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Review article

The refurbishment of gasometers as a relevant witness of industrial archaeology

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ABSTRACT

The term gasometer, coined by the inventor of gas lighting William Murdoch in the late 18th century, is commonly used to indicate a structure for storing gas. Nowadays, the gasometers have a significant historical and cultural interest, belonging to the so-called "industrial archaeology". The most important gasometer typologies are illustrated in this paper, by focusing on relevant European examples of structural recovering and functional conversion evidences, such as the gasometers of Vienna, Oberhausen (Germany), Dresden, Leipzig, Copenhagen, Dublin and Athens. Finally, the main aspects concerning the restoration design of the 80,000 m^3 column-guided telescoping gasometer of Naples are illustrated.

Contents

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1. Introduction

1.1. General

The term gasometer (or gasholder) was coined in the late eighteenth century by the Scottish engineer William Murdoch [17], inventor of gas lighting. Although the term literally means "gas meter" (a meter for measuring the amount of gas), it is commonly used, perhaps improperly, to indicate a structure conceived with the purpose of storing the town or illumination gas.

In the past, these tanks were used to store illumination gas. With the spread of natural gas in the second half of the twentieth century, the use of town gas is disappearing and the gasometers gradually lose their function.

The gasometers represented traditional structures for storing low-pressure gases. They typically stored town gas, natural gas and industrial gas, whose size was ranged from few cubic meters up to 350,000 m^3. The gasometers can be grouped in two basic typologies: telescoping and piston type [7,1].

Telescoping or water-sealed gasometers are composed by telescoping cylindrical shells which move up and down as the quantity of contained gas changes. Water (or oil) seals were fitted between the telescoping cylindrical shells to prevent gas spill (Fig. 1a). They can be classified into two subcategories: column- and spiral-guided gasometers. To guide the telescoping walls there is an external relatively stiff structure, which was made of masonry (Fig. 2a) or steel (Fig. 2b and c). Spiral guided gasometers represent an update version. These do not have a frame and each telescopic wall was guided by the one below, by means a rotation occurring on helical runners (Fig. 2c).

Piston type gasometers contained a weighted piston with seals fitted between it and the lateral cylindrical shell. Also in this case, the quantity of gas governs the position of the piston (Fig. 1b). An example of piston type gasometers are shown in Fig. 2d.

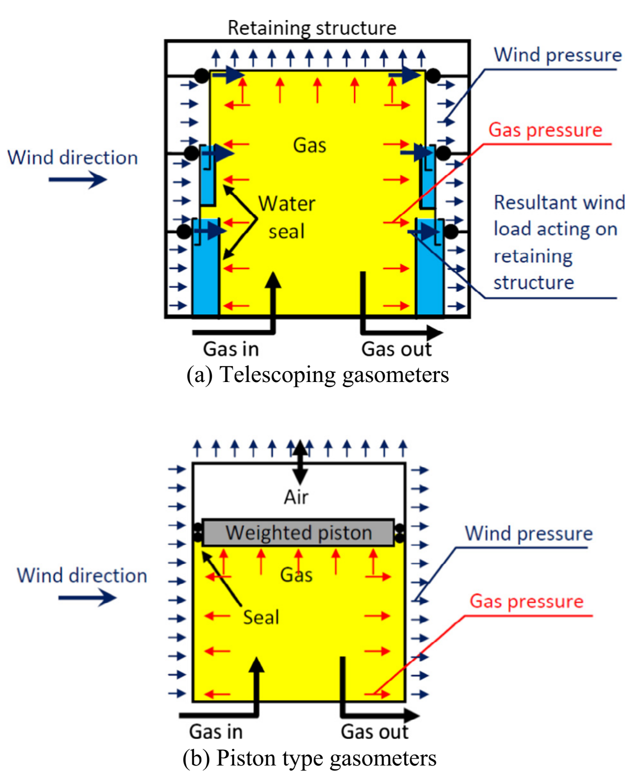

Fig. 1. Functioning scheme and load pattern of typical traditional gasometers.

Regarding the historic evolution of constructive typologies, the surrounding retaining structure of the first gasometers, generally built in 19th century, was made in masonry. Starting from the 20th century, the use of steel as basic material to built the surrounding retaining structure replaces the masonry.

Another subsequent evolution, mainly addressed to improve the lifting effectiveness, was the introduction of spiral guided gasometers.

From a structural point of view, the main difference between telescoping and piston type gasometers, consists in the way how to withstand loads. In fact, for telescoping gasometers, the main scope of telescopic cylindrical shell is to contain gas, therefore it mainly resists to the gas pressures, while the other actions are transferred to the surrounding retaining structure, which absorbs them. On the contrary, in the case of piston type gasometers, the fixed cylindrical shell has the double function to contain gas and withstand all loads.

In general, actions due to dead load, live load, gas pressure, wind, snow, earthquake, temperature, soil and water pressures all have an impact on the gasometer structure. Fig. 1 shows the different load pattern for both telescoping and piston type gasmeters, in the case of pressure and wind actions, which generally represent the most important acting loads.

Nowadays, the gasometers are, in some cases, constructions of significant historical and cultural interest, belonging to the so-called "industrial archaeology" and therefore deserve to be the subject of structural recovers and functional conversions. In the following, some European examples of structural recovering and functional conversion evidences, such as the gasometers of Vienna, Oberhausen, Dresden, Leipzig, Copenhagen, Dublin and Athens are presented (Table 1).

1.2. Vienna gasometers

The Vienna gasometers, Austria, were built was built in the late 1800s in the Simmering district of Vienna and at that time they were the largest gas holders in Europe (Fig. 3a). In 1981, the Vienna gasometers were listed by the country's heritage ministry as outstanding examples of industrial architecture. Starting from 1986 they were no longer used and were shut down.

In 1995 the city of Vienna decided the reuse of these protected industrial constructions for residential purposes and the architectural designs were done by the architects Jean Nouvel, Coop Himmelblau, Manfred Wehdorn and Wilhelm Holzbauer, for gasometers A, B, C and D, respectively. The project preserved the historic exterior brick walls and comprised of 620 apartments, offices and shops (Fig. 3b–d).

1.3. Oberhausen gas holder

The gasometer of Oberhausen, Germany, was a piston type gas holder, made of a framework of 24 steel girders and a 5 mm thick riveted sheet metal [10]. This gasometer represented the largest gas holder in Europe, with a maximum capacity of about 350,000 m^3 and a weighted piston of 1200 t. As it was heavily damaged during the War World II, it was demolished in 1946 and its reconstruction ended in 1950 (Fig. 4a).

After its decommissioning in 1988, on proposal of the Emscher Park International Building Exhibition, the gasometer was converted into a exhibition hall, which today can be considered the landmark of the city of Oberhausen.

During the restoration the weighted piston was fixed at 4.5 m height and a 3000 m^2 exhibition space was obtained below it. On the top of the weighted piston, the main exhibition space was created, with a stage having a diameter of 20 m and seating for