ARTICLE INFO

**ABSTRACT**

The Building Sector exhibits a special impact upon the environment due to the specific activities related to: design (design of building life), manufacturing of building materials, transportation, placement, service and maintenance, demolishing and recycling. Building industry represents from this viewpoint an important energy demanding sector. About 46% of the yearly energy consumption is attributed to constructions.

**Keywords:** construction, materials, environmental impact, embodied energy

**INTRODUCTION**

The notion of sustainable design gives up fighting against nature in favour of making a friendly exchange with it, while striving to stop any process that could bring prejudice for the future generations and repairing what can still be repaired. Today, it is admitted on a wide scale that the excess of CO$_2$ intensifies the greenhouse effect (GES) and bears the responsibility for global warming. Atmosphere is also affected by the presence of other gases, which besides deepening the greenhouse effect of these gases, contributes to the deterioration of air quality and to endangering human beings’ health. Until now, environment protection strategy entailed only direct emissions, but at present, the approach has become wider and more detailed, more sustainable and full ranged. The environment impact assessment made during the planning of a construction takes into account: the CO$_2$ emissions, the energy consumption, the resource saving, the reduction of waste, the reuse of recycled materials and the general influence upon ecology. During the design stage, the concept of building life/functionality should be introduced, taking into account the energy and materials consumed and the impact upon environment and health. The

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building materials industry emphasises more than often the reuse of recycled materials to diminish the energy and CO$_2$ consumption. The concern for "clean" products has given birth to the "engineering of lifecycle" aiming towards being responsible for a product during all the stages of the life of that product. The industry producing building materials should permanently and constantly increase standards to make use of a green process in order to obtain high performance products, which improve human health and comfort during service and placement.

In the design process, an optimal selection of materials should be carefully considered so that the embodied energy diminishes as much as possible.

**MATERIAL AND METHOD**

1. Environmental Impact of Construction Materials

The building sector has a special impact upon the environment through its specific activities during all the stages of the lifecycle of the buildings:
- the production/purchase of raw materials: used to produce building materials (cement, additives, steel, timber), energy sources and power production, water supply;
- erection of buildings: design, production of building materials (concrete, reinforcements, brick blocks, tiles, polystyrene, mineral wool, corrugated sheets, sawn wood, formwork, metal sandwich panels), execution;
- utilisation: use, maintenance, repair, refurbishing;
- post-use: selective demolishing, reuse, reprocessing, recycling.

The traditional approach (quality, cost, time related factors) is based upon the principle of economic efficiency and does not consider the impact upon the environment while, the "sustainable building" approach emphasises the importance of diminishing the impact upon the environment (Fig. 1).

![Fig.1. The transformation from a traditional construction process in a new approach to sustainable construction](image-url)
Statistically, every year, nine billion tons of concrete are produced. For them, it is necessary to use:
- 1.3 billions tons of cement;
- 800 billions litres of water (23 times the daily flow of the Seine);
- 4.7 billions tons of gravel (670 times the weight of the pyramid of Cheops);
- 2.2 billions tons of sand (22 millions of cars- 264000km) [1].

The mining and manufacturing processes generates large amounts of solid, liquid and gaseous waste which also affect the environment: the contamination of the earth, atmospheric pollution, pollution of rivers, waste originating from building construction, maintenance, use and demolishing. A major atmospheric pollution source resides in the transportation of materials.

In Great Britain, buildings generate about 70 million tons of waste per year (17% of the total of waste produced), the majority reaching warehouses and representing thus the widest spread polluting industrial factor [2].

The main essential stages through which the impact of buildings upon the environment can be reduced are:
- the diminishing of the consumption of resources in accordance with the demands and needs of customers, leading also to resource preservation and reduction of costs;
- the reuse of existing buildings and materials, contributing in this way to the diminution of the demand of raw materials and of the waste volume;
- the waste recycling to reduce the amount of waste deposited;
- the use of renewable resources.

Concrete constructions have a major impact upon the environment due to the amount of energy consumed and of the emissions of CO$_2$ which play a significant part in global warming and air pollution, through the production of solid waste originating from demolished concrete.

2. Construction Materials and Embodied Energy

The concept of embodied energy came into existence and was developed at the end of the 1960’s - 1970’s when researchers began to be worried that fossil fuels resources could be exhausted, following oil crisis [1].

Energy was defined as the amount of energy necessary for: the mining of raw materials, the conversion of raw materials in building materials, the transport of the raw materials and their placement in work [3].

The research and prognosis of the experts show that around 2020-2030, mankind will require 60-70% more energy than today. This amount of energy is not available, it is then very difficult to be found and purchased,
and it will become more and more expensive, having serious effects upon the financial resources of the majority of the countries in the world [4].

Function on how energies required are produced, embodied energy shows its potential of becoming an important pollution sources because of the emissions with toxic effects it produces, such as the greenhouse effect, acidification, eutrophisation, etc. In most cases, they also contain large quantities of fossil fuels [1].

Statistical studies performed in developed countries highlight the large amount of energy consumed in buildings that do not have a production-related purpose, where a high level of expenses is evident besides high levels of CO₂ emissions. An analysis performed in Great Britain points out to the following distribution of the yearly energy consumption (Fig. 2).

![Fig. 2. Distribution of the yearly energy consumption](image)

The energy distribution along the whole lifecycle of a construction is given in the Figure in diagram 3. The building sector occupies the first place, with a percentage of 84 points in the total energy distributed in the building.

![Fig. 3. The energy distribution along the lifecycle of a construction](image)
According to Horns Arndt, the embodied energy in the main building materials is the one presented in Figure 4.

As seen from Figure 4, the embodied energy corresponding to cement present the highest values. Cement manufacturing represents a high energy consumption process and it is for this reason that the reduction of this energy must be aimed at.

In order to diminish the quantity of embodied energy in the buildings, the architect and the designer of the structure should take into account the following issues:
- the orientation and siting of the building while observing the geography, climate and seismic conditions of the place;
- the shape of the building;
- the interior temperature and humidity;
- the internal and external noise levels;
- windows and natural lighting.

CONCLUSIONS
The future of the building sector resides in designing and erecting structures from materials which have a lifecycle that corresponds to sustainable development criteria, with as small as possible energy consumption and CO₂ emissions.

The reduction of energy consumptions needed for a healthy and comfortable internal environment can be obtained by applying some passive measures, associated with minimal consumptions, measures that are
integrated in the architectural and constructive concept of the building and by making use of proper green materials [1].

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