Pre-deconstruction audits

PROGRESS webinar 1
Reusing existing, single-storey steel buildings
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Petr Hradil, Margareta Wahlström

VTT Technical Research Centre of Finland
Public sale of building for demolition, 1879
Collection Felixarchief / stad Antwerpen
Basic principles of pre-demolition or deconstruction audits
European Guidelines

- Circular economy action plan for closing the loop: Construction and Demolition is a priority area.
- Tightening EU regulation puts pressure on more sustainable use of materials. Mandatory selective demolition/sorting is recommended by the Commission.
- The Commission is now considering reuse and recycling targets for material-specific fractions e.g. wood, plastics, cartoon.
- Implementation of mandatory audit will most likely be recommended by the Commission.
European Guidelines

Definition
“activity organized by the owner of the building or infrastructure resulting in the inventory of materials and components arising from the future demolition, deconstruction or refurbishment projects, and their management and recovery options.”

Pre-demolition/deconstruction audit is for example:
• inspection for the presence of asbestos required by law
• analysis of the building documentation (e.g. BIM model) to obtain materials bill
• voluntary audit (e.g. BRE SmartWaste) to obtain credits for sustainable certification

Pre-demolition/deconstruction audit is not:
• inspection organized by the contractor to plan his own work (NOTE: contractor can still do the audit for the building owner)
Pre-demolition/deconstruction audit contains:

- identification of all hazardous substances and materials required by building authorities
- any other compulsory information about the hazardous substances and materials
- information about the building, its owner, the auditor and description of the methods used

Pre-demolition/deconstruction audit can also contain:

- identification of materials and components that are not becoming waste
- recommendations about the management of materials and components
- cost and carbon savings by diverting material from landfill
- any other information about the materials and components required by the owner
European Guidelines

Management of elements
- Responsibility of the waste holder
  - Not contaminated
  - Contaminated
- Responsibility of the auditor
  - Reusable
  - Not reusable
- Responsibility of the waste producer
  - Reuse

Management of recyclable waste
- Materials
  - Non-hazardous
  - Hazardous
  - Not recyclable
- Recyclable
- Not recycled
- Recycling

Management of other waste
- Backfilling
- Energy recovery
- Landfill
Waste or product?

'waste' means any substance or object which the holder discards or intends or is required to discard (Directive 2008/98/EC)
Waste or product?

Manufactured component or structure

- Hazardous?
  - NO: Owner wants to...
  - YES: WASTE according to the EU legislation

- Yes: Reuse
- No: EoW for component?
  - Yes: Preparing for reuse
  - No: EoW for material?
    - Yes: Recycling as raw material
    - No: Recycling as waste or disposal

- Fulfills tech. conditions?
  - Yes: Reuse
  - No: ... remanufacture it

- NO: ... recycle it
Pre-deconstruction audit for single-storey steel buildings

Picture credits: Paul Kamrath
Main goal of the audit

The main goal of the audit is to ensure that the recovered building components can be accepted by the building authorities as products in the new construction process.

For the steelwork, three possible reuse classes are recommended:

- **Class A**: Original material test certificates are available and constitute evidence of conformity with the relevant product standard.

- **Class B**: Original material test certificates are not available. Comprehensive testing protocol is applied.

- **Class C**: Original material test certificates are not available. Most conservative steel grade in accordance with structure age and location is adopted.
Step 1
Documentation research and survey planning

- Collection of drawings, previous inspection reports and material certificates
- Identification of the building age
- Identification of possible hazards and needs for decontamination
- Planning of the field survey
Step 2
Field survey

- Visual inspection and photo documentation
- Labelling of components for testing and reuse
- Overall dimensions, details and cross-sections according to the plan:

<table>
<thead>
<tr>
<th>Detailed construction documentation</th>
<th>Details to be checked during the field survey</th>
<th>Members to be checked for cross section dimensions</th>
<th>Building dimensions and structural solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available (limited on-site inspection recommended)</td>
<td>10% min 3 detail types, details selected randomly</td>
<td>10% min 3 different sections, members selected randomly</td>
<td>Minimum inspection for a regular single storey building (e.g. a typical frame): Span; Eaves height; Apex height; Frames spacing; Vertical and roof bracing arrangement; Eaves struts; Fly bracings; Etc.</td>
</tr>
<tr>
<td>Not available (comprehensive on-site inspection recommended)</td>
<td>25% min 5 detail types, details selected randomly</td>
<td>25% min 5 different sections, members selected randomly</td>
<td></td>
</tr>
</tbody>
</table>

1 Percentages to be applied to a group of elements with same geometric and load history (e.g. for a portal frame the three types of details to be checked: base connections, apex and eaves, three different section can be columns, rafters and vertical bracings), if the number of sections or details in the assessed steelwork is lower than the minimum required, all details or sections will be checked.
Step 2
Field survey – preliminary testing

Non-destructive testing
- XRF/LIBS spectrometer
- Hyperspectral camera
- Hardness testing

Minimum-invasive testing
- Small punch tests or Instrumented Indentation tests
- Sub-sized impact tests
- Chemical tests

Standard coupon tests
Step 3
Condition evaluation

• Final decision about reusability of the components
• Evaluation of other non-reusable components and materials
• Optionally evaluation of additional indicators (e.g. recovery costs, residual value, remaining service life or carbon footprint)
Step 4
Recommendations

• Recommended material testing programme
• Limitations for re-designing and future use
• On-site management and interventions
• Optionally also off-site management
Reporting template

Recommended reporting template is divided into four parts:

- **Part A**: General information
- **Part B**: Audit report
- **Part C**: Inventory of reusable components
- **Part D**: Inventory of waste and hazardous substances

Parts A, B and D contain machine-readable information for convenient data collection, analysis and possible material marketing.

<table>
<thead>
<tr>
<th>A1 Description of the building</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1 Building description</td>
</tr>
<tr>
<td>A1.2 Address, site number</td>
</tr>
<tr>
<td>A1.3 Year of steelwork fabrication</td>
</tr>
<tr>
<td>A1.4 Floor area</td>
</tr>
<tr>
<td>A1.5 Main dimensions</td>
</tr>
<tr>
<td>A1.6 Envelope</td>
</tr>
<tr>
<td>A1.7 Crane (description, type, tonnage)</td>
</tr>
<tr>
<td>A1.8 Steelwork is already deconstructed yes / no</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A2 Purpose of the deconstruction (if A1.8 is yes)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>A3 Description of the future use of deconstructed components (if known)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>A4 Building owner (name, address, e-mail, phone)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>A5 Information about the auditor (name, address, e-mail, phone, certification(s))</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>A6 Information about the demolition/deconstruction company (if known)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>A7 Building documentation and drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A7.1 Design documentation            yes / no</td>
</tr>
<tr>
<td>A7.2 Fabrication documentation       yes / no</td>
</tr>
<tr>
<td>A7.3 Documentation of use and inspection reports</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A8 Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A8.1 Mill certificates of delivered steel yes / no</td>
</tr>
<tr>
<td>A8.2 CE marking of delivered steel products or steelwork yes / no</td>
</tr>
<tr>
<td>A8.3 Other certification: ..................................................</td>
</tr>
</tbody>
</table>

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## Reporting template

### General information about reusable components

<table>
<thead>
<tr>
<th>C1.1 Component</th>
<th>C1.2 Dimensions</th>
<th>C1.3 Quantity</th>
<th>C1.4 Location</th>
<th>C1.5 Year of fabrication</th>
<th>C1.6 Will be reused</th>
<th>C1.7 Reuse description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>yes / no</td>
<td>yes / no</td>
</tr>
</tbody>
</table>

### Material information

<table>
<thead>
<tr>
<th>C2.1 Component</th>
<th>C2.2 Steel manufacturer</th>
<th>C2.3 Component manufacturer</th>
<th>C2.4 Certified steel grade</th>
<th>C2.5 Recommended steel grade</th>
<th>C2.6 Recommended material testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Recommended treatment

<table>
<thead>
<tr>
<th>C3.1 Component</th>
<th>C3.2 Observed damage</th>
<th>C3.3 Recommended repairs</th>
<th>C3.4 Existing coating</th>
<th>C3.5 Recommended surface treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Reporting template**

- **Hazardous and dangerous substances**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Present</th>
<th>Quantity/concentration</th>
<th>Location</th>
<th>Recommended treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>yes / no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>yes / no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Inventory of waste**

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Hazardous</th>
<th>Quantity</th>
<th>Condition</th>
<th>Recommended treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>yes / no</td>
<td></td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>yes / no</td>
<td></td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>yes / no</td>
<td></td>
<td>yes / no</td>
<td></td>
</tr>
</tbody>
</table>
Summary

• Pre-deconstruction audit is important tool to identify possible reusable components and structural assemblies and to recommend material testing for their re-certification

• The main beneficiary of the audit is the facility owner, but the audit usually contains also the information required by the building authorities for the construction or demolition permit

• The audit needs to be performed by a (group of) qualified expert(s)
Acknowledgements

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beyond the obvious

Petr Hradil
petr.hradil@vtt.fi

Margareta Wahlström
margareta.wahslstrom@vtt.fi