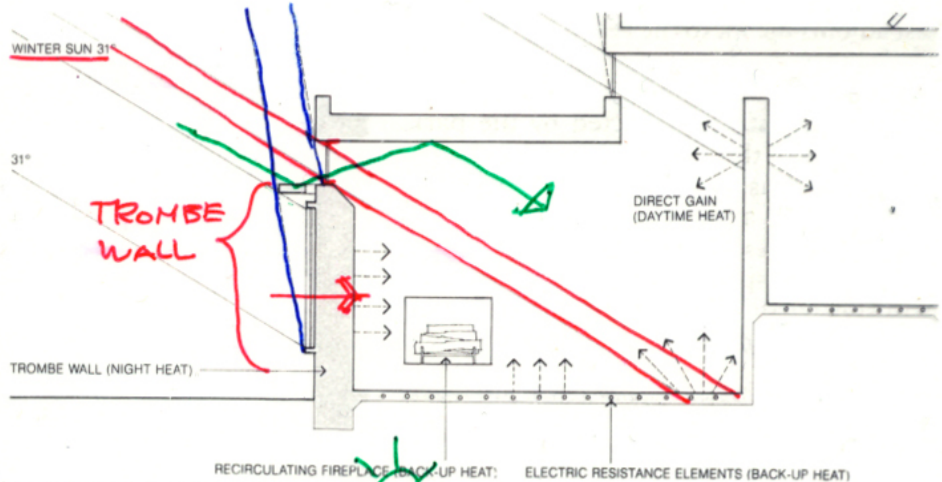


PLAN

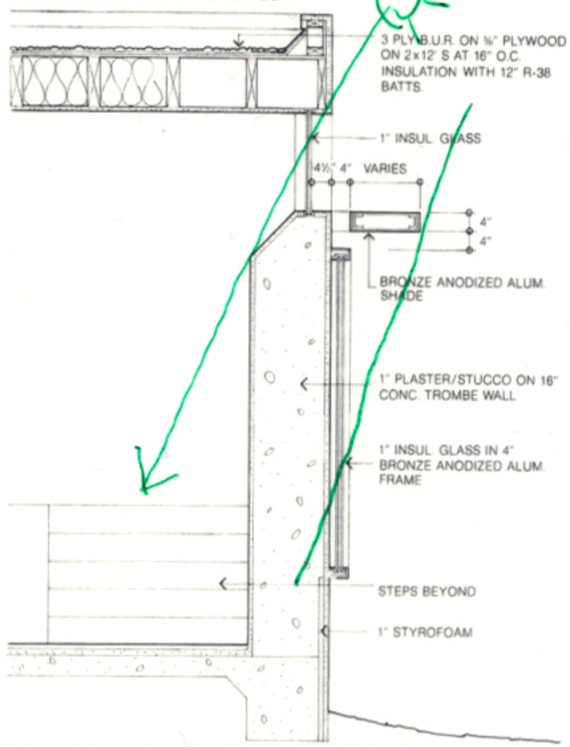
HOT-ARID



LOOKING DOWN INTO THE GUESTROOM/LIBRARY



CROSS SECTION: SOLAR STRATEGY



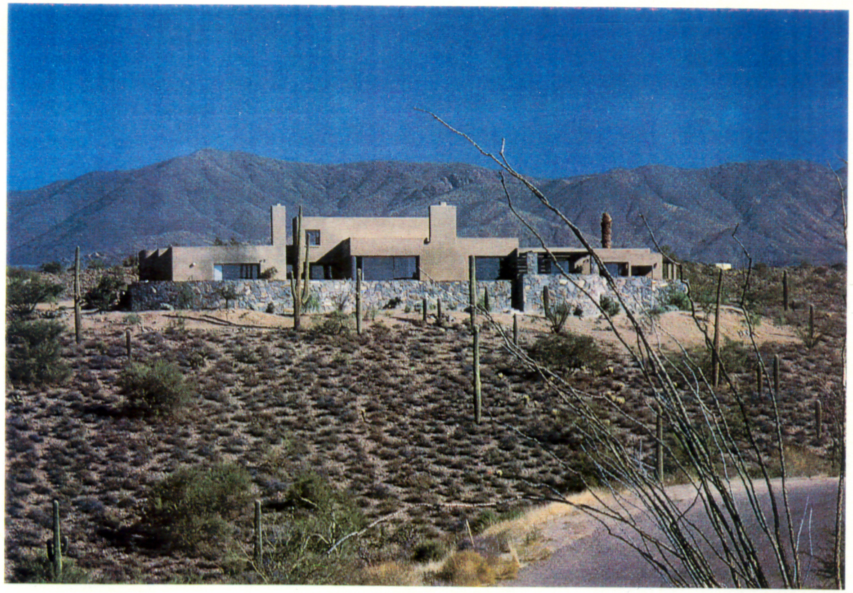
WALL SECTION AT TROMBE AND CLERESTORY

The aesthetic and technical solutions of the nonvented trombe wall (both exterior and interior are illustrated here.

Data

Project: *Kress residence.*
Architects: *Alianza Arquitect An Architects Alliance. Ervin Addy, partner in charge; Robe W. Peters and Jerry W. Geurts design team.*
Site: *1.75 acres in the foothills the Sandia Mountains. Vegetation is typical of New Mexico's high desert country.*
Program: *a one-bedroom residence with guest room/library to serve the retirement needs of the couple who travel extensively.*
Structure: *structural concrete slab on grade beams and piers with structural wood frame wal*

HOT-ARID



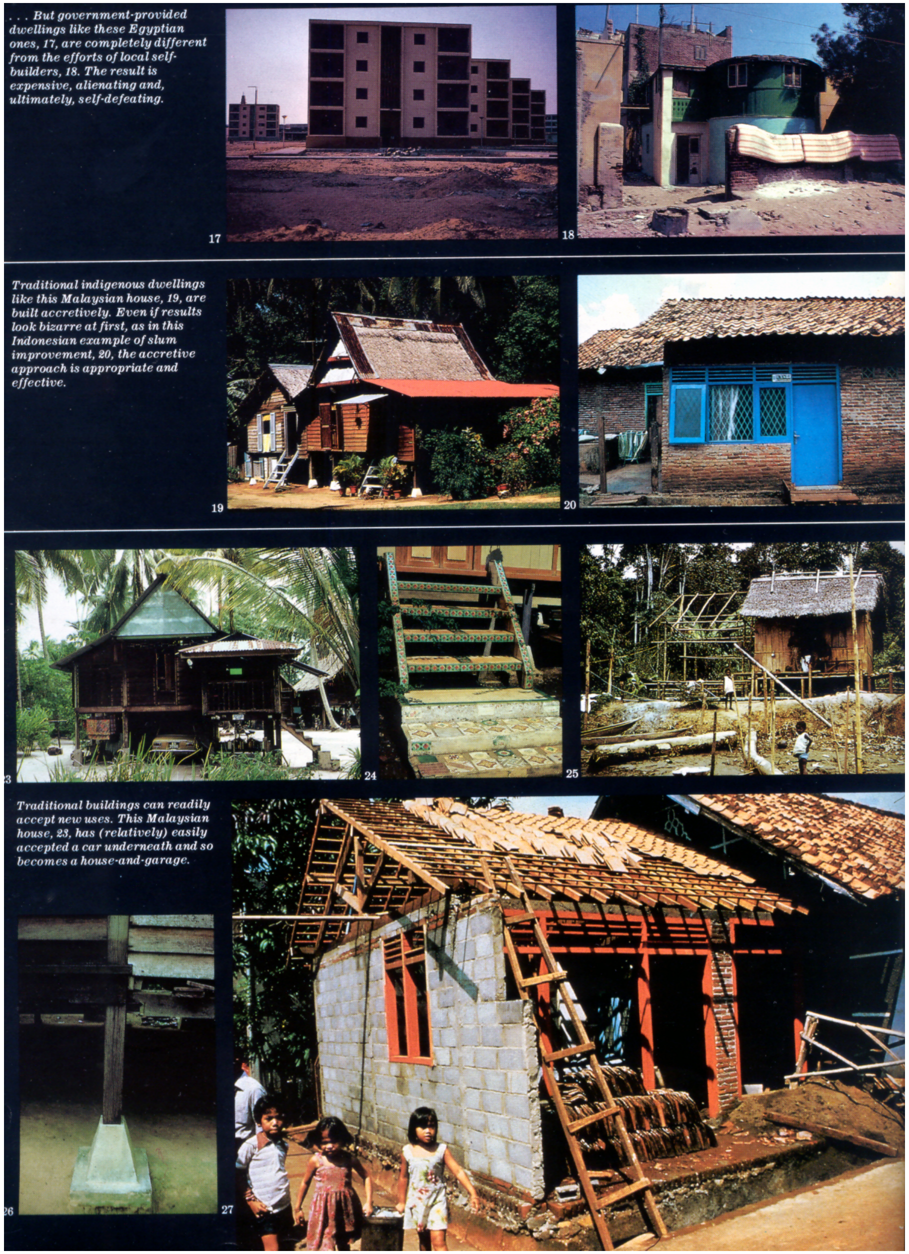

Loren A. McIntyre from Woodfin Camp & Associates

Master Plan: Transportation, Refuse Disposal, and Food Supplies

Few planners would care to lump these categories together, but consider the *de facto* master plan of pole-hut villages built over water. These began in the Late Stone Age and still exist in the marshes of Cambodia and New Guinea and the inner reaches of the Amazon. Transportation is by water. Garbage disposal is into water. And a good part of the food supply comes out of the water. Nor do residents have far to paddle for hunting and fishing: the refuse they throw into the water attracts marsh fowl and fish to the village.

Marc & Evelyne Bernheim from Woodfin Camp & Associates

HOT-HUMID



sultry

still

little air movement

or

very

windy

stormy

HOT-HUMID





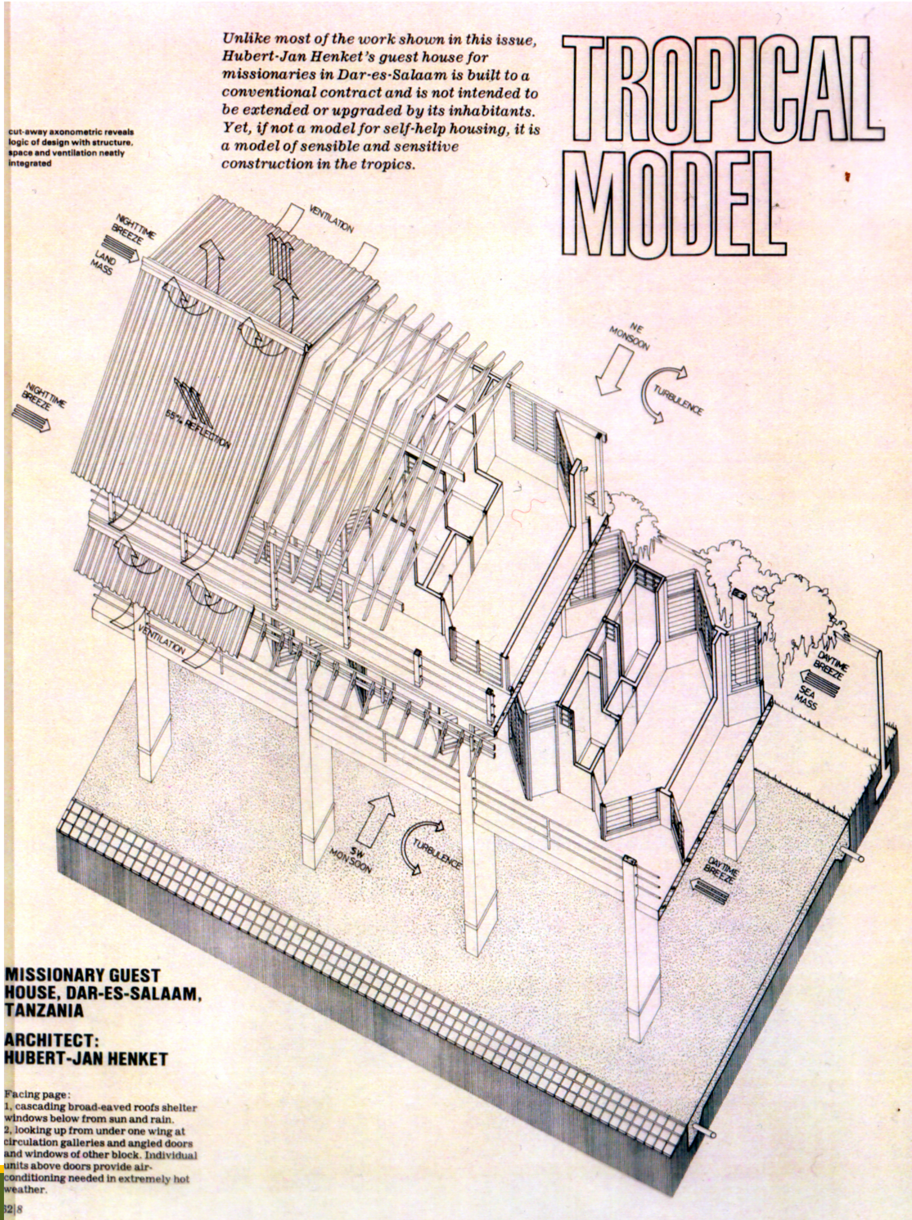
What can we learn from local traditions? Bamboo is one of the fastest growing, renewable natural materials...

HOT-HUMID

HOT-HUMID

HOT-HUMID

Missionary guest house, Dar-Es-Salam, Tanzania



TROPICAL MODEL

Unlike most of the work shown in this issue, Hubert-Jan Henket's guest house for missionaries in Dar-es-Salaam is built to a conventional contract and is not intended to be extended or upgraded by its inhabitants. Yet, if not a model for self-help housing, it is a model of sensible and sensitive construction in the tropics.

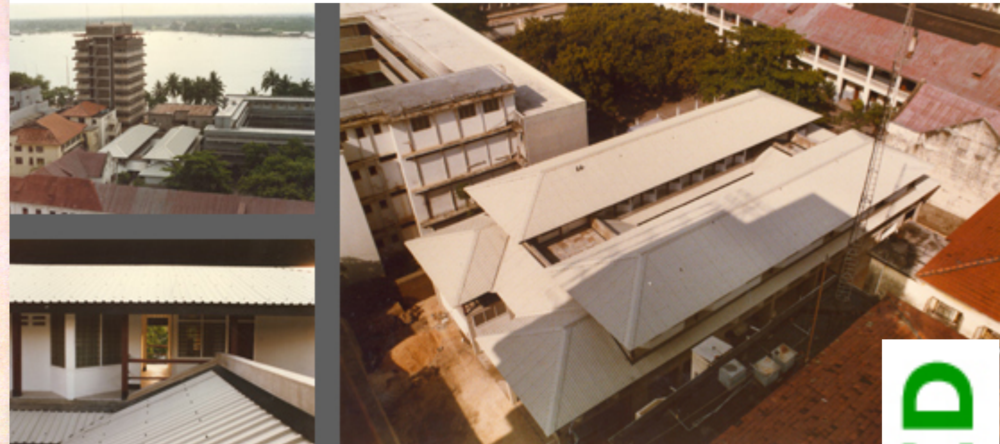
cut-away axonometric reveals logic of design with structure, space and ventilation neatly integrated

MISSIONARY GUEST HOUSE, DAR-ES-SALAAM, TANZANIA

ARCHITECT: HUBERT-JAN HENKET

Facing page:
1, cascading broad-eaved roofs shelter windows below from sun and rain.
2, looking up from under one wing at circulation galleries and angled doors and windows of other block. Individual units above doors provide air-conditioning needed in extremely hot weather.

32|8



A contemporary building that is conscious of the wind and rain and uses modern materials to replicate some effective indigenous traditions.

HOT-HUMID

HOT-HUMID

sun.

Light coloured roof reflects heat.

Courtyards provide shade.

Trees moderate cooling.

HOT-HUMID

Southern plantation houses with large shaded porches.

Louisiana houses of both rich and poor(er) use shutters on the windows to allow air flow while maintaining security.

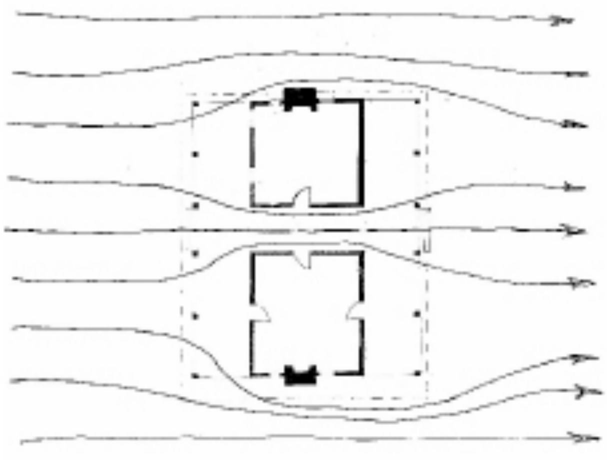
Shot-gun houses

HOT-HUMID

The traditional dog trot house is characterized by two log houses with a central connecting passageway, a porch at either side, and a chimney at each end. Developed in response to its environment, the dog trot house is successful in providing cool shaded space in the Southeast's hot, humid climate. This is accomplished primarily through its successful passive ventilation strategy.

air flow diagram showing section through the central breezeway.

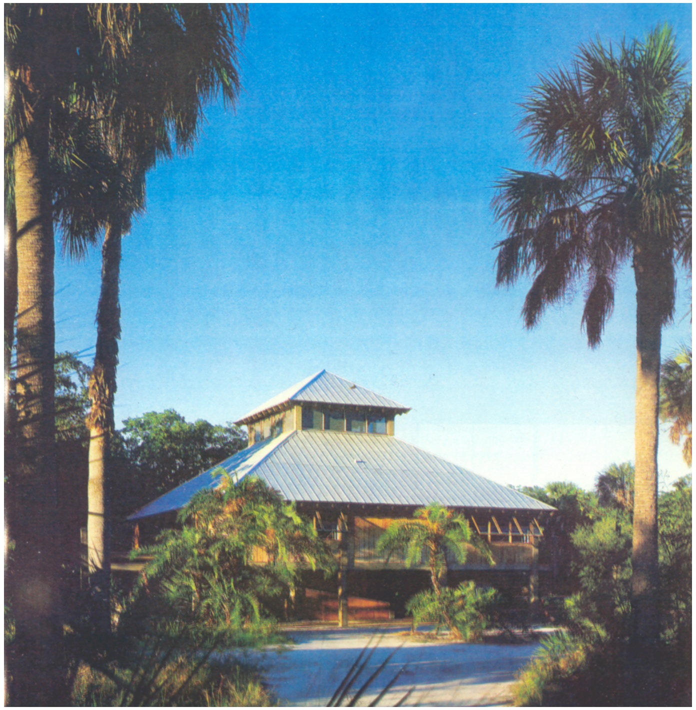
The image above shows air above ground mainly flows above and on the east or west side of the dogtrot. A smaller volume of air travels through the breezeway but at a greater velocity.



air flow diagram showing plan view of dog trot house.

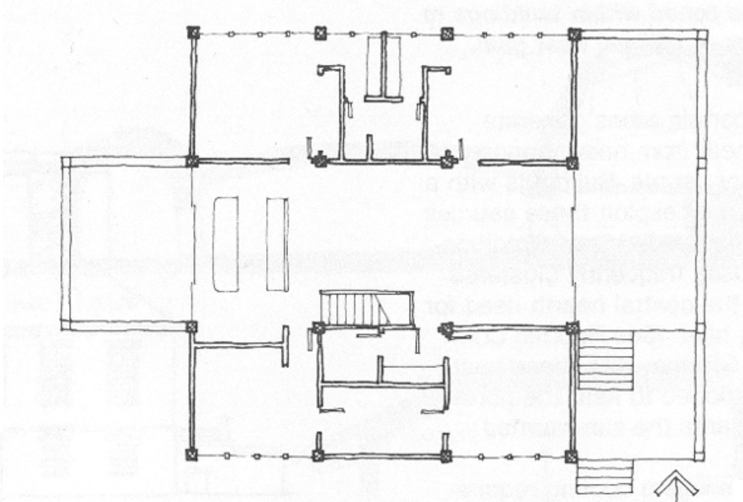
By studying more historic vernacular types that worked well, we can re-learn the principles that made these buildings effective.

Logan House, Tampa, FL



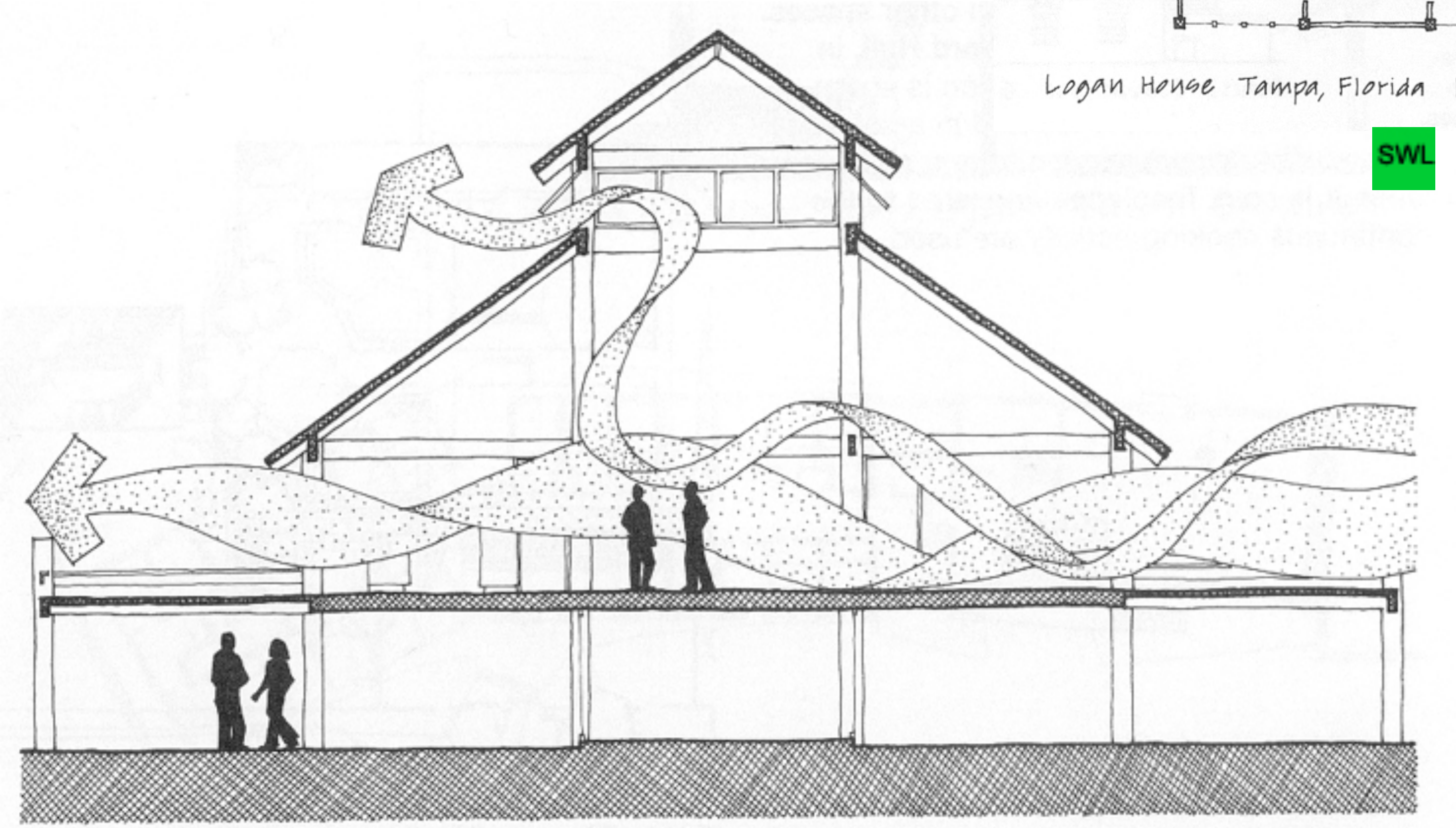
HOT-HUMID

This relatively modern building has become a model for a new kind of vernacular based upon ventilation strategies for hot-humid climates - that were derived from indigenous hot-humid buildings.



Logan House Tampa, Florida Rowe Holmes Assoc.

SWL



Logan House Tampa, Florida Rowe Holmes Assoc.

HOT-HUMID

COLD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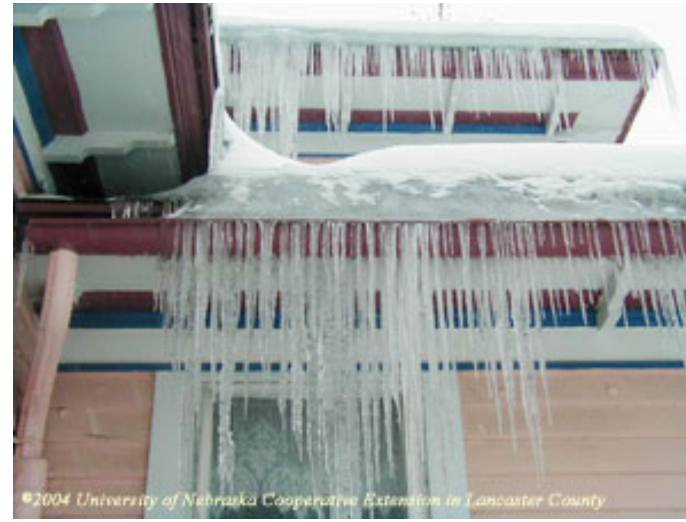

©2004 University of Nebraska Cooperative Extension in Lancaster County

COLD



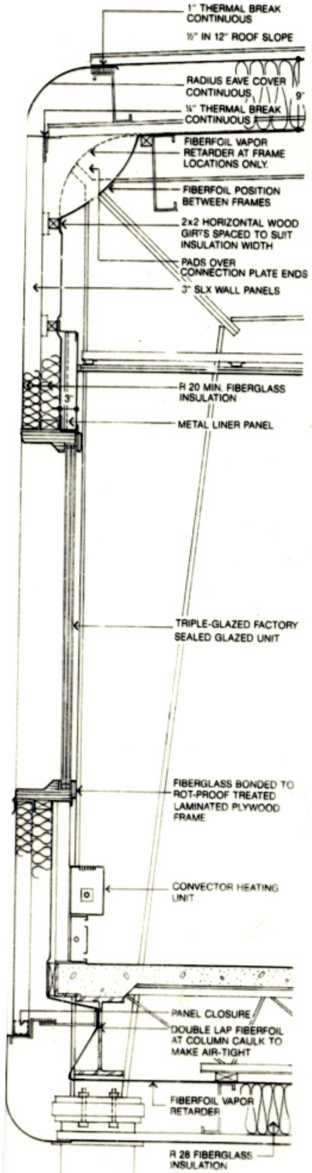


COLD

COLD

Cold climate houses can take varying attitudes towards their roofs. In some cases "stops" are put on the roof to hold the snow in place (so it does not slide off) and the snow is used as extra insulation. The roof must be stronger to prevent structural collapse due to this extra weight.

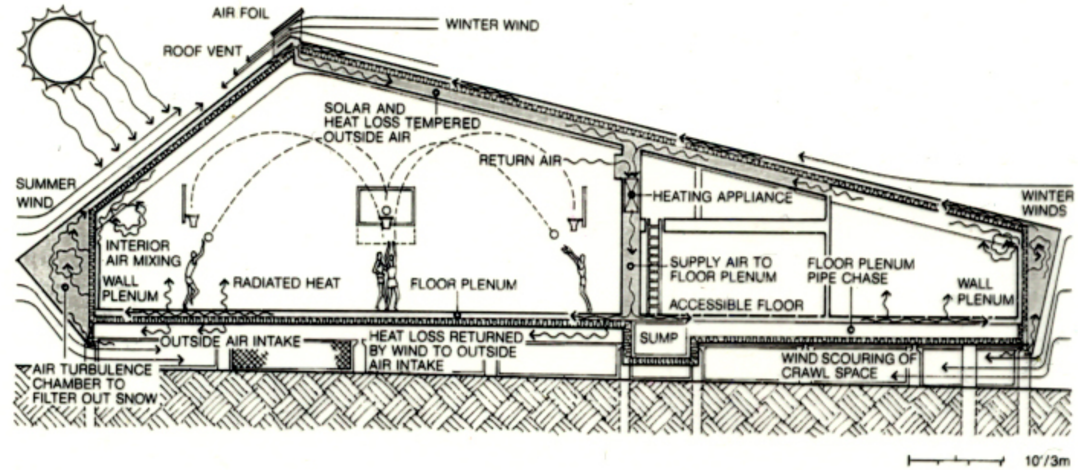
COLD



This wall section at the Polaris Mine Housing (above) shows the foil vapor retarder threading through the structure.

Design for cold climates

The wood-framed Kuchpu Secondary School by CSM architects and planners (right) draws outside air through angled fascia panels, which filter out the snow. The cold air moves under the metal roof, picking up heat from the sun and the building, before entering a heating unit and passing into a floor plenum, where it warms the plumbing prior to its exhaust into the rooms. A ridge air foil keeps the roof free of snow.



Our natural found environment donates very little in the way of renewable or natural materials that will make the design and construction of modern comfortable houses very easy.

Creating a warm, moist environment in a harsh, cold climate puts ourselves quite at odds with physics.

COLD

fiberglass

Insulation is the only real way to keep the heat in. Some types are more environmentally friendly than others.

polystyrene

Sheep’s wool

PASSIVE - BIO CLIMATIC DESIGN

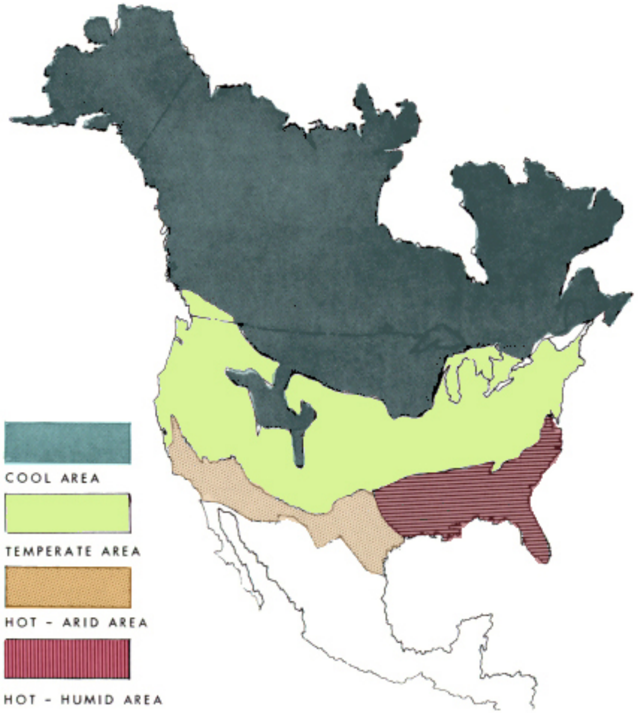
Design must first acknowledge regional, local and microclimate impacts on the buil

COLD

TEMPERATE

HOT-ARID

HOT-HUMID



11. Regional climate zones of the North American continent.

Image: 1963 "Design with Climate", Victor Olgyay.

Bio-climatic Design: COLD

Where **WINTER** is the dominant season and concerns for conserving heat predominate

RULES:

- **First INSULATE**
- *exceed* CODE requirements
-build tight to reduce air changes
- **Then INSOLATE**

YMCA Environmental Learning Centre, Paradise Lake, Ontario

Bio-climatic Design: HOT-ARID

Where **very high summer temperatures** with great fluctuation predominate with **dry conditions** throughout the year.

RULES:

- Solar avoidance : keep DIRECT SOLAR GAIN out of the building

-respect the DIURNAL CYCLE

- use heavy mass for walls

Traditional House in Egypt

Bio-climatic Design: HOT-HUMID

Where **warm to hot** stable conditions predominate with **high humidity** throughout the year.

RULES:

- SOLAR AVOIDANCE : large roofs with overhangs that shade walls and to allow windows open at all times

- PROMOTE VENTILATION

- USE LIGHTWEIGHT MATERIALS that do not hold heat

House in Seaside, Florida

Bio-climatic Design: TEMPERATE

The summers are hot and humid, and the winters are cold. **The four seasons are almost equally long.**

RULES:

- BALANCE strategies between COLD and HOT-HUMID

- maximize FLEXIBILITY in order to be able to modify the envelope

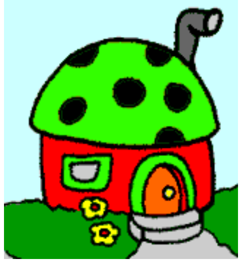
IslandWood Residence, Seattle

COLD

+

HOT-HUMID

=



?

But that is what we have to figure out, isn't it??