

Content from Construction and Demolition Waste: efforts to the circular economy

Pešta, J.^{1,2}, Pavlů, T.¹

¹University Centre for Energy Efficient Buildings of Technical University in Prague, jan.pesta@cvut.cz

²Faculty of Environmental Technology, University of Chemical Technology in Prague

Introduction

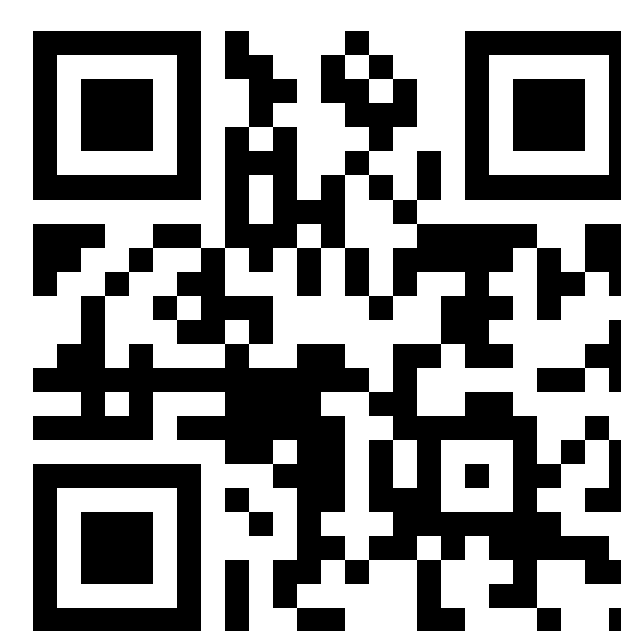
The construction industry is an important consumer of primary raw materials and generates almost 30 % of all waste. The effort to reduce this gap between the amount of consumed primary raw materials and construction waste production leads to the creation of a circular building industry. However, this effort faces various issues: distrust of products with recycled content, low awareness about resource consumption, and low understanding or legislation confusion. To tackle these and other similar barriers, we published the Catalogue of construction products and materials.

This Czech national handbook gives information about the utilization of secondary raw materials to contracting authorities, architects, civil engineers, and construction companies. The Catalogue contains a list of valid requirements for the utilization of recycled materials listed in standards and legislation [2]. Also, it is connected to the online database of products and examples of good practice.

After workshops with experts in the field of construction and demolition waste (CDW) recycling, the most frequent information summarized in the six questions, which are presented here.

Goal and outcomes

The goal of this project is to reduce the amount of CDW, which is produced in the Czech Republic. By summarization of information in one place, we wanted to make the recycling process easier and to reduce the natural resources consumption. In cooperation with the Czech Standardization Agency and supported by the Ministry of Industry and Trade, we published the printed version, created the online database and prepared the technical informative standard for experts.



Why use construction and demolition waste?

Natural resources for the building industry are nonrenewable and therefore limited. Such a resource for the Czech Republic is sand and its quality will be insufficient in the near future.

The recycling processes can be a solution, but there is only a small inquiry for recycled materials now. Despite the fact, that reducing the CDW means less landfilled materials, less consumed natural resources and less energy for nature resources mining.

The Catalog tries to convince the experts, that the demolition site could be an advantageous source of materials and products.

What materials can be recycled in the process of building demolition?

According to the Czech Statistical Office, concrete and concrete products represent almost 40 % of CDW. **Figure 1.** shows the weight percentage of material types in CDW.

The Catalogue describes these types of CDW and their main risk for reuse and recycling and their possible utilization. Such a description of waste concrete is in **Table 1.**

Table 1. The waste concrete, main risks to reuse or recycling and its possible utilization

Specification	The main risks to reuse and recycling	Possibilities of utilization
Foundation structures, floors	Unwanted impurities - the soil content	Backfilling Landscaping
Structural elements from buildings or transportation structures	The quality and properties of recycled aggregate Limitations in standards The quality and properties of recycled aggregate The possibility of unwanted impurities	Gravel replacement (foundation structures, interior structures) [Sand replacement Cement replacement Mineral admixture
Concrete sludge	The separation of materials (aggregate, water, cement slurry)	Aggregate replacement

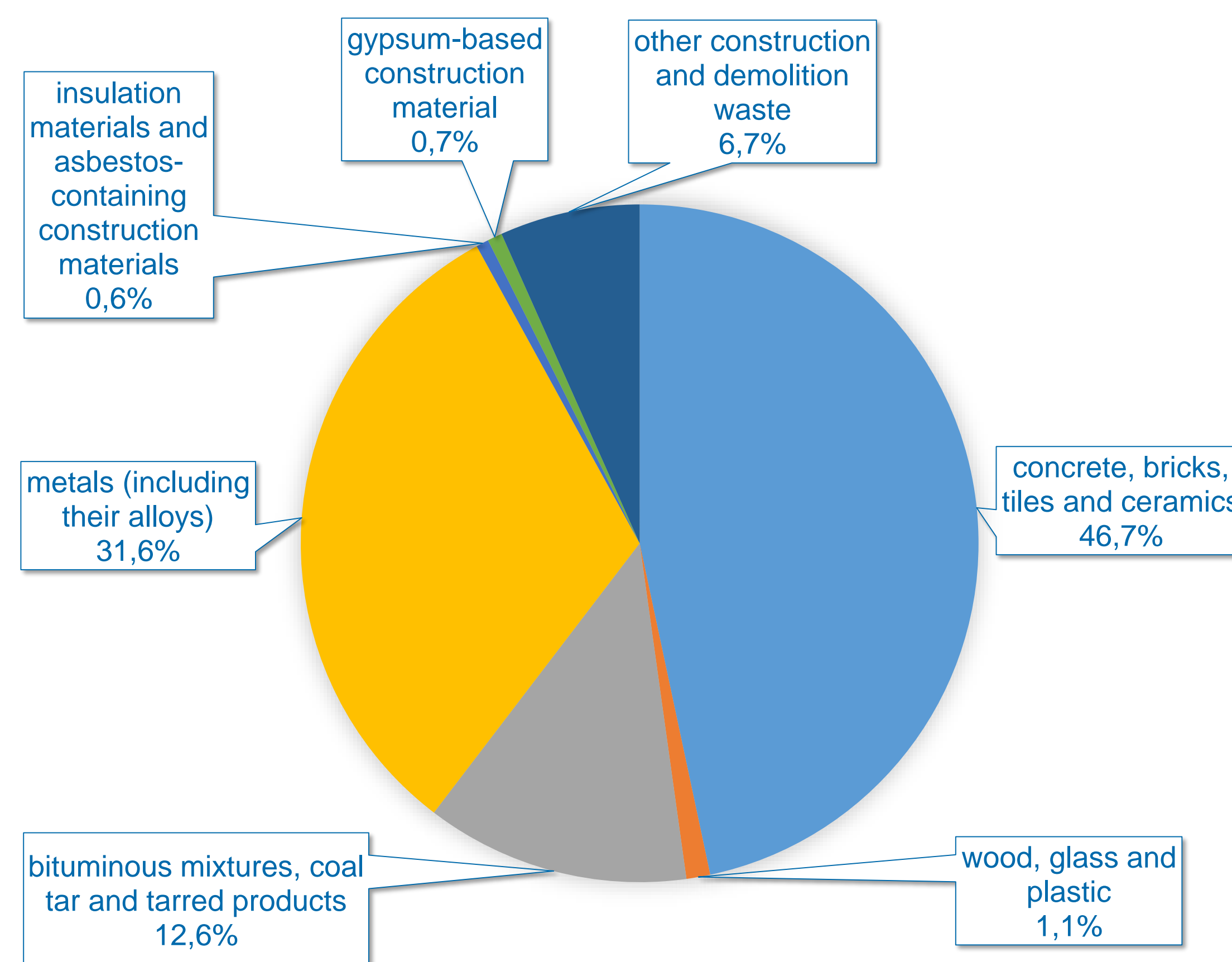


Figure 1. Construction and demolition waste, excluding soil, 2018 [1]

Table 2. The examples of construction products with recycled materials content

Construction product	Recycled materials content	Possible utilization
Recycled mixed aggregate	Up to 100%	Backfilling Landscaping
Recycled concrete aggregate	Undefined	Aggregates for bituminous mixtures Aggregates for unbound and hydraulically bound materials
Recycled aggregate concrete	Up to 50% of coarse fraction of recycled concrete aggregate	Concretes of defined exposure classes
Precast concrete elements	Up to 20% of recycled concrete aggregate with defined origin	Precast concrete elements Same ways as conventional concrete
Concrete blocks for walls with recycled (concrete, masonry or mixed) aggregate	Non defined amount of recycled materials content	Same ways as conventional products Limitations of utilization have to be determined
Metals	Up to 95%	Same ways as conventional products
Reclaimed Asphalt	Up to 100%	Bituminous mixtures
Wood panel	Not specified	Same ways as conventional products
Windows with PVC-U profiles	Up to 100% Approx. 30%	Same ways as conventional products
Mineral wool (stone)	Not specified amount of waste from production	Same ways as conventional products
Mineral wool (glass)	Up to 80% of waste glass Approx. 50% of waste glass	Same ways as conventional products
Expanded polystyrene	Not specified amount of waste from production	Same ways as conventional products
Gypsum plaster boards	Up to 10% of waste gypsum from production	Same ways as conventional products

What is the best approach for building demolition?

The main prerequisite for high potential utilization of recycled materials in the construction industry is a selective demolition process. This process is more fully described in the Catalogue and it has the following phases:

- describing the building object, creation of a program of deconstruction,
- removal of municipal waste and cleanable products,
- deconstruction, technical separation "construction by construction",
- continuous separation of wastes.

How support recycled aggregates with civil procurement?

Civil procurement can be a useful motivation tool for supporting products with recycled materials. The best option for authorities is to require the utilization of products with recycled content in a list of tender specifications.

The Catalog summarizes examples of such specifications, which can be used regarding czech state of art.

How prove the properties of products with recycled content?

Products containing secondary raw materials can be used only in case, that they reach the properties, which are standardized of usual products.

The Catalog summarizes the procedures to test the properties of building products. Also, the Catalog includes the overview of methods for product certification and technical standards.

What products with recycled content can be used for buildings?

Nowadays, there are products and materials with recycled materials content which are normally used in the building industry. Some of them can be used as conventional materials, but others have limitations for their utilization.

The Catalogue gives examples of construction products with recycled materials content, as you can see in **Table 2.**

Conclusion

The Catalogue of Construction Products was published to support the efficient use of products and materials with recycled content and to reduce the amount of construction and demolition waste. The Catalogue was developed in cooperation with experts and it should be a handbook for architects, civil engineers, and contracting authorities. Besides the printed version, the online version is available on www.recyklujmestavby.cz. This website includes also the database of products and materials with recycled content. Furthermore, future work is planned to extend the database with construction products containing secondary raw materials from other industries to support the circular building industry.

Acknowledgements

This work has been supported by the Ministry of Education, Youth and Sports within National Sustainability Programme I, project No. LO1605.

References

1. "Produkce, využití a odstranění odpadů - 2015 | ČSÚ." [Online]. Available: <https://www.czso.cz/csu/produkce-vyuziti-a-odstraneni-odpadu-2015>. [Accessed: 23-Nov-2017]
2. Pavlů, T., Pešta, J., Volf, M., & Lupíšek, A. (2019). Catalogue of Construction Products with Recycled Content from Construction and Demolition Waste. IOP Conference Series: Earth and Environmental Science, 290, 012025. doi:10.1088/1755-1315/290/1/012025