Estimation of building waste flows and adequacy with resources
Plan

• Context
• Methodology
• Presentation of waste diagnoses database
• Results
• Conclusion and prospects
Context

Building sector

Big consumer of materials

Big producer of waste

Key sector for the circular economy

Demolition sector in France = 22.8 T of waste

Limits: flows are poorly known in **France**

Objectives of this study

Quantities

Types of recovery

**Building sector**
Methodology

Objective: identify material flows resulting from the deconstruction of buildings in France

- **Step 1**: Determination of the volume of demolished buildings for each typology (state of the art analysis). The main studied building types are: individual house, apartment building, office and administration, industrial building.

- **Step 2**: Estimation of the constituent quantities (concrete, ceramic, brick, glass, wood, plastic, insulation ...) for several building typologies (analysis of a French database of building waste diagnoses).

- **Step 2.bis**: Determination of the global distribution of the different recovery channels for each type of material (French database of building waste diagnoses).

- **Step 3**: Comparison for the waste streams and global recovery rates for C&D wastes between results of the step 2bis and a previous state of the art.

- **Step 4**: Thanks to the steps 1 and 2, the volume of deconstruction waste can be calculated for the whole building sector. Therefore, the deconstruction flows can be crossed with an analysis of the existing types of recovery (projects of close development, recycling channels, ...).
Presentation of waste diagnosis database

In France, since 2012, it is compulsory to realize a waste diagnosis for the demolition of the following buildings:

- Buildings which have an area upper than 1000 m²;
- Professional buildings which have received hazardous substances.

A waste diagnosis is a 2-step process:

1. Before the demolition
2. Demolition
3. After the demolition

- Estimated inventory (quantity of waste by category + waste recovery possibilities)
- Actual inventory of produced waste and waste recovery

Collection file

ADEME (the French Environment & Energy Management Agency)

Building waste diagnosis database
Presentation of waste diagnosis database

241 projects

Ways of recovery:
- Reuse (on site or out site)
- Sent to an eco-organization
- Waste sent to a sorting center
- Other material recovery
- Material recovery
- Incineration with energy recovery
- Storage
- Other elimination

General data:
Number of buildings
Total area
Type of building...

Building waste diagnosis database

Quantification of waste:

Inert waste
Concrete and stone
Ceramic
Glass
Inert waste mix...

No-hazardous waste
Wood without hazardous substances
Metal
Insulation
Plastic No-hazardous mix...

Hazardous waste
Wood with hazardous substances
Bituminous mixture
Asbestos
Hazardous waste mix...

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 642894.
Results: uses of the building

The main building uses represented in the database are:
- 80 projects of industrial building;
- 61 projects of apartment building;
- 29 projects of office and administration building.

Figure 1. Deconstructed surfaces by building use

Selection of 3 building uses:
- apartment building
- industrial building
- office and administration building
Results: Criteria for selection

To determine the quantity per waste category, the selected projects had to meet the following criteria:

1) The use of building is apartment building or industrial building or office and administration building and the principal material is concrete;
2) It is necessary that concrete/stone quantity is specified;
3) The metal or tile/brick quantities (per m²) are not upper than concrete/stone quantity (per m²);
4) The concrete/stone quantity (per m²) has not to be aberrant in comparison with the other projects;
5) The analysis of the categories of quantified waste must suggest that the sorting of the waste was actually carried out.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Apartment building</th>
<th>Industrial building</th>
<th>Office and administration building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of selected projects</td>
<td>18</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 1. Number of selected projects in function of the studied typology

Low number → low reliability → limit of the study
Results

Total waste quantity between 1.2 T and 1.3 T per m²

* glass, inert mix waste, ceramics, …
** plastics, floor covering, vegetals, no hazardous waste, …
Results: recovery channels

- Inert waste

<table>
<thead>
<tr>
<th>Material</th>
<th>Reuse</th>
<th>Sent to a sorting center</th>
<th>Other material recovery</th>
<th>Incineration with energy recovery</th>
<th>Sent to an eco-organization</th>
<th>Waste storage facility</th>
<th>Incineration without energy recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete/Stone</td>
<td>64%</td>
<td>11%</td>
<td>19%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Tiles/bricks/Ceramics</td>
<td>59%</td>
<td>6%</td>
<td>0%</td>
<td>19%</td>
<td>0%</td>
<td>16%</td>
<td>0%</td>
</tr>
<tr>
<td>Glass</td>
<td>2%</td>
<td>12%</td>
<td>79%</td>
<td>0%</td>
<td>0%</td>
<td>7%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 2. Recovery rates for some type of inert waste (database of building waste diagnosis results).

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<thead>
<tr>
<th>Material</th>
<th>Material recovery</th>
<th>Energy recovery</th>
<th>Waste storage facility</th>
<th>Incineration without energy recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Between 58 and 70%</td>
<td>/</td>
<td>Between 30% and 42%</td>
<td>/</td>
</tr>
<tr>
<td>Tiles and ceramics</td>
<td>20%</td>
<td>20%</td>
<td>5%</td>
<td>5% in inert waste storage facility</td>
</tr>
<tr>
<td>Glass</td>
<td>/</td>
<td>5%</td>
<td>/</td>
<td>95% in no-hazardous waste storage facility</td>
</tr>
</tbody>
</table>

Table 3. Recovery rates for some types of inert waste (results from the state of the art).
Results: recovery channels

- Inert waste

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<th>Material recovery</th>
<th>Reuse</th>
<th>Recycling</th>
<th>Career filling</th>
<th>Road underlay</th>
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Table 3. Recovery rates for some types of inert waste (results from the state of the art).
# Results: recovery channels

- **Inert waste**

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<th>Incineration with energy recovery</th>
<th>Sent to an eco-organization</th>
<th>Waste facility storage</th>
<th>Other elimination</th>
</tr>
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<td>/</td>
<td>/</td>
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<td>/</td>
</tr>
<tr>
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<td>/</td>
<td>5%</td>
<td>/</td>
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<td>/</td>
</tr>
</tbody>
</table>

**Table 3.** Recovery rates for some types of inert waste (results from the state of the art).
Results: recovery channels

- No-hazardous waste

<table>
<thead>
<tr>
<th></th>
<th>Reuse</th>
<th>Sent to a sorting center</th>
<th>Other material recovery</th>
<th>Incineration with energy recovery</th>
<th>Sent to an eco-organization</th>
<th>Waste storage facility</th>
<th>Other elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>2%</td>
<td>23%</td>
<td>21%</td>
<td>34%</td>
<td>0%</td>
<td>20%</td>
<td>1%</td>
</tr>
<tr>
<td>Plastic</td>
<td>0%</td>
<td>25%</td>
<td>65%</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Metal</td>
<td>1%</td>
<td>15%</td>
<td>80%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Insulation</td>
<td>5%</td>
<td>30%</td>
<td>7%</td>
<td>5%</td>
<td>0%</td>
<td>53%</td>
<td>0%</td>
</tr>
<tr>
<td>Plaster</td>
<td>6%</td>
<td>24%</td>
<td>17%</td>
<td>2%</td>
<td>4%</td>
<td>47%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 4. Recovery rates for some type of no-hazardous waste (database of building waste diagnosis results).

<table>
<thead>
<tr>
<th></th>
<th>Reuse</th>
<th>Recycling</th>
<th>Career filling</th>
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<th>Energy recovery</th>
<th>Waste storage facility</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34 %</td>
<td>25.1%</td>
<td>/</td>
</tr>
<tr>
<td>Plastic</td>
<td></td>
<td>From 0 to 5%</td>
<td>From 0 to 5%</td>
<td>/</td>
<td>/</td>
<td>From 95 to 100% in no-hazardous waste storage facility</td>
<td>/</td>
</tr>
<tr>
<td>Metal</td>
<td>From 0 to 11%</td>
<td>From 87% to 98%</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>From 2 to 15% in no-hazardous waste storage facility</td>
<td>/</td>
</tr>
<tr>
<td>Insulation</td>
<td>/</td>
<td>From 0 to 40%</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>From 60 to 100% in no-hazardous waste storage facility</td>
<td>/</td>
</tr>
<tr>
<td>Plaster</td>
<td>/</td>
<td>From 0 to 5%</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>From 95 to 100% in no-hazardous waste storage facility</td>
<td>/</td>
</tr>
</tbody>
</table>

Table 5. Recovery rates for some types of no-hazardous waste (results from the state of the art).
Conclusions and prospects

Conclusions:

- We obtained some orders of magnitude for the waste quantities by m²: between 1.2 and 1.3 T of waste by m².
- Repartition of recovery rates: contrasted results for the comparison database/state of the art.

Limits:

- The number of the projects in the database
- The inputs of the database. The analysis lets suggest that some projects don’t fulfill the collection file correctly.
- The reliability of the results is weak.

Prospects:

- Reliability: consolidate the data with other projects
- Quantities of data:
  - Extend the scope of the study to renovation waste
  - Determine the quantity of waste for other uses of the building and construction systems (concrete, wood, metal...)
Thank you for your attention
Do you any questions?