

REHAB 2017

Proceedings of the
3rd International Conference
on Preservation, Maintenance and Rehabilitation
of Historical Buildings and Structures



Edited by

**Rogério Amoêda
Sérgio Lira
Cristina Pinheiro**

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The relative value of the architectural heritage in seismic hazardous countries: the Severín library (Valparaíso, Chile)

M. P. Urrutia & P. M. Millán

School of Architecture and Design, Pontifical Catholic University of Valparaíso, Valparaíso, Chile

ABSTRACT: In Chile, the value of the heritage concept is relative. The seismic reality has granted a condition of fragility to any architecture built. However, this quality requires a process of cultural adaptation, typological, materials, which has accelerated the search for new forms of construction for conservation. While the seismic hazard temporarily narrows the built, it develops technologically. The city of Valparaíso, declared a Historic-Cultural Heritage Site by UNESCO in 2003, was set as one of the main ports in the South Pacific since the opening of the route through Cabo de Hornos, establishing himself as one of the most important cities the country and getting itself to designate as the "Jewel of the Pacific". However, the city was not without disasters due to its location on the so-called "ring of fire", one of the areas with the greatest seismic hazard worldwide. The earthquake of August 1906 destroyed almost the entire sector into crisis Almendral all buildings of the time. The reconstruction plan, executed four months later, was an opportunity to change the techniques with a view to the Centenary of the Chilean Republic. The paper studies the case of Severín Library as one of the first neoclassical buildings, executed in the city, developed with the goal of being a landmark heritage building in the port city. Located opposite Victoria Square, it is designed by architects Renato Schiavon and Arnaldo Barison and executed in 1912 with techniques that allowed her vocation of continuity in time. Compound with classical elements but with a novel structural type, this building will be an equity benchmark for the time when it was built and by the objectives that originated it.

1 CHILE, A PERMANENT SEISMIC CONTEXT

Chile is one of the most seismic countries in the world, constantly trembling due to its location in the so-called "Ring of Fire", an area composed of several tectonic plates which remain in constant friction and tension where earthquakes and eruptions of volcanoes frequently occur. In the case of Chile, the Oceanic or Nazca plate subduces under the South American continental plate, meaning that, as the marine crust is denser it penetrates under the less dense one due to its weight; being this area a zone of encounter where the earthquakes or tectonic earthquakes occur. The speed between plates is on the order of 8 to 10 centimeters per year and the movement is not regular, but unpredictable (Cisternas, 2001).

Depending on the strength, deformation and the place of encounter between the two plates, the earthquakes can be classified under: Interplate, Outer-rise, Oceanic intraplate, or Continental intraplate (CSN, U. Chile).

Most earthquakes recorded, with a significant magnitude in Chile, are under the type of Interplate; which are caused when the net force of the plate is greater than the friction that tends to block the subduction. Therefore, when it is able to move, the earthquake is generated and its magnitude is consequently proportional to that movement. It is useful to note that, when the phenomenon generates a rupture in the ocean floor, tsunamis occur. Dramatic examples are the

case of the earthquake in the city of Valdivia which happened in the year 1960 with a magnitude 9,5 Mw; where the contact between the plates moved 25 meters along that translated in a column of 6kms of water, generating a colossal energy that was able to cross 40,000km through the Pacific Ocean and reach Japan.

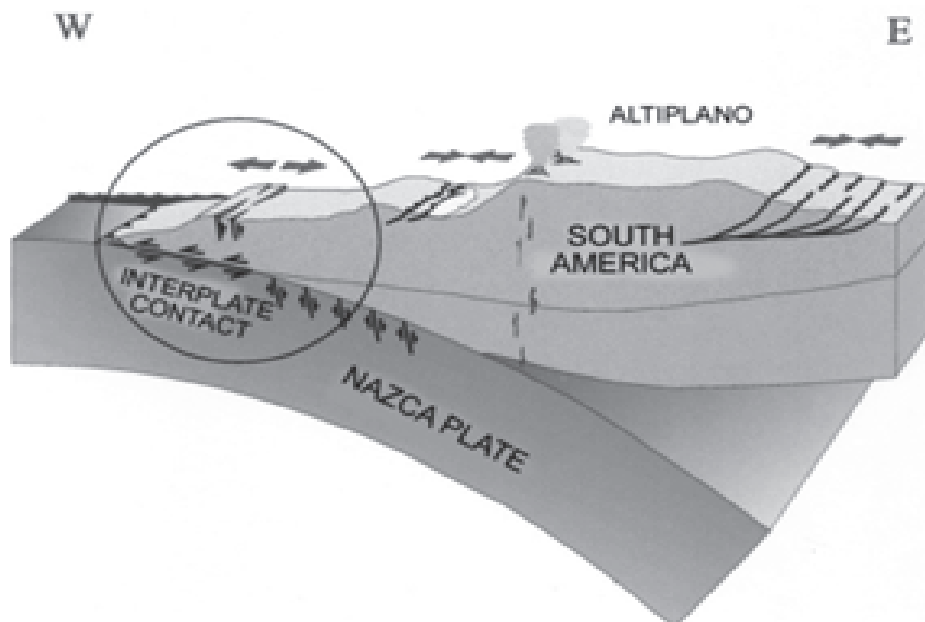


Figure 1. Scheme of Subduction of the Nazca plate under the South American plate. The contact between plates corresponds to an inverse fault in which the continent rises on the ocean floor. In the Cordillera de Los Andes, we can see the volcanic zone and the compression faults. Source Cisternas, A. (May 2011). The most seismic country in the world. Scientific journal anales, seventh series, 17-34p.

The movement lasted for 10 minutes and has been classified as the "Great Earthquake" being the most powerful recorded and cost the lives of 2000 people. Another example is the recent earthquake that struck the Maule region on February 27, 2010 with a magnitude of 8.8 Mw.

On the other hand, earthquakes like the one occurred in the city of Chillan in the year 1939 of magnitude 8.3 Mw, with 5,648 dead and destruction of the city; or the famous earthquake that destroyed the neighborhood Almendral of Valparaíso in the year 1906 are caused by earthquakes of the type Oceanic Interplate, occasioned by the internal deformations in conjunction with a strong coupling.

The Outer-rise earthquake occurs offshore from the ocean trench, where the frictional force produced by the Nazca Plate causes earthquakes of magnitudes smaller than 8.0 Mw. An example of this case is the Valparaíso earthquake in 2001.

Finally, the Continental intraplate quake is associated with internal deformations of the plate at the height of the Andes mountain range. According to the record of the National Seismological Center (formed after the 1906 earthquake), 107 earthquakes have been censused of greater magnitude than or equal to 7.0 Ms since the year 1570 to date, registering 21 earthquakes with tsunami and 11 earthquakes with tsunami of greater destructive characteristics.

It should be noted that the efforts are compound, meaning there is a probability of new earthquakes occurring in those areas where there has been a time of accumulation without movements. Therefore, it can be assured that these natural disasters will continue to occur in the Chilean territory in different magnitudes.

2 CHILE, A HISTORY OF EARTHQUAKES

"On May 13, 1647, at about ten thirty in the evening, there was an earthquake or trembling in the city of Santiago, Chile, which lasted about three prayers, and with such great noise and violence that it ruined it all to the ground "(Palacios, 2016: 41), this was the way that Magno Don Miguel de Lerpa characterized the earthquake to the king of Spain, described by the witnesses as "the greatest earthquake that has been seen in all America" according to the Letter of Pedro Gómez Prado to the king. That fateful earthquake which developed during the night and lasted 3 to 4 minutes resulted in the descent of 25% of the population of all kinds of "people of good life and name, part innocent creatures and the rest slaves and Indians and people of service" (Ibid .: 46).

On July 8, 1730, there was an earthquake with an area of influence from Coquimbo to Concepción, which was also felt in Argentina. It was composed by three movements whose last one finished destroying the buildings that remained standing, to the ground. Although there were considerably fewer people killed, the earthquake meant a considerable material loss in the city of Santiago, Valparaíso, La Serena, Coquimbo and Concepción.

Twenty years later, on May 25, 1751, Concepcion was struck again. Thus, reported the Marquis de Salinas to the Viceroy of Peru on August 9 of that same year: "They threw themselves out of their beds and rushed out without further guidance than their own fear. As they did, during the prevailing darkness, they began to hear the collapse of temples and buildings, making it difficult for many to flee. In this way the aftershocks, despair and chaos led the Penquists to think that they would not live the next morning "(in Ibid .: 60). The subsequent tsunami devastated the shore and the city. About 300 houses were destroyed and the rest became unusable.

Four years after the declaration of independence, when Valparaíso was opening to freedom of trade, a new earthquake occurred on November 19, 1822, shocking for three minutes and in different magnitude, the towns located between Santiago and the port. Valparaiso had innumerable material losses as human. Carlos Thurn, engineer of the time, describes that buildings built near the hill, where there is a rocky soil, resisted the movement better (Palacios, 2016).

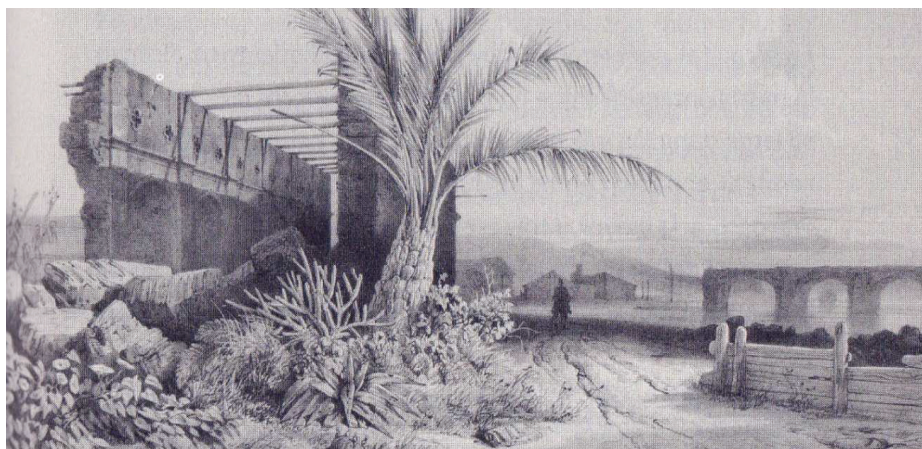


Figure 2. Ruins of the Church of Concepción after the earthquake of 1730. Dumont d Urville, Jules. Voyage au Pole Sud dans l'océanie sur les corvettes L'Astrolabe et La Zelle. Atlas pittoresque. Paris, Gide et Cia, Éditeur, 1846, tome I, platecha 35. In Palacios (2016).

Despite the dramatic facts mentioned, Chile managed to develop at the cost of reconstructions. It is important to emphasize that, in comparison with the rest of the Spanish

colonies, it managed to face adversity, consolidate its political and institutional regime at an early stage, achieving a commercial advantage at an international level.

With a date, close to the war against the Peru-Bolivian Confederation, on February 20, 1835, a strong earthquake shook the populations between Coquimbo and Chiloé, concentrating in the region of Concepción. The newspaper of the time describes "there is no temple, no public house, one particular, one room; everything has concluded: ruin is complete", (Ibid. : 76). The misfortune was of such magnitude that the relocation of the city was evaluated.

Without a doubt, the earthquake of August 16, 1906 in Valparaiso was one of the most disastrous; crushing a city that was growing exponentially and where the result was the fading of its golden age. After the earthquake of 1822, the city had become the commercial transit port of the Pacific, a place classified as safe to trade, store and distribute goods, which supplied to countries like Peru, Bolivia, Argentina, Australia and cities like California, also participating in the nitrate market of the North of Chile (Norte Grande). For those years, Valparaiso reached the category of commercial capital of Chile, and it is for this reason that the natural disaster still resounds within its society. The earthquake started a stage of halt at the port, in conjunction with the opening of the Panama Canal a few years later.

"The streets were maddeningly torrents of human flesh that fled and crashed, fainting and clamoring to the cry of: mercy Lord! They were joined by the cruel chest blows, the screams of which they had seen dead some darling relative. The calls were threadbare. Broken, in great proportion, the loves, all harmony broken in that frightful every man for himself" (Acevedo in Palacios, 2016: 123).

In addition, there was a large fire that could not be controlled due to water supply outages. In conclusion, the Almendral neighborhood was destroyed, and in total there were 3,764 deaths from a population of 16,244 inhabitants.

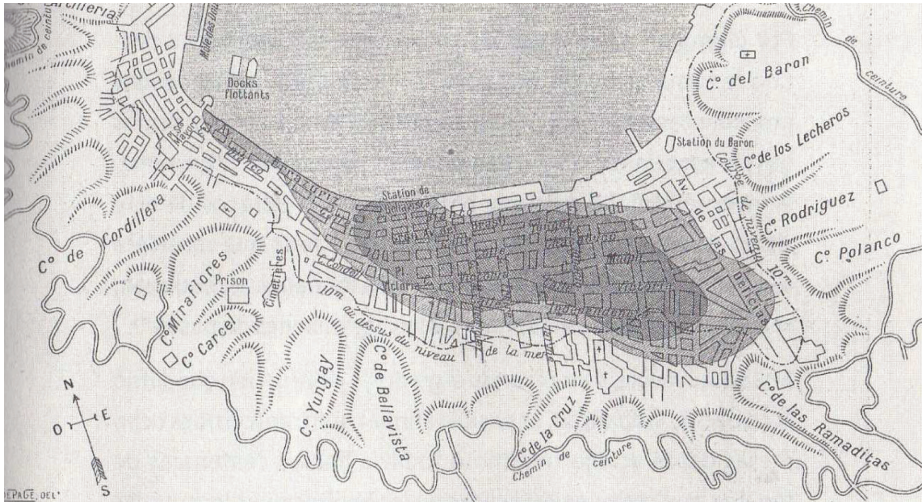


Figure 4. Area with greater damage during the earthquake of 1906 in the bay of Valparaiso. Source: L'illustrations, Journal Universel. Paris, October 13, 1906, p 233. (In Palacios, 2016).

3 THE LEARNING OF SEISMIC EXPERIENCE DURING THE TWENTIETH CENTURY

The earthquake of 1928 in the city of Talca, pushed the regulation in constructive matter in the country. The studies that defined the General Law of Urbanism of 1929 were set in motion, which indicated, for example, the need for a permit application to build. Two years later the General Ordinance of Urbanism and Construction (OGUC) was promulgated (Saez, 2011).

The mentioned rules would begin to run only three years before the city of Chillán completely collapsed on the night of the earthquake of 8.3 Mw, on January 24, 1939. On that

occasion, 47% of the houses in the city were left in ruins, and only buildings made with materials such as wood, reinforced concrete and masonry reinforced with concrete chains were those that mostly resisted. The houses in adobe did not resist the movement (Torrent, 2016).

One of its consequences from this earthquake was the creation of the Development and Reconstruction Corporation (Corporación de Fomento y Reconstrucción, CORFO), whose role was to promote the reconstruction of the country and industrial activity. On the other hand, the first planning figure called Reconstruction and Assistance Corporation (CRA) was created, whose purpose was to provide mortgage loans, to carry out reconstruction plans and to make regulatory plans.

1960 will be remembered by the Chilean society as the year of the "great earthquake". Its magnitude was 9.5 Mw and it swept the cities of Valdivia, Osorno, Llanquihue, Cautín and Chiloé, with epicenter in the sea near of Valdivia, where the earthquake accompanied by a tsunami left the city submerged under the sea. Facing the catastrophe, the Chilean Standard 433 or the standard of calculation of buildings, was developed and was made official in 1972.

In 1985, a new 7.8 Mw earthquake occurred in the central zone of the country, affecting regions IV, V, VI and the Metropolitan Region, with epicenter of the city of Valparaíso, registering a large number of landslides from the hills and 142,489 buildings destroyed. The movement exposed the reality of adobe housing, and consequently the construction of this type was banned in future housing, which unfortunately meant the loss of a constructive tradition from colonial times.

Finally, on February 27, 2010, an earthquake of magnitude 8.8 is recorded in the south of the country. On this opportunity, the technical standards NCh 2369 of Seismic Design of Industrial Structures and Installations and NCh 2745 for analysis and Seismic Design of Buildings with Seismic Isolation that were officially tested during the year 2003, were however question due to the faults that some constructions still presented.



Figure 5. Alto Rio Building, after the 8.8 Mw earthquake in the city of Concepción. Source: emol.cl.

4 THE CASE OF SEVERIN LIBRARY- THE RELATIVE VALUE

The concept of "heritage" throughout history has served an attempt by man to observe the past and preserve it as a vestige, either by its monumental character or by a significant social fact.

The transgressions and material transformations of this patrimony have been the object of eternal debates, most of which have ended up classifying elements, searching for meanings and determining which should remain unchanged. While all this is true, on the other hand these debates have observed man as the main cause of important deteriorations.

This discourse changes when it is a natural component that causes these losses, assuming with resignation an unpredictable result. The case of the Chilean heritage assumes this character of exceptionality and, as we shall see, will very soon try to assume in its own constructions elements that allow its conservation unchanged over time. Thus, we could even speak of a specific concept when talking about heritage in Chile, or rather, a specific concept of Chilean heritage.

To speak of a character of temporality in the patrimonial being itself could lead us to an approach of contradiction. How can it be that something is temporary and at the same time, tries to assume the timelessness that heritage seeks? This dual nature (temporal-timeless) converges in the reasoning of the Chilean heritage concept, a concept that is still in continuous transformation. The survival with the temporality that implies coexisting in a country continually attacked by earthquakes, forces to rethink concepts and observe how reality determines them.

The experts have sought a better solution technique for the valuation of property assets. However, earthquakes reveal the fragile reality and every certain year, nature's mission is to re-raise the heritage and ensure the safety of its users.

Every catastrophe is a test of engineering. An example of this pulse to the catastrophe was the project of the Severin Library.

The Severin Library, located in the city of Valparaíso, was built between 1912 and 1919 on the orders of the philanthropist Don Santiago Severín, who hired the renowned Italian architects Arnaldo Barison and Renato Schiavon to design it. Although there were already libraries that belonged to religious orders, this building housed the first public library of civil character until 1920, the year in which the National Library was inaugurated in the city of Santiago.

The building is located in a particular way, because it is an isolated volume circumscribed in four streets, where you can appreciate its three levels of narrow bay of 12 meters wide by 59 meters long and 15 meters high, totaling 2640m² of surface.

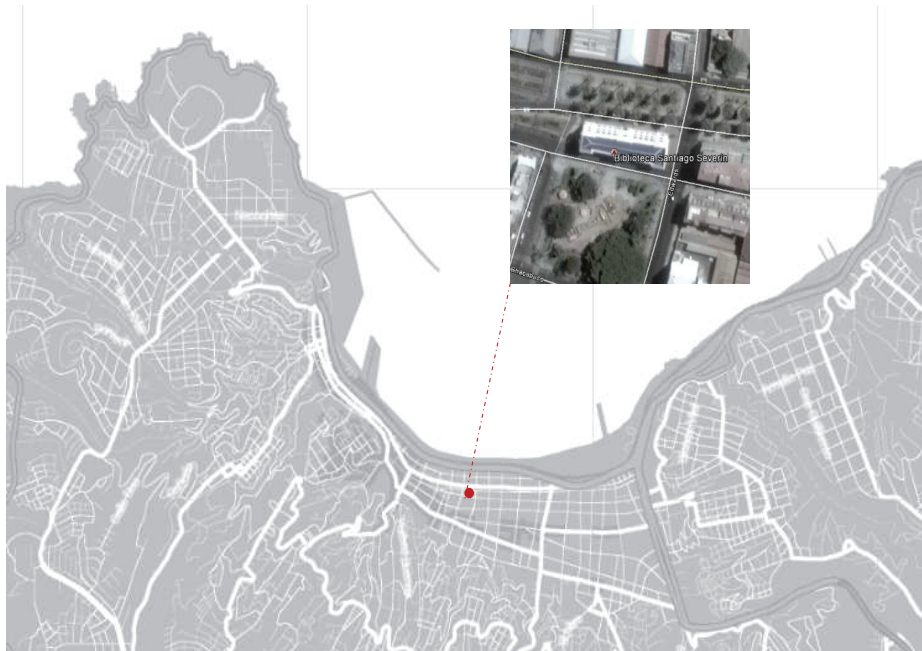


Figure 6. Location on the bay of Valparaíso.

Its style is of late historicist character with elements of the neoclassical and neo renaissance style. The facades are symmetrical with accentuation in the accesses and ends, which have termination in the upper tympanum and remarked pilasters of Ionian order. The window openings are differentiated by level, where the third one has arches of a half point, the second has a segmental arch and the first of straight ending. The first level is characterized by having a continuous cushioning while the latter is crowned with perimeter balusters.

Fernando Pérez highlights the building, "The tripartite dimension dominates the entire composition: vertically a rustic plinth serves as a base to the giant order that includes the two main floors crowned by a balustrade. The alternation of regular and curved tympanum modulates the main facade. Virtual volumes limited by double columns, are located at the ends and the center of the main facade. Between them longitudinal sections appear, rhythmic by pilasters of double height. The same formal motif of the ends is used in the heads of the building. The rhythm and proportions of perforations pay special attention to the light conditions of a library" (2016: 49).



Figure 7. West facade. Source: authors photography.

Formally, the building is composed of a central circulation vacuum, from which two lateral volumes are distributed that give place to the different reading and administrative rooms. Its structure is a mixed construction system, consisting of reinforced concrete and metal structure.

It is important to emphasize that this was a pioneer system in the city and occurred in a context where, although there was no current legislation in place, there was an intuitive interest in improving existing structural systems such as masonry of adobe or ceramic brick and mixed structures of wood with earth bricks. This, through the contribution of elements that offered a better elastic response to occasional loads such as earthquakes, also allowing greater lights and more flexible coatings.

Due to its characteristic form and its innovative construction system, the Severin Library was a first of the age and worthy of a time of industrial advances. In addition, the building is implanted as a symbol of progress and resilience in the face of the earthquake disaster that occurred only six years before its construction.

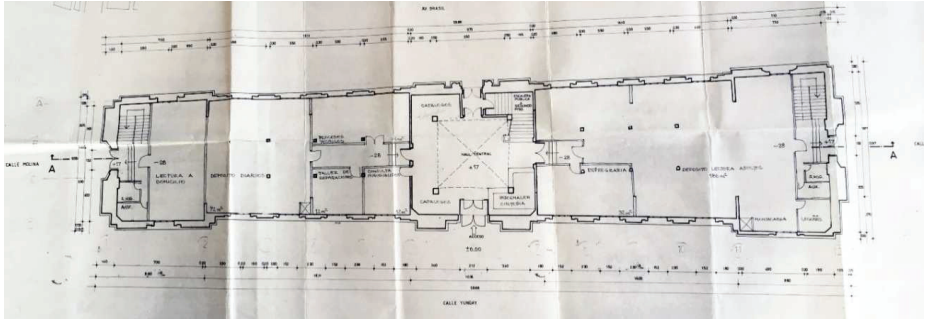


Figure 8. General floor plane. Source: Archive Santiago Severín Library.

For these characteristics, and because it is a true reflection of the architecture that emerged in the country after the fateful earthquake and the one built prior to the First Centennial celebration of National Independence, the building and its surroundings were named Historical Monument in 1998.

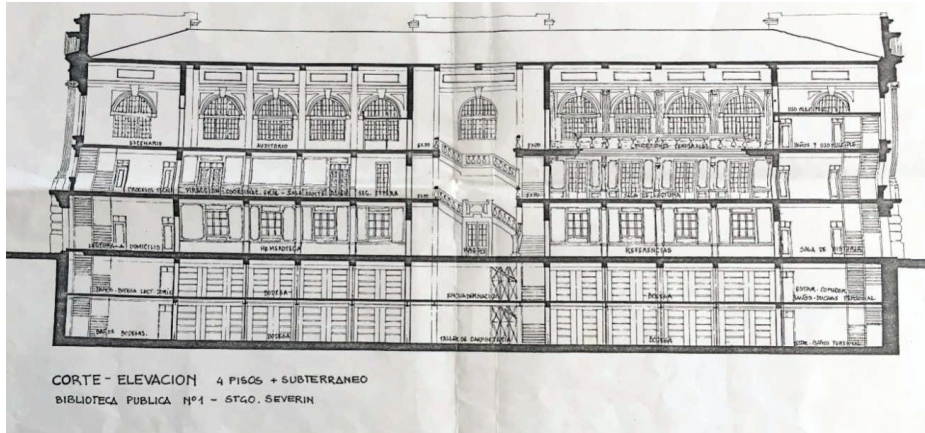


Figure 9. Section cut and elevation plane with underground project. Source: Archive Santiago Severín Library.

The library was not exempt from afflictions from the successive earthquakes. The first one of the year 1985, whose restoration was completed in 1989, with a total cost of 250 thousand US of the time and consisted in the installation of a rigid diaphragm that complemented its structure. A structure of bracing was incorporated to the building, this structure gave rigidity to control the deformations in the plane of the south and north facades.

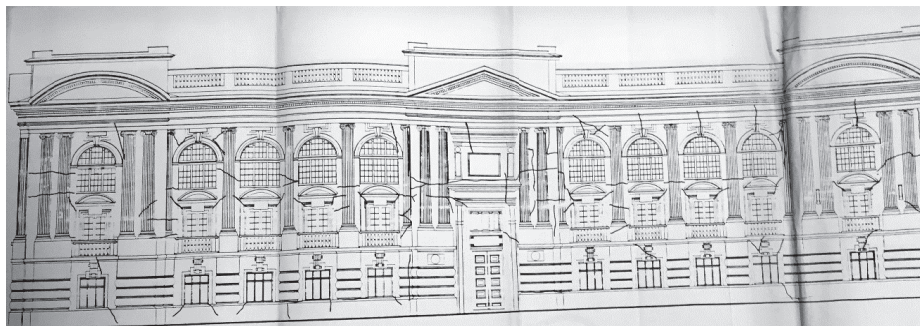


Figure 10. Elevation Yungay street fissures lift, year 1987. Source DOM.

On February 27, 2010, the library was again affected by an earthquake of VII degrees Mercalli suffering damages evaluated in 154 thousand US. According to the reports of structural diagnosis carried out by the Pontifical Catholic University de Valparaíso, the building had a good behavior of its structure in general, not observing damages of major importance or collapse, but the appearance of fissures and detachment of cornices and consoles of the facade was verified. However, in the specific sector of the auditorium, it was necessary to replace the metal structure of the roof that had surpassed its elastic range and whose profiles presented an elastic buckling, which meant the replacement of the profile for a drawer type.

According to the above, it is important to note that the impetus of twentieth-century modern structural design reflected in the Severin Library building has been able to sustain itself over time by presenting smaller or more specific interventions compared to other structures of the time. However, these innovations typical of a turn of the century are characterized by being at the service of a late historicist style, which presents a contradiction from the building point of view. Such contradiction can be explained as an interpretation of the referents and cultural exchange of the compositional architectural tradition between Chileans and foreigners, that is, of a true international style of transposition from Chile to Europe.

5 CONCLUSIONS

Heritage, in its broadest sense, is what we inherit and being aware of it is important for the development of a community and a nation, thus constituting a continuous reassessment of identity. However, in the case of architectural heritage in seismic countries, what is inherited has temporary, sensitive and mutable characteristics, where their age value is variable and not comparable with other realities that do not suffer the same phenomena.

Chile, is continually facing earthquakes and in this country, the architectural heritage is posed as a counterpoint to adversity, rising and being the subject of study for changes in regulations and improvement of construction systems. Indeed, it is important to understand that the case of the Severin Library presented in this document introduced advances in its structure, typical of a context of material revolution, together with the national dedication to proudly show the world its advances in one hundred years of independence.

Although in the Library, as in most of the architecture of the early twentieth century, the European referent remained in a late neoclassical style, and it could be said in simple judgment that this is interpreted as a lack of value and even a mere improved copy. However, for us it denotes the learning and adaptation of the inherited transfer to a changing territory.

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