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CIRCULAR ECONOMY OF CONSTRUCTION AND THE POSSIBILITIES OF CONSTRUCTION WASTE RE-USAGE

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Summary. In these times of modern technologies, fast production and consumption it is impossible to live without waste. Therefore people look for different ways how to recycle waste, how to reuse it, but not to pile it in dumps or burn. In this work the structure of building waste, its amount and the possibilities of recycling this waste are analyzed. The amount of construction waste has been increasing since 2015 and is predicted to grow until 2040 year.

Key words: construction waste; recycling; elimination; usage.

INTRODUCTION

All around the world scientists have been looking for possibilities for how to use different building waste. P. Asokan et. (2009, 2010) made research on how to use glass plastic waste in the production of concrete. The results showed that after putting from 5 to 50% of steeled glass plastics into concrete mixtures the average pressing strength oscillates from 37 N/mm^3 to 19 N/mm^3. Making the concentration of powder of glass plastic waste bigger the pressing strength grew smaller. Other scientists suggest using polyurethane foam waste in the production of concrete. Such a sort of concrete was produced partially replacing fillings of sand or gravel with polyurethane foam (Y, Xu et. al. 2012, K. Miled et. al. 2007). Some other scientists made research on how different polystyrene particles influence the strength of concrete pressing. The management of tire waste raised problems in the whole world. The usage of crushed rubber waste in the production of concrete has been raising more and more interest. Crushed rubber waste can be used in the production of special concrete constructions. We get more deformed concrete than usual partially by replacing the filling of sand by small rubber filling in the concrete mixture, and what is most important, this mixture is more resistant to the impact of cold and ice than the usual concrete used for the production of iron concrete elements for roads and bridges (Kersevicus, Skripkinas 2001; Reda Taha et al. 2008). The addition of crushed rubber into the concrete mixture can replace not only the filling of small sand (the size of crushed rubber particles up to 4mm) but the large one as well the size of crushed rubber particles up to 12,5mm. The sort rubber is very important in replacing the large filling.

The aim of the work: to analyze the patterns of construction waste generation in Lithuania and review the need and opportunities to increase waste recycling in the construction sector.

The tasks of the work:

- To analyze the composition and amount of construction waste in Lithuania;
- Review the principles of the circular economy in construction;
- Present the possibilities of using waste in the construction sector.

Rubber waste which we get after crushing lorry tires is harder and firmer than the ones of car tires, therefore we get a stronger variety of larger filling. It has been stated that having replaced fillings with crushed rubber waste mechanical characteristics of concrete get worse and, having replaced large fillings by rubber waste the diminution of mechanical characteristics of concrete is bigger than using rubber waste instead of a small filling.

CIRCULAR ECONOMY OF CONSTRUCTION

The predominance of linear economics on building site, the abundance of usage of natural resources, climate changing and the growing pollution of the environment are directly related to the predominance of linear economics**.** The growing amount of energy and not renovated usage of materials create a threat to the environment. From this point of view, stable production (including building as well) is acknowledged es the new industrial revolution non which needs a holistic attitude in order a living cycle of any product to be shut and it included different aspects of stability of the product in all its living stages. Most often people using recycling, recollection, re-usage and elimination for the last stage of using products (Figure 1). These strategies are construction especially important in the field of (building) where building and demolition from 25-30% of all possible waste which is 500 mln. tons of waste in Europe (Deloitte, 2016).

Figure 1. **Scheme of circular economy of construction**

The construction sector is the most material-intensive sector in Europe. Construction practices have led to high levels of recycling in the sector, the principles of circular economy do not simply consider good waste management practices, but also require the development of buildings and infrastructure that reduce dependence on the material. European Parliament and Council adopted the directive 2008/98 EB [I] for arranging waste, also foresaw the means how to protect the environment and people's health. ln order to realize the aims of this directive the member states of the European Union should take means to achieve that up to 2020 y. of this at least 70 % of not dangerous building and demolition waste should be made ready to reuse or to recycle it. In many European countries this index has been achieved, but in Lithuania, alas, not.

The management of construction waste should be planned already during the design of the building, but currently in Lithuania the life cycle of the building and its impact on the environment are not evaluated. There are no coordinated organizational, administrative, information technology, financial and legal measures necessary to create a unified modeling system (BIM) that reduces the amount of waste and ensures its efficient management.

About 40 percent of public procurement in Lithuania by value takes place in the construction sector, so it is very important that the volume of green procurement in it increases significantly. From 2021 year making green public purchases stimulates the recycling or reusing of building waste in some other ways. The criteria of environmental protection of making the amount of building waste less and stating the amount of green public purchases in it, also repeated usage, recycling, or other ways of usage help to develop circular economics as well. The goal set by the Government of Lithuania is to buy only green from 2023.

Lithuania has planned to prepare methods for modeling the existence cycle of buildings in 2024. It standardizes the stages of the existence cycle and processes of buildings estimating the influence of buildings as well the number of building materials on changing the climate and people's health. The methods will also analyze the possibilities of repeated usage of building waste.

A circular economy response is to reducing material use in constructions: repair and refurbish buildings wherever possible, adapt existing buildings rather than build new ones, be more efficient in the building process and producing less construction waste, recycle all waste. This is a major challenge for waste management companies, clients, designers, contractors.

THE QUANTITIES OF CONSTRUCTION WASTE IN LITHUANIA

A lot of scientific research has been carried out while investigating the creation of new building materials or perfecting their industrial process, also trying to prolong the longevity of building materials, and lessen the building cost. It would be expedient to start our investigation from the analysis of the composition and amount or building materials if we want to lessen the amount building waste.

Since 2014 y. to 2020 y. the amount of building waste had been growing. The change of it can be seen in Figure 2 (according to the accounts of Environment Protection agency). We notice that the amount waste became bigger a year from 1% to 29% and already the amount of this waste reached 1 mln. tons in 2017. It should be noted that it has not been possible to fix the amount of mixed building waste as yet because the estimation of the market members of the whole amount of building and demolition waste has not been registered. The Biggest amount of building waste in Lithuania has been collected by the grounds of big gabarit waste (the waste is in accepted from physical person and only in sorted fractions), by dump of safe waste (from

physical and juridical person, some dumps accept mixed waste), by enterprises which have the legal right to sort, recycle safe inert building waste.

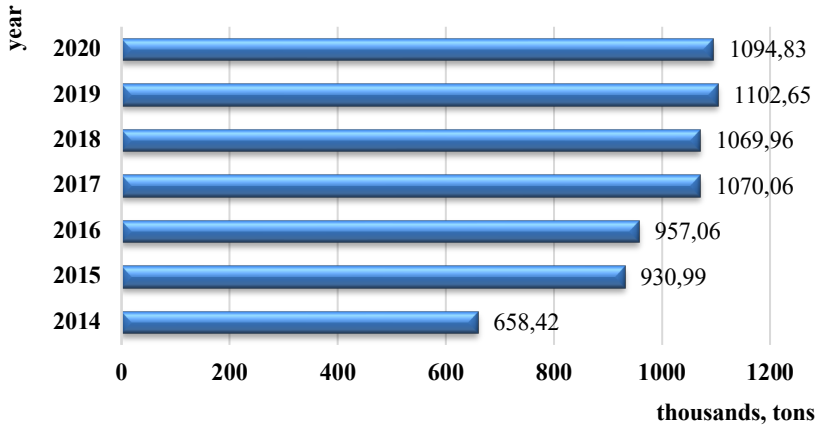

Figure 2. **The amounts of building waste in Lithuania in 2014 -2020 y.**

Construction waste is inaccurately accounted for several reasons: firstly, due to improper disposal method (buried in prohibited places, dumped in ditches or forests, thrown into municipal waste containers), as well as due to improper control. order or wrong order. The situation should change with the introduction of the GPAIS (Unified Product, Packaging and Waste Accounting Information System) system, and now there is talk that construction waste could actually be half as much as it is now.

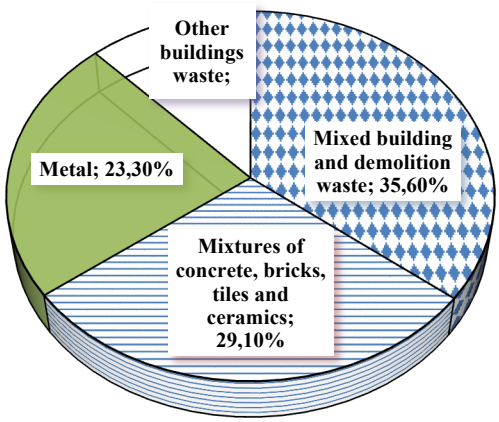

Figure 3. **The materials which are most often processed in the flow of construction waste**

In the flow of the building waste the part of the waste is occupied by the mixed building waste (Figure 3). It about 35,6%, concrete bricks, tiles and ceramics about 29,1%, metals about 23,3% of the building waste. As mixed building waste forms the biggest part in the flow of building waste, we can make conclusion that the waste on the building site is not sorted out, but most often is throw and mixed together with inert and insulating materials. This mixture of different sorts of waste makes a repeated usage of building waste especially difficult. It is absolutely impossible to get second-rate raw materials, from the mixed building waste flow or the index of quality makes their recycling repeated usage impossible.

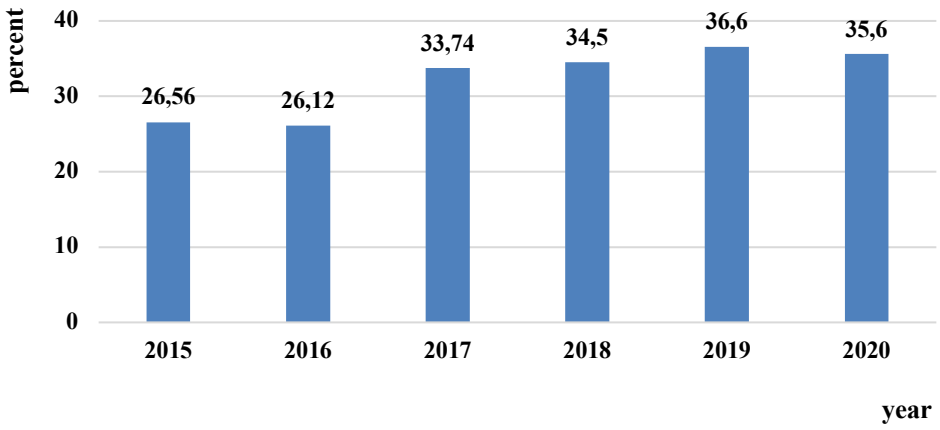

Figure 4. **The change of mixed building waste in the amount of building waste from 2015 to 2020 y. Information: the index of Region centers of managing waste**

In the flow of the building waste the part of the waste is occupied by the mixed building waste (Figure 4). Since 2015 y. to 2020 y. mixed building waste in the amount of building waste grow from 26,12% to 36,6%.

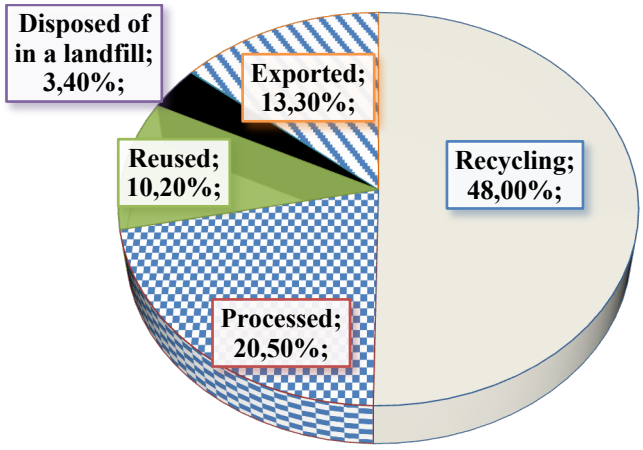

Figure 5. **Construction waste management methods used in Lithuania (2020 y.)**

According to the information provided in the State Waste Prevention and Management Plan 2021-2027 (Figure 5), in 2020 we have 1094,83 thousand tons of construction waste, 48,0 percent of them we recycling, 20,5 percent - processed, 10,2 percent – reused, 3,4 percent - removed. The majority of construction waste was generated in construction companies - during the demolition of structures, less - during reconstruction, repair and construction of new ones.

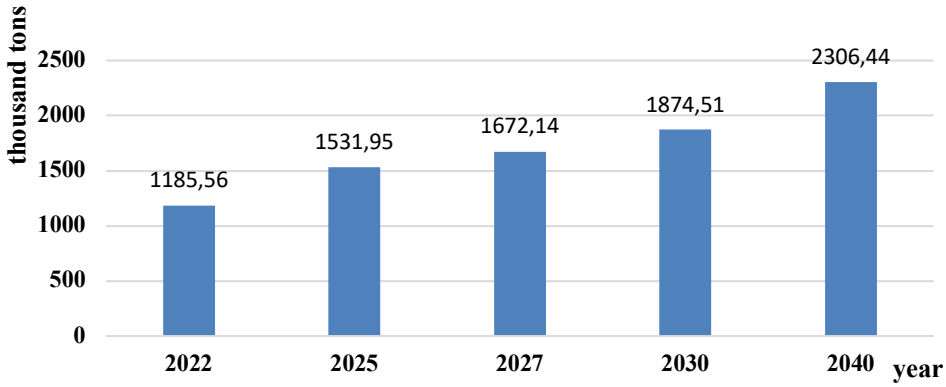

Figure 6. **Variation of construction waste for the future (from 2022 to 2040 y, FORECAST)**

The amount of construction waste depends on the state of the country's economy and the development of the construction sector. After the economic crisis, currently, with the recovery of the construction sector and the implementation of building renovation projects by the Ministry of the Environment, an increase in the amount of construction waste is predicted in Lithuania until 2040 (Figure 6).

RECYCLING OF BUILDING WASTE AND ITS REPEATABLE USAGE

By recycling construction waste, products with high added value are created. They are also used in the construction sector itself (repairing roads, installing drainage systems). The most valuable materials, such as metals, are usually sorted, recycled and sold to other industries as secondary raw materials. Other categories of waste (wood, plastic, paper) are used in incinerators to obtain energy. Inert and other non-recyclable wastes are used to cover landfills, reducing natural resources, and to build and repair internal roads. Not all construction waste is suitable for recycling and reuse. Some of them are dangerous and if handled improperly can negatively affect the environment and human health.

A lot of waste is formed while demolishing and reconstructing buildings. A big part of these materials can be recycled and used repeatedly, however the amount of recycled and reused materials differs a lot. According to the index of the municipalities of Lithuania one can notice the biggest part of building waste is recycled in Lithuania. Lithuania export only 16 % of processed materials from the flow of building waste. Mostly they are iron, capper, aluminum, bronze. The process in applied to the similar amount from the building waste, but only 10% are reused. 4% of the waste in dumped and even less, about 0,4%, is burnt, that is used to produce energy. Such a situation happens to be because the burning Capacities in Lithuania are too small and the enterprises of such a type can accept a very small amount of waste to burn.

According to the state register of waste 121 enterprises in Lithuania have the right to recycle safe inert building waste. 63 enterprises can recycle concrete, 52 - bricks, 32 - tiles and ceramics. Building materials based on plaster and building materials based on asbestos are not recycled n Lithuania. Two enterprises recycled wood, 8 enterprises - glass, 2 enterprises - plastics, asphalt containing tar is not recycled, while tar and tar products are recycled, by 40 enterprises. Metals (including alloys), ground and pumped out silt, materials of isolation not are recycled in Lithuania.

Concrete, bricks, tiles and ceramics make the biggest pat part in the flow of building waste. They are also most easily recycled, that is ground, divided into fractions. The biggest part of different types of road metal is processed and it used in road building and renovating. Wood building waste pe perfectly suits for recycling and production of biomass energy. When plastics well separated it can be reused and recycled. Glass building waste can be used to repeated production of glass.

Concrete is a secure building material and due to it is good characteristics it is used in different constructions all over the world. A lot of scientists examined the usage of different waste products in building material manufactures in order to economize the input of energy and natural resources.

CONCLUSIONS

1. The construction sector is the most material industrial sector in the EU. With continued economic development, we continue to build our building stocks which require significant amounts of construction materials such as aggregates and steel. A circular approach seeks to reduce the sector’s demands on these primary resources.
2. The EU directive of 2008/98 promotes the aim that till 2020 y. 70% of waste, at least should be recycled. If we want to reach that goal we should take use of the experience of those states of the EU where building waste is managed best. For this purpose, these are arranged the State program of waste prevention, the state plan of arranging waste.
3. The present waste politics of EU is based on the principle of hierarchy of waste arranging ways and it is violated in Lithuania, that's why the building sector, can't lessen the need of primary materials and the cost of building objects. If we could integrate repeated usage of waste in the building sector, we could manage to ensure the implantation of circular economy principles and lessen the amount of building waste in dumps.
4. Having analyzed the situation of building waste in Lithuania we can come to the conclusion mixed building waste makes the biggest part (from 26% to 36 %) in the flow of building waste and this shows that building waste is not sorted out on Building sites. If we want, at a smaller price, to make the amounts of mixed building waste less, we should apply to sort waste gathering on the site. It means that on the building site building waste should be sorted out into separate containers and temporarily kept separately: communal, inert, suitable to

recycle and reuse, secondary, dangerous and unsuitable to recycle. The people working on the building site should be taught where and how to put the different waste. ln order to achieve good results workers should be taught regularly how to sort out waste in the right way.

5. Suitable supervision of the waste holders and managers should also be applied and for this reason GPAIS was created. Now this system works irregularly and mistakes in it are quite frequent. The purpose to achieve is to create clear, equal conditions of action to all the participants of the market in order to enable them to legally process the arrangement of building and demolition waste.

6. Lithuania still has no regulations, how to manage construction waste, it is not clear where, on what conditions recycled materials are able and allowed to be used, there is no classification of them. Lithuania has planned to prepare methods for modeling the existence cycle of buildings in 2024.

7. There are no best conveniently approachable ways of production assigned to manage building waste either in Europe or in Lithuania.

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