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Improvement of selective demolition procedures within the framework of prevention of waste generation and further use of construction and demolition waste materials

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1 Introduction

- According to volume, construction and demolition waste is the largest flow of waste in the Czech Republic as well as in the EU. It represents about a third of all produced waste.
- Proper management of construction and demolition waste and the recycled materials resulting from this waste provide a major benefit in terms of **sustainable development, environmental protection and quality of life.**
- **Lack of trust** in the quality of recycled construction and demolition materials is a **significant obstacle for the recycling and reuse of construction and demolition waste.**
- In the selective demolition of buildings and the subsequent recycling and use of construction and demolition waste**, there is great potential for obtaining recycled aggregate** (concrete, bricks) with the required properties for **use as a partial and/or complete replacement of natural aggregate in the production of concrete.**
- In selective demolition, optimal solutions regarding optimal recyclability and reuse of construction and demolition waste should be taken into account.
- **If we want to use recycled materials in high-quality applications** (e.g. concrete production), **it is necessary to ask for more selective demolitions** (e.g. sorted collection/dismantling of concrete and masonry).

2 Legislative documents

- Act No. 541/2020 Coll. on waste
- Decree No. 273/2021 Coll. on waste management details
- Decree No. 8/2021 Coll. on the waste catalogue and assessment of waste properties (Waste Catalogue)
- Decree No. 268/2009 Coll. on technical requirements for buildings
- Act No. 183/2006 Coll. on land-use planning and the building code (Building Code)
- Notification No. 275/2008 Coll. on the introduction of the classification of production (CZ-CPA)
- Government Regulation No. 352/2014 Coll. on the waste management plan of the Czech Republic for the period of 2015-2024
- ZP01/2018 Methodological instructions of the MoE for managing the generation of asbestos-containing waste during the construction and removal of buildings and for their management
- ZP13/2014 Methodological instructions for approving the operation of biogas stations and establishing binding operating conditions from the point of view of environmental protection
- ZP06/2007 Methodological instructions of the MoE for the elaboration of the basic description of waste
- ZP21/2001 Methodological instructions of the Waste Department of the Ministry of the Environment to the Waste Act relating to the management of construction and demolition waste
- ZP18/2018 Methodological instructions of the Department of Waste of the Ministry of the Environment for the management of the generation of construction and demolition waste and for their management (2018)

3 Site inspection to identify waste materials

a) The main purpose of the site inspection (building) is to determine the defined parts of the structure which will become **hazardous waste after** removal from the structure, or **may be a source of hazardous waste.**

b) Furthermore, attention must be focused on **identifying materials** from the individual parts of the building that can be **reused or recycled.**

c) An inspection of the building should provide **information on materials that are sorted at the source** (e.g. hazardous waste), on **materials that can or cannot be reused or recycled, on waste handling methods and the possibilities of recycling.**

d) **Defined parts of the construction**, if the static conditions allow it from the point of view of safety, **will be designated in the documentation to be removed from the construction separately**. This will prevent the mixing of other waste categories with hazardous waste category.

e) **An overview of demolished building materials,** products, by-products and construction and demolition waste**, which must be collected separately,** as well as an overview **of demolished construction materials that are a by-product and an overview of construction and demolition waste that contains hazardous waste** are given in **Appendix No. 24, Decree No. 273/2021.**

f) **Polluting substances that should be removed before demolition** are listed in the Austrian standard ÖNORM B3151.

4 Recommended waste audit procedure

5 Documentation for demolition of constructions

The content of the project documentation for the demolition of the building is specified in Decree No. 499/2006 Coll. in § 5

- Documentation of demolition works
- Accompanying report
- Summary technical report
- Situation drawings
- Documentation of objects and technical and technological equipment
- Evidence section of documentation

6 Preparatory work associated with building dismantling

1. Before starting the deconstruction process, it is necessary to ensure that the building is **cleared of all furniture or loosely stored items both inside the building and in the attic and basement areas.**
2. **Dismantling of all heating elements and central heating distribution systems**. Evaluation of the condition of these heating elements and distribution systems and their classification into categories according to subsequent use or processing.
3. **Dismantling of all objects from toilets, kitchens, bathrooms**, showers in such a way to ensure the possibility of their further use.
4. **Dismantling of all electro-technical wiring** (heavy-current, weak current, measurement and regulation, safety technology (EZS), control systems for all technical equipment, computer networks, telephone wiring, television signal wiring, etc.), **which are located in the rails.**
5. **Dismantling floor coverings** (hardwood flooring, PVC, parquet, etc.)
6. **Dismantling the remaining sanitary technical distribution systems (**ventilation systems, air conditioning, cooling, gas distribution system, water distribution system, sewerage system, central vacuum cleaners) **placed in soffits or on consoles.**
7. **Dismantling of all door and window panels in the building.**
8. **Dismantling of the roof covering of the building, including lathing.**
9. **Dismantling of all external plumbing elements and chimneys.**
10. **If the building contains a roof structure, it is necessary to dismantle all wooden elements of the roof structure.**

7 Technological possibilities for crushing of individual components of SDW

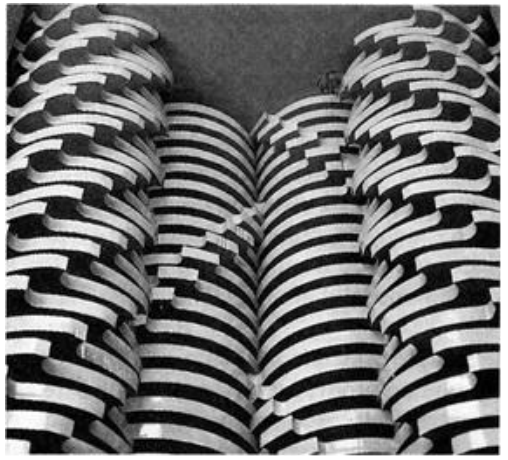
Equipment for crushing inert materials (concrete, brick)

- **Jaw crushers,**
- **Cone crushers,**
- **Hammer crushers,**
- **Impact crushers.**

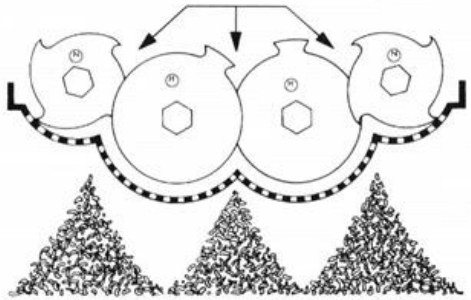
7 Technological possibilities for crushing of individual components of SDW

Crushing of plastic waste fractions

- These are **waste raw materials based on plastics and rubber**, which are usually usable in a crushed state.
- Conventional crushing and grinding methods can be used to crush these materials, most commonly using different types of **knife crushers.**
- It is usually stated that raw material with a grain size of up to 600 µm can be prepared using *conventional crushing.*
- Suitable devices:
  - knife crushers,
  - shredders.



View of the shredder



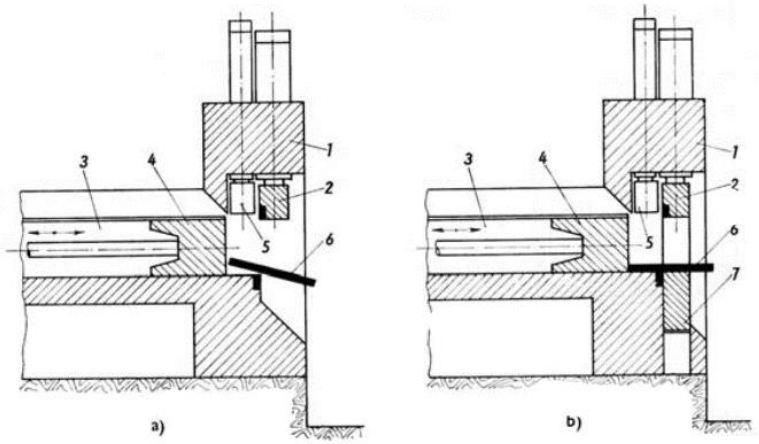
Shredder scheme

Knife crusher scheme

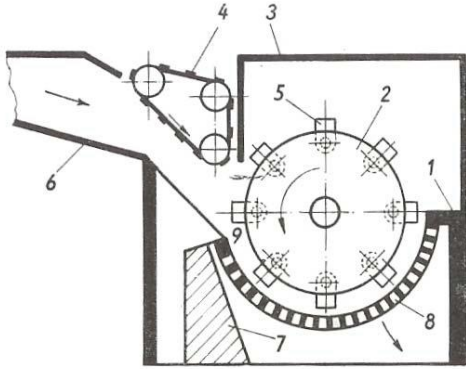
7 Technological possibilities for crushing of individual components of SDW

Crushing metal SDW components

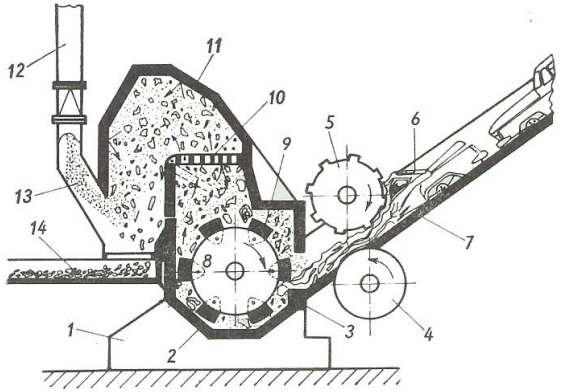
- **Scrap-iron cutting**
  - **Mechanical shears**
  - **Alligator shears**
  - **Hydraulic shears**
- **Metal waste crushing**
  - **Crushers with horizontal rotor**
  - **Crushers with vertical rotor**



Scheme of hydraulic scrapping shears



Crusher with bottom grate



Crusher with top grate

8 Description of a block of flats intended for demolition

Recommended parts of the object description intended for demolition:

1. **General information**
2. **Dimensions of the building**
3. **Structural system of the building**
4. **Foundations**
5. **Non-supporting structures**
6. **Floor construction**
7. **Roof construction**
8. **Window openings**
9. **Door openings**
10. **Balconies**
11. **Plumbing products**
12. **Heat insulation**
13. **Sanitary technology**
14. **Heating**

9 The procedure for the block of flats demolition

Preparation works include:

a) **Cleaning of the block of flats from all furniture** and freely stored objects in the basement and individual floors of the block of flats.

b) **Dismantling of all heating elements and central heating distribution system.**

c) **Dismantling of all equipment from toilets, kitchens and bathrooms.**

d) **Dismantling of all electronic wiring** (heavy-current, weak-current, measurement and regulation, safety technology (EZS), control systems for all technical equipment, computer networks, telephone wiring, television signal wiring, etc.) **that are located in the rails.**

e) **Dismantling of the remaining sanitary technical distribution systems** (ventilation systems, air conditioning, cooling, gas distribution systems, water distribution system, sewage) **placed in soffits or on consoles.**

f) **Dismantling of window and door panels, including door frames.**

g) **Dismantling floor coverings** (hardwood flooring, parquets, ceramic tiles).

h) **Dismantling of all plumbing elements.**

i) **Dismantling of steel railings on stairs and balconies.**

j) **Dismantling of the roof covering including insulation layers.**

k) **Dismantling the heat insulation of a block of flats.**

9 The procedure for the block of flats demolition

Object demolition:

1) **Demolition of the block of flats will be carried out by gradual disassembly from top to bottom.**
2) **Demolition of ceramic tiles, non-supporting elements** (brick partitions) **will be carried out using manual** machines (pneumatic hammer, etc.).
3) **During the demolition work of the pipe shafts, the pipelines of sanitary technical distribution systems** (gas distribution systems, hot and cold water distribution systems, sewage and storm sewers) **will be gradually dismantled.**
4) **Machines with a long arm will be used for the demolition of the external insulation system.**
5) **Demolition of load-supporting elements (concrete structures) will be carried out using machines with a long arm.** During the demolition work, a sufficient amount of water will be provided to sprinkle the dust generated during the demolition.
6) **During the demolition, the demolition contractor ensures the sorting and separation of individual types of waste into prepared containers.** As much as possible, they try to reduce the amount of mixed construction waste during the demolition.

10 Soupis odpadů ze selektivní demolice

Building	Waste type	Waste identification	Waste code	Quantity	Unit	Total quantity
Block of flats	Inert waste	• Load-bearing structures (columns, girders, walls, stairs, foundations, ceiling structures)	17 01 01	1072	tons	1302,5 tons
		• Non-load bearing structures. Partitions. Inert waste.	17 01 02	169	tons	
		• Ceramic facings and ceramic pavement. Furnishing items.	17 01 03	15,3	tons	
		• Slag underfill	10 01 01	44	tons	
		• Glass infill for entrance doors, window openings and skylights	17 02 02	2,2	tons	

10 Soupis odpadů ze selektivní demolice

Building	Waste type	Waste identification	Waste code	Quantity	Unit	Total quantity
Block of flats	Non-inert, non-hazardous waste	• Wooden cladding (height 110 cm from the floor, thickness 40 mm) • Wooden handrail • Wooden door leaf • Wooden sills, width 350 mm. • Hardwood floor • OSB boards	17 02 01	8,27	tons	25 tons
		• Cast iron radiators (incl. steel pipes) • Steel pipe DN60 • Steel railings • Steel door frames • Steel mailbox • Cast iron pipe DN 125 (rainwater, sewage) • Cladding of window openings with sills, cladding of the cornice above the basement • Metal window sills, galvanised, 230 mm wide	17 04 05	11,2	tons	
		• Aluminium entrance door including door frames Fixed shop window	17 04 02	0,06	tons	
		• Plastic window incl. frame • Plastic piping for hot and cold water distribution PPR pipe • Plastic bathtub	17 02 03	2,1	tons	
		• Polystyrene from facade insulation in thickness 140	17 06 04 02	3,3	tons	

10 Soupis odpadů ze selektivní demolice

Building	Waste type	Waste identification	Waste code	Quantity	Unit	Total quantity
	Hazardous waste	• Parquet friezes (2x 16 mm thick) + hobra 20 mm thick. Parquet friezes glued with	17 02 04*	6	tons	11 tons
		• Waterproofing strip • 2 layers	17 03 01*	3	tons	
		• Foamed polystyrene parts 120 mm thick	17 06 03 01*	2	tons	

11 Conclusion

- **We can consider the selective demolition of buildings after the end of their life cycle as a tool that will support:**
  - correct classification of SDW;
  - SDW recyclability,
  - a source of recycled aggregate to be used in the building materials segment,
  - protection of natural resources of aggregates,
  - environmental protection and quality of life protection.