TRENDS AND CHALLENGES IN CONSTRUCTION INDUSTRY

Interview with Merima Šahinagić-Isović,
professor at the Faculty of Civil Engineering Mostar

TRENDS AND CHALLENGES
IN CONSTRUCTION INDUSTRY

Interview with Merima Šahinagić-Isović, full professor at the Faculty of Civil Engineering, University "Džemal Bijedić", Mostar, Bosnia and Herzegovina.

1. Tell us something about yourself

My narrow research specialty **in the field of construction is the field of building materials and structures.** For the last decade, I have been particularly interested in research in the field of durability of structures, and I am one of the first teachers in Bosnia and Herzegovina who teaches the subject Durability and maintenance of structures. Within this area, I study the energy efficiency aspects of existing and new buildings, and the life cycle of buildings and materials. In the context of this issue, I published the book "Elements of Environmental Infrastructure Systems Sustainability", in which I am one of the authors. One part is entirely devoted to the topic of durability of structures.

New trends in construction are focused on research into the use of by-products from industrial production (waste) as additives in the production of composite materials and their components. Therefore, in recent years, my team and I have been engaged in experimental research of local by-products as additives in mortars and concretes. My last book, "Application of red mud in construction", which deals with the problem of this waste material and its application, came from this research.

2. What are the trends in the construction industry

For the last few years, the sustainability criterion has entered the construction industry and methods for its uniform and standardised application in practice are being developed intensively. This approach dictates **the introduction of sustainability already at the construction design stage and in the selection of materials.** Optimisation in three dimensions is sought, with ecological, economic, and socio-cultural aspects being considered at the same time. Sustainable construction is extremely important for sustainable development in general, due to the great influence of the construction industry on the

individual and society as a whole. Sustainability is defined as a measurable dimension, by developing methods for sustainability analysis.

A large number of methods have been developed for analysing the sustainability of building materials and building structures. One of the methods used to determine the impact of a product or building (as a building product) on the environment is life cycle analysis (LCA). The LCA analysis, defined by ISO 14000, includes several steps in which all processes related to the product under analysis are analysed and described. In addition to the production processes of the product in question, it is necessary to include all related processes that precede it, as well as processes that are their consequence. Legislative consideration of sustainability criteria is the future of sustainable construction and buildings.

For the last few years, the sustainability criterion has entered the construction industry and methods for its uniform and standardised application in practice are being developed intensively.

3. Challenges and opportunities in the construction industry

The construction industry is the oldest and most important branch of technology. As a very important segment of the economic development of every country in the world, construction is one of the main indicators of the development and prosperity of society, and it attracts a lot of attention from analysts.

Construction, as a driving economic branch, is today the largest consumer of various types of materials, and therefore one of the largest producers of waste. Construction waste should be recognized as a priority problem to be solved.

Construction waste, according to the definition, is waste generated during the construction of buildings, reconstruction, removal, and maintenance of existing buildings, and waste generated from excavated material that cannot be used without reprocessing for the construction of the building whose construction it was a by-product.

Construction waste is generated, for the most part, due to the demolition of buildings, and the reasons for the demolition of a building can be different. Due to the need to modernize the central city zones, fundamental reconstructions of buildings are often carried out, whereby dilapidated buildings, or buildings that will change their purpose, are usually partially or completely demolished. Also, due to degradation over time and limited operational life (aging and dilapidation of the building), many buildings need to be replaced with new, technically and economically more favourable solutions. The resulting waste construction material is removed from those locations and disposed of in landfills. Another form of this type of waste is caused by numerous devastating disasters, both natural (earthquakes, floods, fires) and man-made (wars, terrorist attacks). After such occurrences, it is inevitable to clear the rubble and remove the waste construction material.

The reasons for the need for increased utilization of construction waste are multiple:

- knowledge about limited natural resources and the need for rational use of what is available (natural aggregates – gravel, sand, and technical building stone, which are the basic non-renewable resources used in construction),
- increasingly strict regulations on environmental protection, which mandate the proper management of construction waste,
- difficulties in finding locations for new construction waste dumps,
- price of present waste disposal.

4. Awareness of the quality of the material and which materials will be used in the future

Contemporary construction practice, in accordance with the current concept of sustainable development, is increasingly addressing material recycling problems. Namely, a possible solution to this problem of solid waste accumulation is provided by the concept of sustainable development.

Recycling implies, in a general sense, the single or multiple use of waste material as an effective substitute for a commercial product, or as a

raw material in an industrial process. In the construction industry, recycling represents the processing of construction waste and obtaining commercial raw materials of high quality, which can be further refined and placed on the market. In order to obtain such a secondary raw material, it is necessary to carry out a rational dismantling of the building, select the material and ensure a technically-technologically suitable plant, as well as quality control when receiving the material in the plant and during processing. Therefore, recycling converts waste building material into raw material.

Research in the world is aimed at solving the question of how construction waste can be optimally processed as a specific type of technological waste (parts of reinforced and non-reinforced concrete, bricks, tiles and other types of covers, plaster, various mixed excavations, asphalt, gravel and sand, stones, light construction materials), in order to obtain products as valuable as possible. Of course, the possibilities of applying the secondary raw materials thus obtained are also being investigated.

In general, the construction industry is relatively conservative, so changes in some established procedures take a lot of time and require long-term policies and strategies. By introducing economic instruments that encourage recycling and the use of recycled aggregate, economic barriers can be overcome.

In recent years, most developed countries have been actively engaged in the development of policies and a series of measures to reduce the depletion of natural resources, as well as foster the sustainability of their use through recycling, and have developed many alternative technologies for the production of recycled materials.

By passing appropriate legal measures, conducting education of a part of the professional population, and educating the entire population, we should gradually try to increase the share of recycled construction waste in the application. EU member states stimulate the reuse of recycled material with additional incentives and many other regulations, and thus contribute to raising human awareness about the way waste is disposed of.

It can be concluded that it is indeed possible to successfully use recycled material in construction. Therefore, it is necessary to carry out permanent education as much as possible and to properly inform the public about all novelties in the construction industry, thus breaking down the barriers that construction engineers and investors have when applying all new ecologically justified products.
This vigilance is, of course, also justified because without such a relationship to the characteristics of the new material it would not be possible to reach any correct conclusions on the implementation of all the necessary requirements.
However, it is necessary to invest all necessary knowledge and expertise on a continuous basis in order to use recycled materials to the greatest extent possible, thereby improving the construction industry and protecting the natural environment.

5. Sustainability is a broad concept that is too often used and misinterpreted. How do you see it in the construction segment

The terms “sustainability” and “sustainable development” have recently entered into various programmes, strategies, and reports. In 1987, the United Nations issued a report defining sustainable development as development that meets today’s needs without jeopardizing the ability of future generations to meet their own needs.

In the context of sustainable development, sustainable construction must ensure durability, but also the quality of structural design, with economic and environmental friendliness.

Sustainable construction implies the application of the basic principles of sustainable development in the field of construction. Sustainable construction is certainly one of the most important segments of sustainable development and includes the use of building materials that are not harmful to the environment, the energy efficiency of buildings, and the management of waste from the construction and demolition of buildings. In the

context of sustainable development, sustainable construction must ensure durability, but also the quality of structural design, with economic and environmental friendliness.

The field of application of sustainable development is practically inexhaustible, given that it is applicable to all types of human activity. It is the same in the field of construction, where the application of sustainable development operates on many levels, and one of them is the production and application of recycled materials, with a special emphasis on concrete.

In the field of sustainable development, the implementation of the well-known 3R principle (Reduce, Recycle, Renewable) is very important. This principle consists of and aims at the following:

- reduction of energy consumption and degree of pollution (Reduce),
- reuse of old concrete (Recycle),
- creation of aggregates for new concrete (Renewable resource).

6. How do you see the significance of building hardware in houses/buildings

Sustainable development and environmental protection have become key goals of modern society. Sustainable development is one of the few ubiquitous topics, it is becoming more relevant by the day, primarily because it is extremely important for modern society.

Sustainable construction can only be achieved by a turnaround in the planning and designing of the building phase, when it is possible to choose an appropriate construction concept and choice of materials, which are in accordance with the principles of sustainable construction and sustainable development in general.

Sustainable construction includes the use of building materials that are not harmful to the environment, as well as the energy efficiency of buildings. The concept of energy efficiency measures in family homes and residential and non-residential buildings refers to a wide range of activities whose ultimate goal is to reduce the consumption of all types of energy in the building in question.
Insufficient thermal insulation leads to increased heat losses in winter, then cold perimeter structures, and various damages caused by condensation (moisture), but also overheating of the space in summer. As a consequence, structural damage occurs, resulting in inadequate and unhealthy living and working conditions. Heating such spaces requires a greater amount of energy, which leads to an increase in the cost of using and maintaining the space while also increasing environmental pollution. Environmental pollution, again, has an impact on damage to buildings, but also on people's lives and health.

Renovation of the roof above the heated space, i.e. the ceiling of the last floor towards the unheated attic, significantly reduces heat losses. Repairing the floor in contact with the ground in an existing house is often not economically justified, due to the relatively small reduction in total heat losses compared to the large investment required for such repair.

However, it should be emphasised that **the greatest heat losses occur through the windows and the outer wall**, and that restoring them can result in significant savings. Heat losses through the windows and the outer wall account for an average of 70% of the total heat losses in the building. **A fact that speaks for itself about the importance of using quality materials**, as well as the performance of all product elements used in facilities (buildings, houses, etc.). It is undeniable that in the production of quality windows and doors, the quality of window hardware is an extremely important segment that needs special attention.

7. What building hardware manufacturers should pay more attention to

In the future, building hardware manufacturers should also pay attention to the aspect of LCA analysis of each product or group of products individually. For LCA analysis, it is necessary to thoroughly analyse and well describe all processes related to the product being analysed. Possible analysis goals are as follows:

- identifying weak points in production or process optimization
- optimization of materials through the analysis of the fulfilment of conditions in the application
- optimization of the production of elements or comparison of individual elements
- optimization of product elements in terms of product life

- optimization of the product in its service life
- accompanying grades in the development of new materials
- assistance in decision-making when trading

Before starting the LCA analysis of a construction product, it is necessary to determine the limits as far as the analysis can go. It is very important to define the criteria for the limits of the analysis at the level of international standards so that the data on the impact of individual products are comparable. The goal of the LCA analysis is to achieve maximum benefit for the investor, but also for the user of the product and the society as a whole.

8. What people should pay attention to when building

When building a new house, it is important to take into account all important factors, already in the conceptual design phase and in cooperation with the designer, in order to build a high-quality, optimal, and energy-efficient house:

- analyse the location, orientation, and shape of the house;
- apply a high level of thermal insulation of the entire outer envelope;
- take advantage of the sun and protect it from excessive sun exposure;
- use an energy-efficient heating, cooling, and ventilation system, and combine it with renewable energy sources.

The decision on the construction of an apartment or house will certainly be influenced by the price per m2 and the location of the building. A well-insulated house consumes less energy for heating in winter as well as for cooling in summer. The loss of heat and energy consumption per m2 will affect not only the monthly expenditure on electricity, but also the quality and comfort of housing, as well as the building's longevity. The two basic parameters to pay attention to are:

- thermal insulation of the outer wall
- energy efficiency at the openings

The thermal insulation of the outer wall can be placed on the outside or on the inside of the wall. The rule is that in new buildings, thermal insulation should be performed on the outside. Thermal insulation on the inside of the wall is unfavourable from a construction and physical point of view and is often more expensive due to the need to additionally solve the problem of water vapour diffusion, stricter requirements in terms of fire safety, loss of useful space, etc. Thermal insulation on the inside of the wall is physically worse because although we achieve an improvement in the insulation value of the wall, we significantly change the heat flow in the wall, which makes the basic load-bearing wall colder. For this reason, special attention should be paid to the vapour barrier in order to avoid the formation of condensate and the appearance of mould. In addition, it is necessary to thermally insulate the part of the partitions that join the outer wall.

Windows are an element of the outer envelope of a building through which the greatest heat losses occur. Total thermal losses through windows represent more than 50% of the building's thermal losses. Losses through windows are usually ten or more times higher than those through walls, which is why it is clear how important the energy efficiency of windows is in the total energy needs of buildings.

In windows as well as in the entire outer envelope of the building, the heat transfer coefficient U(k) expressed in W/m2K plays an important role. Glass and window profiles participate in the total thermal losses of

windows. Window profiles, regardless of the type of material they are made of, must ensure: good sealing, breaking the heat bridge in the profile, and easy opening as well as low heat transfer coefficient.

9. Recommendations for increasing energy efficiency

The whole world is facing two major energy problems today. The first one is the lack of energy and insecurity in its supply, and the second one is the environmental pollution and climate change caused by excessive and irrational energy consumption.

Energy efficiency is the sum of planned and implemented measures aimed at using the minimum possible amount of energy so that the level of comfort and production rate remains preserved. Every person can contribute to the global increase of energy efficiency, by changing habits in everyday life and work for example. Simple measures to increase energy efficiency, at no additional cost, with immediate savings:

- turn off the heating or cooling at night and when no one is staying in the house;
- avoid covering the heating bodies with curtains, coverings, etc.;
- time-optimize heating and hot water preparation;
- in the heating season, reduce the room temperature by 1°C;
- in the cooling season, set the cooling to min. 26°C;
- use natural lighting as much as possible;
- switch off the lighting in the room when it is not necessary;
- turn on washing machines and dishwashers only when they are full, and preferably at night.

Measures to increase energy efficiency at low cost and quick return on investment (up to 3 years):

- seal windows and external doors;
- check and possibly repair the hardware on windows and doors;
- isolate niches for radiators and roller shutter boxes;
- thermally insulate the existing sloping roof or ceiling situated towards the unheated attic;
- reduce heat losses through windows by installing blinds, curtains, etc.;
- install thermostatic valves on radiators;
- regularly service and adjust the heating and cooling system;
- install automatic control and supervision of energy at home;
- install energy-saving bulbs in lighting fixtures;
- replace existing appliances with more energy-efficient ones - A-class energy appliances.

Measures to increase energy efficiency at slightly higher costs and a longer period of return on investment (more than 3 years). The following measures are best carried out at the same time as the necessary reconstruction measures:

- replace windows and exterior doors with better thermal quality windows (recommended window U(k) 1.1-1.8 W/m2K);
- thermally insulate the entire exterior envelope of the house: walls, floors, roof, and surfaces situated towards unheated areas;
- build a windscreen at the entrance to the house;
- repair and restore the chimney;
- isolate the hot water pipes and the tank;
- analyse the heating and cooling system in the house; if necessary, replace it with a more energy-efficient system, and combine it with renewable energy sources.