

The invention of the Balloon Frame, how it affected architecture in the New World. The case of Chile

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THE INDUSTRIAL REVOLUTION AND ITS' CONSEQUENCES IN THE ARCHITECTURE OF THE NEW WORLD

Industrialization in Europe takes place at the end of the XVIIIth century, when due to the invention of machines, manual labor is substituted to elaborate raw materials like iron and animal or natural fibers like cotton, wool or linen.

Associated with this there is a need of colonial expansion in search of raw materials which triggers a race between the leading European countries, such as the Netherlands, France, Spain, Portugal and especially England towards the dominion of new territories in the world. The British Empire is the leader, and its' influence has affected the culture and image expressed in their architectural expressions, of remote countries such as Australia and New Zealand, Hong Kong, India and the American Continent.

Clear expressions of the influence of the British Empire are present in the United States, which suffered a direct process of colonization, in the Caribbean and the major ports, as well the Southern tip of South America due to the development of a sheep station industry.

WOODEN BUILDING TECHNOLOGY IN THE UNITED STATES DURING THE XVIII AND XIXTH CENTURY

We will focus on the invention of the balloon frame system of construction in wood, an invention of the American continent, which allowed the population

and dominion of unexplored areas in a relatively short period of time.

In the American Continent the European inventions were rapidly introduced changing the need of specialized craftsmen who were scarce.

Post and Girt system.

Before the invention of the balloon frame construction with wood was slow and required skilled labor based on mortised and tenoned joints.

In colonial times, wood was used in its' simplest form, building walls of horizontal logs, either left round or hewn square, developing several systems of log corner notching to strengthen the crucial junction.

Far more common than the horizontal log walls, are those in which spaced vertical members provide structural support. The earliest is the medieval post and girt system imported from England and France by the first colonists, in which heavy corner posts and widely spaced intervening posts carry the upper loads. Heavy cross —timbers carry upper floors, which are unsupported by the thin internal walls below. All the structural joints are laboriously hewn into interlocking shapes and held by wooden pegs.

This system dominated the English and French colonies and persisted after the American Revolution.

BRACED FRAME SYSTEM

With the availability of increasing abundance of commercial saw lumber relatively inexpensive

wire nails the braced frame construction is developed, in which the traditional post and girt system, although still employs heavy corner posts connected by heavy horizontal timbers with hewn joints creating a heavy skeleton. Loads are now carried not by widely spaced and equally massive intervening posts and cross members, but light, closely spaced vertical studs nailed between the horizontal timbers.

Internal walls are constructed entirely of light studs, which become strong bearing walls, which help support the floors and roof above. The system takes its' name from diagonal corner braces, common in all types of wooden framing and used for lateral stability.

By the early XIXth century this system was replacing the former post and girt in the English colonies of the Atlantic seaboard, and persisted in the 20th century.

The colonization towards the west used this system in the XIXth century.

THE BALLOON FRAME SYSTEM

Around the time of the Civil War in the United States another more simplified method of frame construction was developed in the mid-west, the balloon frame, which appeared in Chicago around 1830.

This new system eliminated the tedious hewn joints and massive timbers of braced frame and post and girt construction. Balloon frame houses are based on a closely spaced two inch boards of varying widths, two by two, two by four, two by six, or two by twelve, joined only by nails. Corner posts and principal horizontal members are made of boards nailed together.

The principal supporting members are closely spaced two by four or two by six vertical studs of both the exterior and key interior walls.

The studs are continuous from the foundation to the roof and the floors are hung upon the studs.

This system allowed both cheaper and quicker construction eliminating skilled labor.

The main principle of the balloon framing system is the substitution of thin plates and studs, running the entire height of the building and held together by nails, like putting together a box. Fig 1 & 2

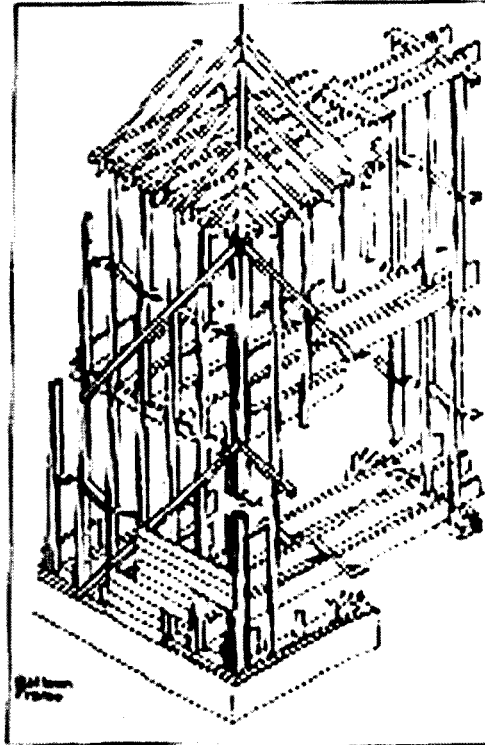


Figure 1
Balloon Frame Structure

THE PLATFORM SYSTEM

Today it remains as the dominant method of house construction in the United States today with some variations, like in the platform framing in which the floors are constructed as independent units, like thin flat platforms. The studs are shorter and erected on these platforms and support the overlaying platform or the roof.

This made balloon framing even simpler and more rigid, and was widely used during the XXth Century.

In its' beginnings the balloon system was widely attacked, first because skilled carpenters were replaced by unskilled laborers reducing the costs of construction in 40% as G.E. Woodward would state in his book «Woodward's Country Homes, New York 1869. Together with cheaper labor nails of steel and

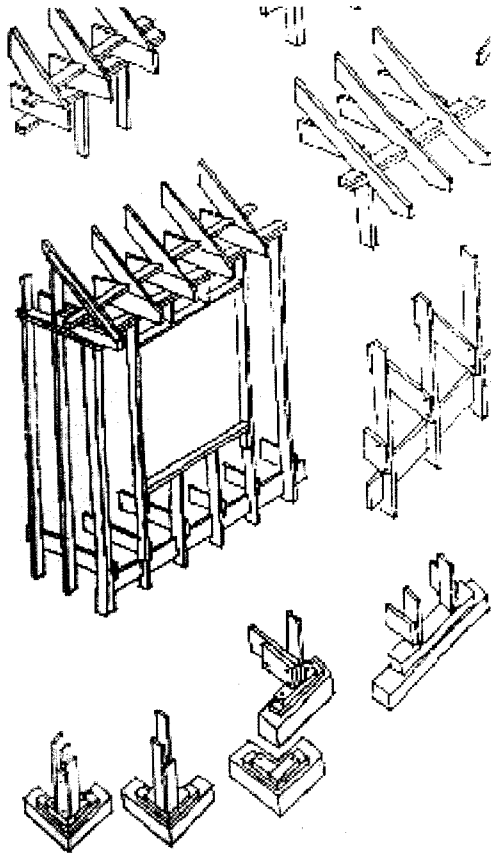


Figure 2
Details, Balloon Frame Structure

iron or wire replaced the expensive wrought iron ones, which became increasable lower in cost.

The development of the system coincides with the improvement of sawmill machinery and mass production of nails.

These machines were developed both in England and in the United States towards the end of the eighteenth century. Thomas Clifford patented one in 1790 and at the same time did Jacob Perkins in Newburyport. In 1807, Jesse reed patented one, which was able to cut, shape and head tacks in a single operation and at a rate of sixty thousand a day.

In its' beginnings, according to Albert Bolles, in his «Industrial History of the United States», says that wrought iron nails had a cost of 25 cents a pound

which was reduced in 1828 to 8 cents a pound and in 1842 to 3 cents a pound.

THE EXPANSION OF THE BALLOON FRAME SYSTEM IN THE UNITED STATES, AND THE AMERICAN CONTINENT

The conquest of the west from Chicago to the pacific boarder of the United States is strongly related with the invention of the balloon framing, as it became the only means for building quickly to satisfy the need of shelter.

The system became so industrialized that whole houses were shipped as a kit with the various pieces numbered to make them possible to be raised easily, and which could be ordered through catalogs.

As Solon Robinson says in the «New York Tribune» of January 18th, 1855, quoted in «Woodward's Country Houses», New York 1869, «If it had not been for the knowledge of the balloon frame, Chicago, and San Francisco could never have arisen being transformed from villages to large cities.

S. Giedion in his book, «Space, Time and Architecture» it states that it is not clear who invented the balloon frame. He then refers to the book «Great Industries of the United States», in which one early witness, writing in 1872, relates that it has been in use for at least fifty years. Woodward, in 1986, also declares that its' history is also obscure, and says it might be traced back to the early settlements of the prairies were it was difficult to obtain heavy timber and skillful mechanics.

He then, referring to Woodward, attributes the invention of the balloon frame to George Washington Snow, (1797–1870), from New Hampshire.

Snow left his home for New York and later to Detroit with his wife. Later he crossed the state of Michigan, reaching the Chicago river in 1832. He was appointed assessor and surveyor; elected alderman and drainage commissioner in 1849, and at one time chief of the pioneer hook and ladder company. He was one of the earliest lumber dealers in Chicago buying «Carver's Lumberyard» in 1835.

He owned considerable land and conducted real estate business. He was a building contractor, as well as a general contractor and financier.

He was educated as an engineer in his youth.

It's name was given for its' lightness and the fear that it would be carried like a balloon in the wind..

Some references credit him as the inventor of the balloon frame, such as Andreas in his «History of Chicago» in 1890 and in «Industrial Chicago» in 1891, the most important book on the development of Chicago. He is also mentioned by the architect J. M. Van Osdel, who arrived to Chicago in 1837, in an article, «The History of Chicago» published in a Chicago monthly, in which he mentions Snow as being the inventor of the balloon frame and being this construction method had superseded the earlier framing system.

In Giedion's opinion in 1941, the first balloon framed building was St. Mary's Church in Chicago, built in 1833 the earliest catholic church in the city. Old carpenters adverted that it would collapse, and was razed and erected three times.

In 1924 Walker Field in his article «A reexamination into the invention of the balloon frame», written for the Journal of the Society of Architectural Historians, attributes the same church to Augustine D. Taylor.

Later in 1981, Paul Sprague, establishes that indeed George Snow is the first one in using the balloon frame technique a year before Taylor, (1832) not in the St. Mary's Church, but in a warehouse.

The system is widely used in the west coast, where the use of wood as a building material was practically unknown, except by the Russians or the Yukon Indians, until 1835 in California. Thomas Larkin, a native from Boston started to build in wood in the city of Monterey, two story houses with balconies, using the Massachusetts cabin as precedent, an unknown typology in the area.

Larkin applied a two story verandah as a means to protect the adobe built houses from erosion, also unknown before his arrival.

Until the seventies the new system was called «Chicago Construction» and was presented in the form of a farmhouse which was sent in sections at the Paris Universal Exposition of 1867.

The inspiration for these houses, were the seventeenth century farmhouses of the early settlers.

THE EXPANSION OF BALLOON FRAMING IN THE WORLD

The adoption of balloon framing system helped the consolidation of cities, not only by the speed and costs of building in wood, which allowed the shift of

societies from an agricultural dependence to concentrated ones based on cooperative and specialized division of labor. It literally changed the image of the places in which the angloamerican culture either landed, or merged with the local conditions.

Especially interesting is the case of India, where the wooden technology had to suffer a process of adaptation to a warmer climate creating new spaces, which were later carried to other places in the world.

A clear example of this is the incorporation of intermediate spaces like the verandah, the courtyard or the open livable roof, space typologies, taken as far as Australia and New Zealand, Hong Kong, the Caribbean, Argentina, Peru and Chile.

Even new materials were used in other parts of the world, such as corrugated iron for siding, originally used in China, a material ideal for siding in places where wood was scarce.

The intense commercial activities of the British Empire drove shipbuilders, and the development of coastal cities, needing shelter for a rapidly increasing population, was a perfect situation for the easy and ready balloon frame system.

The main style associated with balloon framing is the Greek Revival, and became a symbol of the New World. It was first used to express the independence from Europe, in which the United States with the creation of a new Republic looked to the origins of democracy.

The style, according to Talbot Hamlin, in his book «Greek Revival Architecture in America», dominated the east coast of the United States between 1820 and 1860, and in the west coast due to the gold rush from 1840 to 1880.

THE CASE OF CHILE

We will illustrate through the case of Chile, to what extent the balloon frame structure reached and transformed the architecture of even remote places of America, through commercial activities.

We will present two very different cases in Chile, which clearly reflect the enormous influence in the image of the built environment, due to angloamerican commercial activities searching for raw materials.

The first case is coastal city in the desert in the

northern part of the country, were a port, Iquique, built in wood, in Greek revival style, using balloon frame technology with wood brought from Oregon as ballast in the ships. The white gold rush, as the natural nitrates were called, attracted a large number of immigrants with need of shelter.

The second case, totally different in its' origin is the development of sheep stations settlements in the southern tip of South America in the Chilean and Argentinean Patagonia. This time the British searched for large pasture lands for sheep herds coming from Australia and New Zealand through the Falkland Islands.

CASE STUDIES

Iquique

The port of Iquique dates previous to the Spanish domination, and presents its mayor population growth due to the commercialization of nitrates with Europe and the United States, in the XIXth Century, between 1883 and 1919. Nitrates were used as a fertilizer and later as a component of gunpowder. Previous to this founding the British exploited nitrates in Egypt and India in de XVIIth and XVIIIth centuries.

According to Charles Darwin, the first shipments were sent to France and England in 1830.

The opportunity of becoming rich in a short period of time attracted a great number of immigrants, among which carpenters and builders built structures for shelter using wood brought as ballast which was left in the beach once the nitrates were embarked.

A singular architecture was produced in the desert, which had to suffer a process of adaptation to the new local conditions, which we will describe in detail further on.

Greek Revival the style used, becomes popular with the United States of America independence, as it evoked the birth of democracy. Another reason for its' popularity is the discovery in 1804 of the Athens Parthenon by Lord Elgin, and emphasized Greece as the mother of Rome.

The war for independence carried out in Greece in 1821, attracted sympathies in the United States, and from the 1830s. The use of Balloon Framing imposed a style.

It propagated through Pattern Books, especially

those of Asher Benjamin, such as «The Practical house Carpenter» and «The Builder's Guide», or those of Minard Lefever, «The Modern Builder's Guide» or «The Beauties of Modern Architecture», or that of Andrew Jackson Downing, «Cottage Residences».

Almost all the Pattern Book authors took their material from the English Peter Nicholson.

Through Pattern Books, it became possible even to order a complete house, with was shipped and easily put in place with simple tools upon arrival, a precedent of prefabrication.

They were shipped to the West Coast or South America, through Cape Horn.

An increasingly large number of architects trained in the Ecole des Beaux Arts and the United States started to use Greek models, in designs of high quality, such as Benjamin Latrobe, Robert Mills and William Strickland and his disciples.

In the south of the United States, balloon framed structures was used in Ante Bellum mansions with French precedents.

One important aspect of the Greek Revival style developed in the United States is that it is the first style in presenting its shorter facade towards the street. Fig 3

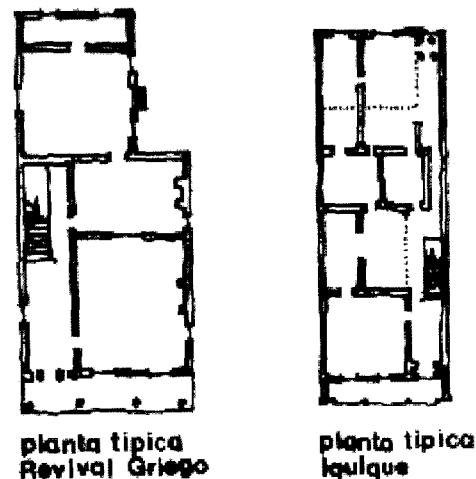


Figure 3
Greek Revival Plan in US and Iquique, Chile

The use of columns is a characteristic, but with the invention of the balloon frame, those of square section, cheaper and easier to build, were applied. This feature is exclusive of Greek Revival, balloon framed architecture in the New World since it doesn't exist in Greek or roman precedents, nor is present in Greek Revival structures in Europe. Fig 4

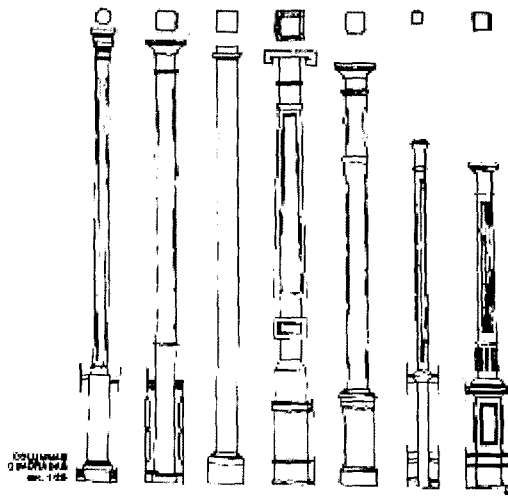


Figure 4
Detail of Square section columns, Iquique, Chile

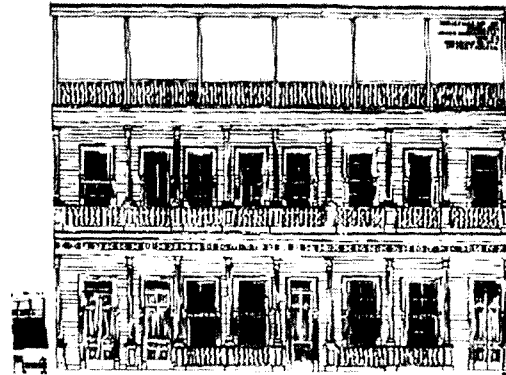
It uses sash windows, with usually a division of six over six, covered with wrought iron railings.

Adaptation process of the precedent in Iquique

The encounter with a warm climate triggered the need of producing a process of adaptation of the original model to the local conditions, through the implementation of a series of intermediate spaces.

Courtyards

Greek Revival houses were usually freestanding structures in the United States, but in the case of



Figures 5 and 6
Wooden Balloon Frame Houses in Baquedano Street, Iquique, Chile

Iquique they were built as continuous structures to avoid hot unshaded spaces as it was not possible to have gardens as water was scarce.

Courtyards are taken from the previous Spanish influence to allow natural light into the rooms and creating an outdoor space.

Verandah

The verandah is applied to the architecture of Iquique creating an intermediate space between the fresh inside and the heat outside. As a consequence a new area was created for leisure of the family, which sat in the afternoons to watch the passers by.

The origins of this element, are not clear, but apparently is a consequence of the encounter of this type of architecture with warm climates, taken from India.

The use of the verandah is especially interesting in the port of Iquique, forming a continuous facade.

Open roofs spaces

This is one of the most interesting aspects of the architecture of Iquique, because of its' uniqueness and gradual evolution.

A double roof with a space in between, which would allow the air to flow and thus refresh the house below is added. With time this space began to grow in height until it became useful for carrying family activities, as an outlook to see the ships approaching the coast or for laundry.

These double roof spaces are also present in India, where it is used for sleeping, but apparently the presence of this element in Iquique, does not relate to this influence, an appeared spontaneously.

Wooden treatment

Wood does not have a good performance in dry climates as the desert, so a protection system had to be developed in this new context. In the case of the roof, this was covered with clam shells, with its' convex side receiving the humidity of the morning fog and thus avoid damage to the roof boards.

In the case of the facades, these were protected with stucco and painting them with bright colors such as orange and blue. Fig.7

Sheep Stations in Patagonia

The occupation of the farther tip of the American Continent known as «Patagonia», took place in the decade of 1880s giving origin to a surprising sheep raising enterprise, developing an non existent architecture in Chile associated to the process. The British Empire searches for large territories for pastureland, to supply the required amounts of raw material needed for the newly industrialized wool industry. It is how this singular architectural

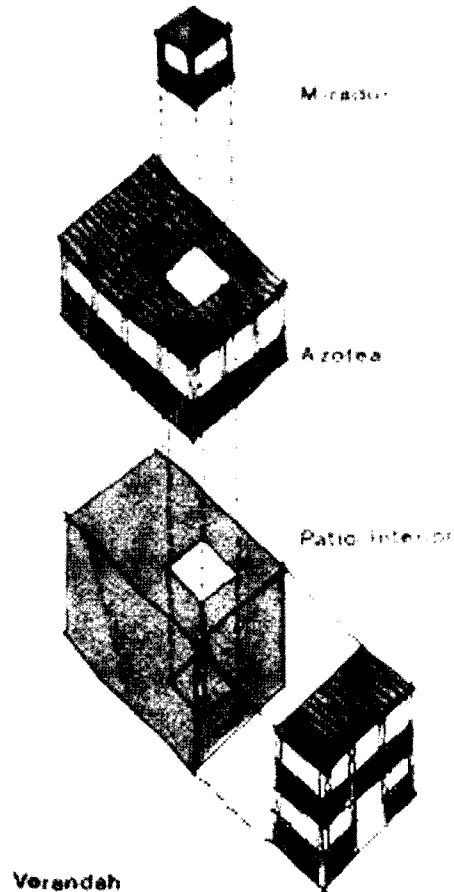


Figure 7
Elements of Greek Revival Balloon Frame model adaptation to climate in Iquique

expression is developed in Australia and New Zealand, which will become the industrial and architectural reference of the Chilean and Argentinean case which arrives to the area through the Falkland or Malvinas Islands. This singular expression responds clearly to the necessary conditions for sheep raising, giving an industrial character to the settlements.

It is important to describe the layout of these settlements, usually located in the center of large

extensions of pastureland with good roads for communication with the rest of the territory.

They are structures around a central roadway, which connects on one end the owner's house and on the other the shearing shed and other building related with the productive process. Halfway in between, the kitchen, dinning room and living quarters for the workers, as well as the offices, workshop and stores as well as the houses for the married couples. Fig.8

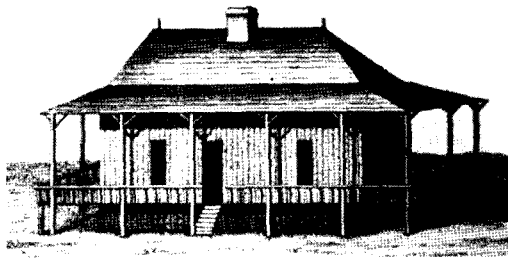


Figure 8
Traditional Prefabricated Balloon Frame House for Married Couples in Patagonia Sheep Stations

Usually a course of water would run parallel to the structuring road, a basic element for survival and for the industrial process.

The most important building is the shearing shed intended for protection of the tasks and storage of the wool.

The first examples were only basic open shed made with logs as structural system raised from the ground

to allow the droppings fall into the ground. It was divided in three areas, a central one for the sheep to be sheared, another on one side, with good light, where the shearing process would take place, and a third on one on the front area where the wool would be classified, pressed and stored. Fig.9

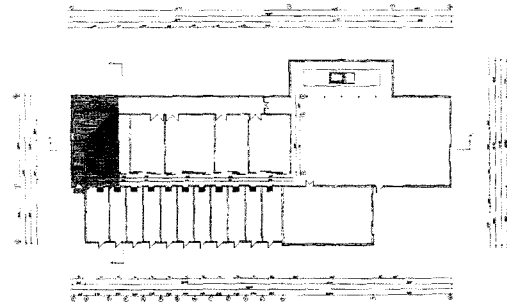


Figure 9
Shearing shed, Río Verde Sheep Station, Patagonia, Chile

Towards 1880 the Worseley scissors are introduced, which because of mechanization gave more speed to the process, and allowed the rationalization of the shed, locating a mechanized guide on one side. Here the shearing process would take place, which was connected, to an engine, which gave way to another building beside the shed, the Machine House. Fig.10 & 11

Due to the profits gained industrial sheds are carried out, considering the use of wood and galvanized iron as siding, system invented in England



Figure 10
Shearing shed Ciaike Sheep Station, Patagonia, Chile

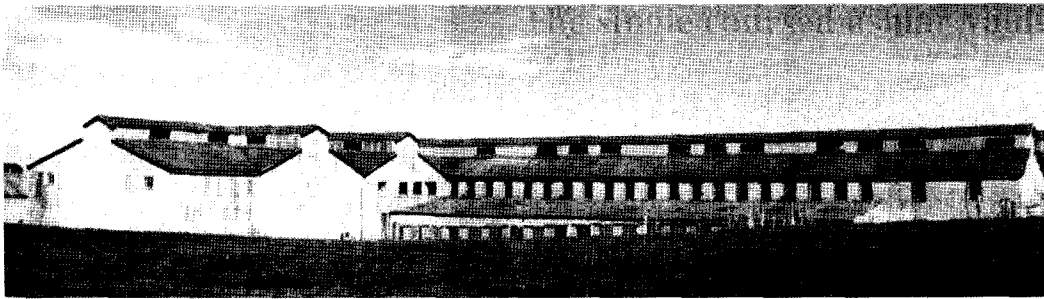


Figure 11
San Gregorio Station shearing shed, Patagonia, Chile

at the beginning of the XIXth century used for storage sheds in the Liverpool docks, probably due to encounters through trade with China.

THE BUILDING SYSTEM

The first elements, which appeared in the settlement were all those buildings required for the industrial process, housing therefore was left for later.

The first shearing sheds were small in dimensions and usually prefabricated, which later grew in dimensions due to the large sheep herd, but maintaining its plan and original functionality.

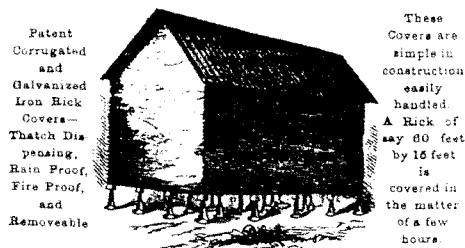
The building has its' precedent in the English «rick», a prefabricated structure in galvanized iron

used for the storage of garden tools, which was raised from the ground and posed over concrete or wooden posts, which allowed a space underneath where the animals could seek for shelter if needed. Fig. 12

At first, wood was used for the shed's siding, being quickly changed for galvanized iron, which gave the definitive image to this architecture, a wood frame of regular pieces, covered by corrugated iron, on its' walls as well as roof, a system which allowed to raise these buildings quickly. They were finally painted for rust protection, which made the sheep station identifiable through its color. San Gregorio Station for instance in yellow and red.

The structure was based on regular pieces of native wood, using the balloon frame technology brought from the United States. This system was a tremendous progress for the region, which until that time used wood for construction based on the Hispanic technology with post and girt technology joined with leather, wooden pegs or notched. Fig. 13 & 14

THOMAS PEARSON & CO.'S HARVESTING APPLIANCES.



Prefabricated Rick. ex Weller J, History of the Farmstead

Figure 12
English rick, as appeared in the local press, XIXth century, England

CONCLUSION

The invention of the balloon frame technology, together with industrialization, allowed America and all those areas which the Anglo-American culture encountered either through colonial or commercial activities, the development of settlements and sovereignty of unexplored areas in a relatively short period of time.

Together with this process an architectural image was expressed in a series of very different contexts around the world, were a new revolutionary building

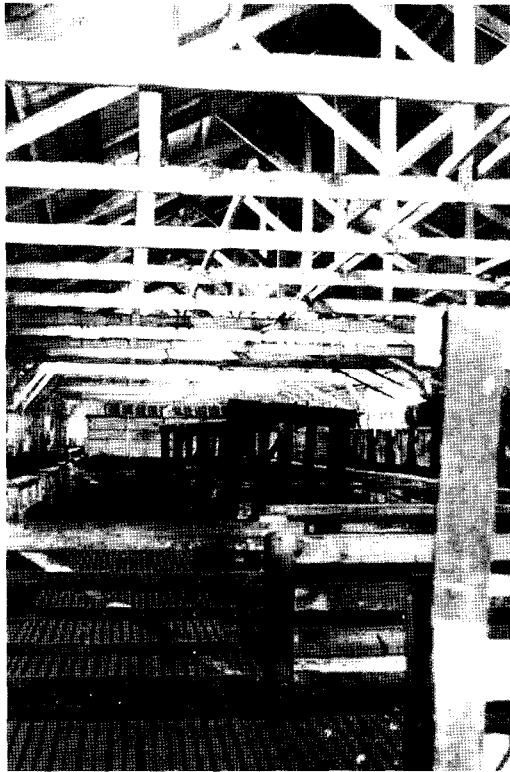


Figure 13
Interior Shearing shed in Oazy Harbour Sheep Station,
Patagonia, Chile

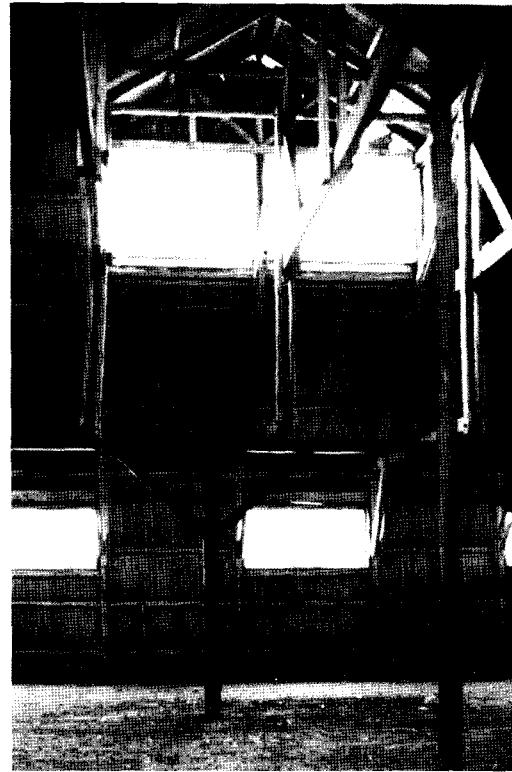


Figure 14
Interior Shearing Shed Caleta Josefina Sheep Station,
Patagonia, Chile

system was developed, together with the associated style of the time, the Greek Revival. Its' invention in the United States and its' expansion through the rest of the world in the XIXth Century is an important contribution not only as part of the history of construction but also in terms of image and character with which it was associated.

We have presented two very different cases one in the desert and one in a climate of extremes. In both we can see that the expression is not coherent with a geographical division, the architecture of Iquique is also present in coastal cities of Peru, and the Patagonia Architecture related Chile and Argentina in the same expression.

More so, these expressions nowadays have become part of the heritage of each of those countries, which we should be preserved for the future.

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