Gr24_HW02: Vernacular and Climate Sensitive Architecture; Auckland

salman.oukati[1]

[1]Building Energy Modeling and Envelope Design

February 21, 2018

Today, vernacular architecture is known as heritage to us from our ancestors who did not have architecture education; they used architecture elements to create some of thier beliefs and thoughts as buildings which reflect human life, nature, history, beliefs and adaptability of our ancestors, today. Vernacular architecture is the tendency to idealism through time, reflecting human nature and lifestyle; leaving time, creates the idealism we seek in every period that it is created; adapting human lifestyle and nature. (Vahid Ghobadian, Civilica, A look to vernacular architecture from chronological and conceptual perspective)

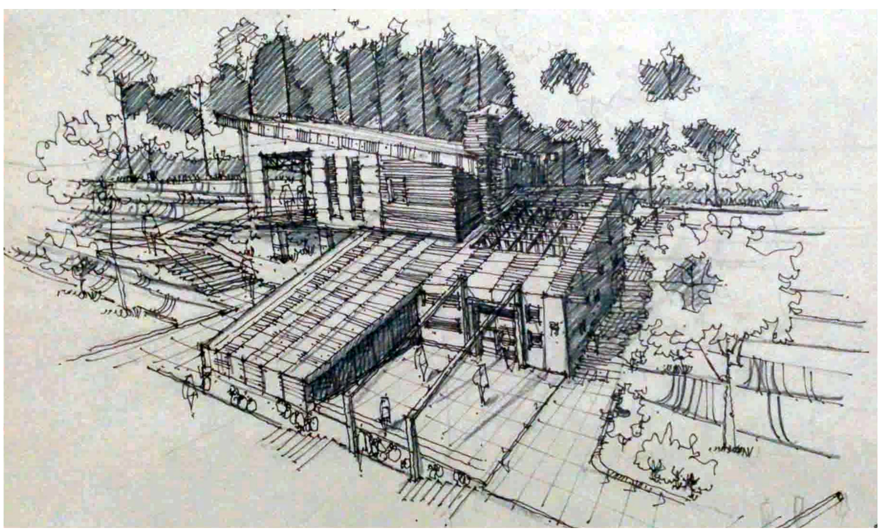

Figure 1: Sketch of vernacular architecture in Rasht

Chapter 1

The first city to analyze is Auckland; located in Northern part of New Zealand in the Southern Hemisphere has Sub-Tropical climate (warm humid summers and mild damp winters); with an average monthly temperature rage between 11 and 20 centigrade. Auckland, having nearly 1.5 million population is the biggest urban area of New Zealand.

The vernacular architecture of the city has undergone a series of changes during time, all saving the main principle of using natural materials found widely in the surrounding areas; from the Maori architecture

Figure 2: Auckland, New Zealand

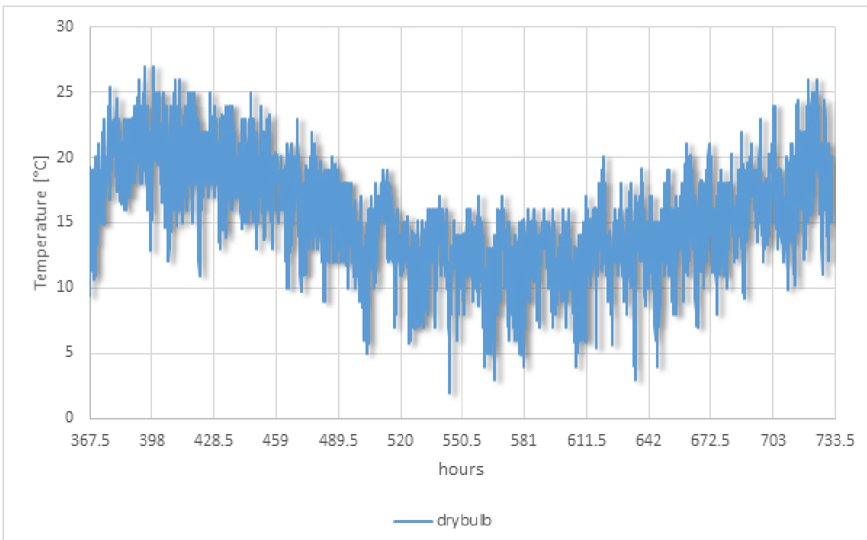

Figure 3: Dry bulb Temperature

Figure 4: The sky line of Auckland city

to post-war and contemporary architecture of New Zealand. The most common materials used are timber, rushes, toetoe, barks, clay and stones.

Early houses

Early houses made by settlers were made by materials found from forests and swamps, mostly. Timber were used to make posts, poles, roofs and wall; while rushes, barks and other plants were used to make thiching. clay mixed with straws or grass built up in layers were used to make a thick and warm wall with a stone foundation to avoid moisture reaching the porous parts; and the external walls had a layer of plaster. Roofs used wide eaves for avoiding rain to enter. All of these methods were used to create cob houses, helping heating in winters and cooling in summer periods.

Figure 5: Riverlands cob cottage

Figure 6: Example of a method used to construct rammed earth buildings in Auckland

The sod house on The sumner road near Heathcote bridge was made by Captain James Penfold. He built the house using the sods which he cut from the riverbank. Blocks of earth cut with a spade and laid on top of each other create the so called Sods, which is clearly visible in the following image.

As Auckland is heavily forested, the most common used material is wood to make houses. Many roofs were covered using narrow timber tiles from blocks. Early roofings used fern fronds, reeds, bark sheets, bitumen-coated fabrics and long boards. They were pitched between 30 to 45 degrees to make the rain run off.

Nearly all houses in Auckland have tightly designed plans, they are usually small, tightly sealed and insulated to provide rapid heat buildup in the morning. Vernacular building used sun shadings in East and North while having bigger openings in the South facade (note. Auckland is located in Southern Hemisphere) but overhangs were designed for summer shading.

Chapter 2

Auckland's climate is charecterized as an oceanic climate (sub-tropical, warm humid summers and mild

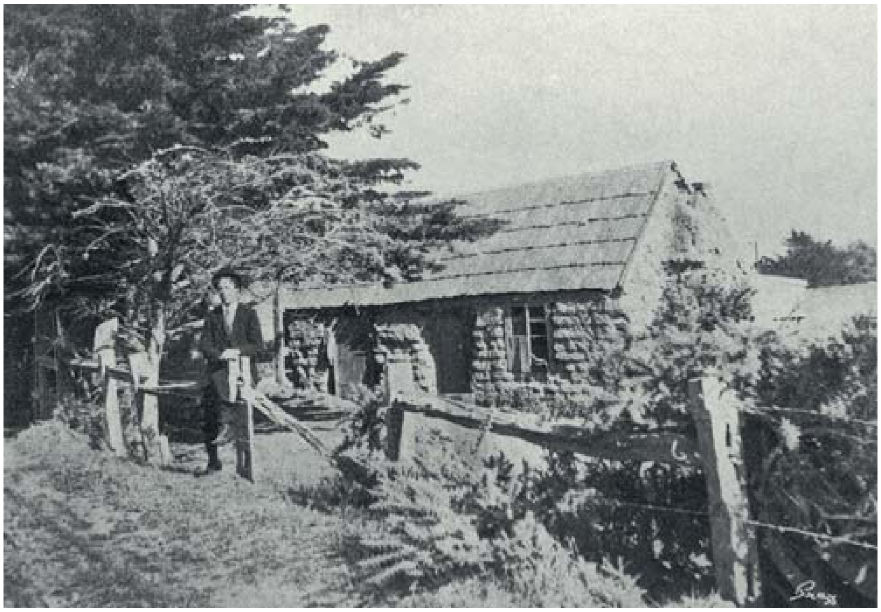

Figure 7: Sod whare, 1910

Figure 8: Highwic (1860) in Epsom, Auckland (Gothic style)

damp winters); also noting the fact that Auckland is located in the Southern Hemisphere, different methods and strategies can be used to reduce energy consumption for heating, cooling, ventilation and illumination of the building.

Having in mind all strategies, some were used already by architects and settlers of Auckland through out the history; using earth and timber due to thier heat capacity, use of tight plan design, well designed overhangs, stone foundations due to moisture, pitched roofs, South facade bigger openings and etc.

Other methods that can be implemented in the design of a building for reducing energy consumption in Auckland are listed as followed:

Figure 9: Auckland's Old Government House (1856), constructed of timber fashioned to look like stone

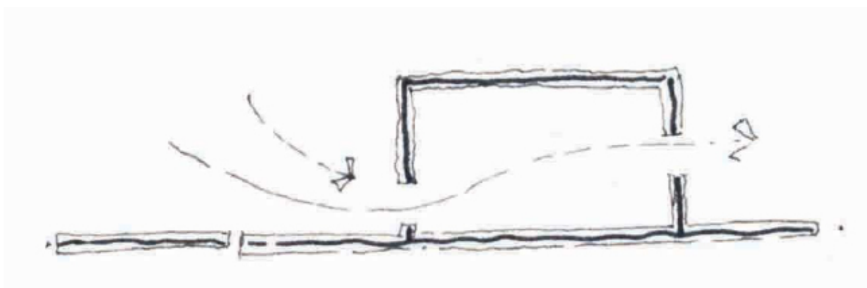

Figure 10: Example of the use of wind for natural ventilation

- Heat gain from lights, people, and equipment greatly reduces heating needs so keep home tight, well insulated (to lower Balance Point temperature)
- For passive solar heating face most of the glass area South to maximize winter sun exposure, but design overhangs to fully shade in summer
- Provide double pane high performance glazing (Low-E) on west, south, and east, but clear on north for maximum passive solar gain
- use of low mass tightly sealed, well insulated construction to provide rapid heat buildup in morning
- shade to prevent overheating, open to breezes in summer, and use passive solar gain in winter
- Tiles or slate (even on wood floors) or a stone-faced fireplace provides enough surface mass to store winter daytime solar gain and summer nighttime 'coolth'
- Sunny wind-protected outdoor spaces can extend living areas in cool weather (seasonal sun rooms, enclosed patios or courtyards)
- use of light weight construction with slab on grade and operable walls and shaded outdoor spaces
- Lower the indoor comfort temperature at night to reduce heating energy consumption
- Low pitched roofs with wide overhangs

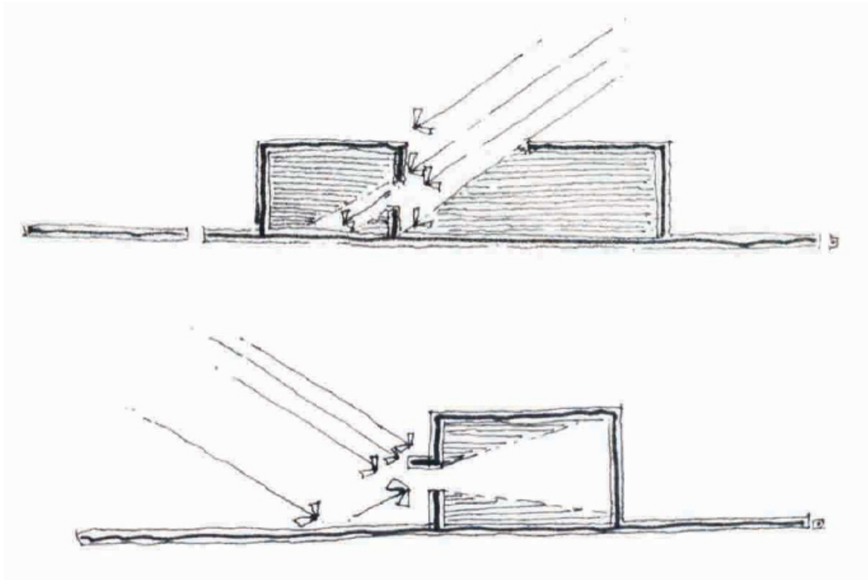

Figure 11: Examples of use of direct (top) and indirect (bottom) use of sun for illumination and heat gain.

- Organize floorplan so winter sun penetrates into daytime use spaces with specific functions that coincide with solar orientation
- Small well-insulated skylights (less than 3% of floor area in clear climates, 5% in overcast) reduce daytime lighting energy and cooling loads
- Locate garages or storage areas on the side of the building facing the coldest wind to help insulate
- Keep the building small (right-sized) because excessive floor area wastes heating and cooling energy
- Extra insulation (super insulation) might prove cost effective, and will increase occupant comfort by keeping indoor temperatures more uniform

Contemporary examples:

Sydney firm Luigi Rosselli Architects was asked to create the housing for seasonal employees, who herd cattle off the open ranch into pens for periodical sorting, transportation and treatment.

The row of individual residences sits behind a 230-metre-long wavy facade made from compacted earth, which the architects claim is the longest rammed-earth wall in Australia. They named the project The Great Wall of WA after its length and location in West Australia (WA).

The zigzagging wall wraps around the en-suite bedrooms, which are set at an angle beneath a bank of sand. This sandy roof, coupled with the 4.5-centimetre-thick facade, provides a naturally cooled retreat from the heat of the sun.

"The rammed-earth wall meanders along the edge of a sand dune and encloses twelve earth-covered residences, created to provide short-term accommodation for a cattle station during mustering season," said Rosselli.

The layers of compressed earth that make up the wall are visible across both the exterior and interior of the residences. Its red colouring comes from the locally sourced clay, which is bound together with gravel

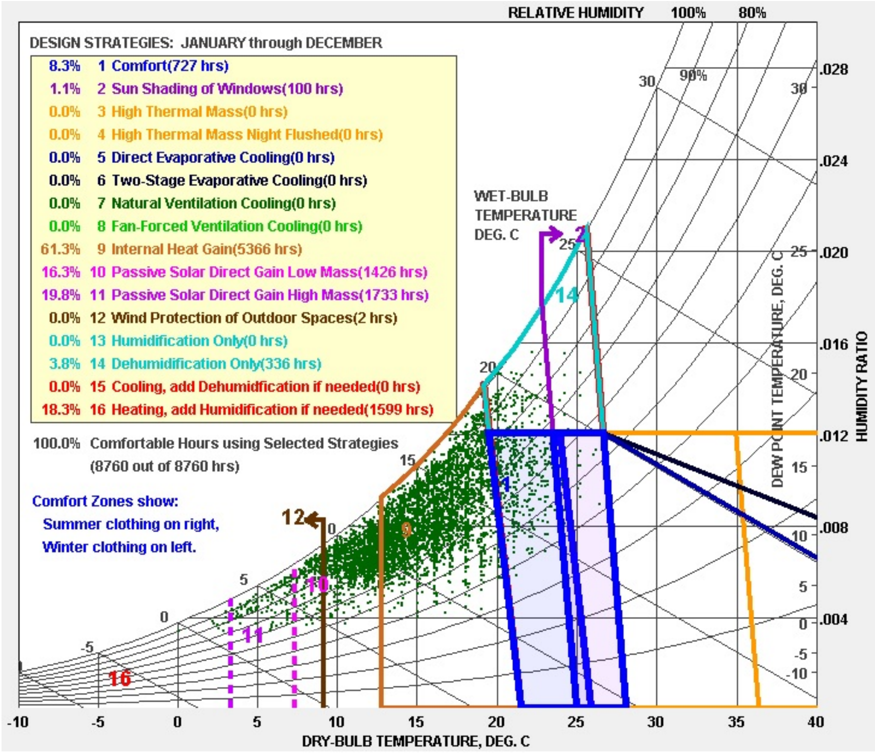

Figure 12: Auckland Psychrometric chart

Figure 13: Housings made of rammed earth

from the bed of an adjacent river and water from a local bore hole. The shape of the outer wall affords residents a degree of privacy and shade from their neighbours. Each unit has its own private terrace sheltered

Figure 14: site plan

below a bronzed metal awning, and a shared garden.

References:

- www.dezeen.com
- www.archdaily.com
- www.civilica.com (Irans main conference and article publisher)
- www.nzgbc.org.nz/ (New Zealand Green Building Council)
- https://teara.govt.nz/en/building-materials/page-1
- http://www.heritage.org.nz/resources/conservation-plans
- https://theculturetrip.com/pacific/new-zealand/articles/a-walking-tour-of-aucklands-architectural-landmarks/
- http://www.rammedearth.co.nz/
- http://www.pzazz.co.nz/articles/living-and-dining-articles/history-new-zealand-home-architecture/
- Vyavasay Vidya Partisthan; Research Thesis; Rajkot, India; Thesis in Earth architecture
- Climate consultant software
- www.fao.org

Figure 15: interior