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Short Communication

The D5 Silo of Manganese of the Lampreana (Zamora): History, Construction Characteristics and Technology

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Abstract

Spain's National Network of Silos and Granaries building a total de 665 silos and 285 granaries. 20 different typologies of silos were built, highlighting type D over all of them with a total of 389 units. This typology prolonged its construction for 34 years, appearing several subtypes (D1, D2, D3 D4 y D5). The Manganese of the Lampreana silo (Zamora) is a D5 type silo with 3,350 t of storage capacity, distributed in 24 storage tanks called cells, built in 1968. Architecturally speaking it is a simple and powerful silo. It has a rectangular shape, made up of three rows of square cells, the outer rows of cells rested directly on the ground storey floor and the center row is raised. Front tower between two cells, being embedded between them in a central position, achieving a compact and robust volume. The structure is made up of reinforced concrete pillars at the corners of the cells and the cell walls of reinforce bricks. Technologically speaking it has many similarities with its predecessors, types A and B. Here the elevator receives the grain directly from the reception hopper raising wheat and emptying it onto an upper horizontal belt conveyor, where dampers motorized valves, it is distributed across other tubes to one of the three cells in each bay. The grain is unloaded onto lower horizontal belt conveyors lying at different heights. From there it is carried to a raised cell for bulk offloading onto a lorry.

Introduction

The storage of wheat as a raw material for human consumption has been done since ancient times [1]. A turning point in this type of storage came with the invention of the grain elevator by J. Dart´s in 1843, going from traditional granaries or Horizontal Storage Units (HSU) to silos or Vertical Storage Units (VSU) [2,3]. In Spain, in order to ensure the supply of wheat, the state created the Servicio Nacional del Trigo (national wheat service, SNT) [4,5] that applied a regulatory and interventionist policy. The SNT around 1945 elaborated the General Plan of the Spain's National Network of Silos and Granaries (NNSG) to build silos and granaries throughout the country where wheat can be stored [6,7]. Four different groups of silos were built depending on their function:

a) Receipt. Close to the farmer and with less capacity. Includes 11 typologies (A, B, C, D, E, F, GV, H, J, MC and MR).

b) Transition and Reserve. In strategic places, with greater capacity, to receive the cereal from the receipt silos. 6 typologies (TR, TC, TE, TH, TV and TF).

c) Port silos. With functions similar to Transition and Reserve silos located in ports. One typology (P).

d) Seed selection. To select and condition seed for subsequent sowing. Two typologies (SV and SA).

With Spain's accession to the European Economic Community, the use of silos was reduced to a minimum, being 2002 the last year in which many of them were used. The Spain's agricultural guarantee fund, the Fondo Español de Garantía Agraria (FEGA) transferred the responsibilities of the silos to the regional governments (Spain's 'autonomous communities'), recovering control in 2014 [8] causing many to be in a process of abandonment and deterioration. Farm cooperatives and a number of private companies for grain storage leased some of them. This is the case of the Silo type D5 of Manganese of the Lampreana (Zamora). To this day, it is used by the cooperative COBADU store grain or as pick-up sites for onward shipment.

The objective of the work was trace the history of D5 silo of Manganese of Lampreana, analyses their construction characteristics and technology. The information gathered is valuable for anyone wishing to learn more about these buildings and would be highly useful for projects designed to conserve and find new applications for this segment of the agro-industrial heritage.

Materials and Methods

In the present work, information has been collected from the cereal storage silo belonging to NNSG in Manganeses of the Lampreana (Zamora). Research began with data collection from the FEGA archives in Madrid and data records on file with the regional government of Castilla y León at Valladolid. In the second phase, detailed photographs of the silo were taken and information was collected on its characteristics; which were grouped as follows:

a) General features: geolocation, year of construction.

b) Architectural features: typology; capacity (t); ground plan and roof shape; tower position; number of cell rows; number of cells; shape of cells; cell material; cell row position relative to the ground.

c) Technological facilities: including existence of: weighbridge (t); railway; dust suction system; seed cleaning and selection machinery; thermometric probes; gas dosage system; refrigeration facilities; lift; on-site high-voltage line

and substation; and information on; machinery capacity (t/h); No. elevators; No. upper storey horizontal conveyors.

In addition, to supplement the information silo manager were interviewed as described by Fuentes et al. [9].

Results and Discussion

The SNT began the construction of Spain's National Network of Silos and Granaries (NNSG) in 1951. FEGA built the last silo in the NNSG in Valchillón, Córdoba in 1990. In these period (1951-1990) were building a total de 668 silos and 282 granaries. 20 different typologies of silos were built, being the first typologies A (1949-1959), B (mainly in the 50s), C (1952-1956) as well as TR1 (1949), TR2 (1950), TR3 (1950), TR4 (1955-1957) and TR5 (1956-1973) and P (1952-1965) [10]. Highlighting type D over all of them with a total of 389 units. This typology prolonged its construction for 34 years (1953-1987), appearing several subtypes (D1, D2, D3 D4 y D5).

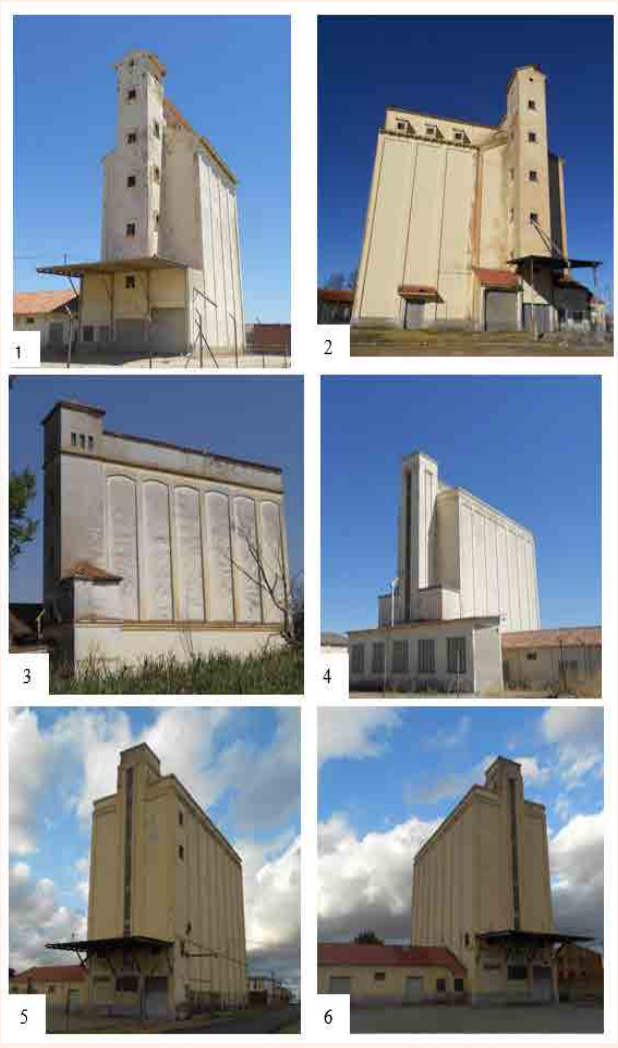

Figure 1: Silo subtypes type A: 1) D1 at 4 Villardefrades, Valladolid; 2) D2 at Tábara, Zamora; 3) D3 at Barbadillo, Salamanca; 4) D4 at Simancas, Valladolid; 5- 6) D5 at Manganeses of the Lampreana, Zamora.

Subtype D1 has bare façades from the ground to 4 the double-pitch roof. The upper gallery is positioned over the central raw and fitted with mansards for readier access to the outer cells. The tower, built flush against the front façade, features conventional windows [10] (Figure 1.1). Subtype D2 is D1 units with an addition on one of the side façades, an arrangement that affords them certain peculiarities [3] (Figure 1.2). The sole subtype D3 silo was built at Barbadillo, Salamanca, it has a single row of 14 six on-the floor cells. It is aesthetically the same as a D1 silo without the two outer rows of cells. The reception hopper and steel canopy are positioned at the rear, opposite the tower (Figure 1.3). Subtype D4 units interiorly to the same on- and off-the-floor row as D1, it differs from that subtype in that it has a parapeted flat roof and its tower has continuous rather than conventional windows. Two small structures attached to either side of the tower house offices and a bulk loading area. The result, an elegantly proportioned building [10] (Figure 1.4).

Subtype D5 is a D4 in which the side structures, built up to accommodate cells, flank the tower to the top, providing for a more compact volume than in D4 (Figures 1.4,1.5,1.6). The 138 units of this, the most numerous type, were built across a period of years (1957-1987). In 20 cases, primarily in northern Spain where rainfall is heavy, they were fitted with a pitched roof to better evacuate rainwater, detracting from the overall elegance of the design [10]. Some authors have classified the D5 silos with pitched roofs under a separate subtype, D6 [11,12].

The Manganeses of the Lampreana silo (Zamora) is a D5 type with 3,350 t of storage capacity, distributed in 24 storage tanks called cells, built in 1968 (Figure 2). Architecturally speaking it is a simple and powerful silo. It has a rectangular shape, made up of three rows of square cells, the outer rows of cells rested directly on the ground storey floor and the centre row is raised. Front tower between two cells, being embedded between them in a central position, achieving a compact and robust volume. The structure is made up of reinforced concrete pillars at the corners of the cells and the cell walls of reinforce bricks. It is finished off with a flat roof.

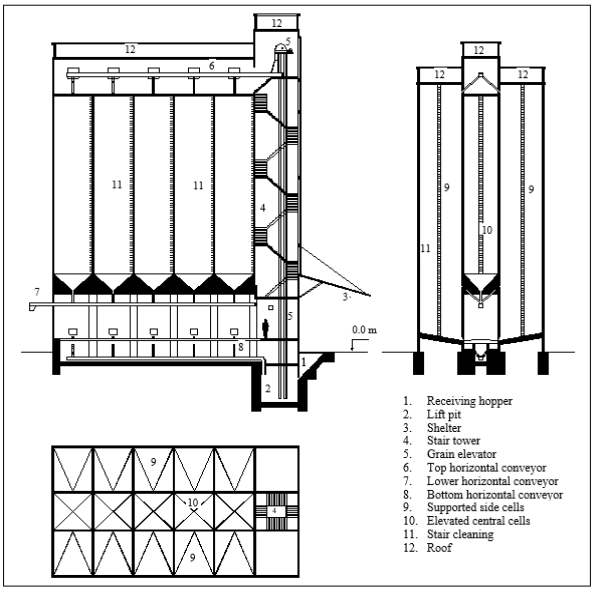

Figure 2: Section and plant of a typical silo type D [6].

The equipment present in The Manganese of the Lampreana silo consists in two elevators in the tower. Both receive grain loaded off trailers or lorries through a reception hopper (Figure 3). The elevators used in the silo have two square section frames inside which a strap carrying small scoops rises on one side and descends on the other [10]. One of the elevators (grain elevator) raises the grain to the top of the tower where it is emptied onto an upper horizontal belt conveyor, where dampers and motorized valves it is distributed across other tubes to one of the three cells in each bay (Figure 3). The other (cleaning elevator) is only used where necessary to remove impurities, raising and then dropping the grain into the cleaning machinery. The grain is unloaded onto lower horizontal chain-driven belt conveyors lying at different heights depending on whether the cells stand-off (central) or on (side) the floor. Portable telescopic tubes are also installed to redirect the grain back to the elevators if necessary. From there it is carried to a raised cell for bulk offloading onto a lorry. This silo has vacuum dust collection systems similar to the facilities in types A and B [10].

Figure 3: Detail of hopper area and upper horizontal belt conveyor and distribution tubes in D5 silo at Manganeses de la Lampreana, Zamora.

Conclusion

a) The Manganeses de la Lampreana silo (Zamora) is a D5, built in 1968 type with 3,350 t of storage capacity, distributed in 24 cells. The cells are square made of reinforced brick and the silo has a flat roof.

b) This silo is a reception silo whose objective was to be close to the farmers and transfer the cereal from it to the larger Transition and Reserve silos [13-16].

c) It is a simple and powerful silo. It has a rectangular shape, made up of three rows of square cells, the outer rows of cells rested directly on the ground storey floor and the center row is raised. Front tower between two cells, being embedded between them in a central position, achieving a compact and robust volume.

d) The machinery installed is simpler, essentially consisting in equipment to load the cells at the top and unload the grain at the bottom and to clean it of impurities before or after storage.

References

1. Tucci PL (2012) The controversial history of Porticus Aemilia. Classical Archeology 63: 575-591.

2. Salido J (2011) Cereal storage in Hispano-Roman rural establishments. In: Horrea d'Hispanie et de la Méditerranée Romaine. Velázquez House, Madrid, Spain (Eds.), J Arce B Goffaux pp. 127-141.

3. Fernández FMV (2016) Cataloging of vertical cereal storage units of the basic network of Castilla y León, proposal of a new classification and reuse possibilities. MS thesis, Univ De León, León, Spain.

4. BOE (1937) Decree Law of August 23, 1937, on wheat management. Official State Gazette (Spain) pp. 309.

5. Valls A, García F, Ramírez M, Benlloch J (2015) Understanding subterranean grain storage heritage in the Mediterranean region: The Valencian silos (Spain). Tunneling and Underground Space Technology 50: 178-188.

6. SNT (1947) The national network of silos. National Wheat Service, National Agricultural Products Service, General Archive of the Spanish Fund for Agricultural Guarantee (FEGA), Madrid, Spain p. 23.

7. SENPA (1994) Reordering and resizing of the SENPA silo network. National Service of Agricultural Products, General Archive of the Spanish Agricultural Guarantee Fund (FEGA), Madrid, Spain.

8. BOE (2014) Royal Decree 2/2014, of January 10, which modifies the Statute of the Spanish Agrarian Guarantee Fund, approved by Royal Decree 1441/2001, of December 21. Official State Gazette (Spain) p. 21.

9. Fuentes JM, López SM, García AI, Ayuga F (2015) Public abattoirs in Spain: History, construction characteristics and the possibility of their reuse. Journal of Cultural Heritage 16(5): 632-639.

10. Fernández FMV, Marcelo V, Valenciano JB, Javier LF, Pastrana P (2020) Spain's national network of silos and granaries: architectural and technological change over time. Spanish Journal of Agricultural Research. 18(3): 17.

11. Azcárate CA (2009) Forgotten cathedrals The national network of silos in Spain 1949-1990. T6, Ministry of the Environment and Rural and Marine Affairs, Madrid, Spain pp. 555.

12. Moreno A (2014) A technological analysis on the national network of silos and granaries from industrial engineering in the agricultural field: with what machinery and how did they work? In I Conference on Agricultural Industrial Heritage: silos for debate. Villanueva del Fresno, Spain, pp. 26-28.

13. Tortella G (1994) The economic development of contemporary Spain. Economic history of the 19th and 20th centuries. Alianza Editorial, Madrid, Spain. pp. 429.

14. SNT (1950) Types of silos and their construction. National Wheat Service, National Agricultural Products Service, General Archive of the Spanish Fund for Agricultural Guarantee (FEGA), Madrid, Spain.

15. SNT (1959) Presentation on the national network of silos in Spain. The various types of silos, their construction and evolution. National Wheat Service, National Agricultural Products Service, General Archive of the Spanish Fund for Agricultural Guarantee (FEGA), Madrid, Spain p.14.

16. SENPA (1978) Storage network. National Service of Agricultural Products, General Archive of the Spanish Agricultural Guarantee Fund (FEGA), Madrid, Spain.