SILOS, Reused Machine-Buildings: A Proposal for Its Transformation

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Abstract. Second half of the 20th century: The Spanish rural landscape changes with the imposing profile of Silos. In the urban edge, next to the railroad, they are risen competing in height with church steeples. Today they are inseparable elements of the image of many peoples of cereal geography of any region of Spain. They are consequence of the autarkic economy of that time (storage of grain and state control over distribution and price) Silos were the answer given by the engineering efficiency and economy of means: A type of store operated by screw-conveyor moved with electricity, transport grain to fill high slender square plant cells. Hydraulic push offset between cells that form a matrix-walled plates constructed of thin sheets of brick or concrete block, armed only horizontally. And huge vertical loads carried by thick foundation reinforced concrete pillars. The political regime change and the energy crisis of the late seventies caused these magnificent building-machines stopped being used. Its radical specialization led them to death. After years of neglect and transfer of ownership between administrations, a consciousness has emerged in Spain (National Plan of Industrial Heritage, 2000) that has prevented its demolition, and recognize the values they bring to the landscape and structural-construction of its own, as beautiful works of Engineering which are worth cataloguing / protection. Hence this proposal tries to intervene these giants through new uses, transforming, allowing their conservation. This process investigates various structural types and implements strict standards of construction resolved with efficient construction solutions. The result is returned to society by publishing their work, while stressing heritage values, demonstrates the new strength of these local systems.

1. Introduction
Joseph Dart created in Buffalo in 1846 the so-called "sea leg". In a few years and with the help of technological advances he rose to the final image of the famous "grain elevators" that fascinated the eminences of European architecture [1]. After a century the construction of grain silos began in Spain to solve the postwar famines caused, among other factors, by a deeply obsolete and ill-fated agrarian system [2]. Therefore, in the 1940s and as a method of autarky, the National Silos and Granaries Network (RNSG) was created in 1940 as part of the National Wheat Service created three years earlier. This was an organ of the State founded to handle grain distribution nationwide. The construction of silos is carried out between 1949 and 1990 creating an infrastructure of 954 units [3].

However, this system was abandoned when, in 1986, Spain joined the European Economic Community [4], becoming dependent on Community legislation. The state monopoly on wheat came
to an end. Therefore, the silos of the RNSG, with the exception of some cases, were considered inadequate due to their insufficient storage capacity, being disused and transferred to the Autonomous Communities [2]. From this moment the silos are deprived from the function they were designed and the need to think on their value and the possibilities they offered. On the other hand, there arises a need to propose new uses that prevent their abandonment and that revert in new formulas to transform the cit

2. Development
The abandonment of silos in Spain occurred in 1994. A report informed that most of them were unsuitable for the function they were supposed to do. [2]. However, its rehabilitation and adaptation to new uses has not been immediately promoted, many years went by for these constructions to be found of some interest. We are not talking about a collective interest, but only certain groups that have begun to worry about the preservation of these buildings. It is important to think about on the reasons why currently it is not usual to carry out initiatives to keep this heritage and whether these premises are well founded or there are arguments that refute them.

One of the reasons is the lack of awareness of society about the value of industrial heritage, due to the commonly concept of heritage. People are used to appreciating the value of a place for its beauty and singularity, it is difficult for the citizens to recognize this factory character. However, they should not be evaluated aesthetically by the same criteria as the traditional artistic or architectural heritage, [5] but must be understood as the result of circumstances in a historical moment that give its particular characteristics and aesthetics. In addition, the value of industrial heritage lies not only in the singularity of a construction or in its beauty as an isolated element, but also in the idea that this element is part of a whole system created in many territories and it is a testimony of part of history [6]. Another error is relating it to the patrimony close to the present, since the term heritage is generally associated with elements that do not constitute the recent history and therefore it is customary not to value buildings made in the last decades. One should not follow this mistake since, despite being a heritage close to our days, it should not be deprived of its historical value, a value that lies in the reinforcement of collective memory, in the capacity of showing us a part of the social and economic history of a time so, we must act from now on to ensure its conservation [7].

These circumstances have led, among others, to the demolition of the silo of the port of Malaga (Figs. 1 and 2), demolished in 2006, considered as the only representative building of its typology [2]. This example so close to our days, in which not even a technical team of urban planners and architects were able to avoid demolition, is a sign of the lack of awareness about the importance of this heritage.

Figures 1. and 2. Málaga’s Silo before and after its demolition. @Malagaayeryhoy, 1 to March 2013

Another factor that has conditioned the promotion of initiatives for the rehabilitation of the silos of the Network is the lack of anticipation. For a long time, patrimonial elements have been rehabilitated
which, because of their idiosyncrasy, could be considered safe values, since they are aesthetically attractive elements, with a good location ... Nevertheless, it must be realized that it is necessary to go further and anticipate the evolution of The cities and their needs anticipating possible patrimonial actions. This is what happens with a lot of silos; Many of them are far from the population centers or in manufacturing areas whose environment can be unpleasant and with few opportunities. But nowadays rehabilitation must transform those circumstances that a priori appear as negative in positive, knowing to recognize the potential that they have, and going from seeing the disadvantages to visualizing the opportunity that these constructions offer to create new foci of growth, to supply of The services that the citizenship needs and, ultimately, to build the city.

On the other hand, together with the constraints mentioned above, there is the important expenditure necessary to cover the costs of the commissioning of the building [8]. We are facing constructions of an imposing volume that even lacking of pathologies of importance need a strong investment for their adaptation. This is why the idea of the real need of such an expense for the town should be considered, since it is a risky investment. However, even though it may be considered a daring investment, the alternatives that arise in the absence of rehabilitation of the building must be taken into account, since there will come a time when it will be deteriorated or ruined and its demolition will be necessary. Besides supposing a considerable expense, it contributes to enlarge the ecological footprint. In addition, due to factors such as the scarcity of urban land or its high price, much of the industrial heritage has been used to develop strategies consistent with its annihilation as a formula to generate a new cycle of revaluation of industrial and adjacent soils [9] [10] in such cases, the costs of demolition of the current and construction of the new would almost certainly assume A significant increase in cost over rehabilitation, as well as the amount of resources consumed.

Another condition is the town planning regulations that govern the municipality. There are usually very strict management plans in such areas or uses that forbid the performance on this type of buildings. In addition, many of the possible rehabilitations for silos would be linked to the urban regeneration of the sector in which they are located, for which it would be necessary to generate management tools in greater detail than the General Plans. This fact leads us to influence in the importance of awareness of the value of our heritage. Much of the responsibility for the conservation of our silos lies there and the power to modify those regulations is in their hands.

At the moment most of the grain silos is in the hands (or in process of being) of the Town Councils after long years of transference between administrations. That is why, today, municipalities are the main responsible for their conservation as heritage, and must promote initiatives for their rehabilitation, becoming the main agents of urban dynamization in front of them. From a municipal point of view this should not be seen as a burden but as an opportunity

As a didactic heritage [7] and testimony of a time in the agri-food industry of our country, silos can and should act as an element that contributes to the reinforcement of local identity. Once rehabilitated, as an active part of the urban fabric, and taking into account the impressive volume and height it presents, the silo would become a symbol within the city. It would be one of the elements that contribute to the character and identity to the municipality or neighborhood, so that it would arise the interest of the citizenship as part of the industrial heritage and as a landmark.

The fact of turning the silo into a landmark within the city does not only imply the before mentioned. This action can bring about enormous changes in the urban fabric and collect more purposes related to the improvement of the city. In this way, it would seek to transform the city through the monumentalization of the building, understanding the concept of monument as "everything that gives permanent meaning to an urban unit". [11] Passing to the monumentalization of the city through a change of urban configuration whose focus is the element to
be dignified and to which it is intended to attribute all its value, i.e: "monumentalize the city" means organizing it in a way that emphasizes the signs of collective identity basic for the urban consciousness of this community."

It is important to understand the potential of silos as a key element for urban regeneration because we are faced with an immense majority of silos whose location in the municipality corresponds to areas of the periphery (Fig. 3). These places sometimes suffer a significant degradation or have undergone an uncontrolled growth. Urban planners were focusing only on addressing the housing shortage and thus generating a deficit of important community equipment and a poor urban fabric. In addition, in Spain today the population growth is very low, so our concern should not be as much the growth of the city as the regeneration of the existing spaces, improving the quality of life through its rehabilitation and endowing the Municipality of all those services that it lacks.

Figure 3. Examples of interventions in Spanish Silos. From left to right, Silo of Espera (Cadiz), Silo of Fuentes de Andalucia (Sevilla), Silo of Pozo Blanco (Cordoba)

The rehabilitation of the silo can then become the starting point for recovering the urban quality of an entire area and for the reactivation of the city's economy [12]. In fact, many of the silos have considerable plots of land. According to data collected by the group of researchers "SilosyGraneros.es" 80% of the units of the National Silos and Granaries Network located in Andalusia has a plot of between one thousand and five thousand square meters. This makes easy its reuse among other things because it can be used to integrate other units that complement the function given to the silo. It could allowed to generate a new public space of quality: whether a place of outdoor recreation or a commercial mall. This last could act as the engine of a regeneration of the environment, all this among the many possibilities that could be observed.

There are, therefore, two degrees of performance on silos as driving elements of urban revaluation [9]. On the one hand to use it as an engine for regenerating the environment, carrying out its rehabilitation to generate the equipment that the municipality needs and, taking advantage of the large area that they have in many cases, so that it becomes an attraction of the area and allows an interest for the area where it is located. Certain activities could have place and revitalize the area. On the other hand, and in cases in which the sector is much deteriorated, starting from the reuse of the silo as a focus of restructuring and propose a plan of action in the whole sector. For this purpose, it would be convenient to create a Special Plan for Internal Reform that contemplates units of action that will provide a solution to the problem that the area presents. Focusing this Plan to an improvement in the definition of the urban fabric, to give a higher quality through sanitation or disposal of the urban services it lacks or the intervention on any other factor that helps the degradation of the area.
New social needs imply new opportunities and consequently the recovery of the building and its area with new functionalities.

In short, what once meant a strategic geolocation of the building in the field of agriculture production, today is again an opportunity to recover that strategic position for which was initially projected in a new urban and social context.

3. Results and discussions
The Research Group "Heritage and Environment" of the University of Granada's Higher Technical School of Building Engineering (PMA-ETSIE) aims to promote this unique heritage and promote its recovery through its study and through the elaboration of proposals of reutilization developed, among others, by the students of Final Grade Project. The group has had the opportunity to work on two of these "containers", in the towns of Pinos Puente and Padul, in the province of Granada. In order to develop and propose "new ideas" for the recovery and regeneration of these buildings and their areas of influence for the benefit of the community.

3.1 Padul
The village of Padul, which has a population of around 8,400 inhabitants, is located in the Lecrin Valley, an enclave of connection between the Vega de Granada, the Alpujarras and the coast. The main economic engine of the region is agricultural production.

The silo is located in the southern area of the population nucleus. At the beginning of its activity in 1966 [2] it was located in the outskirts of the municipality (figure 2), in the southwest border, strategic position since it facilitated the entrance of the means of transport that gave or received the wheat.

However, in time construction activity and housing demand caused the municipality to expand to a point where the building is inside the consolidated urban land (Fig. 3). In addition, at present the City Hall is located in the southern area very close to the silo (Fig. 4), where there are also community facilities of various kinds.

![Figure 4. Panchromatic Digital Orthophoto of Andalucia 1977-1978. Source: es.goolzoom.com](image)

![Figure 5. Basic Color Ortofoto 2015-2016. Source: National Plan of Orthophoto Aerial](image)

Another fact to take into account is the degradation that presents the plot in which the silo and the surrounding area is located. This circumstance is due to a growth of the municipality trying to answer to the demand for housing without attending other criteria or establish any type of urban strategy. The
result is the anodyne urban fabric and no facilities, giving rise to the usual residential neighborhoods of the periphery that are only a place of passing by and not of activity or enjoyment of citizens.

The proposal to reuse the silo that the PMA-ETSIE is studying will be aimed at creating a landmark in the city that can be recognized by all. This will contribute to the character and identity to the municipality through its monumentalization [11]. This will be assisted by an urban performance on the plot with the aim of creating a quality public space (Fig. 5) and becoming a claim to generate life in the area. The social needs that the locals demand will be channeled and interpreted by their political representatives and our group.

3.2. Pinos Puente
The town of Pinos Puente, with an approximate population of 11,000 inhabitants, is at 16'800 km from the capital Granada and it is located north of the Vega de Granada. The distant situation of Pinos Puente with respect to the city of Granada has been, among others, the cause of not having suffered the speculative dynamics of other towns closer to the capital. This fact has allowed the maintenance of this type of compact city to a main nucleus. At the same time, it has maintained a certain degree of industrial development that was initiated in the 19th century: industries in the agri-food sector.

At the western limit of the town of Pinos Puente next to the Vega is its industrial area (Fig. 6), an area of deteriorated appearance and almost marginal to the rest of the town, where the bad smells and some pollution are their unfortunate signs of identity.

One of the most neglected and destroyed example in this area is the plot of what was once the "Azucarera Nueva del Rosario". Today an unrecognizable place with almost an empty space of 32,000 sq.m. in which some incoherent and disused buildings stand reminds of his brilliant past. Taking advantage of the disused area, in the sixties it was decided to install a grain silo considering the good conditions offered by the plot in relation to its large area, its infrastructure and especially its optimal rail and road communication.

This grain warehouse was operational and operating very little time, a little more than ten years since its construction, having been closed in 1977. From then until today, the silo has been inactive and unused. Taking advantage of this fact, the PMA-ETSIE Research Group is studying together with the City Council of Pinos Puente a project to recover the place as a nucleus and germ of the economic and

![Figure 6. Current status Silo of Padul.](image)
social development of the municipality space, relocating and balancing with the new uses of this revitalized industrial zone, turning into a platform for knowledge and agri-food production.

Figure 7. Panoramic view Silo of Pinos Puente

The idea seeks to create a ring that joins this productive platform with the Bridge of Visigodic origin, on the one hand, a large axis of civic and administrative use created by the recovery of adjacent spaces and emblematic buildings and, on the other hand, of a fluvial park that incorporates the integral recovery of the margins of the river Velillos in all its urban section. In short, we are once again developing an exercise of applying the criteria for exploiting the industrial heritage and its potential to restructure and sanitize the city (Fig. 7) that has been degraded by poor urban planning.

Figure 8. Proposal Area Silo of Pinos Puente. Panoramic view. Source: G.Fernandez Adarve, PMA-ETSIIE- UGR

4. Conclusions
The future begins to be built in the present learning from the past. Making a city today, far from urban growth [15] is to regenerate and recover the good of our past, adapting it without giving up progress and the current moment; Quoting Aldo Van Eyck, "every space is a place and every time is an occasion" [16]
In the space the buildings "have known" to adapt themselves to the times traditionally. The limitation of resources was a powerful spur to the imagination. What once had a function, knew how to change and adapt itself to new social times and demands. It is in our recent history that we have tried to demonstrate that we are capable of making everything new, and have succeeded, at the high cost of expending part of our heritage (excluding the unsustainable associated economic cost).

Fortunately, today it is usual to provide new opportunities to those buildings that have not so much historical value. The design of a city should not be a mere technical exercise. The multidisciplinary teams should be able to propose urban regenerations that attend to the demands of the current social life and encourage the occupation and the use of the urban centers, subjected to speculative processes and without inhabitants. These emblematic buildings can be "central places" for that regeneration.

Let us achieve these buildings to have new opportunities.

The silos at the time provided a clear strategy for development and progress. Its location and typology proved a clear productive strategy. As functional buildings, the disappearance of the generating activity caused its disabling and closure. We must take advantage of them and know how to interpret and channel, attending to the new social functionalities, recovering the strategic function for which in the day they were designed, helping to regenerate its surroundings and the city in which they are inserted.

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