Notes on the architectural responsiveness of foreign immigrants to local climates, resources and cultures in Chile from 16th to 20th century.

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Abstract

Chile, a country with diverse climatic environments (from Latitude 18° to 55° S , from seaside to Andes mountains) has received a number of immigrating groups which settled in order to exploit natural resources or just colonising. Some of them are:

- British trade, nitrate extraction and port activities (19th century): 20°S Lat., 23°S Lat., 23°S Lat and 33°S Lat**.**
- Early Spanish colonisation (16th century): 24° S Lat
- American copper mining (20th century): 34° S Lat.
- Planned German immigration (19th century): 39° to 42° S Lat..
- Croatian immigration (from 19th century) and Patagonia exploitation :53° S Lat..

These groups brought their building technologies. They also had to adapt them to local environment and resources, leading to creative and environmentally sound solutions. Architectural examples, are presented. Some of these techniques are identified and summarised.

Conference topic: education and transfer of technology
Key words: colonial - architecture, regional, climate.

BRITISH TRADE, NITRATE EXTRACTION AND PORT ACTIVITIES

The nitrate exploitation by British companies during 19th Century took place in the Northern part of Chile where one of the most arid desert of the world exist. Many exploitation camps were built close to Capricorn Tropic: Chacabuco, María Elena, and others. Also, trade and port activities involved British settlements at Iquique and Antofagasta, at near the same latitude, by the sea.

The main objective of buildings and urban design at these camps was the provision of shade, as solar radiation rate is about 7.5 kWh/m2 per day in summer and 4.2 in winter.

At figure N 1 Chacabuco administrator house is shown. Veranda surrounds the house creating shade and an intermediate space. A double roof , one made of wood just for shade and the proper roof below can be seen. This device avoids high solar radiation increasing in roof and inner environmental temperature of the house. Vegetation in the veranda contributes to humidify air, which is very dry.

Another example of shade design is shown in Figure N 2, which is a part of María Elena nitrate camp urban design.

Again a veranda can be seen in front of workers houses. Central space is planted with trees (which are very hard to grow in this dry environment) and a wooden ventilated roof is placed at the centre for shadowing as well. Trees humidify air at this common outer space. Walls and roof are made with adobe or earth blocks which adds thermal mass (temp daily range is 30 K)

The following examples were built at seaside in the cities of Iquique and Antofagasta. Although these two port cities are at more or less the same latitude than the nitrate camps, solar radiation is significantly lower because the climate is cloudy during the morning along the year. As it is close to the sea climate is also humid but without rain (temp. daily range is less than 10 K)

There are two strategies mainly used in British houses at this climate: to provide shadow and to ventilate in order not to let air humidity to accumulate.

Figure N 2

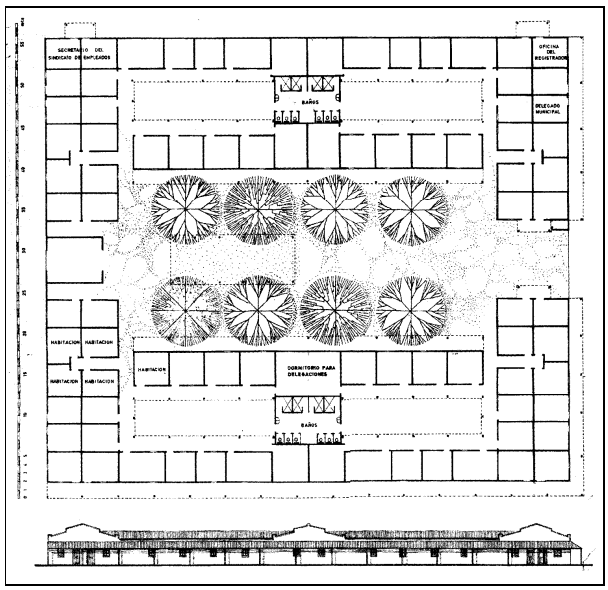


Figure 3

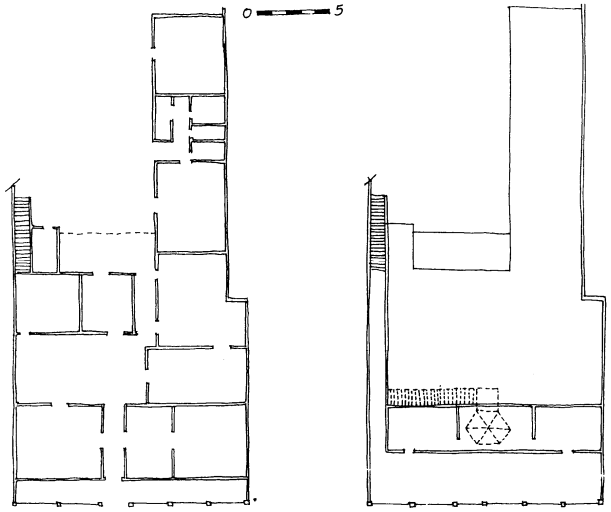
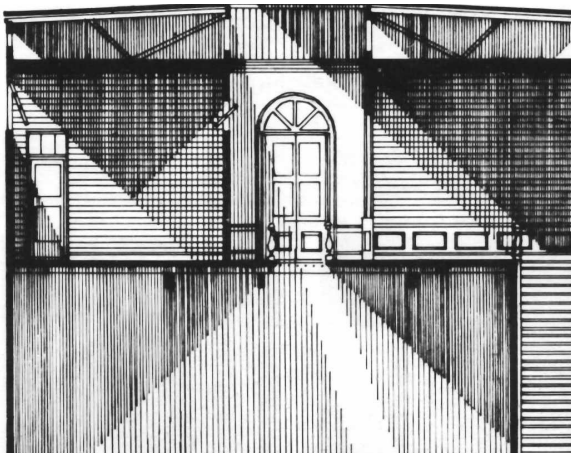


Figure 4



At Figure N 3 Iquique´s main street with a two stories, row and veranda house is shown. The shadow is provided by the double skin created by the veranda, the 1st floor corridor and the 3rd floor covered deck. Shutters protect windows as well.

At figure 4 and 5 plan and section of one of these houses are shown. As can be seen, a lantern provides natural light and stack ventilation throughout the house. Cross ventilation is also provided through windows.

INFLUENCE OF EARLY FOREIGN ARCHITECTURE IN NOWADAYS BUILDINGS

Influence of early foreign architecture is still strongly evident at Iquique and Antofagasta.. At Figure 6 an inner shadowed patio of a religious guest house by the architect G. Kapstein is shown.

Figure 5

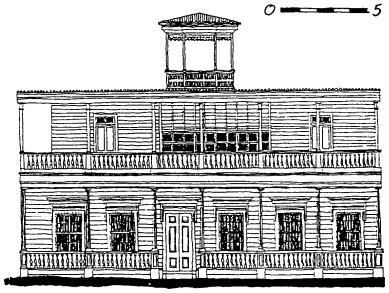


Figure 6

At Figure 7 a ventilation lantern placed in an inner patio of a contemporary hotel is shown.

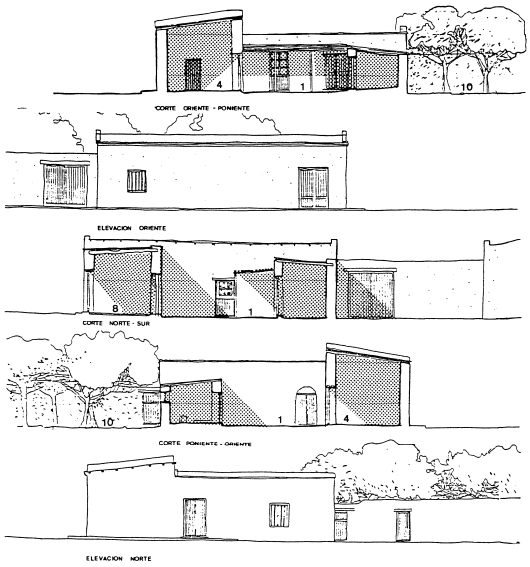
Figure 7.

EARLY PRE AND SPANISH COLONIZATION

At the same zone of nitrate camps, Spaniards arrived during VI Th century and built many small towns that still exist almost intact. Towns were built under strict geometric rules of orthogonal streets and houses with inner patios. Climatic adaptation was mainly achieved using thermal capacity of fabric as adobe for walls and roofs. and stone for walls. At these places, where temperature daily range is normally 30 degrees, this is one of the most important design strategies in order to flatten peak outdoor temperatures. Shadowed patios with trees surrounded by buildings for controlling strong wind and sun were also heavily used.

At Figure 8 an early Spanish house in San Pedro de Atacama is shown with its patios, trees and shadowed intermediate spaces.

Figure 8



Pre-Columbian civilisation at the same place of the above house has had a very different urban and architectural design proposal. From 400 years BC to 300 AC the town of Tulor, close to San Pedro de Atacama was inhabited by people dedicated both to agriculture and grazing. This is a town with a very complex spatial organisation and a great skill in adobe building, and where both domestic activities and storage activities took place.

Climatic control was achieved by building thick adobe walls for thermal mass and heat capacity, but at this time not keeping with orthogonal Spanish influenced rules but with circular plans instead. Living units and warehouse units were placed very close to each other thus creating narrow and shadowed patios and passages in between. Windows and doors were very small. All the town was surrounded by a high wall built to stop the sand to come into it. Nowadays sand completely covers the town.

At Figure 9 part of Tulor plan can be appreciated

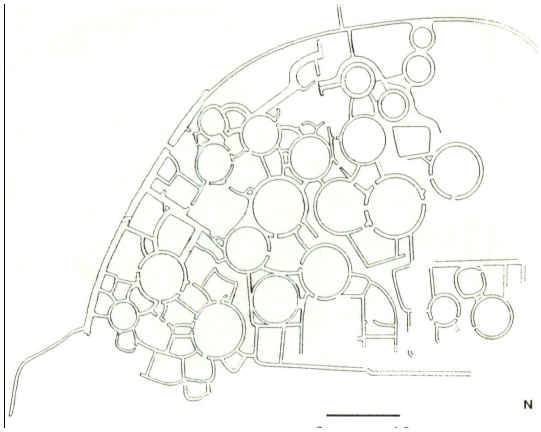
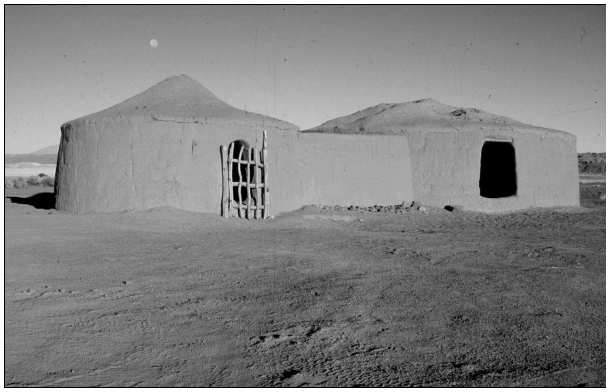


Figure 10 Tulor house reconstructed



AMERICAN COPPER MINING AT SEWELL IN THE ANDES MOUNTAINS , CENTRAL CHILE.

At the beginning of the 20th century an American copper mining established at Sewell, at 38° S. Lat and 2.200 m. of altitude.

The singularity of this camp, is that it grew as a town: of 16.000 inhabitants in 1960 located in a small and steep piece of land (36 Há) which was more secure against landslides than the surrounding ones.. It has a rough climate, very cold, chill wind and snow in winter, high daily temperature range and little vegetation.

In terms of climatic adaptation the more important design strategy here is to have the more of sun radiation as possible in winter in order to collaborate with electric heating and to have an airtight envelope in order to avoid draughts , as wind is very heavy

The buildings designed by Americans here, were all facing North, which is the sun orientation, made of timber (balloon frame) with plaster over wood, concrete slabs, metallic roof and small windows with wind control.

As it is a mixture of materials, timber plays the role of more responsiveness to rising inner temperature when sun is shinning outdoors. Concrete slabs add mass and heat capacity to rise time lag and flat the peak temperatures.

The envelope, sealed by concrete plaster makes the building weatherproof

There are roofed corridors along the buildings and common areas at the end of them creating protected and intermediate zones and also inner common areas natural lighted by skylight windows

PLANNED GERMAN IMMIGRATION (19TH CENTURY)

The German colonisation in the middle of the 19th century was planned by the government of that time in order to settle people who was used to live and to exploit agriculture and grazing in a rainy and cold climate. In the South of Chile, the climate is similar to that in the North of Europe. Some connections with the German government opened immigration to this part of Chile, mainly near the Lake District between 39 and 42° S. Lat.

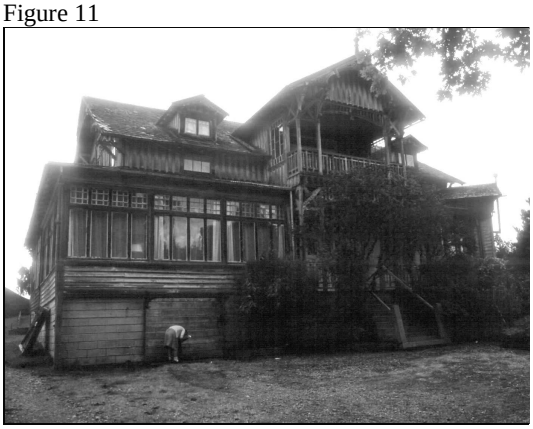
This colonisation renewed the whole house building system from 1850. Since that date, houses can be found with ubiquitous use of timber placed over sedimentary rocks and metallic sheet roof.

General disposition of this kind of house were: compact plan commonly with square form, outdoor warehouses connected with roofed corridors with timber columns and pigeon lofts used as store or children rooms. Later on, roofed corridors were closed with windows becoming greenhouse corridors.

Climatic adaptation is clear: these houses were all built over one or even two meters above ground level, in order to avoid contact with saturated soil. Very compact plans, glazed corridors and small operable windows diminish contact with cold temperatures and make heating more efficient.. Corridors converted as greenhouses facing North provide some heat in winter.

At Figure 11 one of these houses can be appreciated.

Figure 11



CROATIAN IMMIGRATION (FROM 19TH CENTURY) AND PATAGONIA EXPLOITATION.

South America´s southern end is called Patagonia. Croatian people settled here during 19th century for grazing lambs and exploit wool and meat at the vast grasslands called *the pampa*. Also settled British Scots, Welch and people from other counties

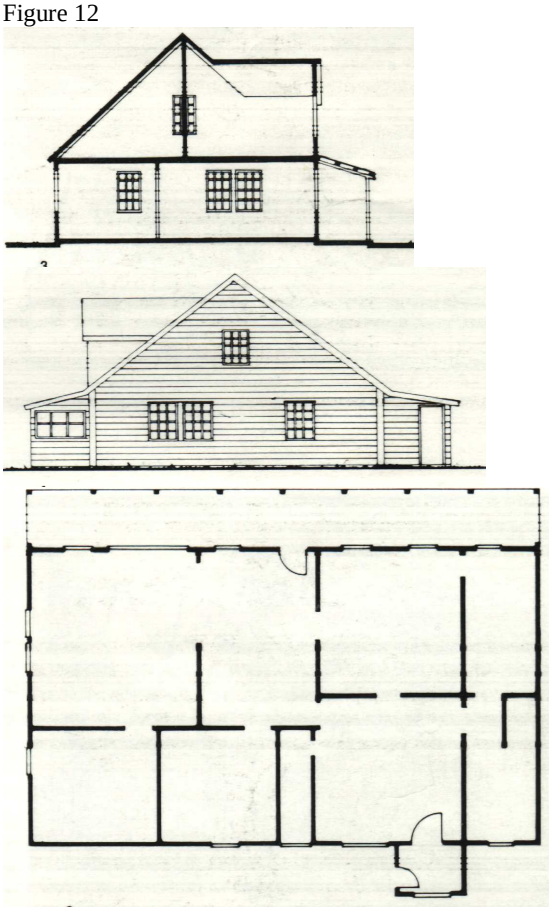
Climate all the year round here is cold and with very strong winds (very often 100 Km/ hr and over).

Their techniques for building houses have influenced building design at the Patagonia very strongly ever since.

At the beginning all houses were made of timber. Later on people found that bricks and mortar performance with wind storms was sometimes better. Consequently, there are examples made of both systems: neo-classic architecture in the city of Punta Arenas, houses at the *estancias* and industrial examples at the huge lamb meat cold storage. Climatic strategies of architecture design are: compact two floor plan, airtight envelope, small operable windows, steep roof, sometimes there are greenhouses attached to buildings, thermal insulation at cold storage buildings, wooden wind shields in order to calm wind at working areas and porched double door entrance.

At Figure 12 an example of one of the first small wooden houses is shown.

Figure 12



CONCLUSIONS

The immigrations groups that settled in Chile at different times brought their building knowledge and technologies, but also they had to adapt them to local environment and resources, leading to innovative and environmentally sound solutions that were extensively applied in each region.

Influence of early foreign architecture is still strongly evident, but mostly in terms of form. Later designs have replaced materials and craftsmanship, loosing their original environmental qualities.

This paper aims at rescuing these architectural examples in order to keep the memory towards an environmental design history, as a contribution to future architectural and environmental design in Chile.

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