

O 13. CONSTRUCTION WASTE MANAGEMENT: KEY STUDY OF SKOPJE

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ABSTRACT: Waste is one of the biggest environmental problems. Waste generation has been increasing. Contemporary waste management covers the minimization of waste and after that recycling and reuse and other forms of recovery. Waste disposal is the least favorable option. In the frame of waste construction waste has a significant part of total waste generation, which seriously affects the environment. The construction sector generates about 33% of the total waste in the EU. In North Macedonia and in the capital city of Skopje construction waste generation also has been increasing. This waste frames waste from construction, renovation, demolition, and other activities. It contains various materials such as many types of metal, glass, wood, concrete, and many other components. Construction waste has a big potential for economic and environmental benefits. In Skopje, the amount of collected construction waste is about 330 tons of which 34 tons belong to asbestos waste which is hazardous waste. The amount of reusing and recycling is on a low level. Proper construction waste management can contribute to the development of the circular economy. N. Macedonia and its capital city Skopje has an obligation to follow and implement the EU standards and regulation in the sphere of waste including construction waste.

The main goal of this paper is to analyze possibilities for improvement of construction waste management and use its potential towards to circular economy. Also, the paper aims to analyze regulation in this sphere and to propose the improvement of this regulation as a precondition for sustainable construction waste management.

Keywords: Waste, Construction, Management, Circular Economy, Regulation

1. INTRODUCTION

The construction sector plays an important role in the Macedonian, s economy. It generates about 8 % of the national GDP In the technical structure of investments in fixed assets, construction works participate with 50.% (State Statistical Office 2022). Construction is also a significant consumer of intermediate products (raw materials, chemicals, electrical and electronic equipment, etc., and related services). Because of that, the construction sector can significantly influence the development of the overall economy. Construction including demolition produces a significant volume of waste. This waste contains a wide variety of materials such as concrete, ceramics, bricks, asphalt, wood, paints, glass, various metals, plastic, and other components that can be reused, recycled, and recovered. Sustainable construction waste management can contribute to the development of the circular economy. Sustainable waste management is very important for a circular economy, which is crucial for sustainable environmental protection and economic development. A circular economy has a big potential for economic growth, opening new jobs, and development of new technologies. It understands waste minimization and reuse, recycling, and other recovery of all waste streams and only as an exception landfilling. Most of the construction waste is non-hazardous. However, some of this waste can contain hazardous elements, such as lead, asbestos, plasterboard, paint thinners, strippers, fluorescent bulbs, and aerosol cans. These can pose particular risks to the environment and impede recycling. This produces problems for the use of its potential. Sustainable construction waste management covers proper following and designing of construction waste chains. In general, a waste chain is defined as the full range of activities that firms undertake to bring a product or a service from its conception to its own. It begins with design, transport, storage, distribution, building activities, and demolition, to the end of its life cycle. Separation of hazardous elements on a source is important for the use of this waste.

Waste is a big contemporary global problem (Wolf & Stainley 2011). N. Macedonia and its capital city Skopje and Skopje region should follow and implement the EU standards and regulations in the

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sphere of waste including construction waste. The process of implementation of this regulation gives some positive results, but problems appear with its practical implementation (Sapuric & Dimitovski 2015). Besides some progress, the country, as well as its capital city Skopje, and Skopje region, faces numerous problems with waste management. The first steps of construction waste management in the Skopje Region have been performed.

2. MATERIAL AND METHODS

The research that has been done in the process of preparation of this paper has analyzed the legal, strategic, and planning documents of the EU and N. Macedonia, as well as the reports and documents of Skopje. Also, there were analyzed the relevant studies. The interviews with relevant experts have been performed. Statistical data both on the EU and national levels have been collected and analysed.

Relevant published literature has been reviewed. The conditions in the Skopje region were compared with the conditions in other regions in the country and in the EU. Also, it has prepared a SWOT analysis, which includes strong and weak points, as well as opportunities and threats.

3. RESULTS AND DISCUSSION

Skopje region includes the city of Skopje and 10 municipalities in the frame of the city and 7 municipalities around the city.

The population in the Skopje region according to the 2021 census is 607.007 inhabitants or 33.04 % of the total residential population in the country, which is 1,836.713 and it is the most populated region in the country. (State Statistical Office 2022). The Skopje region is the smallest on the surface with 1.802 square kilometers and covers 7.3% of the total area of the country.



Picture 1 . Map of N. Macedonia and Skopje region.

The country as well as the Skopje region makes efforts to improve waste management including construction waste according to the EU regulations and standards by using the experiences and support from the EU.

The EU Waste Framework Directive (Directive 2008), as a most important part of EU waste legislation, determined very ambitious goals to recycle and reuse 70 % of construction and demolition-generated waste. It is not for now released in most EU countries, but the EU remains strongly dedicated to sustainable construction waste management. The EU waste legislation has been transposed into the Macedonian legislation. The most important is the Law on waste management (Law 2021). It is a basic law in the waste sphere and regulates the general principles for all types of waste management. The law defines construction waste as inert waste, which is waste that is resistant and does not undergo significant physical or chemical transformations, does not dissolve, does not burn and does not react in any other physical or chemical way, does not biodegrade, and cannot endanger the environment. Construction debris is defined as waste during construction and demolition.

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Proper management of hazardous waste still presents a problem in the Union, and data on its treatment are partly missing. EU countries have different results in the selection recycling and reuse of construction waste. Construction and demolition waste is the biggest waste stream in the EU by weight, accounting for over 800 million tonnes per year, i.e., around 32 % of the total waste generated (EU Commission 2018). Greenhouse gas emissions from material extraction, manufacturing of construction products, and construction and renovation of buildings are estimated at 5-12% of total national GHG emissions.

Table 1 shows the structures of waste generation in the EU and the different streams of waste management in the EU countries. Table 2 explores the data from the EU countries and non-EU European countries, including N. Macedonia, for total waste generation from economic activities and households.

The figures from table 1. and 2. show that the EU countries have different results in establishing sustainable waste management in all waste streams. Those are also the data from non-EU countries including Macedonia. According to this in 2020, in Macedonia construction waste, including demolition waste is about 3,8 % of whole waste generation from economic activities and households. However, it is worth mentioning that there are still problems with data collection and precise waste evidence from all waste streams in Macedonia including construction waste. This also applies to the Skopje region.

Table 1. the EU countries have different results in establishing sustainable waste management in all waste streams.

Waste generation, excluding major mineral waste, EU, 2004-2020
(million tonnes)

	2004	2006	2008	2010	2012	2014	2016	2018	2020	Change 2020/2004 (%)
Total	779.5	789.9	760.5	758.7	758.3	769.0	784.6	812.9	776.3	-0.4
Agriculture, forestry and fishing	62.3	56.7	45.5	20.2	20.4	17.7	19.7	19.4	20.7	-66.7
Mining and quarrying	10.4	7.1	10.0	7.9	7.5	7.7	6.9	8.1	7.5	-28.3
Manufacturing	239.9	225.8	216.8	190.5	176.4	176.0	179.0	179.8	166.6	-30.5
Energy	85.4	93.3	84.1	78.6	88.8	87.4	74.7	75.7	45.7	-46.5
Waste/water	75.2	83.3	98.9	129.9	155.0	180.7	196.8	208.5	212.4	182.3
Construction	34.4	33.4	34.8	42.1	39.8	38.6	37.8	41.3	38.7	12.5
Other sectors	97.7	111.2	88.7	103.5	89.6	85.1	88.5	94.0	89.0	-8.9
Households	174.1	179.2	181.6	186.0	180.7	175.9	181.2	186.1	195.7	12.4

Source: Eurostat (online data code: env_wasgen)



According to the data of the State Statistics Office (Anonym 2022), in the country in 2020, the total amount of waste generation by section of economic activity was 1,488,000 tonnes. Of the total generated waste, 71.90% was non-hazardous and 28.10% was hazardous waste. The greatest share of the generated waste was from the section of mining and quarrying, 521,000 tonnes (35.03%). The amount of recycled waste or waste delivered for recycling was 538,000 tonnes. By the waste types recycled or delivered for recycling, the greatest amount was from the category of metallic wastes, non-ferrous, paper and cardboard wastes, and plastic wastes.

Regarding the amount of communal waste, the total amount of collected municipal waste is 605,638 tonnes, 84% from the households and remaining 16% from companies. The largest amount of collected communal waste was recorded in the Skopje region, or 172,288 tonnes. Table 3 shows the structure of municipal waste in the Skopje region.

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Table 2. the EU countries have different results in establishing sustainable waste management in all waste streams

Waste generation by economic activities and households, 2020
(% share of total waste)

	Mining and quarrying	Manufacturing	Energy	Waste/water	Construction and demolition	Other economic activities	Households
EU	23.4	10.6	2.3	10.8	37.5	5.9	9.4
Belgium	0.0	20.9	1.5	31.4	30.5	7.9	7.8
Bulgaria	81.6	4.2	5.2	2.9	1.6	2.5	2.0
Czechia	0.3	12.1	1.1	15.5	42.9	12.2	15.9
Denmark	0.1	5.4	3.9	7.5	54.8	10.3	18.0
Germany	1.3	13.7	2.0	12.0	56.3	5.1	9.6
Estonia	15.2	24.6	35.0	4.6	9.8	7.4	3.4
Ireland	9.4	22.4	1.0	12.6	32.6	10.1	12.0
Greece	31.7	11.1	5.3	11.4	19.1	5.5	15.9
Spain	2.3	12.4	0.8	20.8	30.8	11.5	21.3
France	0.1	6.0	0.3	8.1	68.5	6.3	10.8
Croatia	11.6	7.5	1.1	16.3	23.8	19.5	20.2
Italy	0.8	15.2	0.9	24.6	37.8	4.1	16.6
Cyprus	6.9	9.5	0.1	6.6	50.2	9.8	17.0
Latvia	0.0	17.0	4.1	33.7	9.7	12.9	22.6
Lithuania	1.0	32.7	2.3	18.4	8.3	16.3	20.9
Luxembourg	1.1	6.5	0.3	3.5	82.1	4.2	2.2
Hungary	0.8	15.2	11.4	12.1	25.4	7.5	27.6
Malta	1.1	0.9	0.0	2.5	85.3	4.7	5.6
Netherlands	0.1	10.6	0.4	7.4	65.4	8.7	7.4
Austria	0.1	7.5	0.6	3.5	76.5	5.2	6.7
Poland	36.6	16.1	6.6	13.4	13.0	6.6	7.8
Portugal	0.1	17.8	1.3	22.9	10.7	15.4	31.8
Romania	84.3	4.6	3.1	2.0	0.9	2.2	3.0
Slovenia	0.1	17.9	12.1	3.8	6.3	51.4	8.4
Slovakia	1.6	24.0	5.5	8.9	9.0	32.5	18.5
Finland	75.1	8.2	0.8	1.0	11.8	1.0	2.1
Sweden	76.5	3.1	1.2	4.5	9.3	2.3	3.1
Iceland	0.0	24.2	0.0	2.0	3.6	31.0	39.2
Liechtenstein	0.0	1.1	0.0	0.3	92.5	0.1	6.0
Norway	1.3	13.6	1.6	8.0	44.2	12.9	18.4
Montenegro	25.3	2.5	29.0	0.3	13.8	10.5	18.5
North Macedonia	35.1	35.0	0.5	17.9	3.8	7.7	0.0
Serbia	78.0	1.9	13.5	1.1	1.2	0.9	3.5
Türkiye	25.6	19.2	22.6	0.3	0.0	5.8	26.5
Bosnia and Herzegovina	11.3	27.3	46.3	0.0	1.3	0.4	13.4
Kosovo (!)	19.9	9.4	52.5	0.3	0.2	3.1	14.6

(!) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion Declaration of Independence.

Source: Eurostat (online data code: env_wasgen)



Table 3 shows that the highest percentage of collected communal waste or 81,68% is mixed waste which shows that separated waste selection and collection is still at a low level. As mentioned above in the state the percentage of construction waste is 3,8 % of total waste generation, excluding the generation of waste from excavated soil. But as mentioned above there are still problems with waste data evidence in the country and even more with construction waste the problems are bigger. The Annual 2022 report from Public Enterprise “ Drisla Skopje“ (Report 2022), which operated with Skopje regional landfill Drisla, noted that in 2022 collected and disposed of 33,216 tonnes of construction waste (excluding from excavated soil). Also in 2022, 203 tons of asbestos waste, mostly construction waste was collected and disposed. That shows that there is no precise data and precise road map related to construction waste and it has to be based on some estimations. Because of this, there are differences in construction waste data.

Table 3. Waste composition in the Skopje region

Waste type	Average collected waste in tonnes	%
Papers	12,178	2,01
Glass	3,754	0,62
Plastic	13,063	2,16
Metal(iron, still, aluminum, etc.)	2,302	0,38
Organic waste food, leaves, greenery, etc)	40,259	6,65
Textile	8,373	1,38
Ruber	1,487	0,25
Mixed waste	494,693	81,68
Other	29,531	4,88

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According to an estimation from 2021, the amount of construction waste in the Skopje region is based on two scenarios. According to the lower scenario, the amount is about 250,000 tonnes and the higher scenario is even about 350,000 tons.. The estimation is that generation waste from excavated soil in the Skopje region is between 1,000,000 and 1,200,000 tons. It is worth mentioning that construction waste depends on different construction activities, which are very variable from year to year. Furthermore, The Plan for Waste Management of Macedonia for 2021- 2031 noted that the estimated amount of construction waste is about 500,000 tonnes (Anonym 2021). It means that only about 10% of construction waste was collected This Plan defines construction waste as a priority waste stream.

At the landfill Drisla there is a a site with a facility for the proper storage, processing, and treatment of asbestos waste. There is a plant with a specially designed and managed cell for the disposal of asbestos waste. A cell can accommodate 100,000 m² of asbestos tiles. Those tiles should be packed in protective bags with dimensions 1m x 1m x 70 cm. The situation with the processing of construction waste in the Skopje region will be significantly improved with the procurement of a machine for crushing certain types of waste, such as concrete, bricks, plaster, and similar waste, with the capacity of processing 10,000 tons of construction waste monthly. It will be satisfactory for processing a significant part of collected construction waste. whole collected waste from the Skopje region. That should be performed by the end of 2024.

In the near future, has to be established completely following the construction waste chain from the production, storing, mapping, and construction activities to the end of its “life”, by recycling, processing, reusing, or disposal as a least favorable option. It should also reach progress in the system of waste sorting at the generation place and a phased approach and progress with new infrastructure and equipment. In the first place, it should be at least for wood, concrete, bricks, ceramics, plastic, stones, and plaster. Extended producer responsibility has to be enhanced.

A SWOT analysis made in the research of preparing this paper shows, strong and weak sides, and also opportunities and threats.

Table 4. SWOT analysis

Strong sites	Weakness	Opportunities	Threats
Developed distribution system, possibilities from using EU funds, exiting regulation, developed a legal system for fees for improperly behavior with waste, revenue streams are not directly dependent on material price fluctuations, direct customer relations, use of the existing distribution/collection system.	Distance from waste source to processing place still does not satisfy specialization in construction waste management, undeveloped infrastructure, and lack of equipment.	Further, strengthen regulation, strengthen stimulation, public-private partnership, stimulate private companies, and increase demand for recycled products.	Lack of market acceptance of recycled materials, non-development market, high cost of recycling, contamination of input material streams with hazardous substances, and low public awareness.

4. CONCLUSIONS

Construction waste contains a very valuable component. Sustainable construction waste management can contribute to the development of a circular economy, create new jobs, develop new technologies, and better protection of the environment. This management has to be supported by economic instruments. The improvement of construction waste management should be developed in phases, with the improvement of infrastructure and supplying the equipment. Waste management in the Skopje region has to improve: waste identification, source separation, and collection, improve waste logistics and waste processing, and involve quality management. The private sector should be strongly involved. All relevant sectors such as the business sector, science, and local and central government should cooperate in aim to establish an efficient system of management of this waste stream.

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