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OJS

Índice / Contents

Recognition and Reuse of Industrial Heritage for its Conservation. Cornish Machine Houses in Pachuca and Real del Monte, Hidalgo, Mexico

Ir a la versión en español

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Translation by Lucienne Marmasse

ABSTRACT

Recognizing the importance of an architectural heritage would be the beginning for its conservation. One way to contribute to this is to consider reusing it. The purpose of the study is to value one of the most important tangible inheritances of the Pachuca and Real del Monte Mining District in Mexico, such as the Cornish Engine houses, which marked the mining landscape of the 19th century, with the arrival of the technology of the steam. Analyze its architecture based on documentary research and its current vestiges and reflect on its conservation perspective, supported by the assignment of a use or reuse, considering the theoretical bases of industrial heritage, as well as a look at what has been done in other places such as Spain and Great Britain, towards avoiding the loss of a part of this important heritage.

KEY WORDS

Cornish engine houses; industrial heritage; recognition; conservation; reuse

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

INTRODUCTION

During the 19th and early 20th centuries, the incorporation of steam technologies shaped the industrial mining heritage of Pachuca and Real del Monte, Hidalgo, Mexico. Coming from the county of Cornwall, England, steam engines to drain tunnels would come to solve the problem of flooding that was preventing the exploitation of mines from continuing. The engines and their respective housing units, known as "Cornish type" or "Cornish", began to predominate the landscape, with their stone and red brick chimneys, characterized by their remarkable craftmanship and the thick columns of smoke they produced through the combustion of wood or coal to heat water and produce steam. According to sources that we will cite below, there were around twenty of them made throughout this time period, yet only four of them remain with sufficiently recognizable traces to allow for a hypothetical reconstruction of events, made with the support of historical photographs. The recognition of this technological innovation enhances the value of these assets but, in accordance with the theory of architectural restoration, reusing them favors their conservation, which is not always easy: converting these buildings that housed now obsolete technology into living buildings fit for use in the modern world is a difficult yet not impossible challenge that, as has been seen in examples across Mexico, Spain, and of course, England.

HISTORICAL BACKGROUND

The British arrived in Real del Monte in 1825. The "Company of Adventurers to the Mines of Real del Monte" (Randall, 1977, p. 9) departed from Cornwall County, England, in 1824, attracted by the description of the riches by European explorers of the New World, such as Alexander von Humboldt. The Mining District of Pachuca and Real del Monte was in crisis due to the flooding of their tunnels. Through the use of steam technology, they hoped to reactivate mining activity in the area, which did happen, yet the British company went bankrupt in 1849, subsequently withdrawing from the area. Several factors led to this situation: Principally, their dependence on England, lack of timely communication, labor difficulties with Mexican and foreign workers, changes in the mineral beneficiation system, among others. However, steam technologies and their powerhouses —or pumping houses— continued to be used in the mining district up until the beginning of the 20th century, something that Mexicans with the help of British businessmen and

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

technicians, took advantage of to mine other veins of the Pachuca mines and not only, as they had intended, in Real del Monte.

CORNISH ENGINE HOUSE TECHNOLOGY

The purpose of the steam engines contained in the Cornish houses, was to pump water from the mining tunnels —which were flooded by water levels or by seepage from the surface during the rainy season— to higher levels (countermines). Invented in England, by Thomas Savery in 1698, and later improved by Thomas Newcomen in 1712 and James Watt in 1790 (Laws, 1973, pp. 4-6; Cano, 2010, p. 14), before finally being perfected by James Watt in 1790 (Laws, 1973, pp. 4-6; Cano, 2010, p. 14). By 1800 there were already around 500 such machines at work in England. By the time the Company left Cornwall in 1824 and the machinery arrived in Real del Monte in 1826 (Randall, 1977, pp. 65-74) and according to Hernández Ibar's archaeological study at the Acosta mine in Real del Monte, the basic operating system of the machines brought to the Mining District of Real del Monte and Pachuca corresponded to Watt's final version. The Acosta machine, dated to 1874, measured 85'' and was manufactured by the Harvey and Co. foundry. (Hernández, 2002, p. 39).

Figure 1 shows its basic parts —installed inside the powerhouse— and then shows the operating cycle, based on the description of Hernández (2002) and the company Crofton Beam Engines, one of the most important companies in the preservation of this type of heritage in England, which used Watt's version (Croftom Beam Engines, 2015, p. 2).

> *1.* The cycle started with the pumping lever in a downward position, facing the draft. The cylinder inlet and exhaust valves remained open while the balance valve was closed. The operator would open the valve, steam would enter at the top of the piston and push it down, this would raise the pumping plunger; halfway through the stroke, the inlet valve would close and the steam would continue its expansion (Croftom Beam Engines, 2015, p. 3).
>
> *2.* Halfway through the cycle, the exhaust valve would close and the balance valve would open, allowing steam above the piston to pass into the cylinder, which is lifted by the weight of the plunger, displacing steam into the vacuum below the piston (Croftom Beam Engines, 2015, p. 3).

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

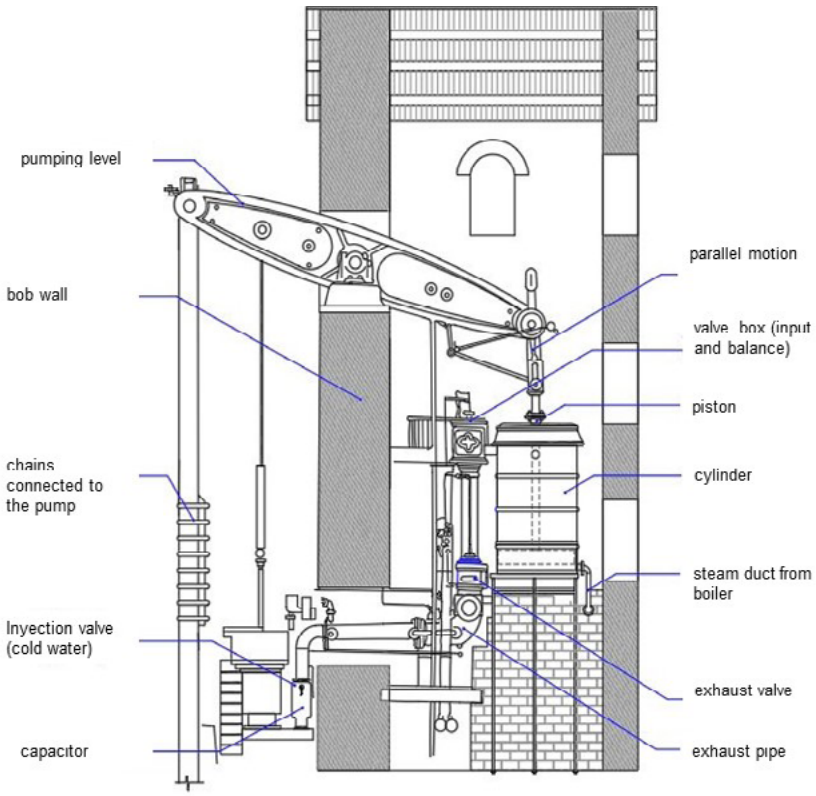

FIGURE 1. Schematic diagram of a drainage machine in cut, together with the Cornish house (Schematic diagram: Lozada y Lagarda, 2021; source: Laws, 1978, p. 5).

3. At the end of a cycle, the balance valve closes as the exhaust valve opens. At the same time, the inlet valve opens to allow another steam injection. When the exhaust valve opens, a stream of cold water is injected into the condenser; the valve is connected to the exhaust system, causing the steam under the piston to condense, thus producing a vacuum (Croftom Beam Engines, 2015, p. 3).

4. At the next cycle, the pressure difference between the steam above and the vacuum below causes the piston to drop. In this way, steam is injected into the cylinder which was used twice and recovered as hot water inside the boiler (Croftom Beam Engines, 2015, p. 3).

Cornish type engine house architecture

The necessary parts of a Cornish type powerhouse —the likes of which can be found in Real del Monte as well as in Pachuca, as will be seen later— were basically the following:

- Pumping machine housing
- Boiler room
- Chimney

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

Within the same set of the mine where the Cornish house was located, there was generally a dam or cistern for the storage of water that fed the boilers, also used for the daily activities necessary for the operation of the mine's basic functions. The drainage machine had to be located on one side of the draught, which varied according to the topography of the property, which also included the gallows or derrick, the winch house, repair shops, warehouses, administrative offices and living quarters. For control and security, the complex was surrounded by stone walls and access was granted through a wooden or iron gate (Lozada, 2008). Barton describes this type of building (1999, pp. 4-21).

In turn, the engineer responsible for the design of the machine projected his plans for the house. The aesthetic issue was secondary: the scarce ornamentation was presented in the frames of the openings, in the finials or in the body of the chimney. The building had to find a way to sit carefully, because of the need to place it on one side of the flue, where the pumping lever gave. This meant a great risk for the machine and for the workers since, where it to break, it would cause a collapse that could obstruct the mouth of the flue. At first the levers were made from wood; later they would be made of stronger materials, almost always two large pieces of iron. Its weight could exceed 50 tons in a large machine. In Cornwall, where they had their own nomenclature, that beam was known as the "*bob*"; hence the wall supporting it was called the "*bob* wall", which was the thickest, made of specially selected stones. In general, the whole house was built, from the foundation up, of stone to support the weight of the machine and the additional load imposed by the pumping action. In order to make it easy to handle, ashlars were used, which were placed in a running bond pattern, laid with lime and sand mortar.

The dimensions of the main elements cited by Barton correspond to the houses built in Pachuca and Real del Monte. The rectangular floor plan measured an average of 7 x 10 m, with a height of 23 m at the ridge walls and 16.50 m at the bottom. The thickness of the "*bob* wall" fluctuated between 1.07 and 1.83 m, while the other walls were half as thick. The foundation depth ranged from 3.00 to 4.27 m.[1] The openings were kept as small as possible to avoid weakening the structure. Generally, the final finish of the exterior was left exposed, leaving the stone visible.

A gable roof was the norm, with an average slope internal angle of 45°. Inside, there were platforms on three levels: One at the

[1] Dimensions were converted, in some cases rounded, from feet to meters (Barton, 1999).

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

base of the cylinder, one approximately at its highest part, with a third one level with the pumping lever. Among the main risks for the powerhouses —were fires. Dry timbers from the roof structure and ladders, plus the large amount of oil and bait used for lubrication, making them particularly. As a preventative measure, attempts were made to make the buildings fireproof. Iron was used for the stairs and roof beams, stone slabs for the floor, eliminating wooden materials in as much as was possible.

To one side of the pumping machine house was the boiler room (Figure 2)[2] (Colectivo Proyecto Arrayanes, 2006), an elongated enclosure of a single level, practically half the height of the house mentioned above. Nearby must have been the sheds where firewood or charcoal was stored. Naturally, in that room were the boilers, whose bases were made of stone or brick, which were connected to the base of the chimney. The walls were made of stone laid with lime and sand mortar, flattened with the same material. They would usually have a gabled roof with openings made for ventilation.

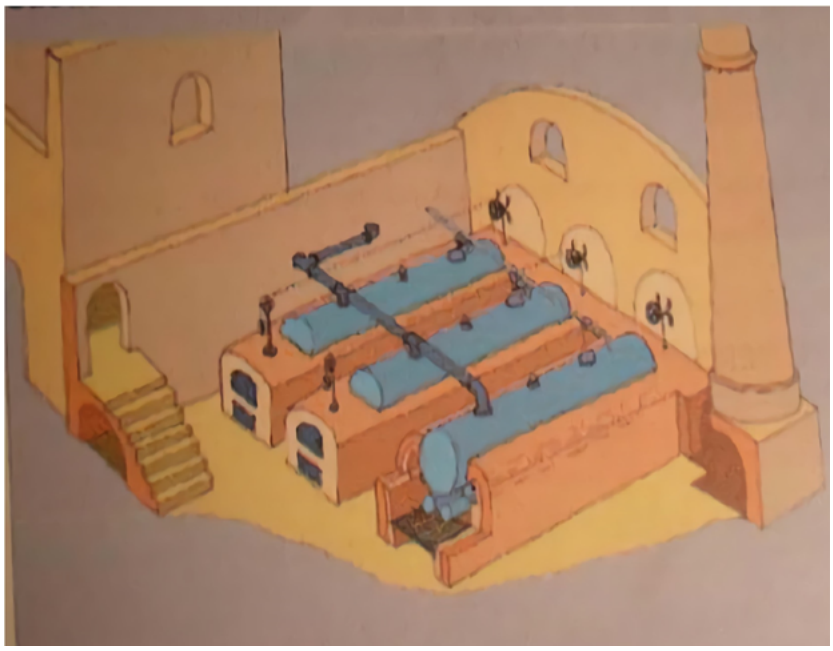

FIGURE 2. Isometric of a section of the pumping house within the boiler room (Source: Arrayanes Project, 2006).

The chimneys, an outstanding architectural element, allowed the gases produced by the combustion process occurring under the boilers to be ejected. Their approximate height was between 16.46 and 35 m, with a diameter between 1.00 and 1.83 m at its widest

[2] The image belongs to an article published by the Colectivo Proyecto Arrayanes, whose purpose is to protect the mining heritage of the District of Linares, in Andalusia, Spain, where steam engines and Cornish houses were also installed.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

part and a base of between 1.00 to 3.35 m. They were regularly made by using stone already available in the region for the base (white quarry is used again in the area) for up to approximately two thirds of the total height, with the rest being made from annealed red brick, although some houses used it for the totality of the body. It is deduced that this facilitated the construction process, as the partition wall was easier to raise as the height of the canyon increased. Most of the houses in the region were made separate from the pumping houses, but they could be attached, to achieve greater stability and reduce costs. Construction took a relatively short time; Barton mentions three months, providing weather conditions were favorable.

The base materials for the construction of the steam engine houses in the area were, firstly, white quarry stone (the passage of time giving them a straw-colored patina blackened by humidity), the main source of which came from Tezoantla, a nearby community southeast of Real del Monte; then, the annealed red brick was used for decorative details in the openings or as enclosures; the drainage house shows an apparent finish of ashlars in the masonry on the exterior, but one flattened with lime and sand mortar on the interior, and finally, the roofs had a wooden structure covered with *tejamanil,* interlocking wooden slats, which was later replaced by zinc sheeting (Lozada, 2008).

TECHNOLOGICAL DISPLACEMENT AND THE RECOGNITION OF INDUSTRIAL HERITAGE

At the beginning of the 20th century, this orifinally British technology was overtaken by the arrival of electricity: the steam engines were subsequently dismantled, leading to the destruction of almost all the buildings that housed them. Their preservation depended almost entirely on their viability of adaptation to house the new type of machines, yet that could be more complex than just creating new or additional spaces —there was no real need or perceived benefit for conservation. Almost 100 years later, in 1995, formal awareness, or valuation— of industrial architecture in Mexico began with the Comité Mexicano para la Conservación del Patrimonio Industrial, A. C.[3] (CMCPI), affiliated with the International Committee for the Conservation of Industrial Heritage (TICCIH), created in 1978, and the International Council on Monuments and Sites (ICO-

[3] Mexican Committee for the Conservation of Industrial Heritage, A. C., editorial translation.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

CONVOCATORIA 2022-2023
CALL FOR PAPERS 2022-2023

ICOMOS). Subsequently, in 2006, TICCIH Mexico was created. The *Ley Federal sobre Monumentos y Zonas Arqueológicos, Artísticos e Históricos Federal*[4] was passed in 1972, but industrial heritage is not explicitly protected, so there was no legal tool to prevent the loss or ruin of many buildings of this type, along with the various items inside them: machines, tools, documentation, among many others, despite the work done by the aforementioned institutions to safeguard and rehabilitate this heritage.

THEORETICAL CONSIDERATIONS ON THE REUSE OF INDUSTRIAL ARCHITECTURAL HERITAGE

In a brief allusion to the theoretical cornerstones of architecture, Vitruvius, in *The Ten Books of Architecture*, refers to three qualities that a building classified as a public utility must possess: firmness, utility and beauty (Vitruvius, 1787, p. 14). In a very similar way, the Mexican theorist José Villagrán García attributes the following values to Architecture, the: social, factual, aesthetic and useful (Villagrán & Del Moral, 2002, p. 13). That is to say, utility is an inherent part of what makes architecture what it is and differentiates it from other visual arts. However, with the passage of time and the acquisition of its status as a historical asset, architecture can modify its program of needs or even make them disappear altogether. That is why the theory of architectural restoration in general emphasizes maintaining buildings use in favor of their conservation, but, of course, as long as their historical, formal and, in fact, functional essence is not transgressed (ICOMOS, 1964).

Specifically in the case of industrial heritage, the starting point is a problem that arises when the original purpose is displaced by socio-cultural change, the availability of natural resources and, mainly, technological evolution (specialists mention this the most). In principle, the *Carta de Monterrey* points out that two of the reasons why this category of heritage suffers a greater degree of abandonment and lack of protection is the inadequacy for its modern day use in productive processes and the lack of vision by both its owners and the authorities, in being able to design new projects for its continued use (ICOMOS Mexico, 2006). Consequently, the letters *of Nizhny Tagil, Burra* and *Seville* call for their use to be, for present and future social benefit, part of conservation; even to be seen as a form of sustainability, for its cultural contribution to citizenship,

[4] Law on Archeological, Artistic and Historic Monuments and Zones, editorial translation.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

as it increases people's awareness of their industrial heritage, and even for its help in mitigating business crises, acquiring a role in the economic and social regeneration of areas in decline.

Even with the benefits that a new use brings to industrial heritage, it should focus, according to the *Burra Charter* (ICOMOS Australia, 1999, pp. 1-2), on cultural significance; therefore, it should be respectful of the property as well as its essence and authenticity: if there is respect for the different contributions over time, including those related to use, they can be removed if they are considered detrimental to the place. The reintroduction of a new type of use for a place, or a change of use, would be to help a better interpretation of the site and increase the enjoyment of living, visiting or working it, but these actions must be reversible and identifiable; likewise, in the case of any reconstructions. Therefore, any adaptation must be compatible so as not to affect the existing essence, preserving the original circulation patterns and functional legibility of the property. Any new work incorporated must be empathetic to the volume, texture and, in general, the original existing architectural appearance, without falling into imitations. Something fundamental before making any change is to register the factories, associations and meanings (ICOMOS Australia, 1999, p. 3). The *Seville Charter* points out that the intervention should be a process in constant evaluation, allowing the incorporation of new data (Sobrino et al., 2018). The *Niznhy Tagil Charter* suggests the inclusion of an exclusive area to represent the original use of the property (TICCIH, 2003). Models, plates, videos, among others, can be valuable tools for this purpose.

The implementation of an ideal use for industrial heritage, which has longevity or that can be constantly renewed, making it more sustainable in the long term, is not considered easy, given the rapid evolution of technology, which accelerates the obsolescence of the eventual project, and implies an adequate selection of the assets that can be restored (Sobrino et al., 2018). In this sense, a methodology will be proposed that, from the surveying of the properties, the programming of its intervention and in general the whole process of execution and subsequent maintenance, will take into account technological innovation. The importance of creating projects for productive economic activities, such as tourism or the provision of services, requires the consensus and support strategies of governments, as well as financing, tax incentives and specialized guidance for the development of projects for the companies that own these historic properties. These assets should be included in municipal heritage catalogs, urban plans and rehabilitation areas

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

when they are abandoned or in the process of deterioration. On the other hand, when carrying out the proper identification and valorization, not only the architectural and aesthetic instances should be taken into account, but also the functional, technological and sociological ones also (ICOMOS Australia, 1999; TICCIH, 2003; Sobrino et al., 2018). Use, then, could be continued, modified or reinstated as a preferable and appropriate form of conservation.

In short, although the original use of the Cornish engine houses has been displaced in present-day life, it is important to attempt to reuse them in order to favor their conservation. In the following section, an architectural analysis of the most complete vestiges remaining in the study region is put forth.

STEAM ENGINE HOUSES IN THE MINING DISTRICT OF PACHUCA AND REAL DEL MONTE

The British arrived in Real de Monte in 1825 and had the machinery in place by 1826, when they began to install it as the mines were being rehabilitated, mainly on the Vizcaína vein mines. According to Randall (1977), the first machine was assembled at the Morán mine: it was small and horizontal, but there are no traces of the powerhouse (pp. 74-77).

A list of the mines that had steam machinery and buildings of from the Cornish time or later has been made. Several publications record them, such as *La minería: el Distrito Minero Pachuca-Real del Monte a través de la Historia* (Soto, 1985)[5] as well as *Inmigrantes británicos en el Distrito Minero de Real del Monte y Pachuca* 1824-1947 (Villalobos, 2004)[6] and *Ruta de la plata* (Oviedo & Hernández, 2011)[7]; also tourist audiovisuals, such as Hidalgo Tierra Mágica, A. C. (2021), among others. Thus, the following are referred to:

- *Pachuca*: Maravillas, Guadalupe, Xotol, Santa Gertrudis, Corteza, San Pedro la Rabia, Rosario, Bordo, Pabellón, San Juan. Later non-cornic: Minerva, Hacienda de Guadalupe, Hacienda de San Francisco, Camelia.
- *Real del Monte*: Morán, Dolores, Acosta, Terreros, San Cayetano and Dificultad.[8]

[5] Mining: the Pachuca-Real del Monte Mining District through History, editorial translation.
[6] British immigrants in the Real del Monte and Pachuca Mining District 1824-1947, editorial translation.
[7] *Silver route,* editorial translation.
[8] The Dificultad mine, which is of German origin, has the largest steam engine house in the district; it is not described in the present article, but will form part of

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

- *Mineral de la Reforma*: San Juan la Blanca, Blanca, San Agustín la Blanca, San Barrón, Dos Carlos, San Guillermo, San Francisco, Santa Gertrudis and Cabañas.
- *Omitlán* (later, non-cornic): Hacienda de Velasco, Hacienda de Sánchez y Cabrera.

For the powerhouses, only photographic records survive to tell the tale of the predominance they once had over the landscape. Among them, the Maravillas mine (Figure 3) and the Xotol mine (Figure 4): yet, architecturally, only the chimney of the latter survives.

The following is a list of the mines where the four best preserved Cornish engine houses remain within Pachuca and Real del Monte, along with a hypothetical reconstruction of their likely original forms.

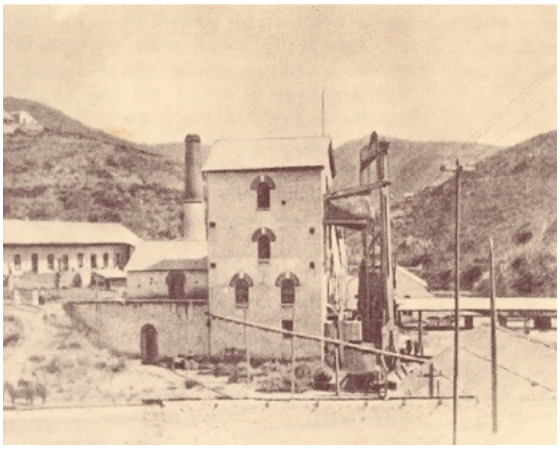

FIGURE 3. Maravillas Mine (Source: Soto, 1985, p. 250).

FIGURE 4. Xotol Mine, Barrio de Camelia (Source: Mediateca del INAH, ca. 1900).

The Corteza mine (Figures 5, 6 and 7) is located north of Pachuca, in the Anáhuac neighborhood, one of the most disadvantaged in the city. According to data from the Archivo Histórico de Minería, in a report by the mayor of Tulancingo, Pedro José de Leóz, by 1750 good metals were being extracted from it. In 1770 another report, made for the Viceroy Marquis de Croix, mentions it as abandoned due to it being too full of water, a situation that continued until 1780. At the beginning of the nineteenth century it began to enter production again, but due to the pressure of the insurgents,

a later study of the continued use of steam machinery subsequent to those of the Cornish type.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

in 1812 it was abandoned again. Steam technology was installed after 1860. It came to function as a warehouse for diamond drilling samples of the Real del Monte and Pachuca Company (Archivo Histórico de la Compañía de Real del Monte y Pachuca [CRDMyP], 2010).

The mine has no current use; its vestiges are abandoned and parts of the roof and walls have already collapsed. There are no visible traces of the chimney.

FIGURE 5. La Corteza Mine (Source: Villalobos, 2004, p. 26).

FIGURE 6. La Corteza Mine. Current state (Source: Hidalgo Tierra Mágica, A. C., 2021).

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

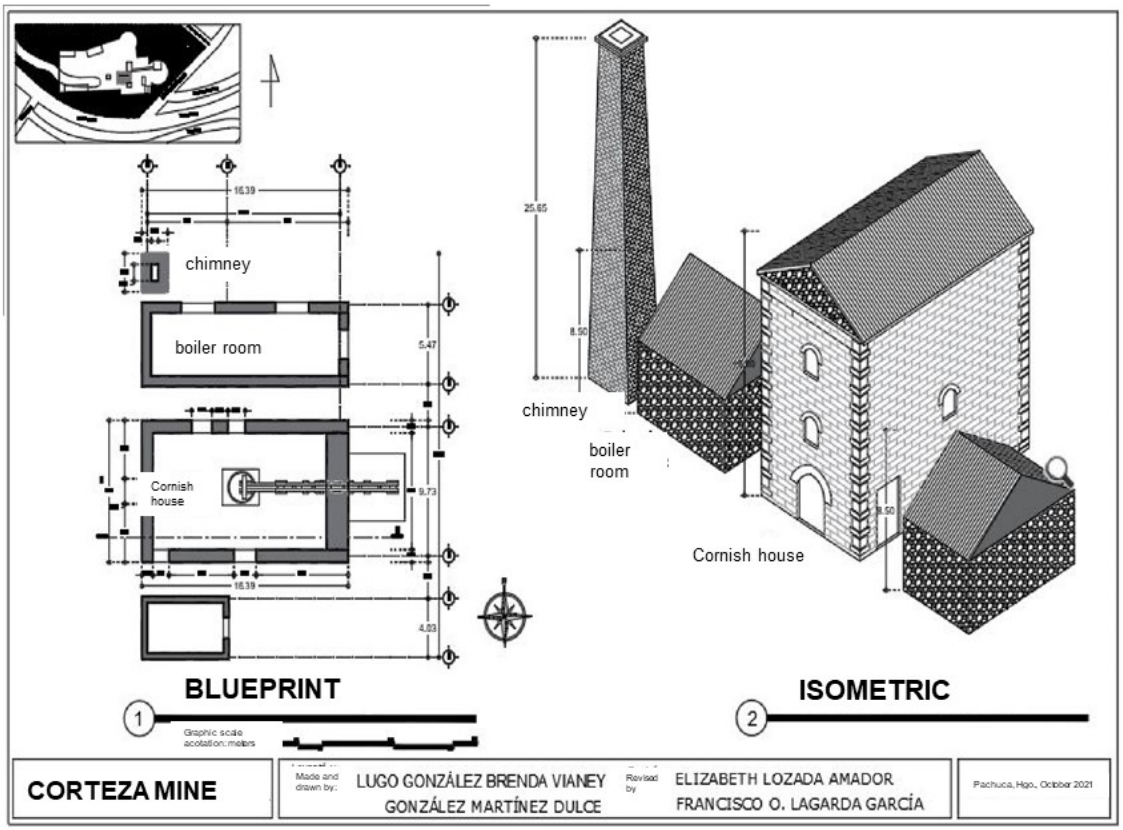

FIGURE 7. La Corteza mine. Hypothetical reconstruction (Plan: Lugo, & González, 2021).

The San Pedro la Rabia mine is north of Pachuca (Figure 8), in the middle of a desolate landscape where the expanding urban sprawl has not yet reached. Although it is difficult to get close to it, it can be seen from the road leading to the Cristo Rey viewpoint on the Santa Apolonia hill. This powerhouse is different in that it has a chimney attached to it (in the others the chimneys are free-standing) (Figure 9). Its state of conservation is perhaps the most dilapidated, but its natural context makes it stand out and gives identity and historical context to the landscape of the region. It currently has no practical use or function.

The proposed use for the two previous sites is to incorporate them into the Mining Archaeological Route of Pachuca,[9] in order to visualize them externally. In the meantime, it is necessary to consolidate the buildings and rehabilitate the complex in order to approach the site in an orderly and safe manner. In La Corteza, since

[9] Tourist tours promoted by the municipality, during which you can visit some of the mining sites, including the Paraíso mine, where you can enter the patio and the winch house. The remains of the Camelia mine are also included. Some other mining complexes can only be seen from the outside, such as the Hacienda de Loreto and the San Juan mine; others can be seen in the landscape, such as the aforementioned chimney of the Xotol mine.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

FIGURE 8. San Pedro la Rabia Mine (Source: Schwartz, 2021, https://projects.exeter.ac.uk/cornishlatin/cornishinlatinamerica.htm)

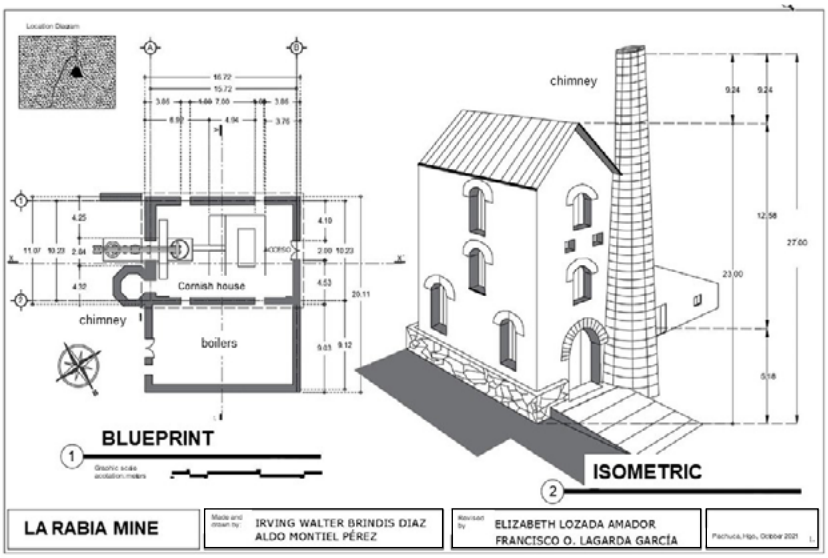

FIGURE 9. San Pedro la Rabia mine. Hypothetical reconstruction (Plan: Brindis, & Montiel, 2021).

it is immersed in the urban stain, it would be possible to think of a complex for community use that would benefit the neighborhood where it is located.

The Dolores mine is located in Real del Monte (Figures 10, 11), next to the main public parking lot for visitors to the town. It was exploited since the 18th century by Pedro Romero de Terreros. The British company received it in ruinous conditions. According to the inventory of 1824, it was an operating shaft 135 m deep, with the mouth provided with masonry arches, walls, remains of galleries, stables and barns, all in a disastrous state. By 1849 the British handed it over to the Mexican Company with the following: "A steam engine with a 65-inch cylinder, used in the general drainage; its three boilers; buildings for living quarters and for housing the engine, boilers and a furnace; three sets of pumping apparatus"[10] (Randall, 1997, pp. 240-241). Warehouses and workshops

[10] Editorial translation from the Spanish version.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

for carpenters and blacksmiths, stables for hundreds of mules and horses, and barns to store their straw and other fodder were built in the yard (Todd, 1977).

Current use: it is being rehabilitated by the Real del Monte and Pachuca Company and the Archivo Histórico y Museo de Minería, A. C., as a site museum and a school of design and crafts.

The Acosta mine (Figures 12, 13) is located within the boundaries of the town of Real del Monte; and still has passable vehicular access road. Its exploitation began in the Spanish era, pass-

FIGURE 10. Dolores Mine (Photo: Lozada, 2007).

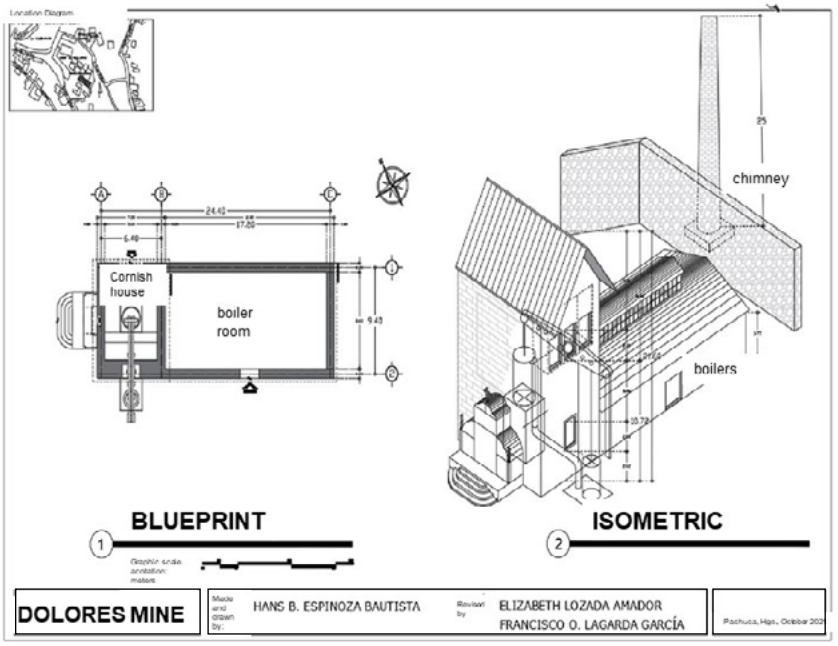

FIGURE 11. Dolores Mine. Hypothetical reconstruction (Plan: Espinoza, 2021).

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

ing through English and North American entrepreneurs, and it still has vestiges from that time. The arrival of steam technology at the mine was recorded in mid-1839, when John Rule ordered the installation of a 30'' engine (Randall, 1997, pp. 109-110). By 1861 it had two steam engines, which were dismantled along with the buildings that housed them. The current Cornish house that stands out in the complex dates back to 1874, a date carved on its east facade. It houses an engine that was completed on January 11, 1875. The bases of the boilers are preserved and it's chimney, is one of the only ones that remains perfectly preserved in the region. The superintendent's living quarters are also preserved from the same period (Archivo Histórico y Museo de Minería, 2008). It is currently a site museum in which the entire complex has been restored, yet, the Cornish house, together with its chimney, are the undisputed protagonists of the place.

FIGURE 12. Acosta Mine (Photo: Lozada, 2007).

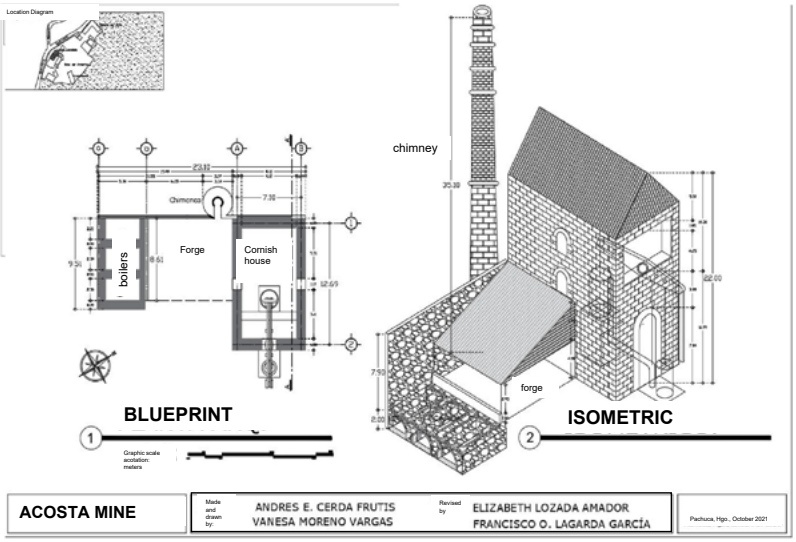

FIGURE 13. Acosta mine. Hypothetical reconstruction (Plan: Cerda, & Moreno, 2021).

USE AND CURRENT STATUS OF CORNISH PUMP HOUSES IN ENGLAND AND SPAIN

The county of Cornwall, England, is undoubtedly the main reference in the preservation of the eponymous, i.e., Cornish, engine houses that arose during the Industrial Revolution. Perhaps because of the large number of engine houses that were built there, there has been greater conservation and today, many of them can be seen completely restored, as well as some on display, with their machines still working, as if they had never stopped over a century

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

ago —such as is the case of East Pool Mine, a site museum where the steam engine is preserved (Figure 14). Another case is East Wheal Rose: the engine house ended up immersed in what now serves as an amusement park, with a little steam train that makes it different and uniquely attractive to children (Dinning, 2014, p. 1).

Other cases of reuse are found at Wheal Lushington, where one such house was repurposed as a private residence and another as a coffee shop (Nilfanion, 2010). It is believed that the residence never had the machinery installed in the first place

In 2006 the Cornwall and West Devon Mining Landscape was designated a World Heritage Site, based on the criteria of its industrial impact in the United Kingdom and the world: it retains its urban and rural landscape integrity satisfactorily enough and there is clear authenticity in form, design and materials as well as in the location of the elements, as the mines, machinery and associated buildings are well consolidated and even the loss of some of their architectural details is reversible. The protection of the area has been reinforced with the world designation, declarations and local plans that set the guidelines for protection and management (Unesco World Heritage Convention, 2021).

If there is one place in the world after England that preserves the largest number of Cornish engine houses, it is the Linares region of Spain (Figure 15). Their current use is limited to serving as a testimony of history and now forms part of a popular tourist route. The architectural complexes, which had other types of spaces, such as offices, workshops, and living quarters, among others, have been adapted to current uses. In these places the rehabilitation has touristic purposes, with the use of the natural landscape. Their state of conservation allows them to be properly identified. The Los Lores mine, in this area, with the help of decorative lighting, highlights its constructive manufacture and allows appreciation of its aesthetic value, not really originally a priority in the construction of a building house machinery.

ANALYSIS OF RESULTS

The importance of the architectural vestiges of the Cornish powerhouses remaining in the region studied could not be doubted: each one of them shows constructive and basic area distribution variants that, together with their territorial context, make them unique.

As for their repurposing, most of the cases of rehabilitation that have been presented now are part of a museum complex, and serve as a landmark in the landscape environment, as in Linares.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

The reduced space inside the powerhouses and the need to intervene as little as possible in the existing vestiges for archaeological studies make their rehabilitation almost a contemplative exercise. The constructed spaces surrounding them are more easily adapted to modern uses, and in the houses that have been rehabilitated, they have been placed at the service of the whole complex. The engine house that served as a residence or dwelling house and its cafeteria in England are notorious, considering that, despite its cramped, tall, narrow yet sturdy shape -in general not spacious-, it was still possible to adapt to a new purpose, showing that even when it is inconvenient to inhabit an original and historic space, it is still possible —and can often be wonderful and unique as a result.

It is evident that the Cornish houses that have a current use are preserved in better physical condition than those who have not found a new purpose, and although they are incomplete, there has been no need to reconstruct their missing parts, since the characteristic design of their architecture allows this to be done in plans and models that already constitute a legacy for future generations.

Regarding what remains in the study region, those located in Real del Monte: the Acosta mine and the Dolores mine, are part of complexes rehabilitated as site museums. The constant vigilance and attention obtained by using the constructions makes their maintenance and future more secure.

In the case of those located in Pachuca, the difficulty of access currently prevents a hypothetical reconstruction of greater scope, but their state of conservation, in addition to historical photographs, allow for their architectural identification; however, the sites lack of clarity on rightful land ownership makes it very difficult to push restoration initiatives. For this reason, their importance is documented and recorded, while the possibility of rehabilitating these facilities and making them the trigger for the development of the surrounding areas is being pursued.

CONCLUSIONS

The nineteenth-century Cornish houses, built around British steam technology, in the Mining District of Pachuca and Real del Monte are tangible testimony of a unique industrial heritage in Mexico, an enclave of something that in the United Kingdom is regarded as world heritage. The district could have been formed as a homogenized region for this type of architecture, but this possibility was lost over time, leaving only isolated cases that separated would have required greater care and attention, unfortunately this has

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

not been the case. The Cornish houses of Pachuca are at risk because of their apparent abandonment which, it is assumed, is partly due to their lack of a modern day purpose. This does not suggest that they should have a random use forced upon them without first carrying out a proper architectural, territorial and archaeological study of each site to determine the correct execution of intervention (of which an approximation has been made here). Each site has its own complex set of circumstances, such as ownership status and economic capacity, in addition to: territorial accessibility and socio-cultural environment, which can give properties definite advantages or disadvantages. Therefore, the rehabilitation of the Cornish houses in Real del Monte was always a. more viable and likely occurrence, due to its access routes and the tourist attraction that the site has become in the back drop of one of Mexico's registered quintessential '*pueblos magicós'* (magical towns). The cases in Pachuca require generating the conditions for approaching these sites, including pedestrian and vehicular pathways and security for visitors. Their reuse can be part of the socio-economic regeneration where they are immersed, as established in the *Nizhny Tagil Charter* in point 5.V:

> Continuing to adapt and use industrial buildings avoids wasting energy and contributes to sustainable development. Historic heritage can play an important role in the economic regeneration of deteriorated or declining areas. The continuity implied by reuse can provide psychological stability to communities facing the sudden end of a long-standing source of employment (TICCIH, 2003, p. 4).[11]

So, although mining is no longer the primary source of employment in the area, the possibility of rescuing all of its historically significant buildings should not be underestimated. The region has a history that should be exalted and an identity that needs to be reinforced through the tangible witnesses it still has, but there is a lack of will, initiative and awareness of the benefits that can be generated by undertaking the rescue of these buildings. Much remains to be studied about the case and also about buildings for non-Cornish steam engines -yet this must be undertaken in a separately dedicated study-, one which represents the different stages of industrial development, yet the focus must be on building upon history and, above all, to bring it closer to the society that

[11] Editorial translation from the Spanish version.

Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

now has inherited it, providing it with a purpose and thus new life in the 21st century.

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Intervención

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OJS

Índice / Contents

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Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

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Intervención

ISSN 2448-5934

JULIO-DICIEMBRE 2021
JULY-DECEMBER 2021

OJS

Índice / Contents

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