ANALES de Edificación

Received: 20/11/2024
Accepted:28/11/2024

Anales de Edificación
Vol. 11, Nº1, 50-57 (2025)
ISSN: 2444-1309
DOI:10.20868/ade.2025.5515

Estudio y análisis de la problemática de los incendios durante el siglo XXI en grandes edificios patrimoniales de valparaíso, Chile
Study and analysis of the problem of fires during the 21st century in large heritage buildings in valparaíso, Chile

Mª Paz Sáez Pérez [a]; Danica Javiera Mazuela Oyarzo[b]

[a] University Lecturer. PhD, Department of Architectural Constructions. Advanced Technical School of Building Engineering, University of Granada, Spain. mpsaez@ugr.es
[b] Master MARA, Department of Architectural Constructions. Advanced Technical School of Building Engineering, University of Granada, Spain. Danica11@correo.ugr.es

Resumen-- **Valparaíso was recognized as the most developed city in Chile during the 19th and early 20th centuries. As the main port, it attracted a large number of European and North American traders who settled there. The dynamic interaction between them and the port's inhabitants resulted in a cultural syncretism reflected primarily in its architecture. However, the entire city still bears witness to this heyday, reflected in its urban fabric and numerous properties with high historical, architectural, and heritage value. Nevertheless, these properties are constantly exposed to fire disasters, the subject of the present study. Although these catastrophes are not new, they continue to occur, exacerbating this issue in recent years. The city's decline is reflected in their subsequent condition, with a total of 30 affected properties counted for the present study, all of them currently in various states.**

Palabras clave— Architectural heritage; Fire damage; Deterioration; World Heritage Site; building rehabilitation; reuse.

Abstract— **Valparaíso fue reconocida como la ciudad más desarrollada de Chile durante el siglo XIX y principios del XX. Como puerto principal, atrajo a un gran número de comerciantes europeos y norteamericanos que se establecieron allí. La dinámica interacción entre ellos y los habitantes del puerto dio lugar a un sincretismo cultural reflejado principalmente en su arquitectura. Sin embargo, toda la ciudad sigue siendo testigo de este apogeo, reflejado en su tejido urbano y en numerosos inmuebles de alto valor histórico, arquitectónico y patrimonial. Sin embargo, estos inmuebles están constantemente expuestos a catástrofes provocadas por incendios, objeto del presente estudio. Aunque estas catástrofes no son nuevas, siguen produciéndose, lo que ha agravado este problema en los últimos años. El deterioro de la ciudad se refleja en su estado posterior, contabilizándose para el presente estudio un total de 30 inmuebles afectados, todos ellos actualmente en diversos estados.**

Index Terms— Patrimonio arquitectónico; daños por incendio; deterioro; Patrimonio de la Humanidad; rehabilitación de edificios; reutilización.

I. Introduction

In recent decades, there has been increasing interest in research into the conservation of both historical and modern buildings with artistic and heritage value (Theocharis ET AL., 2018). Architectural heritage, as part of our cultural heritage, plays a crucial role in the creation of new spaces and the development of our cities.

At the same time, one of the critical challenges the world faces today is sustainable development and how best to achieve it. This has important implications in all fields and heritage conservation is no exception. This has led to demands for a new approach that combines both protective and conservation work

D.J.M.O. is máster MARA at Departamento de construcciones arquitectónicas,. Escuela Técnica Superior de Edificación, Universidad de Granada. M.P.S.P. is associate professor at Departamento de construcciones arquitectónicas in Escuela Técnica Superior de Edificación, Universidad de Granada..

(Huynh ey al., 2020; Rodrigues, Matos, Di &Costa, 2018; Ruggiero, Marmo & Nicolella, 2021), recognizing the diverse heritage values attributed to buildings (Chave et al., 2017; Mardones 2018; Rey, Vegas& Ruiz, 2018; Sampaio et al., 2021) and thus helping to protect the environment and promote the sustainability of our cities (Onecha, Dotor, Marmolejo-Duarte, 2021; Salman &Hmood, 2019).

In this context, it is imperative to ensure the safeguarding and promotion of cultural heritage, which directly affects the achievement of the Sustainable Development Goals (SDGs), by being a transversal driver of aspects related to the safety and sustainability of urban environments, the deceleration of environmental degradation, the promotion of clean and sustainable energies, and the promotion of alliances to achieve these goals (https://es.unesco.org/sdgs), thus contributing to the promotion of peaceful and inclusive societies (Hosagrahar, 2017), being this type of reference studies today in the heritage context (Saez & Marín, 2023; Marín & Sáez, 2022). In line with this approach, the European Union has set itself a strategic goal for the 21st century to achieve the sustainability and renewal of architectural heritage buildings (https://eur-lex.europa.eu/legal).

In recent times, the proper conservation of built heritage has become essential for its use and enjoyment, and for the creation of tourist attractions, leading to a significant increase in its importance and its influence within society. The preservation of architectural heritage now plays a crucial role in enhancing the quality of life of the residents of our towns and cities and also makes an important contribution to the local economy and cultural life (Borri & Corradi, 2019; Du et al., 2016).

However, ensuring the preservation and restoration of heritage buildings involves adapting them to new uses and conditions, complyingwith new regulations, and addressing the issues arising from outdated historic construction systems, so as to prevent damage and environmental impacts that could jeopardize their survival. These buildings must be conserved without altering their original character (Yi et al, 2013; Balayssac & Garnier, 2017; Ramesh et al., 2021) and to this end action must be taken to prevent deterioration and control ageing processes (Nowogónska, 2020; Drobiec; Grzyb; Zaja, 2021).

Cities have always been exposed to various types of catastrophes since their inception, including earthquakes, volcanic eruptions, floods, or fires. It is through the destruction of urban areas that they have regenerated after disasters, implementing new uses, addressing the deficiencies that partly caused these events, promoting the creation of new construction systems, and making changes in the urban fabric to better respond to new challenges they may face.

While these events will occur time and time again, all the aforementioned measures will help mitigate potential damage to city infrastructures. Thus, the following question arises: How is the situation addressed when it is not the entire city that is affected? And for the specific case of disasters related to fires, how is regeneration approached when a building still retains its architectural essence after a fire?.

Many are the cases of buildings with high architectural value affected by fires around the world, which have subsequently been restored. However, this issue continues to escalate, as highlighted in a study published in 2021: *"Despite current technology in fire prevention and extinguishing science, we have watched with despair as some heritage buildings have fallen victim to flames. From 1975 to 2005, the number of disasters has increased by around 400%..."* (Venegas et al., 2021).

Valparaíso, the city under investigation in this study, is no exception. Its problem also lies in the significant increase of properties with high historical, architectural, and heritage value affected by fires, particularly in the 21st century. However, the subsequent care process is somewhat unclear or non-existent, despite the heritage protection of certain areas of the city.

Since its inception, this urban area has always been exposed to catastrophes such as earthquakes, landslides, floods, and fires. Concerning earthquakes, at least seven of these events can be counted, with the most significant being the one in 1906. This event prompted a complete reorganization of the city, leading to the adoption of new seismic-resistant construction systems. Many of its buildings still possess this quality today (Sánchez & Jiménez, 2011), contributing in part to the city's designation as a UNESCO World Heritage Site in 2003.

Regarding fires, there is a long history of occurrences. As early as 1840, the first incidents of this kind began to be recorded (Arango, 2019). In fact, even before the discovery of the territory currently occupied by the city, in 1536, the area was already plagued by fires. Its initial inhabitants *"...referred to Valparaíso as "Alimapu," an Araucanian term meaning "burnt land," although it is important to clarify that this was not an ancestral omen, as that indigenous expression referred to fires in xerophytic grasslands..."* (Vela-Ruiz, 2018).

The city's relationship with fires is extensive. They began to occur with high frequency from 1843 onwards (Arango, 2019), with more than eight years of major disasters being recorded (1843, 1850, 1852, 1856, 1858, 1862, 1936, and 1953). As the city's population increased, so did the impact of fires. Fig. 1 shows an engraving documenting the fire that occurred in 1843.

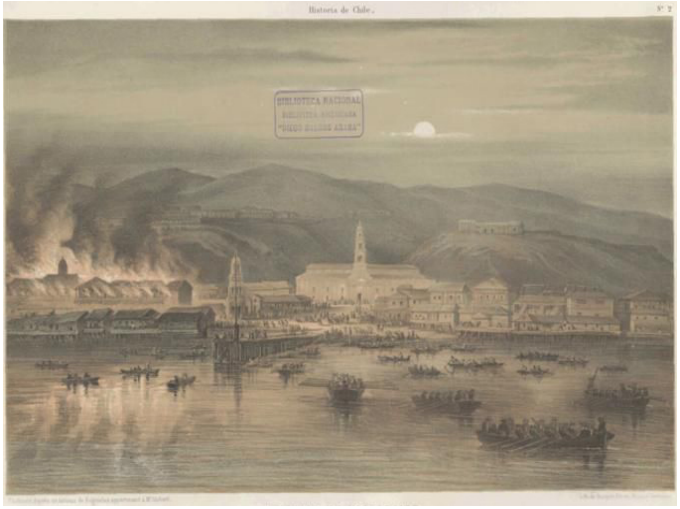

Fig. 1. Engraving by Claudio Gay, year 1843, of the Valparaíso fire. (Source: www.memoriachilena.gob.cl)

Fig. 2. Comparison of the property before the fire and after the fire. (Source: Left www.bbc.com.. Right. Author, 2023).

Plans for inspection and urban regulations were developed, allowing for control over constructions with a focus on materiality and daily uses. This recurring issue led to the establishment of the country's first fire brigade in Valparaíso. However, it should be noted that fires remain a problem for the city. Currently, there is no action protocol for fire-affected listed buildings. The first law protecting buildings or monuments was enacted in 1970 as the "National Monuments Law" (Ley 17.288, 1970), focusing on interventions and maintenance. Valparaíso's designation as a World Heritage Site in 2003 led to the implementation of new urban and territorial planning tools.

An example is shown in Fig. 2, comparing buildings before and after fire reconstruction.

Despite the city's long-standing relationship with such disasters, property fires continue to pose a significant problem. The city's decline is reflected in the subsequent condition of these buildings, with a total of 30 affected properties counted for the present study, all of them in different conditions today.

Given the importance of the topic, the main objective of the study was to conduct an analysis of buildings with high heritage, architectural, and historical value in the city of Valparaíso that have suffered fire incidents during the 21st century. The aim was to determine the causality and current conditions of their conservation states.

The study aims to quantify and determine the number of buildings burned during the 21st century to date, compiling a detailed record of each affected property through the examination of its history, architecture, classification, and fire incidents. This includes documenting its conditions before and after the fire. Additionally, the study seeks to define and recognize the current structural and legal conditions of buildings affected by fire.

This will enable the creation of a graphic and relevant data record for each affected building, facilitating the preservation of both listed and unlisted heritage in the city of Valparaíso and reducing the loss of its cultural legacy.

II. METHODS

For the research development, a compilation of all fire-affected buildings in the city was conducted to study and understand the occurrence of incidents and the actions taken regarding the issue raised.

Initially, a model form was developed to organize the bibliographic information gathered as a preliminary study of each property. Subsequently, a second type of form was created for information regarding the current conditions of the fire-affected buildings.

Regarding the scope of the study, it should be noted that, concerning the fire-damaged buildings, a timeframe for their inclusion was established, corresponding to the 21st century. However, two buildings affected by fires in 1983 and 1996, respectively, were exceptionally included due to their temporal proximity, aiming to analyze the raised issue more comprehensively. All buildings from which sufficient information could be obtained to conduct a case study were recorded.

As a second criterion for selecting the study buildings, all those with a degree of classification, high architectural and historical value, and located in protected areas of the city were considered in the sample.

After locating all of them, the city was divided into six sectors, each delineated according to areas, both within the city plan and on the hills, as well as by historical and popular recognition in small commercial and/or urban nuclei: Playa Ancha Sector - Port Sector - Cerro Alegre/Concepción Sector - Bellavista Sector - Pedro Montt Sector - Almendral/Barón Sector. Fig. 3 shows the map with the indicated sectors, displaying the geographical distribution of fire-affected buildings.

After gathering the buildings and their corresponding information, case study cards were designed, incorporating the previous studies conducted. The first type of card included data on the building's history, architecture, formal and constructive composition, classification, and references to the fires that affected the properties.

Upon completing the preliminary study of each building and compiling the data obtained from the bibliographic study of the cases, a second type of card was devised. This card was completed with data gathered from on-site visits and a general study of the buildings. It included photographic material depicting the current conditions of the buildings,

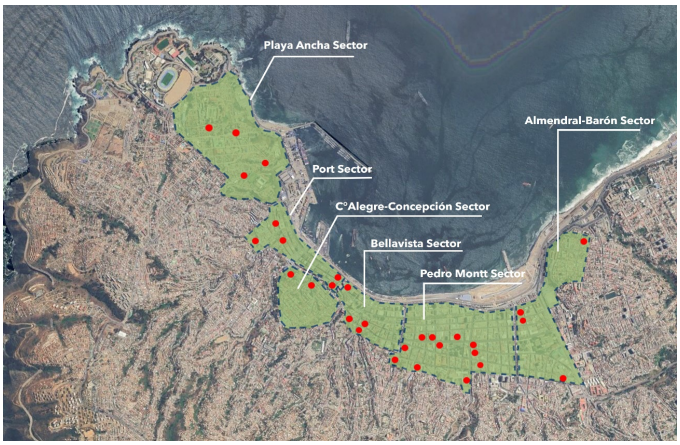

Fig. 3. Map of the city of Valparaíso with the six delimited sectors and the properties affected by fire. (Source: Author, 2023).

bibliographically collected information, and on-site data such as years of fire, year of construction, original intended use, use after the fire, location, and representative typology, among others.

Regarding the classification of the buildings studied, an order was established based solely on the most recent fire that affected them, considering that several buildings experienced more than one fire.

To conclude, the data collected from both types of cards were organized into tables, where they were sorted and cross-referenced to obtain the results. Subsequently, all data were presented in the form of graphs, from which percentages referring to all sections present in the study cards were obtained.

All fire-affected properties corresponding to the case studies exhibit unique qualities specific to the city in which they are located: Valparaíso. Throughout its history and unique geography, the city has shaped these buildings up to the present day.

III. Results

According to the information gathered from the two types of cards mentioned earlier, the data were grouped into different categories to establish relationships between the various conditions of properties affected by fire incidents.

Initially, based on the "Year of construction" of the 30 collected properties, a temporal classification was made according to the periods of the city's major development. This was done to determine the degree of architectural and historical loss of the buildings. The timeframe was divided into two periods: the second half of the 19th century, between 1845-1899, and the early 20th century, which saw the 1906 earthquake that originated and modified the construction techniques of the city's buildings.

Highlighting these periods is important given the value of the buildings that could represent a loss, aiming to identify their current state. Therefore, based on the construction years of all properties, as shown in Fig. 4, it is revealed that 20% of the cases were built in the second half of the 19th century, while 70% were constructed at the beginning of the 20th century. This demonstrates the loss of buildings that possess a unique construction system.

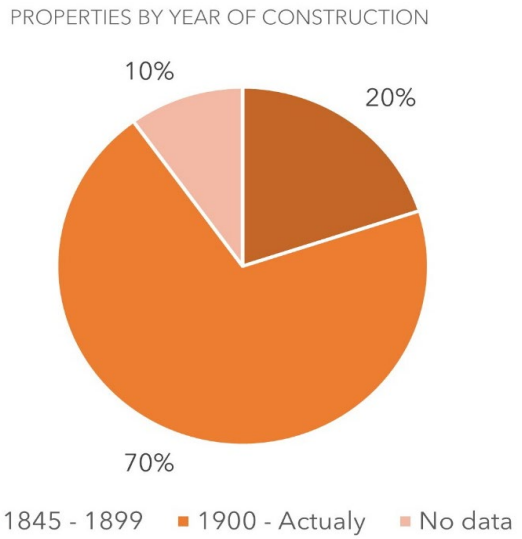

Fig. 4. Years of construction of the fire-affected properties.

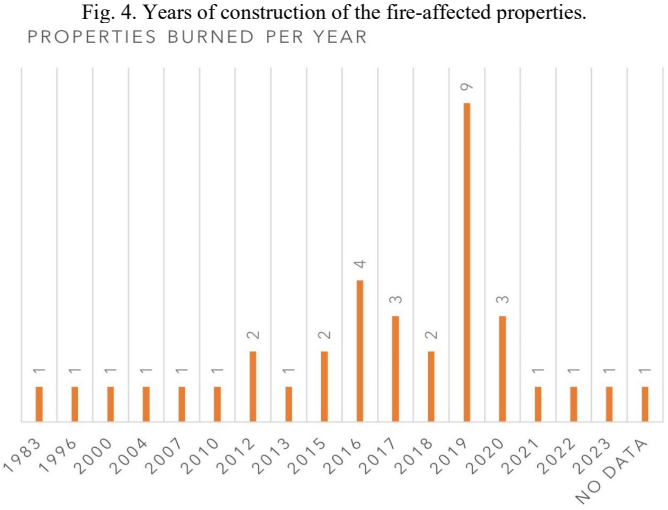

Fig. 5. Years of the fires and number of properties affected

According to the "Year of fire," the highest number of incidents occurred during 2019, with a total of 9 properties damaged by fire. Following this year, 2016 had 4 incidents, while both 2017 and 2020 each had 3 incidents (Figure 5).

In total, fires in the case studies have occurred over 17 different years. The total number of incidents recorded for the case results in 36 fires, some of which occurred multiple times in the same property, as shown in Table 1.

By "Fire entity," although the study has been conducted on individual damaged properties, the inventory reveals that in several instances, not only one property was affected, but the fire spread to adjacent buildings. Therefore, the 30 properties were classified into cases where the damage occurred individually and cases where the damage was in conjunction with other buildings.

TABLE I
PROPERTIES THAT HAVE BEEN SET ON FIRE MORE THAN ONCE AND THE YEARS OF THE FIRES

Building	years in which they were set on fire		
Building N°6 Iglesia y convento San Francisco	2013	2010	1983
Building N°18 Comercio calle Victoria	2019	2020	
Building N°24 Casa subida Ferrari	2019	2015	
Building N°26 Casa María Luisa Bombal	2020	2016	

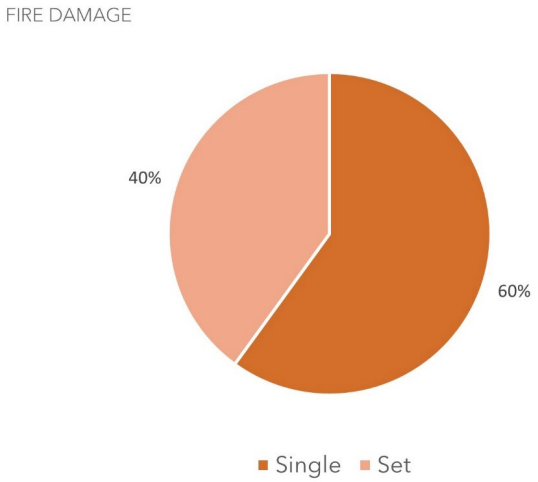

Fig. 6. Entity of the fires, type of impact, individual or collective.

From the graph in Fig. 6, it is observed that 60% of the constructions, corresponding to 18 buildings, had individual damage without propagation to other properties, while 40% of them did spread to other buildings, resulting in a larger-scale fire and consequently the loss of more than one building.

The following Table 2 categorizes all cases, indicating for each the number of properties affected by the fire and the entity.

Of all the properties with individual damage, amounting to 18 cases, 11 experienced either total interior loss or total loss of the property.

On the other hand, out of the 30 case studies, 57% of them experienced total loss or total interior loss.

The entity of the fires indicates the magnitude of what just one fire can generate in the city. Added to the loss of a property with high architectural, historical, and heritage value is the loss of urban fabric, with a significant portion of the urban fabric disappearing. This will lead to other urban and territorial issues.

Classified according to the "Initial use" before the incident

TABLE II
NUMBER OF PROPERTIES AFFECTED IN EACH CASE STUDY AND THEIR ENTITY.

Number of properties affected by fire		Entity (fire severity)
Building N°1 Luis Cousiño	1	Total interior loss
Building N°2 Comisaría de Carabineros	1	Total interior loss
Building N°3 Palacio Subercaseaux	4	Total interior loss
Building N°4 Teatro IPA	3	Partial loss
Building N°5 Teatro Imperio	1	Partial loss
Building N°6 Iglesia y convento San Francisco	2	Total interior loss
Building N°7 Casa calle Las Heras	1	Total interior loss
Building N°8 Casa sector Márquez	1	Total interior loss
Building N°9 Farmacia Av.Pedro Montt	1	Partial loss
Building N°10 Casa Gran Bretaña	2	Partial loss
Building N°11 Residencial Av.Francia con calle Victoria	2	Partial loss
Building N°12 Mercado Cardonal	1	Partial loss
Building N°13 EdificioTottus	2	Total interior loss
Building N°14 Instituto Keller	2	Partial loss
Building N°15 Casa el Peral	1	Partial loss
Building N°16 Esquina frente Imperial	2	Total interior loss
Building N°17 Comercial Fruna	2	Partial loss
Building N°18 Comercio calle Victoria	2	Total interior loss
Building N°19 Banco Estado Condell	1	Total interior loss
Building N°20 El Mercurio	1	Partial loss
Building N°21 Farmacia esquina Edwards	1	Total interior loss
Building N°22 Comercial Din	2	Partial loss
Building N°23 Farmacia esquina Condell	2	Total interior loss
Building N°24 Casa subida Ferrari	1	Total loss
Building N°25 Casa ascensor Villaseca	1	Total loss
Building N°26 Casa María Luisa Bombal	1	Total loss
Building N°27 Residencia Ancianos	1	Partial loss
Building N°28 Feria artesanías Parque Italia	1	Total interior loss
Building N°29 Cité Av. Independencia	1	Partial loss
Building N°30 Casa pasaje Gálvez	1	Total loss

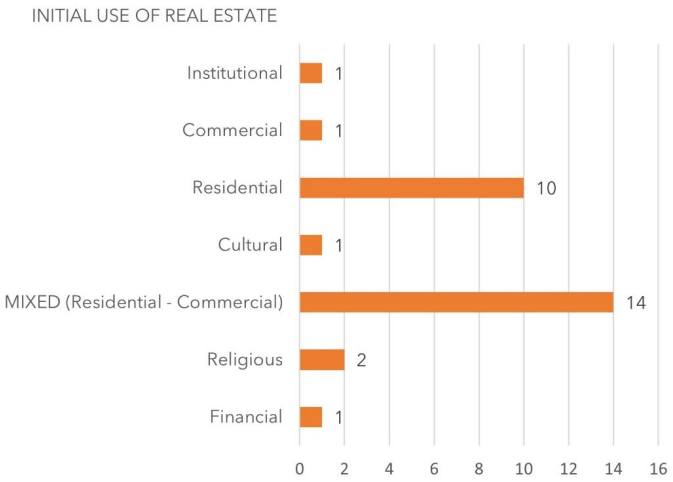

Fig. 7. Initial architectural program of the properties.

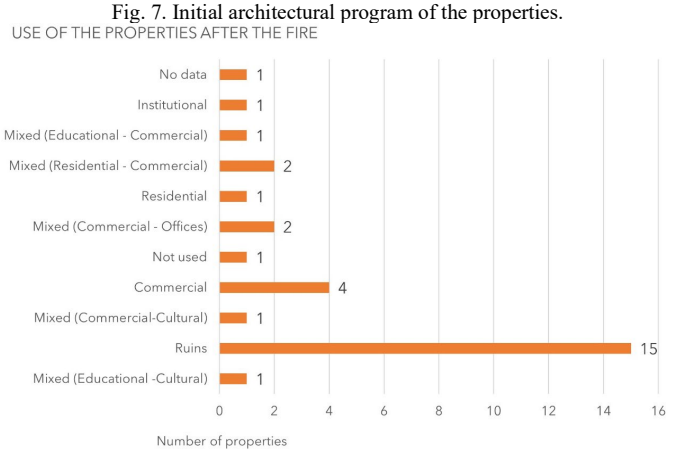

Fig. 8. Uses of the properties after the fire

that the properties had (Figure 7), it is found that 80% of these constructions housed a Residential program, equivalent to 10 properties out of the total cases, or were of a Mixed (residential-commercial) type, equivalent to 14 properties.

On the other hand, to assess possible changes resulting from the fires, data on the "Use of properties after the incident" have been collected. It can be observed from Figure 8 that 50% of the fire-affected properties have lost their initial architectural program, remaining in ruins after the incident.

Table 3 includes information regarding the aforementioned uses. It confirms that after the fire, the programmatic situation undergoes a radical change in a large portion of the properties. Highlighted in gray are the detailed variations in the uses of 50% of the properties that are currently in ruins, while the other half either retains its pre-fire use or has changed program due to reconstruction or rehabilitation works.

According to the "Recovery status" of the properties, they will be analyzed based on five criteria: Rehabilitated, with rehabilitation project, Reconstructed, Not rehabilitated, and under rehabilitation.

Below, in Table 4, the recovery statuses, the years elapsed from the fire until the present, and the number of years elapsed between the fire and its reconstruction or rehabilitation are compared.

Initially, it is noted that out of the 30 cases, 15 of them are Not rehabilitated, which corresponds to the 15 properties mentioned earlier that are in a Ruined state. Of the properties

TABLE III
COMPARISON OF INITIAL, PREVIOUS, AND POST-FIRE USES OF THE PROPERTIES. PROPERTIES CURRENTLY IN A STATE OF RUIN ARE HIGHLIGHTED IN GREY

	Intended use	Pre-fire use	Use after fire
Building N°1 Luis Cousiño	Financial	Financial	Mixed (Educational - Cultural)
Building N°2 Comisaria de Carabineros	Religious	Institutional	Ruins
Building N°3 Palacio Subercaseaux	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Ruins
Building N°4 Teatro IPA	Mixed (Residential - Commercial)	Mixed (Commercial-Cultural)	Mixed (Commercial-Cultural)
Building N°5 Teatro Imperio	Cultural	Commercial	Commercial
Building N°6 Iglesia y convento San Francisco	Religious	Religious	Not used
Building N°7 Casa calle Las Heras	Residential	Residential	Ruins
Building N°8 Casa sector Márquez	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Ruins
Building N°9 Farmacia Av.Pedro Montt	Mixed (Residential - Commercial)	Mixed (Commercial-Office)	Mixed (Commercial-Office)
Building N°10 Casa Gran Bretaña	Residential	Residential	Residential
Building N°11 Residencial Av.Francia con calle Victoria	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)
Building N°12 Mercado Cardonal	Commercial	Commercial	Commercial
Building N°13 EdificioTottus	Residential	Residential	Commercial
Building N°14 Instituto Keller	Mixed (Residential - Commercial)	Mixed (Educational-Commercial)	Mixed (Educational-Commercial)
Building N°15 Casa el Peral	Residential	Residential	Ruins
Building N°16 Esquina frente Imperial	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Ruins
Building N°17 Comercial Fruna	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)
Building N°18 Comercio calle Victoria	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Ruins
Building N°19 Banco Estado Condell	Mixed (Residential - Commercial)	Financial	Ruins
Building N°20 El Mercurio	Institutional	Institutional	Institutional
Building N°21 Farmacia esquina Edwards	Residential	Mixed (Commercial-Office)	Mixed (Commercial-Office)
Building N°22 Comercial Din	Mixed (Residential - Commercial)	Commercial	Commercial
Building N°23 Farmacia esquina Condell	Mixed (Residential - Commercial)	Mixed (Commercial-Office)	Ruins
Building N°24 Casa subida Ferrari	Residential	Residential	Ruins
Building N°25 Casa ascensor Villaseca	Residential	Residential	Ruins
Building N°26 Casa María Luisa Bombal	Residential	Institutional	Ruins
Building N°27 Residencia Ancianos	Residential	Residential	Ruins
Building N°28 Feria artesanías Parque Italia	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	Ruins
Building N°29 Cité Av. Independencia	Mixed (Residential - Commercial)	Mixed (Residential - Commercial)	No data
Building N°30 Casa pasaje Gálvez	Residential	Residential	Ruins

undergoing reconstruction or rehabilitation, equivalent to 12 buildings, only 4 of them have undergone comprehensive rehabilitation, highlighted in gray in Table 4. Meanwhile, only one case is under rehabilitation, corresponding to the Church and Convent of San Francisco (Building No. 6).

And finally, according to the "Property regime," it is obtained from the data collected and shown in Figure 9, that 70% of the total case studies belong to private ownership. Of the remaining 30%, only one property, Building No. 2, Carabineros Police Station, is owned by the State of Chile. The ownership type of the rest of the properties is unknown.

After gathering data regarding the "Property regime" of the properties, they were compared with the current state of the properties. Table 5 contrasts the parameters to verify the relationship between the property regime and the deterioration of the buildings.

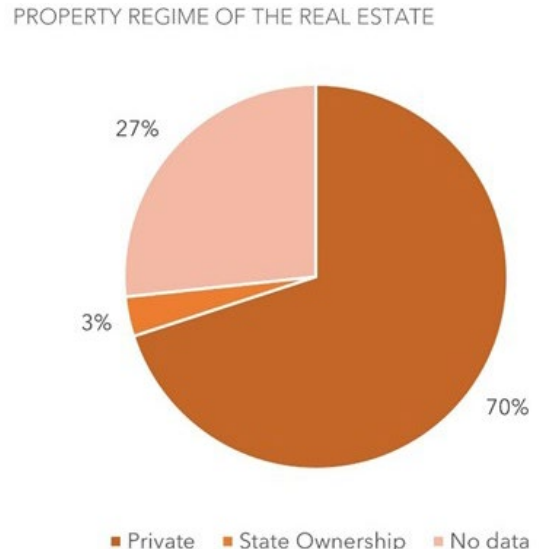

Fig. 9. Property ownership regime of the properties.

TABLE IV
COMPARISON BETWEEN THE RECOVERY STATUS OF THE PROPERTIES, YEARS ELAPSED SINCE THE FIRE, AND YEARS UNTIL THEIR RECOVERY.

	Years since the fire	Recovery status	Years until rehabilitation or reconstruction
Building N°1 Luis Cousiño	27	Rehabilitated	12
Building N°2 Comisaría de Carabineros	19	With rehabilitation project	
Building N°3 Palacio Subercaseaux	16	With rehabilitation project	
Building N°4 Teatro IPA	11	Rehabilitated	1
Building N°5 Teatro Imperio	11	Rebuilt	2
Building N°6 Iglesia y convento San Francisco	10	In Rehabilitation	2
Building N°7 Casa calle Las Heras	8	No rehabilitation	
Building N°8 Casa sector Márquez	7	No rehabilitation	
Building N°9 Farmacia Av.Pedro Montt	7	Rehabilitated	1
Building N°10 Casa Gran Bretaña	7	Rebuilt	
Building N°11 Residencial Av.Francia con calle Victoria	6	Rebuilt	1,5
Building N°12 Mercado Cardonal	6	Rebuilt	0,5
Building N°13 EdificioTottus	6	Rebuilt	3
Building N°14 Instituto Keller	5	Rebuilt	0,5
Building N°15 Casa el Peral	5	No rehabilitation	
Building N°16 Esquina frente Imperial	4	No rehabilitation	
Building N°17 Comercial Fruna	4	Rebuilt	1
Building N°18 Comercio calle Victoria	4	No rehabilitation	
Building N°19 Banco Estado Condell	4	No rehabilitation	
Building N°20 El Mercurio	4	No rehabilitation	
Building N°21 Farmacia esquina Edwards	4	Rebuilt	2
Building N°22 Comercial Din	4	Rehabilitated	1
Building N°23 Farmacia esquina Condell	4	No rehabilitation	
Building N°24 Casa subida Ferrari	4	No rehabilitation	
Building N°25 Casa ascensor Villaseca	3	No rehabilitation	
Building N°26 Casa María Luisa Bombal	3	No rehabilitation	
Building N°27 Residencia Ancianos	2	No rehabilitation	
Building N°28 Feria artesanías Parque Italia	1	No rehabilitation	
Building N°29 Cité Av. Independencia	0,5	No rehabilitation	
Building N°30 Casa pasaje Gálvez	No data	No rehabilitation	

Ultimately, it was found that out of the properties belonging to private owners, and in terms of the recovery of fire-affected properties, only 2 are Rehabilitated, 6 are Reconstructed, 1 is Under rehabilitation, and 1 has a rehabilitation project.

On the other hand, among the properties belonging to private owners without intervention, it is found that 6 buildings are in ruins - at risk of collapse, 3 of the properties have been demolished, 1 is abandoned, and the remaining one is illegally occupied, utilizing the vacant lot left by the property years after the fire.

TABLE IV
COMPARISON BETWEEN THE RECOVERY STATUS OF THE PROPERTIES AND THE OWNERSHIP REGIME.

	General Condition of the Property	Property Regime
Building N°1 Luis Cousiño	Rehabilitated	Private
Building N°2 Comisaría de Carabineros	In project	State Ownership
Building N°3 Palacio Subercaseaux	In project	Private
Building N°4 Teatro IPA	Rehabilitated	No data
Building N°5 Teatro Imperio	Rebuilt	Private
Building N°6 Iglesia y convento San Francisco	In rehabilitation	Private
Building N°7 Casa calle Las Heras	Abandoned	No data
Building N°8 Casa sector Márquez	Ruins-danger of collapse	Private
Building N°9 Farmacia Av.Pedro Montt	Rehabilitated	Private
Building N°10 Casa Gran Bretaña	Rebuilt	Private
Building N°11 Residencial Av.Francia	Rebuilt	No data
Building N°12 Mercado Cardonal	Rebuilt	Private
Building N°13 Edificio Tottus	Demolished	No data
Building N°14 Instituto Keller	Rebuilt	No data
Building N°15 Casa el Peral	Abandoned	Private
Building N°16 Esquina frente Imperial	Demolished	Private
Building N°17 Comercial Fruna	Rebuilt	No data
Building N°18 Comercio calle Victoria	Ruins-danger of collapse	Private
Building N°19 Banco Estado Condell	Ruins-danger of collapse	Private
Building N°20 El Mercurio	Rebuilt	Private
Building N°21 Farmacia esquina Edwards	Rebuilt	Private
Building N°22 Comercial Din	Rehabilitated	No data
Building N°23 Farmacia esquina Condell	Ruins-danger of collapse	Private
Building N°24 Casa subida Ferrari	Ruins-danger of collapse	No data
Building N°25 Casa ascensor Villaseca	Demolished	Private
Building N°26 Casa María Luisa Bombal	Ruins-danger of collapse	Private
Building N°27 Residencia Ancianos	Ruins-danger of collapse	Private
Building N°28 Feria artesanías Parque Italia	Demolished	Private
Building N°29 Cité Av. Independencia	Rebuilt	Private
Building N°30 Casa pasaje Gálvez	Illegal occupation	Private

IV. Conclusions

From the study conducted through the analysis of properties with fire-related issues in the city of Valparaíso, the following conclusions are drawn:

- Regarding the construction year of the properties, it is established that the loss of properties due to fire not only represents the loss of the buildings themselves but also signifies the loss of a pioneering construction system for its time, given the seismic-resistant characteristics of many buildings constructed during the first half of the 20th century.
- Based on the analysis of the properties, it is determined that fires in buildings with high historical, architectural, and heritage value have occurred over a total of 17 years, resulting in 36 incidents. The lack of action, supervision, and prevention regarding fire-affected properties has led to these events occurring repeatedly, even affecting the same building on more than one occasion.
- The significant impact of fires on properties results in a gradual deterioration of the urban fabric, leading to the emptying of various sectors of Valparaíso due to the abandonment of affected properties and the disappearance of the characteristic block typology of the city.
- One recognized obstacle to the recovery of structures is the exclusive dependence of the properties on their owners, with 70% of them belonging to private owners. Legal provisions and bureaucracy stemming from the property regime result in an extensive process for recovery and rehabilitation.

It is concluded that the responsibility for the progressive deterioration of the properties lies with the owners. 80% of them are in a state of partial loss or total disappearance. Regarding rehabilitations, the absence of intervention criteria set forth in the law or ordinances leaves open the possibility of reconstruction without safeguarding the basic values of properties with exceptional qualities.

There is a notable abandonment of structures and deterioration due to the lack of intervention by owners, mostly private, as well as by the state over the years (Sáez, Mazuela, 2024).

It is noteworthy that many properties could have been recovered through rehabilitation efforts if action had been taken promptly after the fires. However, the average number of years between the fire and intervention, based only on rehabilitated properties, is three and a half years, and this has only occurred in 4 buildings.

From the case studies, it is concluded that all legal provisions and bureaucracy stemming from the property regime lead to an extensive process for recovery and rehabilitation. In the case where the cause of deterioration is a fire, the chances of recovery are very slim.

The architectural qualities, classification, use, and current states of the buildings allow the conclusion that most of the fire-affected properties remain in a state that can lead to partial loss or total disappearance for many years.

Acknowledgements

This research was funded by Pre-competitive Research Projects Program, belonging to the Research and Transfer Plan of the University of Granada (PP2022. PP.27) and was supported by the REMINE Project Programme for Research and Innovation Horizon 2020 Marie Skłodowska-Curie Actions, Horizon 2020, WARMEST Project Research and Innovation Staff Exchange (RISE) H2020-MSCA-RISE-2017, RRRMaker project Marie Skłodowska-Curie Research and Innovation Staff Exchange, and Scientific Unit of excellence “Ciencia en la Alhambra,” ref. UCE-PP2018-01 (University of Granada) and was carried out under the auspices of Research Group RNM 0179 and HUM 629 of the Junta de Andalucía and Master MARA (Ugr).

References

Arango, D. (2019). Valparaíso ignífuga: El urbanismo para la prevención de incendios (1840–1906). In *XI Seminario Internacional de Investigación en Urbanismo, Barcelona-Santiago de Chile*. https://doi.org/10.5821/siiu.6496

Balayssac, J.-P., & Garnier, V. (Eds.). (2017). *Non-destructive testing and evaluation of civil engineering structures*. Elsevier. https://isbnsearch.org/isbn/9780081023051

BBC. (2019). Figure 2. Recuperado el 11 de abril de 2023, de https://www.bbc.com/mundo/noticias-america-latina-50643444

Borri, A., & Corradi, M. (2019). Architectural heritage: A discussion on conservation and safety. *Heritage, 2*, 631–647. https://doi.org/10.3390/heritage2010041

Chaves Moreno, E. A., Pachón García, P., Cámara Pérez, M., & Compán Cardiel, V. (2017, octubre). Caracterización de propiedades dinámicas de edificios patrimoniales mediante análisis modal operacional. *V Congreso Internacional sobre Documentación, Conservación y Reutilización del Patrimonio Arquitectónico y Paisajístico*, Granada.

Comisión Europea. (2019). *Informe sobre la aplicación de la Directiva 2010/31/UE relativa a la eficiencia energética de los edificios*. https://eur-lex.europa.eu/legal-content/ES/TXT/HTML/?uri=CELEX:52019DC0022&from=PT

Drobiec, Ł., Grzyb, K., & Zaja, J. (2021). Analysis of reasons for the structural collapse of historic buildings. *Sustainability, 13*, 10058. https://doi.org/10.3390/su131810058

Du, F., Okazaki, K., Ochiai, C., & Kobayashi, H. (2016). Post-disaster building repair and retrofit in a disaster-prone historical village in China: A case study in Shangli, Sichuan. *International Journal of Disaster Risk Reduction, 16*, 142–157. https://doi.org/10.1016/j.ijdrr.2016.02.007

Gobierno de Chile. (1970). *Ley N° 17.288. Legisla sobre Monumentos Nacionales*.

Hosagrahar, J. (2017). Culture at the heart of the SDGs. *The UNESCO Courier, 1*, 12–14. https://es.unesco.org/courier/april-june-2017/cultura-elemento-central-ods

Huynh, T., Nguyen, B.-P., Pradhan, A. M. S., & Pham, Q.-Q. (2020). Vision-based inspection of bolted joints: Field

evaluation on a historical truss bridge in Vietnam. *Vietnam Journal of Mechanics, 36*, 77. https://doi.org/10.15625/0866-7136/15073

Mardones, G. (2018). The defense of the architectural heritage: The Chilean case. *ARQUITEXTOS, 25*(33), 73–86.

Marín-Nicolás, J., & Sáez-Pérez, M. P. (2022). An evaluation tool for physical accessibility of cultural heritage buildings. *Sustainability, 14*, 15251. https://doi.org/10.3390/su142215251

Memoria Chilena. (s.f.). Figure 1. Recuperado el 4 de junio de 2023, de http://www.memoriachilena.gob.cl/602/w3-article-99714.html

Nowogońska, B. (2020). Consequences of abandoning renovation: Case study—Neglected industrial heritage building. *Sustainability, 12*, 6441. https://doi.org/10.3390/su12166441

Onecha, B., Dotor, A., & Marmolejo-Duarte, C. (2021). Beyond cultural and historic values: Sustainability as a new kind of value for historic buildings. *Sustainability, 13*(15), 8248. https://doi.org/10.3390/su13158248

Ramesh, G., Srinath, D., Ramya, D., & Krishna, V. (2021). Repair, rehabilitation and retrofitting of reinforced concrete structures by using non-destructive testing methods. *Materials Today: Proceedings*. Advance online publication. https://doi.org/10.1016/j.matpr.2021.02.778

Rey Rey, J., Vegas González, P., & Ruiz Carmona, J. (2018). Structural refurbishment strategies for industrial heritage buildings in Madrid: Recent examples. *Hormigón y Acero, 69*(285), 91–99. https://doi.org/10.1016/j.hya.2018.05.001

Rodrigues, F., Matos, R., Di, M., & Costa, A. (2018). Conservation level of residential buildings: Methodology evolution. *Construction and Building Materials, 172*, 781–786. https://doi.org/10.1016/j.conbuildmat.2018.03.129

Ruggiero, G., Marmo, R., & Nicolella, M. (2021). A methodological approach for assessing the safety of historic buildings' façades. *Sustainability, 13*(5), 2812. https://doi.org/10.3390/su13052812

Sáez-Pérez, M. P., & Marín-Nicolás, J. (2023). Design of a support tool to improve accessibility in heritage buildings—Application in case study for public use. *Buildings, 13*, 2491. https://doi.org/10.3390/buildings13102491

Sáez-Pérez, M. P., & Mazuela, D. (2024, marzo). Analysis of the problem of the fire in buildings with patrimonial value during the 21st century in Valparaíso, Chile. *IX Congreso Internacional de Innovación Tecnológica en Edificación (CITE2024)*, Universidad Politécnica de Madrid, España.

Salman, M., & Hmood, K. (2019). Conservation of historic districts: Challenges of integration in modern cities within sustainable perspective. In *XIII International Conference on Virtual City and Territory: Challenges and paradigms of the contemporary city* (p. 8530). CPSV, Barcelona. https://doi.org/10.5821/ctv.8530

Sampaio, A. Z., Pinto, A. M., Gomes, A. M., & Sanchez-Lite, A. (2021). Generation of an HBIM library regarding a palace of the 19th century in Lisbon. *Applied Sciences, 11*(15), 7020. https://doi.org/10.3390/app11157020

Sánchez, A., & Jiménez, C. (2011). Valparaíso: La ciudad-puerto más importante de Chile y la vulnerabilidad de su patrimonio arquitectónico a los riesgos sísmicos. *Estudios Geográficos, 72*(271), 559–589. https://doi.org/10.3989/estgeogr.201122

Theocharis Katrakazis, T., Heritage, A., Dillon, C., Juvan, P., & Golfomitsou, S. (2018). Enhancing research impact in heritage conservation. *Studies in Conservation, 63*(8), 450–465. https://doi.org/10.1080/00393630.2018.1491719

UNESCO. (n.d.). *Objetivos de Desarrollo Sostenible (ODS)*. https://es.unesco.org/sdgs

Vela-Ruiz, A. (2018). ¿Valparaíso o pirópolis? Historia de una gestión ineficaz en el control de los incendios. 1843–1927. *Revista Archivum, 8*(9), 279–295.

Venegas, D., Erazo, O., Farías, O., Ayabaca, C., & Medina, A. (2021). Fires in world heritage buildings. In *Artificial Intelligence* (Vol. 1, pp. 1–15). https://doi.org/10.1007/978-3-030-68080-0_32

Yi, J., Park, W., Lee, S., Huynh, T., Kim, J., & Seo, C. (2013). Evaluation of vibration characteristics of an existing harbor caisson structure using tugboat impact tests and modal analysis. *International Journal of Distributed Sensor Networks, 2013*, Article 806482. https://doi.org/10.1155/2013/806482