The Subercaseaux Building

Evaluation of the structural capacity in traditional construction in Valparaiso

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Abstract

The goal of this paper is to present the structural condition of some buildings located in Valparaíso's historic district. These buildings use traditional construction systems, and have fared good in earthquakes, sometimes even better than new structures. It analyses in depth the case of the Subercaseaux building, a structure with this traditional construction system, seriously damaged during an explosion in February 2007. Preliminary studies have suggested that restoration of the remaining walls is possible, but none of the interior structure was left. A reinforced structure in steel was installed provisionally. This paper asserts a critical evaluation of this action, and proposes a plan to help the conservation of traditional construction systems.

Figure 1. General views form Valparaiso.

Introduction

The historical downtown of Valparaiso city, declared Cultural Heritage by UNESCO in 2003, has a valuable architecture from XIXth and first half of XXth centuries; at that stage the port of Valparaiso was one of main ones from the Pacific Coast in America.

The reason of the inscription as Cultural Heritage is based in the quality of its architecture, which is product of an early globalization, and as a consequence of its Port quality; this previous facts plus to the exceptional geographic condition[1].

The actual condition of the city's historical downtown is complicated, due to the sum of problems of economics, social, infrastructure obsolescence and degradation of its architecture and public spaces. Since the inscription of the area in the World Patrimony List, the local and national government have started a series of recuperation programs and the improvement of public spaces, trying to attract new habitants and investors. Despite the process has been long and not free of difficulties, until now there still are a lot of the old problems.

Because of the lack of maintenance in electric and gas public networks, in February 4th of 2007, took place a terrible explosion in the core of the historical downtown, with a tragic balance of 4 deaths and the lost of valuable built patrimony.

[1] As shown in UNESCO website, it fits to the iiii criteria : "*Valparaiso is an exceptional testimony to the early phase of globalization in the late 19th century, when it became the leading merchant port on the sea routes of the Pacific coast of South America. UNESCO*"

After a year since the tragic event, it is possible to verify the complexity of taking a recuperation project ahead in the Historical Downtown in spite of the public relevance this issue has got.
The difficulties are diverse, and they involve different actors. In one hand, all the technical and historical information is too basic and hard to obtain, which makes difficult every work and research; in the other hand, the low past experience in specialized interventions on historical buildings, and the low experience in interdisciplinary research, makes the procedures difficult in decline of the intervention's quality.

This work's focus is to approach the technical aspects which are part of an intervention project in patrimonial architecture. It's considered that the lack of knowledge of the old traditional techniques, which is traduced in a lack of research and observation of the traditional methods when the intervention time arrives, causes unfixable damage in the national patrimonial architecture. An example of this case is the Subercaseaux Building, which is "evicted" after the explosion, from a constructive and structural point of view, while there are many different examples of buildings that, using the same technology, and about the same age, they have survived time, despite earthquakes.

Background

Urban development of Valparaíso

Valparaiso's urban development, unlike the most of the cities in Latin America, its characterized by the spontaneity of an unplanned growth. The place was discovered en 1536, as a convenient cove for ships, near to the capital of the kingdom, Santiago. From this point on, starts the development of this small town in the Pacific's shore, which during the XVII century had little population, precarious houses, and was politically dependent of the "Corregimiento de Quillota".

The port had a geographic conformation pretty much particular; a north oriented bay, surrounded by scarped hills with slow water courses (brooks) between them which descended to the sea. Flat ground was little. The first settlement is located in the west side of the bay (port area) which was divided by a giant rock ('*Cueva del Chivato'*) in the area called "El Almendral". The city was absolutely divided, concentrating public services, administrative services and commerce in the port area, while houses and '*quintas'* in "El Almendral" sector.

This topographic characteristic did not allow the square network developing – el damero – typical planning in Hispanic-American cities. The city grew absolutely spontaneous, always conditioned by this flat ground and the hills with their brooks.

During the XVIII century, the city grew in importance and population, which is traduced in the construction of infrastructure and public buildings. The port needed bigger attention and a more efficient administration, for this reason it becomes municipality in 1789. This promotes a generalized improvement in urban matter: streets paved with stones, channeling of brooks, fixing of public squares, founts installation, among other improvements. Finally in 1802, the Spanish Crown gave to the city the title "*muy leal e ilustre cuidad de Valparaíso del Puerto Claro*" (similar to: the very loyal and prestigious city of Valparaiso of the Claro Port). Nevertheless

the city still being – in comparison to other regional urban centers - a precarious establishment.

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At the same time, the hill's slopes were increasing in houses density and consolidating potential neighborhoods, with a characteristic and particular architecture, result of the adaptation of construction technologies and systems to the port topography. This construction's order obeyed to the accessibility possibilities from step paths which were drawn in the hills.

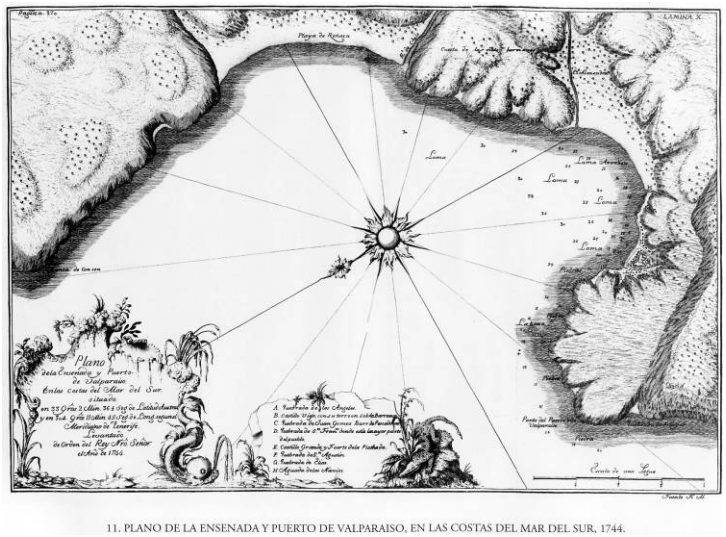


Figure 2. Map of Valparaíso, 1774.

The lack of flat ground was a continuous problem in the port, especially because of the lack of space for installing public buildings, and the connectivity problems the city suffered. This is fixed through the systematic stuffing of the deep city's bay, a expensive and titanic engineering work which continued until the first decades of the XX century. This produced a network of longitudinal ways parallel to the sea shore, becoming the main streets of the city. The resulting blocks (manzanas) adopted irregular shapes, condition which buildings adapted to.

Figure 3. Picture from Valparaíso, after the earthquake in 1906.

It is important to remark that the history of chilean cities is marked by earthquakes occurrence. In Valparais's case, there are strong earthquakes registries in 1730 (8,5 Richter Magnitude); 1822 (8,0-8,5); 1906 (8,6); 1971 (7,9); 1985 (7,8); all of them, have caused great buildings destruction, besides the many fatal victims. The architectonics shapes, the technologies used are in direct relation with earthquakes. This is why the use of adobe was abandoned, and clay bricks or wood is chosen. The proportion of shapes, relationship between spans and fills in walls, thickness – and weight – of structures, are all the aspects that were resolving and accommodating based in earthquakes experience.

In year 2003 the historic district of the city was declared Cultural Heritage by the UNESCO, and since that moment begins different programs with the main aims to renovate the city.

Valparaíso during XIXth century

Valparaiso is an urban and architectural product of the XIX century. Although during the XVII and XVIII centuries there were high activity in the port, its urban structure was still unstructured; there were not many high architectonic quality buildings or relevant public works neither.

Since early XIX century Valparaiso is unquestionably outlining itself as one of the main ports of the pacific sea shore; its strategic localization makes it a forced stop for the most of the ships which were coming from Europe with destiny at different pacific ocean's nations. Valparaiso stops being just Santiago's port, to become the port with most commercial traffic of the pacific, before the inauguration of Panama Canal. This is reflected as an economic, commercial, cultural, and social growth, which leaves deep marks in the city.

This economic charge affected the urban development, and in the need of giving to the city urban equipment matching its commercial activity and demographic growth. During the first half of the XIX century, the link between the two parts of the city is achieved : The port area and "El Almendral sector". Besides, the construction of public and private buildings is regularized, industrial and residential neighborhoods are defined, lands are divided in lots for houses construction, streets and avenues are drawn up. In the next decades the city will get all the technological advances available, as water supply networks, city trains and public lightning.

From an economic point of view, the main banks and almost all commercial houses of the country had a local agency or branch in Valparaiso; through this port, retailers from many nationalities went by, and also many of them established in the country. Around the hald of XIX century, important English, German, French, and Italian colonies lived in the city, who translated – beside their families – their cultural behavior. The histories of the travelers who lived in Valparaiso around this time, remark the cosmopolitan quality of the port[2] which marked some the city areas, until now.

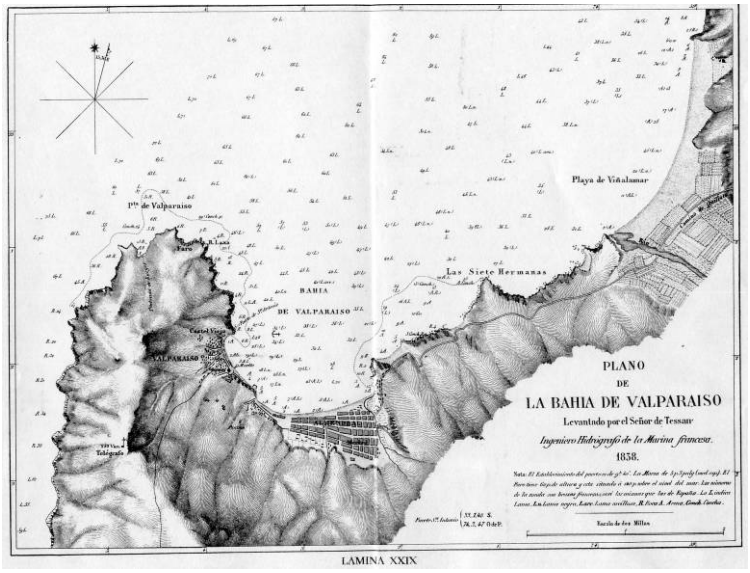
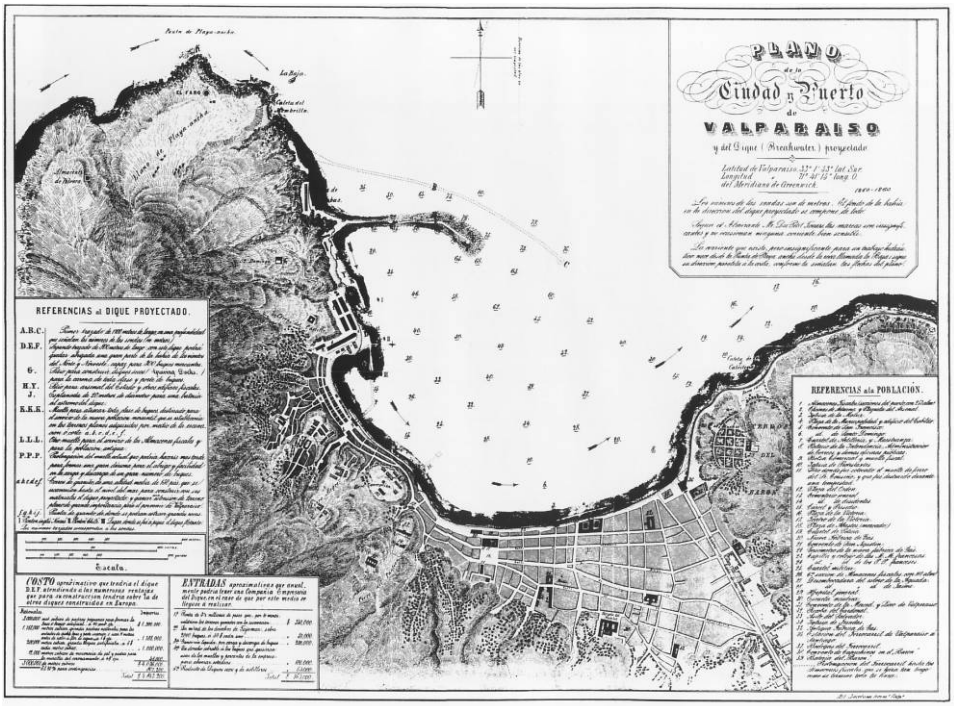


Figure 4. Map of Valparaíso. 1838

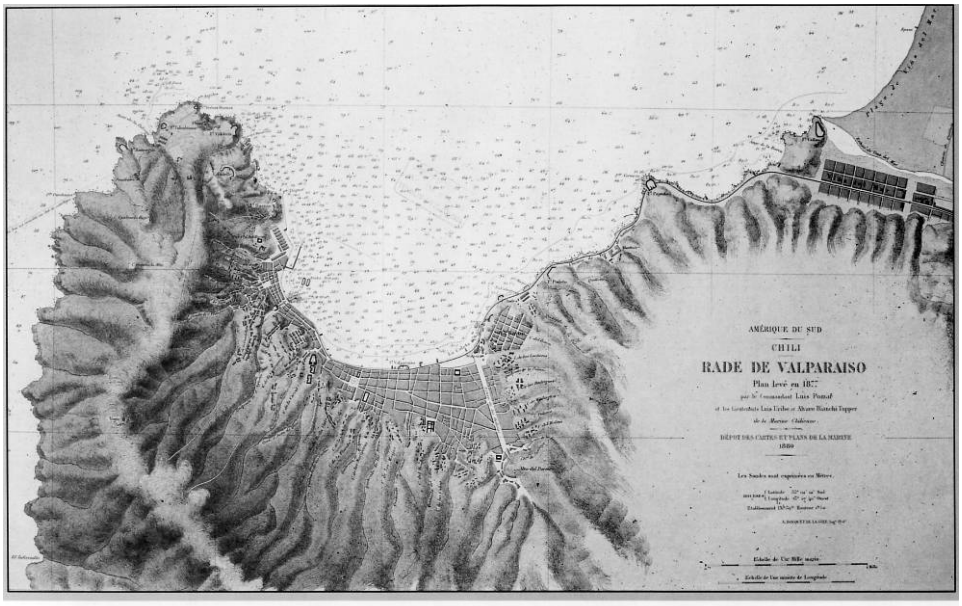
[2] Graham, María. *Diario de mi rediencia en Chile 1822* (Journal of a residence in Chile during the year 1822). Editorial Francisco de Aguirre, Santiago de Chile 1992; Darwin, Charles. *Darwin in Chile (1832-1835) Viaje de un naturalista alrededor del mundo* (Journal of Reaserches into the Natural History and Geology of the Countries Visited During the Voyage of h.m.s. Beagle Round the World Under the Command of apt. Fitz Roy, R.N). Editorial Universitaria. Santiago de Chile 1995.

During the first half of XIX century, important buildings are erected in the flat ground, specially for administrative or commercial destiny. It's also common the commercial and residential use typology in big areas of the city. Bigger resources are available, and then buildings are better in constructive quality, and got more exquisite styles. The arrival of foreign architects and the constant linking to Europe means the importation of styles and crazes. The city gets a neoclassical and historicist looking. The use of adobe as main construction material stops, and the use of the clay brick starts, mixed with steel beams and columns; wood is utilized as well, especially in houses over the hills, which got a neoclassical looking too. The Subercaseaux Building is an example of this kind of buildings, located at "Barrio Puerto" (port neighborhood), in an intense commercial activity street.



46. PLANO DE LA CIUDAD Y PUERTO DE VALPARAISO Y DEL DIQUE (BREAKWATER) PROYECTADO, 1850- 1860.

Figure 5. Map of Valparaíso. 1850-60



59. AMERIQUE DU SUR, CHILE, RADE DE VALPARAISO,1877.

Figure 6. Map of Valparaíso. 1877

During these years, squares, streets and avenues are transformed and embellished; big engineering works are achieved as the brook's channeling, going down through the hills, with the construction of vaults which unloaded in the sea. This allowed improving in accessibility and circulation through and across the hills, which population were growing. The first elevators or railways are constructed in the last years of XIX century, and they constitute one the most interesting examples of the innovation and appropriation capacity occurring in Valparaiso.[3]

History of Subercaseaux Building

We are in the second half of the XIX century, in Valparaiso, where, as it has been already explained, the city was an important center at a national and international sense. As consequence, and by its condition of port city, it is going to receive a series of external influences, which architectonically is reflected as importation and adaptation of styles and constructive technologies.

This building was erected in 1888, probably [4], by the Chilean architect Fermín Vivaceta[5] in Planchada Street – actual Serrano street – in the middle of the port neighborhood. In this area of the city is located a very dynamic sector, which is going to concentrate the port, commercial and administrative activities. Serrano Street was one of the most important commercial streets in the neighborhood.

Figure 7. Building localization in Valparaíso

Regrettably, it has been impossible to get the original plans and drafts; for this reason, and according to the recommendation in this kind of cases [6], the study of analog cases is appealed. The historical data we are quoting corresponds to a recent publication, product of an investigation in progress,[7] even though there are no original plans, it adds data which could help to the reconstruction of this building's history.

3 During the first decades of XX century they got to exist more than 30 elevators in all the bay of Valparaiso. At present time they remained only 15 in operation, being one of the central points that UNESCO like to emphasize for being an exceptional value of the site. The rest has disappeared product of fires or out of use.

4 Jiménez , C., Ferrada, M. *Identidad arquitectónica heredada de fines de siglo XIX y comienzos del XX en el área histórica de Valparaíso*. Universidad de Valparaíso. Valparaíso 2007.

5 Fermín Vivaceta was one of the first architects, educated in Chile.

6 Brandi, C. *Teoría de la restauración*. Alianza Editorial. Madrid 1988.

7 Jiménez, Op.Cit.

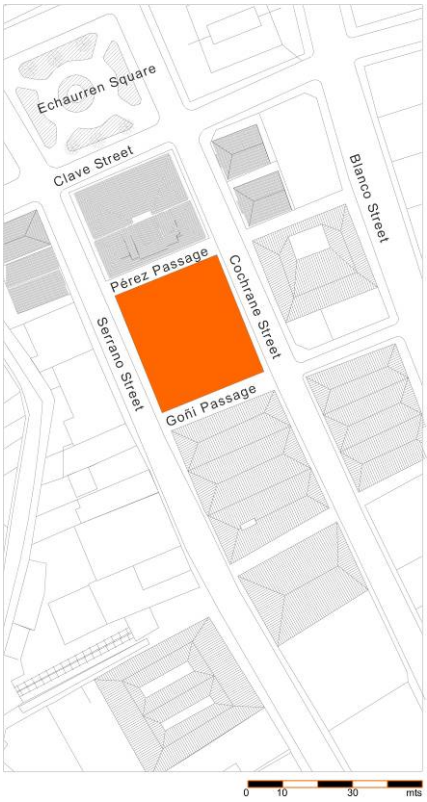


Figure 8. The block building

The Subercaseaux building corresponds to a repeated typology, with a lower commercial floor, and upper residential floors. It has been already explained the city was not originated from an official or formal foundation, added to the topographic characteristics, gives as result irregular blocks, which the buildings must adapt to. This building is an example of it, as one the named "edificios manzana" (block building), which occupied a whole block of the urban net, with a strong urban compromise, having to respond – in design and use – to four fronts.

Serrano Street is with no doubt the main one, and this is shown in the design of it main façade. The back street (Cochrane) is a secondary way, which contains services accesses, and its design is much more simple and austere. The lateral street, pedestrian, are really simple with low amount of holes in its walls, and few accesses.

Around the its construction time, the building is resolved in a neo-classical style, pretty much simple. Because of the experience acquired in past earthquakes, buildings are not excessively slender; in this case, the building has two floors and a central patio. In its interior there were two yards which gave light to the inner rooms.

This building has suffered a series of intervention along its history. The commercial use of its lower floor stills intact, despite all inner subdivisions. In high floors residential use has stayed as it, but suffered many architectonic modifications. This is mainly explained because of the change in the citizen type. Originally high floors were occupied by the retailer families, but today, these apartments are divided and occupied by many families who are living in precarious conditions. Besides there a whole new floor and the yards were transformed.

In February 2007, due to the explosion of a colindant building, several damages occurs to the Subercaseaux building. The inner wooden structure and the ceiling are the most damaged ones. The external walls stand, as well as some interior walls, all made out from clay brick masonry.



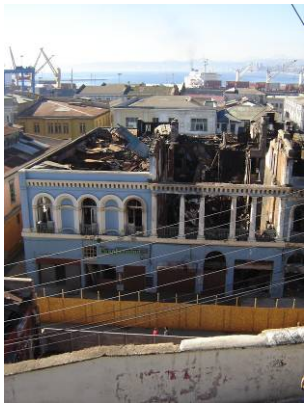



Figure 9. General views during and after the fire.

The impact this event produces encourages local specialists intervention and even the arrival of the UNESCO [8] General Director with a commission, to offer aid and technical assistance. The photographs show the magnitude of the disaster but also the resistance of the main walls of the building. Generally, those thick clay brick masonry walls are the ones who stand. During the following days to the tragedy, all the remaining of the structure is demolished situated at the west facade, in front of the Subercaseaux building.

The reason for such an action is the lack of security the rest of the walls offer. As it is possible to see, what remains standing are discontinuous fragments that, in a first glance, should be demolished. This crew in charge of the evaluations was composed by civil engineers.

In opposition, the Subercaseaux building kept all the perimetral walls and some of the interior ones. The evaluation of the structure's state takes several months and finally it is proposed to keep only the exterior shell and demolish the interior walls wich survived the explosion. Given the fact that the perimetral walls were in a vulnerable situation when the interior walls were demolished, a bracing system is proposed, made out of steel, composed by two horizontal stripes and bracings to the exterior. It is suggested as a provisory work during the process of getting to a definitive solution for the building.

It`s interesting, the fact that this work evaluates only one aspect of the building, the structure, and using traditional methods to examine the work.

Previous to the detailed presentation of the work's transformations, and its critical analysis, technical characteristics will be explained.

Hypotheis

The patrimonial architecture of Chile's Central Zone, mostly corresponds to buildings erected during the republican era: XIX and early XX centuries. In the specific case of Valparaiso, the technology used for these buildings was Clay Brick Masonry – in some cases steel reinforced - and Wood Framed Structure. On the XX century's first decades appears the use of Reinforced Concrete.

If we consider the last earthquakes registered in the central zone of the country (Anex 1), and we look at the structural behavior of this buildings,

[8] Koïchiro Matsuura, the Director-General of UNESCO today offered the Organization's assistance in repairing damage caused by the fire that destroyed part of the historical city centre of Valparaiso, Chile, killing several people, on 3 February.

"Firstly, I wish to extend my sincere condolences to the families and friends of the victims of this tragedy," the Director-General said. He also announced that "UNESCO stands ready to extend emergency assistance to the appropriate Chilean authorities in their effort to repair the damage caused to the historic centre of Valparaiso. We are in touch with the authorities and will do all we can to help them preserve this outstanding landmark. I have fond memories of my visit to Valparaiso, in the company of its mayor, before the city was inscribed on UNESCO's World Heritage List in 2003. I remember the city as a place of great beauty, bearing rich testimony to the region's cultural, economic and social history."

A mission of UNESCO's World Heritage Centre will visit Valparaiso in early March and will discuss restoration plans with the local authorities. The fire in the World Heritage site is reported to have been caused by a gas explosion in the historic centre of the colonial city, Chile's main sea port. Several buildings are reported to have collapsed or to have been severely damaged due to the fire. The remarkable late 19th century building, the *Edificio Subercaseaux*, a timber and brick construction in the Neo Classical style, was burned to the ground.…

which are part of the Patrimony built using traditional techniques, previous to the massive use of reinforced concrete, we can prove, in spite of its discordance with the actual seismic norms, they have resisted the strongest earthquakes taking small damages.

It is desired to show this building's panorama, from its constructive characteristics, interventions and structural behavior, as a way of producing an information basis in order to contribute to the future restorations and structural reinforcements after disasters, mainly in the case of earthquakes, as in fires too, like the Subercaseaux Building case.

Method

Survey of the structure and materials characteristics

The constructive characteristic and the structuring criteria in Valparaiso (and many other cities in Hispanic-America) is about being an adaptation of foreign models and typologies, European specially. These constructive typologies arrives with foreign builder architects who established in America, and according to the local reality, hey generated innovative and original solutions as an answer to the American cultural reality. Specially this considerations talk about the relation between the local weather, available materials, habitant's life style, and in many cases, the seismic reality of these countries. This is a determinant factor in the history of chilean architecture.

Years where this building appears are characterized by the great contact between the port and the rest of the world, as the arrival of foreign engineers and architects (most of them English, German, north-American, French, Italian) [9] This kind of urban "palace" are fundamentally neo-classical style, which most of the chilean cities – and Hispanic-American - took part in, the independence from Spain, as much the old buildings as the new ones, which transformed, adapting a new image.[10]

The most used materials in this time were clay brick, stone, wood, and steel. There already existed some accumulated experience with the last earthquakes and its destructive power over buildings; for this reason, buildings were projected capable to resist these attacks of the nature. Nevertheless, this wasn't easy work, and the earthquakes magnitude was bigger than expected in most of the times, plus other factors, as the soil class and damage accumulation, among others.

The improvement and perfection of constructive systems looking for improvement of the structural behavior at construction, was a constant preoccupation, and the concept of "amarra" (tying) is seen constantly as a need to secure not only the stability of the construction, but to protect the lives of their occupants.

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9 Some names are: Juan Dazzarolla; Ettores Petri; Arnaldo Barison; Renato Schiavon; Estaban O. Harrigton.

10 "*La fisonomía de las ciudades chilenas, es especial Santiago, era, a comienzos del siglo XIX, neo-clásica…. A partir de la Independencia estas construcciones neo-clásicas, y aquellas levantadas en el auge anterior (…) comenzaron a alterarse, y la antigua casa (…) se enriqueció con aportaciones extranjeras inteligentemente asimiladas, y el cambio en su organización funcional y en su estética fueron de tal suerte oportunas que, conservando su rango colonial, noble pero algo tosco llegó al refinamiento en su más cumplida expresión.*" Pereira Salas, E. La arquitectura chilena en el siglo XIX. Ediciones de los Anales de la Universidad de Chile. Santiago, 1964 Pág. 7.

Material characteristics

This particular work (2 and 3 stories) it's composed by a clay masonry structure (72 cms wide) with lime mortar. In its perimeter and two of the interior's main axis's. The bond type employed is detailed in Figure 10. There's no evidence of the use of any bracing metal element, like beam sections or strap, as it's observed in other city buildings, build some decades later, with the same technology.

The rest of the walls were wooden structures, with different fillings (brick or clay): The floor structure is also of wood; made from oak and oregon pinewood, set with 65 cms in between axis's.

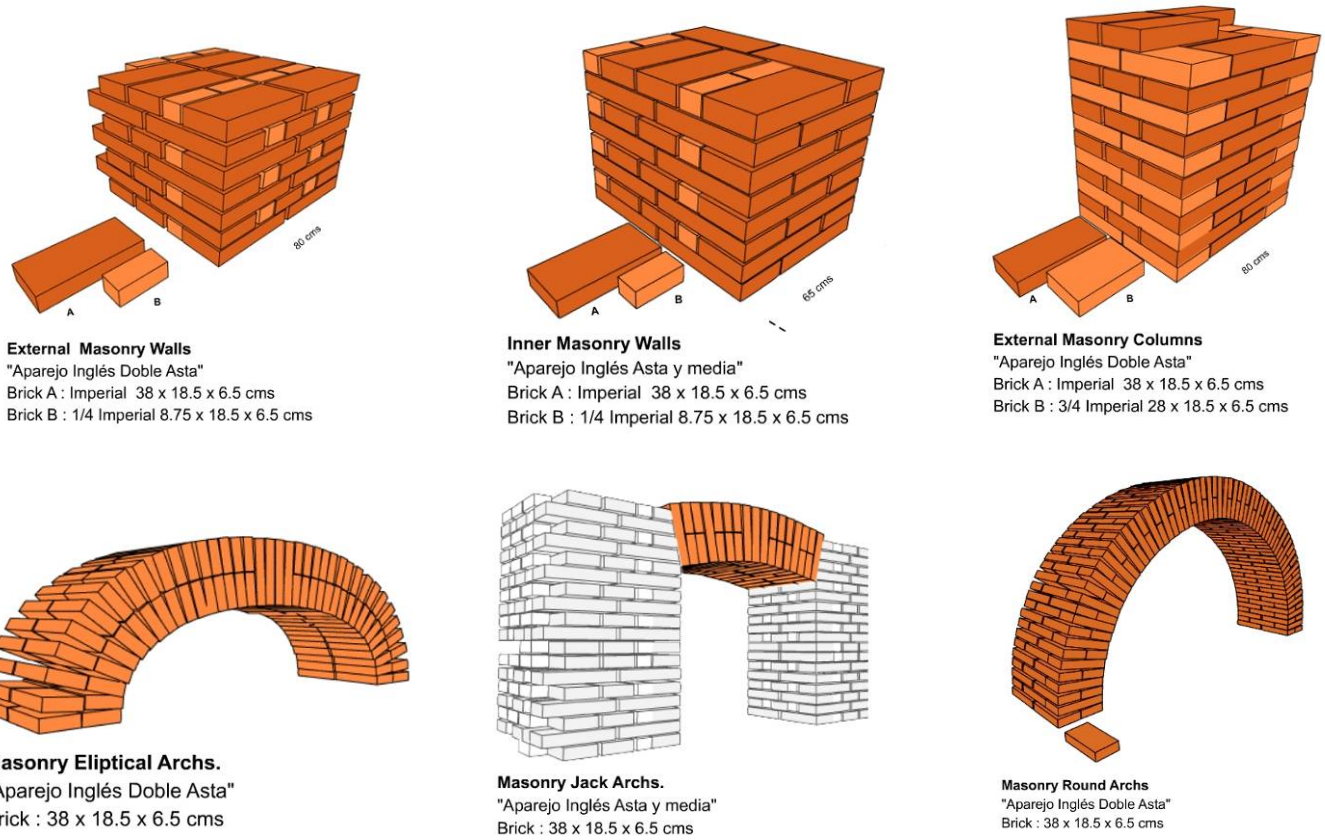


Figure 10. Masonry walls

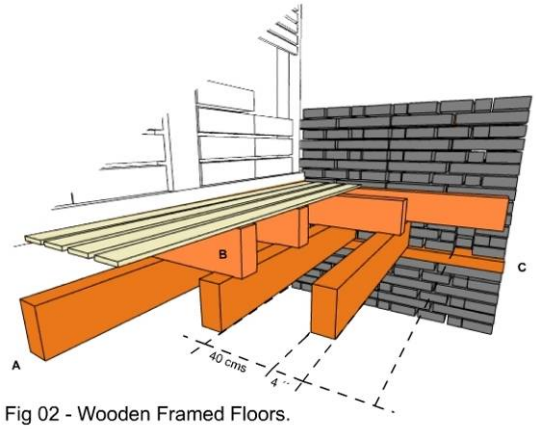


Fig 02 - Wooden Framed Floors.
A.- Main Oak Joists 4x8" @ 40cms
B.- Secondary Oak Joists 4x8"
C.- "Empotrado" Beam 2x4"
D.- Wooden Subfloor

Figure 11. Wooden roof structure.

Structural Behavior.

There is no evidence of the use of any steel bracing element, like steel beams, rails or strapping as it's observed in other city buildings, build some decades later , with the same technology.

Therefore, we are in the presence of a structure that works mainly on compression and can't handle horizontal stress of the seismic kind. In this cases, the presence of elements that work as buttresses is very important, and from this non flexible walls, capable of absorbing the horizontal stress, avoiding the wall displacements and its consequences.

These type of buildings are forbidden, according to the actual seismic norms. This means that to project such a building in our present time isn't possible, with that materials and those building characteristics.

In the historical buildings case, a great part of them doesn't fit to this seismic norms, specially the ones prior to the use of reinforced concrete or steel, as massive type of construction in the country.[11] This leaves an important part of the buildings in a very vulnerable condition in front of seismic activity, but at the same time, the number of buildings that, being build in clay masonry without strapping or brick isn't minor, and have endured strong earthquake, maintaining good conditions. The images show buildings prior to the great 1906 earthquake, that destroys a great part of the plan zone buildings in the city of Valparaiso. All these works, all standing, resisted even the strong earthquake of 1985.

Therefore the theme claims a more precise revision of these works characteristics, their environment, the conservation state at the time of the earthquake, the material type used, among others. Preliminary we can say that the soil type is a relevant factor: The large majority of these works is located over rock soil, no filled, that absorbers the earthquake better in the earthquake: the lack of conservation generates damages issues accumulated in time and previous earthquakes, weakening of the structure due to humidity, as the most important factors.

The Subercaseaux building did endure in a great way the two previously mentioned earthquakes. The clay masonry walls state confirms it: even after the explosion, they remain in a good shape, making a homogeny mass, without the presence of cracks. We don't have any figurative chart prior to the explosion, but, from the photographic documentation available it is possible to detach that its condition was optimal.

It is planted the following hypothesis of the original structural system of the building. In the presence of these building systems, the geometry of the work is relevant: this one is a regular closed body, where there are two interior walls that work as strut elements (buttresses) of the whole system. We can also observe that the general volume is short, not svelte, therefore the seismic stress would be less destructive; we point at the amplification of the force (momentum) due to the base distance.

All these walls are thick, heavy ones, homogeny and mostly (with exception of the main façade) with more fill than transparency. These makes them less vulnerable walls, on wich the own weight is a very important aspect of their structural performance.

[11] The steel will begun to be use in a massive way in Chilean buildings during the second half of XX century. The reinforced concrete however, was use more in the first decades of XX century in developed cities, as it was in Valparaiso.

The most vulnerable zones would be the volume corners and the lintels, that is to say, all the parts where appear structure discontinuity.

The floor wooden structure acts also as a strapping element, in the form of a diafragm, specially because it is a very thick system, made out of very strong pieces. The vulnerable pints in these cases would be the entailment between the beams and the walls. The effect that an earthquake can cause is the wall displacement, or the wall “beating”. The evidence we have at hand reveal that the floor and ceiling structure were in perfectly united to the wall. The problems observed are originated more from humidity or non technical interventions. All this, as we pointed before, weaklings the original structural system.

After the explosion, practically all the wooden structure is lost or seriously damaged. As it was pointed out, all the materials used in the previous interventions were, in the majority of the cases, of rapid combustion. The clay masonry, including the perimetral and the interior ones stand, without significant inclination or collapsing danger, even though they are much altered. The photographs show the stat of the building prior to the explosion. This state made possible to suggest an hypothesis for the recuperation of the original structural system (clay masonry walls and a wood floor structure) ; however, after a technical study, it is proposed an reinforced based in a new structure, considered the demolition of the rest of the work`s interior walls, leaving only the ones of the perimeter and the incorporation of a steel structure, of beams and strut. This structure was planned as provisory, while the future of the building was resolved (an eventual purchase from the Municipality, i.e.)

Interventions Analysis.

An historical building obviously presents a series of modifications and changes, which shows the history of a place. In certain situations, monuments become real document of an historical period, though its interventions. However, in some occasions, these interventions affect significantly the building, part of its values. Therefore, it is important, before the formation of intervention criteria, the evaluation of the transformations in a building to determine what meaning and value they have today. Although its recommended to respect the passing of time in a building, it is also true that in some situations action is taken without any criteria, and interventions makes damage – even technically – and its advisable their elimination. Next we are going to critically revise changes suffered by Subercaseaux building along its history.

All interventions must be properly analyzed and valued[12], to determine the right intervention criteria. We shale revises, according to Cesare Brandi[13] recommendations, the three historical moments: creation, curse, and the present moment of “re-discovery”.

As there are no original plans, the building, and photographic and documental records available, become into documents which talk about its hypothetic original situation. Induction will be a working method as well, studying other analog buildings which do have original plans-drafts.

12 Carta de Venecia. Art.11

13 Brandi, C. Teoría del Restauro.

First Moment: Origin.

From a formal point of view, it is an urban building, whole block, with public use in the lower floor, and houses in upper floors. Its main façade, as the image shows, is facing Serrano Street, high activity and movement commercial street, around that time. Its Cochrane street façade is less elaborated and grouped the service accesses, for commercial uses and apartments. Other buildings in the same street, facing Serrano and Cochrane Street, are resolved in a similar way, what reassures the main street and structural character of Serrano Street.

In its lower floor, the façade is pretty much transparent, with predominance of transparency over fill.

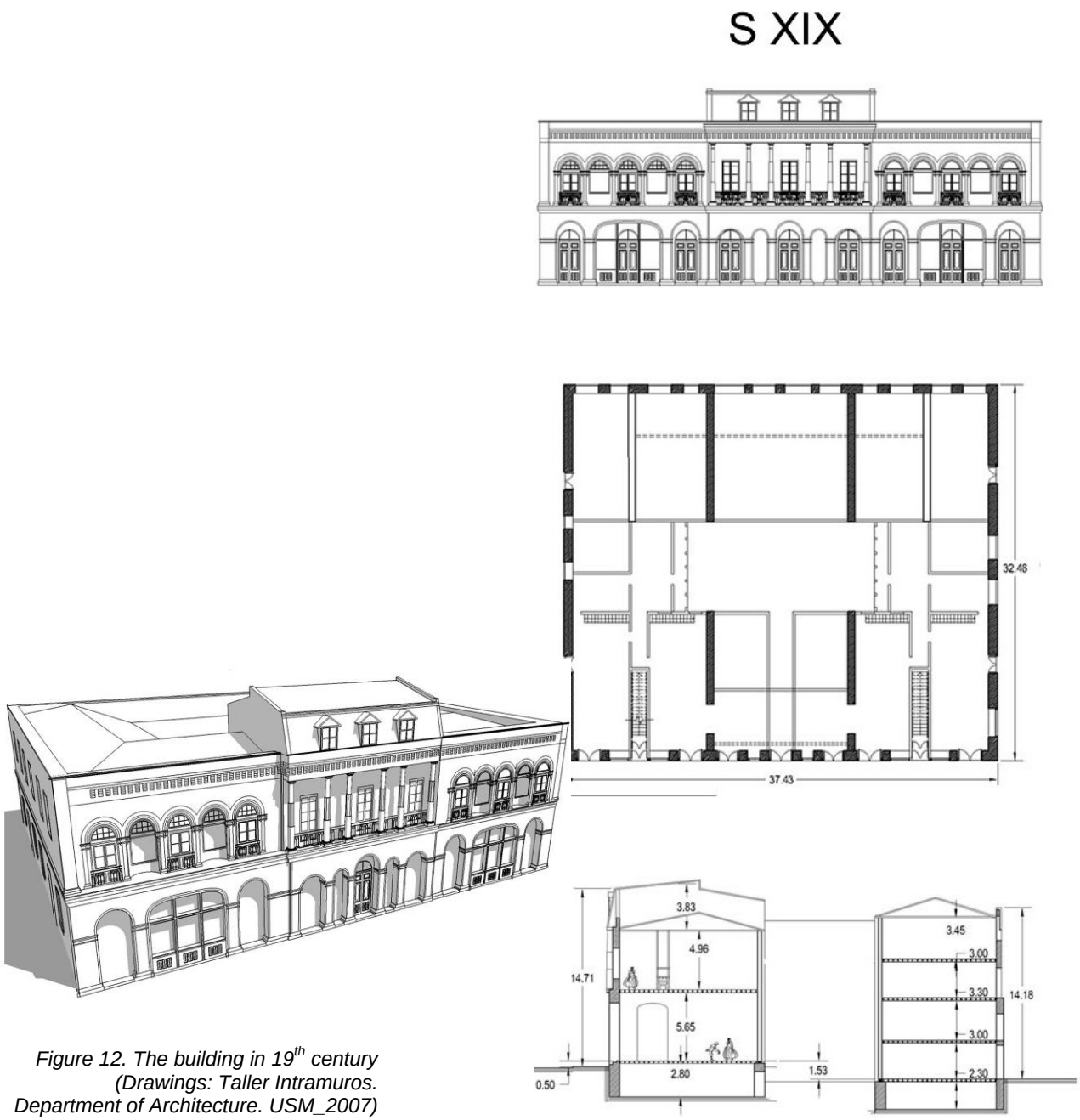


Figure 12. The building in 19th century (Drawings: Taller Intramuros. Department of Architecture. USM_2007)

Second Moment: The curse

The building has suffered important transformation along its history, which mainly modified its inner distribution and exterior aspect. Lower floors still being occupied by commerce, but they're divided in some stores to increase capacity. The type of families occupying these floors changes also. They mainly are low resources families living piled up, in bad conditions.

An important intervention represents the installation of a volume in the inside of the yards, a steel reinforced structure.

Most of the volumetric changes are related with increasing the building's capacity. This is the reason why in higher floors, old rooms are divided adding one extra floor, in almost the whole perimeter.

These changes are not easily perceptible from the outside. Nevertheless they weaken and degrade the original design, specially the two inner yards system.

In its lower commercial floor there are many transformations made, affecting its main façade in Serrano Street. Those changes affect aesthetically and structurally the original design, because they suppress brick columns to get wider spans. All these interventions happens using reinforced concrete. There are doors and windows change too.

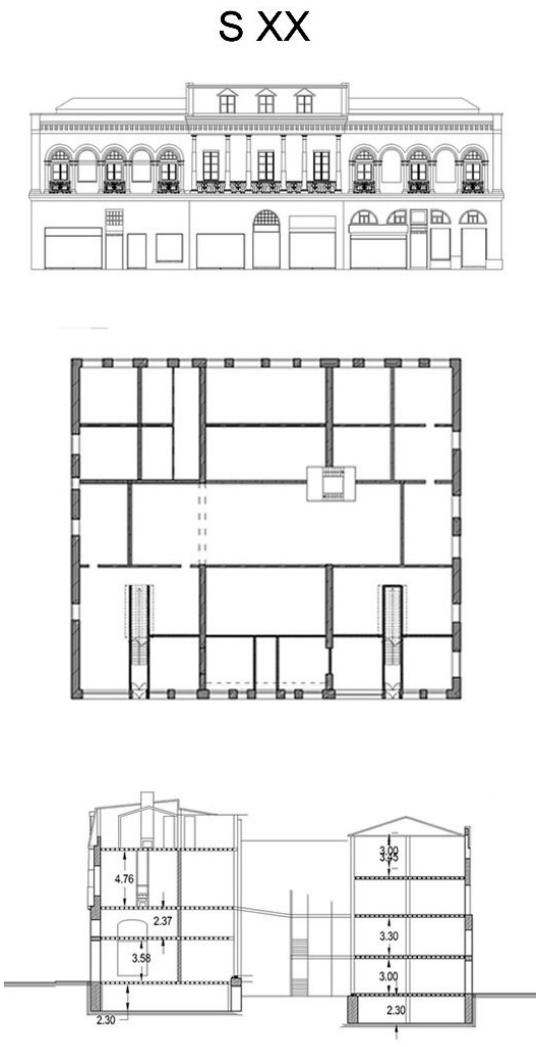


Figure 13. The building in 20th century. (Drawings: Taller Intramuros. Department of Architecture. USM_2007)

Third Moment: Present Day

We can divide this stage in two different moments: the intermediate state after the February explosion in 2007, and actual. The state of the building after the explosion is described: perimeter wall and some inner elements. This state would allow, in my opinion, to suggest an integral restoration, considering all that's still standing, plus its historic and urban importance.

This condition changes after the decision of eliminating all inner elements, and incorporating an additional structure, apparently provisory, but, as all kind of materials utilized and its link system with bearing walls, cannot be eliminated without making even more damage in this walls.

Finally and lamentably, a few months the tragedy happened, there's no clarity about the destiny of the building: who is going to manage its recovering and what kind of use it is going to lodge. It hasn't been object of a detailed and specialized evaluation about its general conservation state.

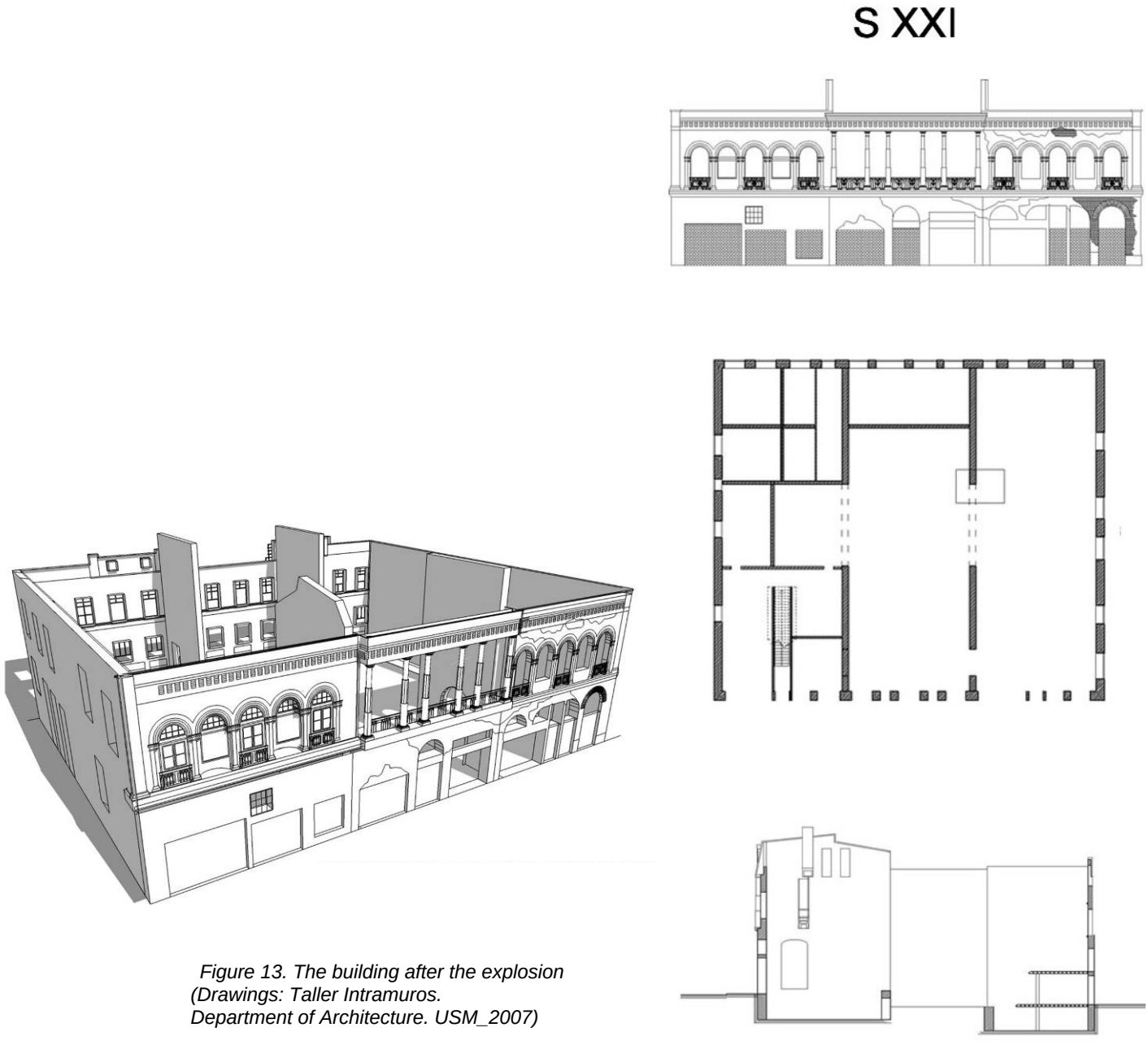


Figure 13. The building after the explosion (Drawings: Taller Intramuros. Department of Architecture. USM_2007)

The value of the building, today.

From an urban point of view, the remain of the building (perimetral walls) is relevant because of its location and magnitude: it is located in the historical downtown, in one of the oldest and most important street, and occupies a whole block, facing four streets. Its valuable because it's a part of the harmonic group of this part of the city. Because its location and size (ca. 2700 m^2), can be used for public programs, in relation to cultural, turistic and educational themes[14]. Besides it part of a group of buildings from the XIX century, therefore it has an historical value for the history of local architecture.

As the technology used is interesting, because is part of these constructive systems adaptations, characteristic in Valparaiso, nevertheless, after its interior cleanse, façade becomes an element with no referents or sense, without a context.

After the disaster it gets a sentimental value for Valparaiso community, specially for the port neighborhood and the victims families.

Typological Analysis

We are going to present a series of building which fulfill the conditions of belonging to a same period in the urban-constructive history of Valparaiso, and they survived the most important seismic event in the last 100 years. All this still standing buildings, although they are transformed fundamentally because their use changing, or specific interventions, as will be explained.

The concept of typology is associated to certain condition underneath the resulting shape. It would be an organization defined from some aspects, and materialized in different shapes along the history[15]. The concept appears wide in its definition and accepts transformations; it's about a methodological element that helps to the interpretation and architectonic analysis.

The typology we are presenting, corresponds to an urban building, this means, because of its magnitude, location and program, it is relevant in the construction of the city. In Valparaiso's case, with an irregular layout, there are varied buildings conforming whole blocks (or half blocks), being because of this, significant in the urban weave.

From the use point of view, it is possible referring to an architectonic typology typical in Valparaiso's Plan about XIX and early XX centuries; buildings with commerce in lower floors and residential use in higher (permanent housing or hotels) The Subercaseaux building would be a exemplary case of this typology.

The next table shows some general aspects relevant to considerate in a preliminary evaluation of its structural behavior.

- **Year of Construction:** Allows to stablish the number of important earthquakes the building has suffered. This allows to establish if

[14] A recent study concludes with the necessity to install infrastructure for the great amount of students who exist in Valparaiso. Interrelated University programs are recommended, like libraries or centers of extension. Also cultural ones like theaters or cultural center, among others. This in addition would help the revitalization of the district.

there is accumulated damage and visualize which have been the eventual structure reinforcement took place, besides the use transformations experimented.

- **Location:** It is relevant because it is in direct relation with the kind of ground. In a city as Valparaiso there are different kinds of grounds; in one hand the rocky ground of the sector port and hills; the sandy ground from the Almendral zone, where water obstacles existed; the filling ground, that corresponds to all the area gained in the advance on the sea. The behavior of a same structure in these different grounds is very different.

- **Main Materiality.** It is a fundamental aspect, that it allows to analyze the technical aspects of the building, from the detailed study of the types of materials, its physical and chemical characteristics, the specific constructive techniques.

- **Original Use / Actual Use:** The use transformations the building experienced are significant as it goes alternated the way as the building was used; the changes of use are associated generally to changes in the structure, with the incorporation of elements and the suppression of others.

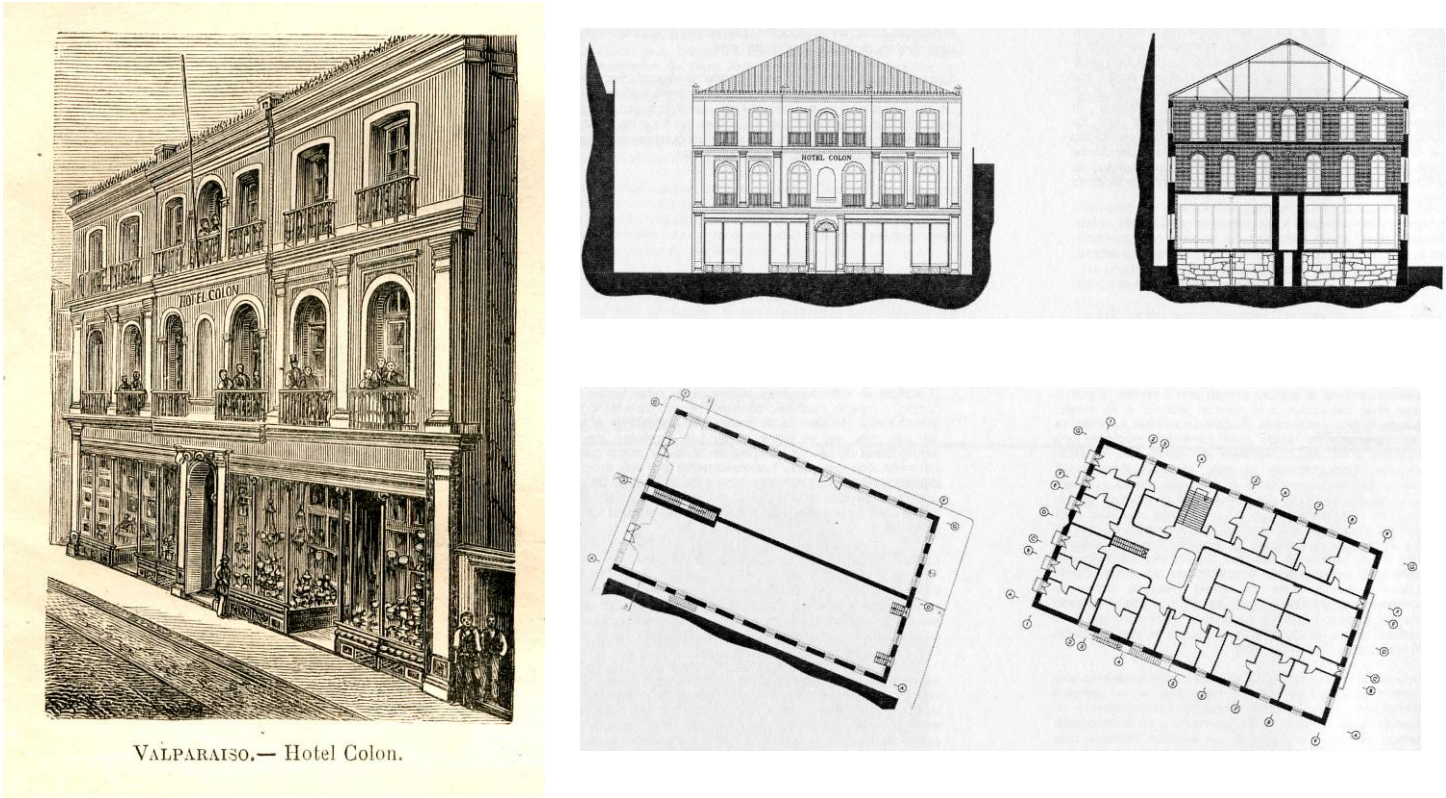


Figure 14. Hotel Colon. Built before 1872; masonry structure; hotel and comercial use.(Print: Tornero, R. 1872; Drawing: Jiménez, C. 2007)

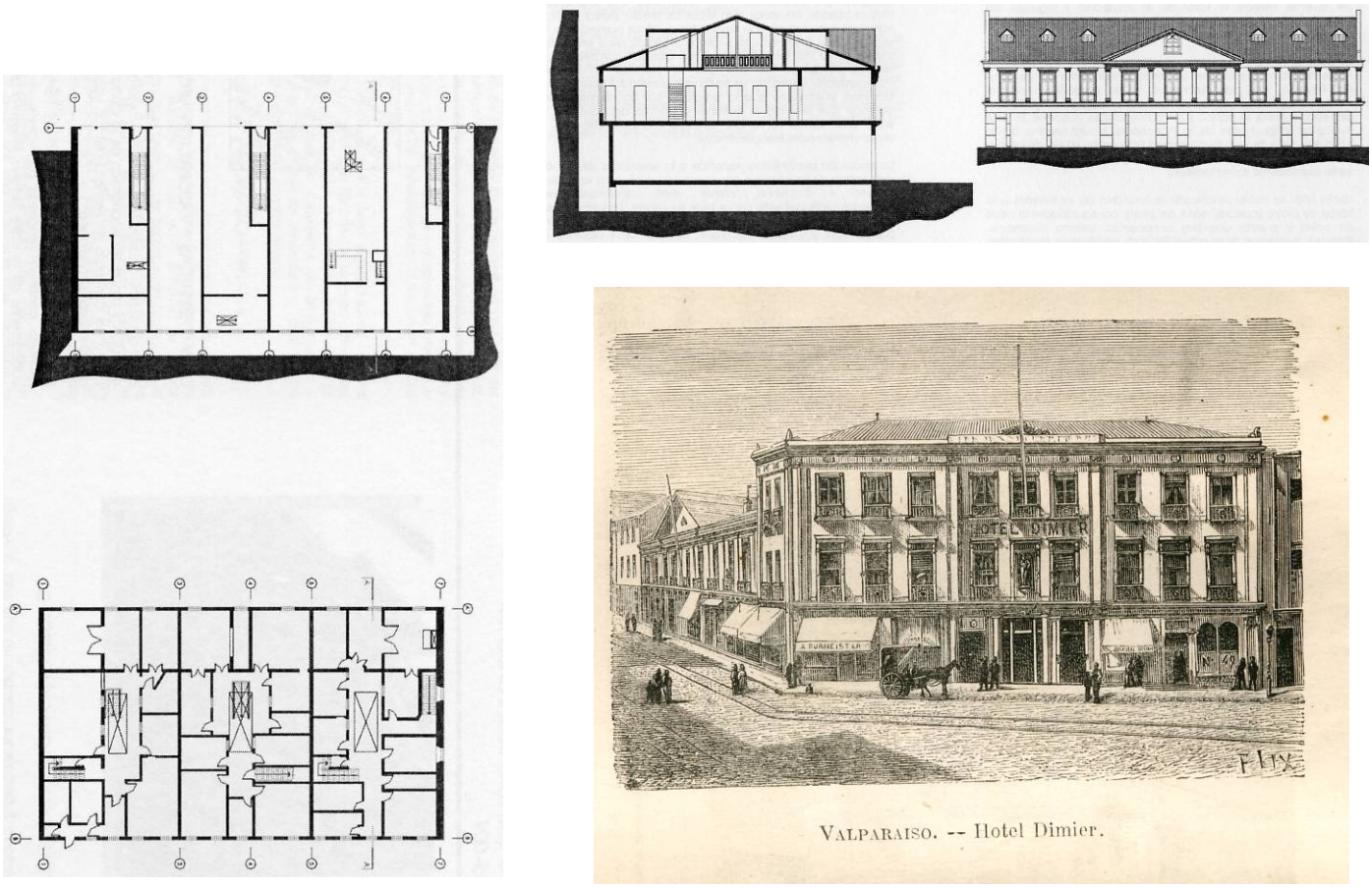


Figure 15. Hotel Dimier. Built before 1872; masonry structure; hotel and comercial use.(Print: Tornero, R. 1872; Drawing: Jiménez, C. 2007)

Results

The original idea was evaluating the structural behavior of Subercaseaux Building, as a way to establish its actual state, after the explosion, and then propose, with the final results the constitution of the original system and the necessary reinforcements. Nevertheless, after the demolition of the resting inner structures decision, and the proposal of a metallic perimeter tying structure, all the rest of the original system is destroyed. Now, walls are even more damaged than after the explosion, because of the demolition of inner walls which acted as buttress, and perimeter walls are drilled, lowering it section and resistance.

Because the level of alteration of the original building has been modified in an irreversible way, the authenticity of the subject is in danger. It would be absolutely hard to plan an intervention, without the principles of integrity and authenticity

Intervention criteria

The following intervention criteria are recommended, given the current condition of the building.

-To respect authenticity and integrity of the building's remains.
This aspect refers to differentiate original pieces from new interventions both in shape and style, as well as in the use materials and technology. There is also the necessity to watch for the recovery and reintegration of the building's remains.

-To recover the inner meaning of the interior patio
This typology, very frequent in architectural works from similar age and material conditions, is characterized by a patio located right in the middle of the building, whose first purpose was to light surrounding facilities, but also became an important distributional device. Subercaseaux Building patio can be recreated according to new functionalities, but it will preserve the meaning of an interior, vertical and bright unitary element.

-To recover traditional techniques in the original remains
The remaining walls should be recovered using the original techniques and materials. It is also possible to recover some plaster and decorative work, and even to refresh or recreate structural and constructive criteria, based on the study of the original system.

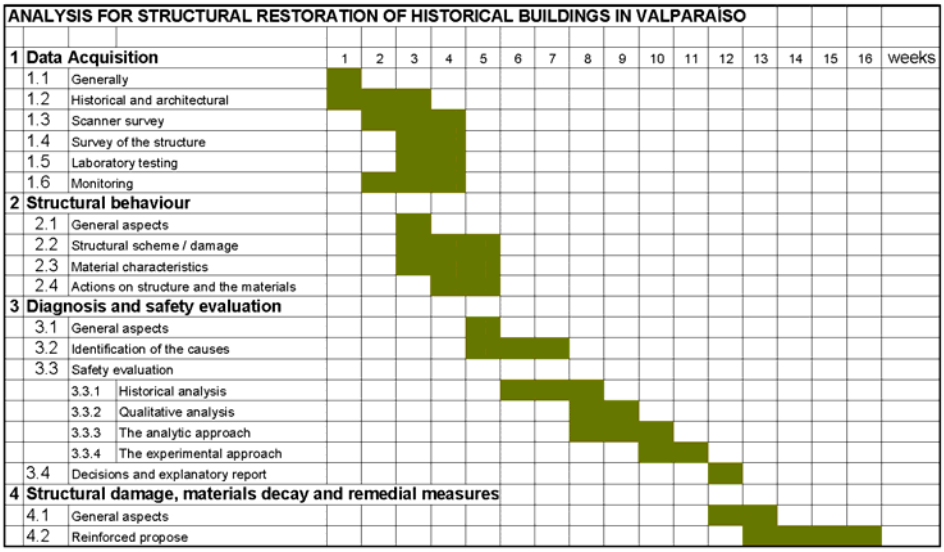
-To contextualize the original remains
The remaining walls should be integrated with the new shapes and materials with full respect of their original condition, in order to prevent them to look as plain facades wrapping a new building.

Future Actions.

As a first step facing the panorama it is pointed out to the urgent necessity of developing scientific investigation regarding historical structures: the building systems used, the technologies and their structural behavior. All this, considering the methodologies and recommendations suggested by specialists and researchers.

A Gantt chart of programming is put aside[16], and an estimated budget of the Professionals involved, adapted to the national reality.

[16] In base of the document from ICOMOS "Recommendation for the analysis, conservation and structural restoration of architectural heritage". (2000).



PROJECT COSTS

		U$	Chilean $
1 TEST			
1.1	In situ dynamic characterization	3.500	1.750.000
1.2	Seismic monitoring	4.000	2.000.000
1.3	Diagnostics tests	1.100	550.000
1.4	Laboratory tests	1.500	750.000
1.5	Scanner 3D survey	2.200	1.100.000
			6.150.000
2 PROFESSIONALS			
2.1	Architect	8.000	4.000.000
2.2	Engineer (structural)	9.000	4.500.000
2.3	Engineer (chemical)	3.500	1.750.000
2.4	Historian	1.500	750.000
			11.000.000
	TOTAL		**17.150.000**

Figure 16. Guidelines and costs for an analysis for strucutral restoration of historical buiding in Valparaíso.

Management

In the specific case of the Subercaseaux building, until now, there has not been solved the way the recovery of the rest of the building is going to take place. Information of press in the last months talks about the possible purchase by the Municipality of Valparaiso, as for another two buildings in similar condition.

Being a building located in UNESCO patrimonial area, it could be possible to assign money resources available from the BID (Inter American Develpoment Bank) credit, for the recovery of these remains.
All the initiatives that have considered aim to install a public use, associated to the cultural, tourist or the educative area.

The State as owner suppose an advantage, because there are bigger possibilities of getting allowances or tributary benefits, in the case of private buildings. In the case it is designated to be a public building, it would benefit the university community for example, it is possible to obtain associated benefits.

The recommendation in all cases is: administration of the new building should be in a corporation or foundation hands, capable of integration with different institutions – as universities – with independence from specific administrations of them, and independence from the local Municipality too. The building can be given in "comodato" (use loan) for a certain period, against the development of an specific project, which social and economic profitability are guaranteed.

Conclusions

The seismic reality of Chile makes imperative to research in a very exhaustive way the structural behavior of the traditional building systems, as much as to contribute to the conservation of such buildings as to the development of structural reinforcements methods compatible with these traditional methods.

The Subercaseaux building case shows the lack of experience in these kinds of interventions and in specific intervention, with the consequent loss of a rich building patrimony. In most cases, the criteria don't start from observation and knowledge of the pre-existent structure, but by the imposition of the behavior of a new structural system, with its new materials associated. Under this analysis, it's very complicated to conserve integrally the local architectonic patrimony; in the end, we will keep facades, braced from within, completely emptied out and unlinked by the materials that are in novo installed within. This contradicts completely the recommendations made by specialists, for example, the ICOMOS International Scientific Committee fon Analysis and Restoration of Structures of Historical Heritage, (ISCARSAH) which is very strong condemning Façadeism

"*The value of architectural heritage is not only its appearance, but also in the integrity of all its components as a unique product of the specific building technology of its time. In particular the removal of the inner structure maintaining only the façades does not fit the conservation criteria.*"[17]

The interdisciplinary teams work is also fundamental, to integrate different kinds of studies into the same discipline.

"*A combination of both scientific and cultural knowledge is indispensable for the study of all architectural heritage. Only in this context can the guidelines help to better conservation, strengthening and the restoration of buildings. The purpose of all studied, research and interventions is to safeguard the cultural and historical value of the building as a whole and structural engineering is the scientific support necessary to obtain this result. Conservation architectural heritage usually requires a multidisciplinary approach involving a variety of professionals and organizations*."[18]

[17] ICOMOS Charter "Principles for the analysis, conservation and structural restoration of architectural heritage (2003)" Ratified by the ICOMOS 14th General Assembly in Victoria Falls, Zimbabwe, in 2003.

[18] ICOMOS "Recommendation for the analysis, conservation and structural restoration of architectural heritage". (2000).

A relevant aspect for the development of future researches is related with the possibility to acces all historical and documentary information as possible. This can become a problem when the local archives aren't organized or back up data has been lost.

It is fundamental too to have the truest actual recompilations that allow us to perform the correct analysis and modelatings. The actual recompilations we had at hand didn't fit the minimum pre-requisites necessary to serve as a base of analysis of its structural behavior.

Finally, to take into consideration all the forward experience gained up to this date in the Structural historic matter, as much as in universities and institutes developed researches, as in every conceptual and methodogical adding which are gathered in the ICOMOS letters and recommendations, and other specialized organisms, that assure the integral conservation of the architectural patrimony.

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Appendix 1

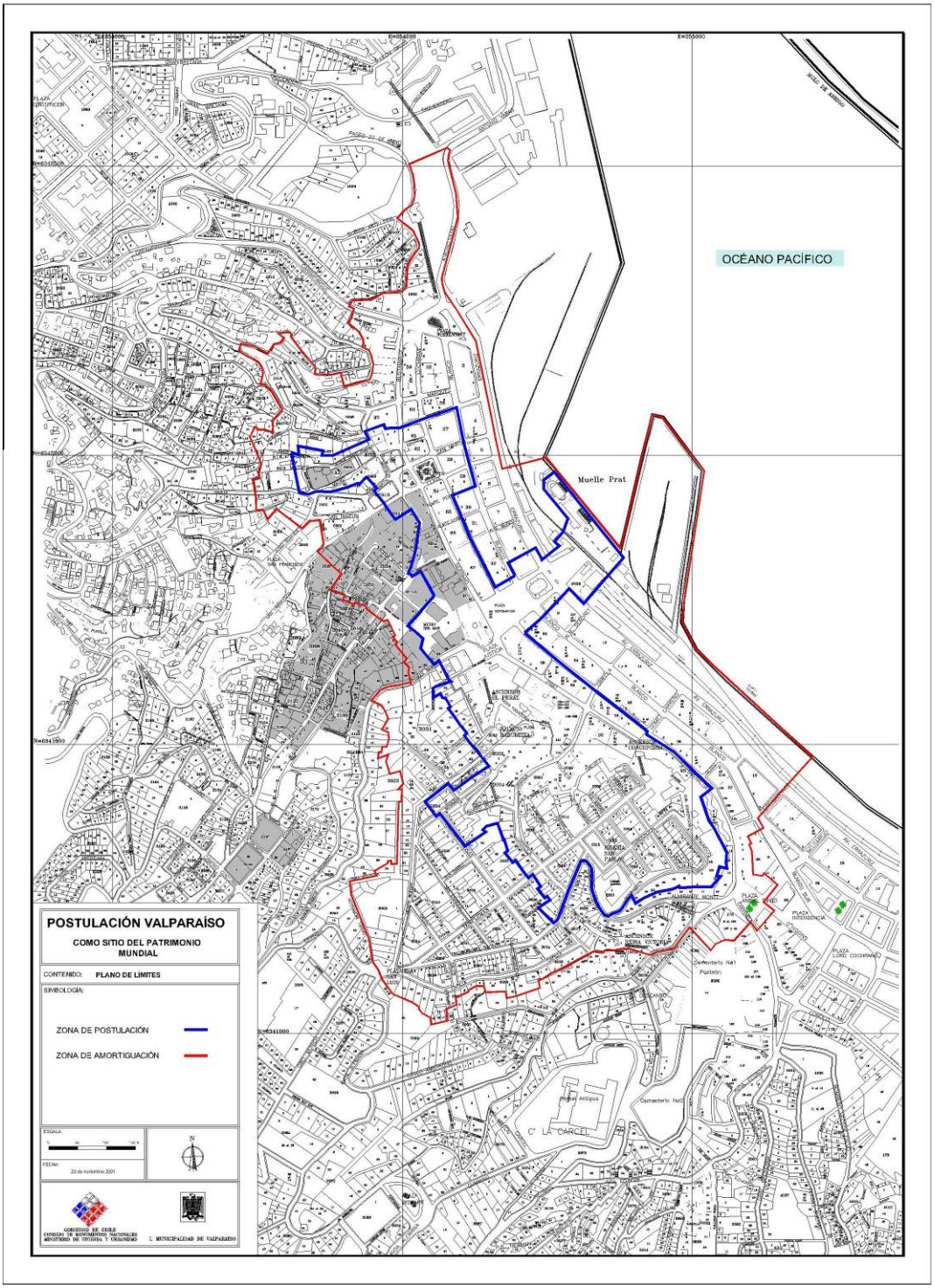
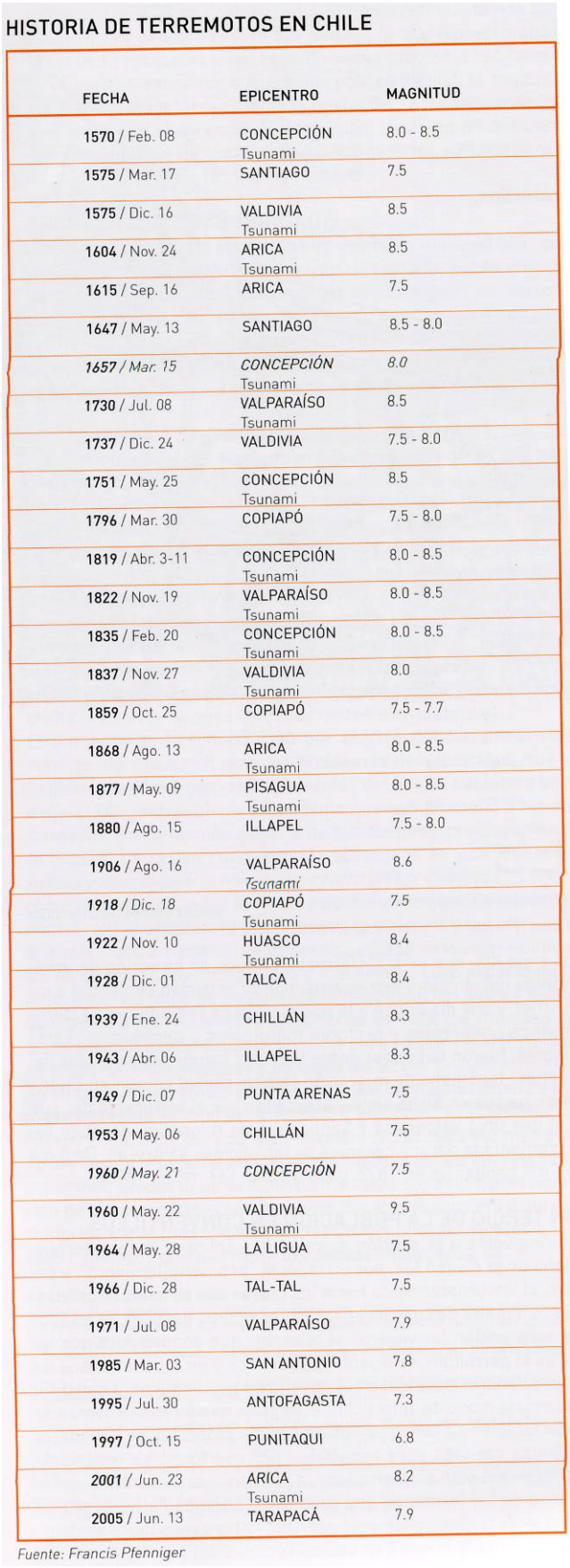


Figure 17. Limits of the UNESCO area in Valparaíso



HISTORIA DE TERREMOTOS EN CHILE

FECHA	EPICENTRO	MAGNITUD
1570 / Feb. 08	CONCEPCIÓN Tsunami	8.0 - 8.5
1575 / Mar. 17	SANTIAGO	7.5
1575 / Dic. 16	VALDIVIA Tsunami	8.5
1604 / Nov. 24	ARICA Tsunami	8.5
1615 / Sep. 16	ARICA	7.5
1647 / May. 13	SANTIAGO	8.5 - 8.0
1657 / Mar. 15	*CONCEPCIÓN* Tsunami	*8.0*
1730 / Jul. 08	VALPARAÍSO Tsunami	8.5
1737 / Dic. 24	VALDIVIA	7.5 - 8.0
1751 / May. 25	CONCEPCIÓN Tsunami	8.5
1796 / Mar. 30	COPIAPÓ	7.5 - 8.0
1819 / Abr. 3-11	CONCEPCIÓN Tsunami	8.0 - 8.5
1822 / Nov. 19	VALPARAÍSO Tsunami	8.0 - 8.5
1835 / Feb. 20	CONCEPCIÓN Tsunami	8.0 - 8.5
1837 / Nov. 27	VALDIVIA Tsunami	8.0
1859 / Oct. 25	COPIAPÓ	7.5 - 7.7
1868 / Ago. 13	ARICA Tsunami	8.0 - 8.5
1877 / May. 09	PISAGUA Tsunami	8.0 - 8.5
1880 / Ago. 15	ILLAPEL	7.5 - 8.0
1906 / Ago. 16	VALPARAÍSO Tsunami	8.6
1918 / Dic. 18	*COPIAPÓ* Tsunami	7.5
1922 / Nov. 10	HUASCO Tsunami	8.4
1928 / Dic. 01	TALCA	8.4
1939 / Ene. 24	CHILLÁN	8.3
1943 / Abr. 06	ILLAPEL	8.3
1949 / Dic. 07	PUNTA ARENAS	7.5
1953 / May. 06	CHILLÁN	7.5
1960 / May. 21	*CONCEPCIÓN*	7.5
1960 / May. 22	VALDIVIA Tsunami	9.5
1964 / May. 28	LA LIGUA	7.5
1966 / Dic. 28	TAL-TAL	7.5
1971 / Jul. 08	VALPARAÍSO	7.9
1985 / Mar. 03	SAN ANTONIO	7.8
1995 / Jul. 30	ANTOFAGASTA	7.3
1997 / Oct. 15	PUNITAQUI	6.8
2001 / Jun. 23	ARICA Tsunami	8.2
2005 / Jun. 13	TARAPACÁ	7.9

Fuente: Francis Pfenniger

Figure 18. Register of the most destructive earthquakes in Chile, since 16th century.