

Approach to the quantification of the sustainable value in industrial buildings

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Abstract

In recent years, there have been advances in favour of buildings being more environmental friendly. Basically, sustainable construction has centred on residential and office buildings. It could be said that there is a lack of sustainable aspects in the construction field of industrial buildings.

This article aims to analyse the sustainable environmental requisites demandable for an industrial building, by defining a system of specific indicators to assess building behaviour against these requisites generating an assessment model as a base for measuring the building “environmental sustainability index”.

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1. Introduction

The technological progress occurred in the short period of time since the industrial revolution to the present day, has been accompanied by a series of appreciable changes in the planet. Not only are today’s generations the heirs to this technological progress and advance but also the environmental alterations derived thereof, some of which are irreversible. Environment protection and social and economic development are essential to achieve sustainable development [1].

Centering on this need for change and work pending execution in the construction sector, the sustainable development era must demand radical changes. The globalization of the construction industry [2] has promoted the incorporation of a relative new universal vision of this sector: the sustainability, already used in the 1970s referred

to “sustainable economic growth”. Construction action is one of the causes with great impact on the environment, according to the conclusions of the *Vital Signs 2005* report drafted by the Worldwatch Institute of Washington [3], which points out the construction sector consumes up to 60% of the materials extracted from the earth. Furthermore, their use in construction generates half the CO₂ emissions dispersed in the atmosphere. Therefore, the architecture and engineering professions must include environmental protection in their daily tasks to fully comply with their work [4]. Today, it is no longer possible to carry out (design and construction) building projects without assessing their impact on the environment. These disciplines must use tools, which provide them with knowledge on the affections associated with their work [5,6], and assist them in taking decisions resulting in more environmental friendly projects.

In recent years, numerous countries, have with greater or lesser success launched initiatives to achieve more environmental friendly buildings throughout their life cycle: from extracting materials to their demolition [7]. Thus we have terms like: *sustainable construction*, *building energetic efficiency*, *bioclimatism*, *passive architecture*, etc. aiming to provide new trends to achieve the target of reducing the

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Fig. 1. General concept of sustainability in the construction sector.

construction activity impact. The incorporation of these design criteria in construction has acquired special relevance with the incorporation of the so-called sustainable development concepts within politically correct and desirable practices for society as a whole [8]. Thus, the advance in the research and development of new knowledge systems concerning sustainable construction has been constant (Fig. 1).

It must be mentioned the advances made in the residential construction field have not continued in the industrial building design process, whose specific characteristics make them different. It can be claimed definition of sustainable aspects is lacking in the industrial plant construction field. The industrial building sustainable conception should be tackled in the same way as residential or office buildings. The relation extant today between industry and sustainability represents a rich interesting research field, give the complexity and amount of study areas, not to mention the importance of identifying factors making industrial building architectural requisites compatible and compliance thereof sustainable.

2. Determining factors of industrial buildings when comparing with other typologies

The industrial construction sector is part of the non-residential Building sub-sector. It comprises¹ “the development of industrial building construction activities, including new designs, enlargements, modifications, maintenance and reforms” [9]. The construction of installations for developing production activities, whose production processes do not need a building for their execution, such as incineration plants, cement plants, blast furnaces and

other similar structures; are also included in this sector. Generally speaking, the participating agents are: construction contractors, construction companies, industrial building design companies and projection direction firms.

As a definition of factory or industrial building we could adopt Prof. Losada’s² “a space where industrial production and storage tasks are performed. The term factory as alternative for industrial buildings includes generic aspects of industrial production. Nevertheless, both terms have in common the existence of constructions, i.e., man-designed spaces materialized via the use of natural or artificial products, elements and construction systems within a controlled environment”.

Traditionally, the industrial building was considered an isolated container inside which certain production activity occurs. Sustainable industrial building aspects considered today refer mainly to the production process performed inside. Attention is focussed on aspects like contamination caused by the production process or activity throughout the building life cycle (air, noise, water, etc.) and process waste deposition or recycling dedicating very few resources to research on the building itself. A more sustainable vision considers the same as an architectural element permanently interacting with sustainability requisites.

The building design through a systemic approach entails making an integrated study of the industrial plant that it is defined as main system. Likewise, this system consists of several subsystems or subdivisions interrelated to each other. The optimal integration of all subsystems must, therefore, be explored with the aim of obtaining the most suitable solution. The main subsystems of the industrial plant are as follows: the industrial process, the auxiliary services necessary for the correct performance of the process, the building or structural frame, the production control system and the lay-out or activity distribution.

The architecture implies the spatial arrangement in such a way that a separation between the external arrangements of the industrial area, which is characteristic of the urbanism [10,11], and the inner arrangement of the building or place defined by the layout could be established. An enveloping system, borne by a structural frame, defines the latter separation. The enveloping system, together with the structural frame, forms the building.

The industrial building typology should be adapted to the productive process and to the necessary auxiliary services. Each process has special features and there exists infinity of processes. In other words, groups of industries should be established in such a way that perform similar characteristics in respect to materials, building shapes, spans among columns, more habitual illumination types and ventilation or storage zones particularities. Among the

¹Definition as per the US Census Bureau. The North American Industry Classification System (NAICS).

²Losada Rodríguez, Ramón. Escuela Superior de Ingenieros de Bilbao. First version of the book “sustainability via value analysis applied to industrial building”.

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