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THE BUILT ENVIRONMENT IN TRANSITION

ACTE
Architecture · Construction
Transition socio-Écologique

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URMIBALI project : How can digital documentation technologies be a support for urban mining and reuse of building materials? A new method for data acquisition on traditional residential buildings in Liège.

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1. Introduction

Wallonia's dwellings stock, largely made up of single-family and traditional buildings, is energy-intensive and must be renovated by 2050 to meet EU energy efficiency and circular economy goals. These renovations will significantly increase demolition waste, which already accounts for 39% of regional waste.
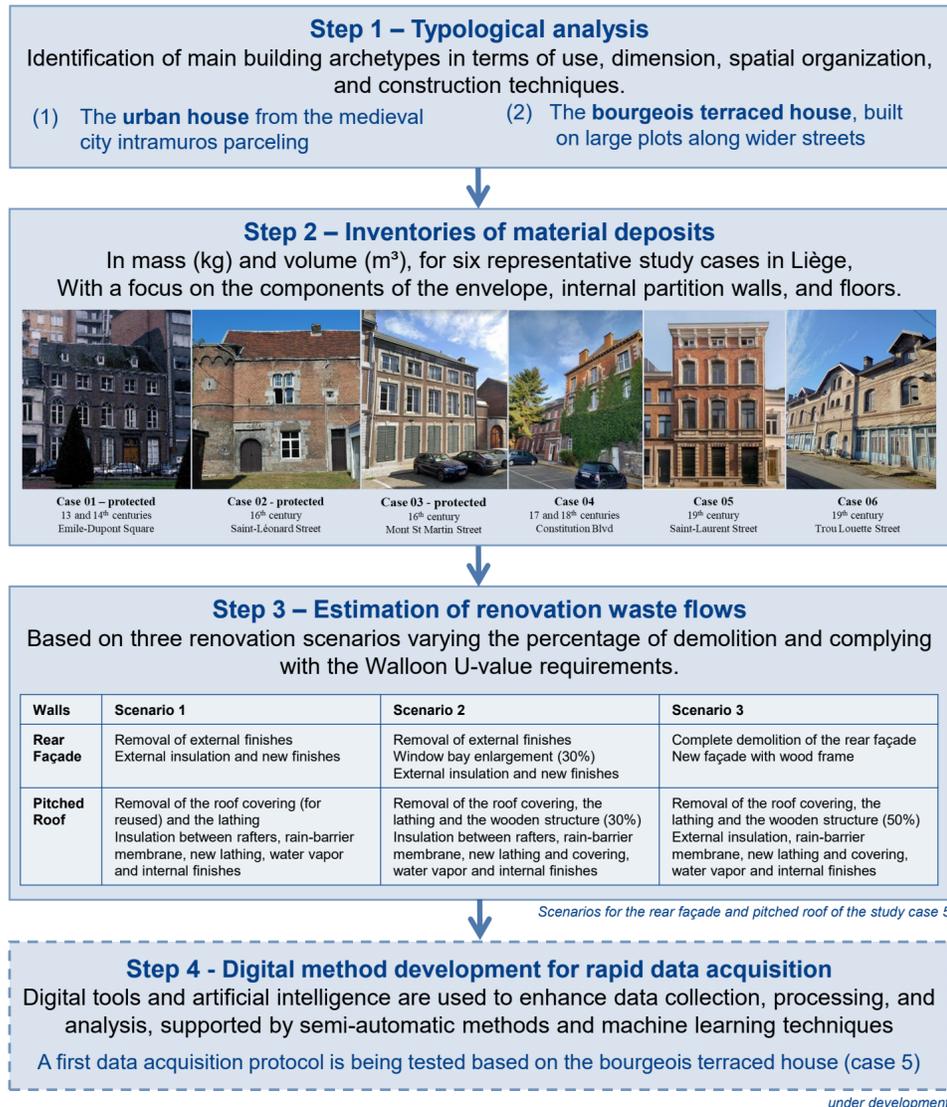
Although Urban Mining (UM) views waste as a resource for reuse and recycling, traditional materials such as wood, stone, brick, and tile remain under-researched, with limited data on their recovery. Moreover, Wallonia lacks high-resolution data on its building stock and waste flows, highlighting the need for developing on-site and rapid, method to acquire those data.

The research aims to analyze existing material deposits in traditional residential buildings built before 1919 in the city of Liège as well as waste flows generated through their renovations. The objective is to develop:

o A digital method for inventorying material deposits
o A theoretical framework for predicting demolition waste flows.

2. Methodological steps

The methodology follows an interdisciplinary approach, combining heritage digital documentation, historical knowledge of building techniques and materials, and energy renovation expertise.
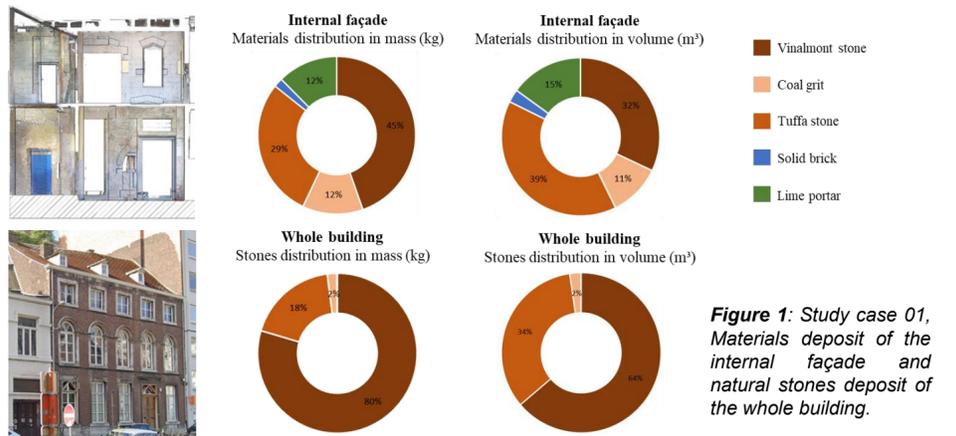
Step 1 – Typological analysis
Identification of main building archetypes in terms of use, dimension, spatial organization, and construction techniques.

(1) The urban house from the medieval city intramuros parceling
(2) The bourgeois terraced house, built on large plots along wider streets

Step 2 – Inventories of material deposits
In mass (kg) and volume (m³), for six representative study cases in Liège,
With a focus on the components of the envelope, internal partition walls, and floors.

Case 01 – protected
13 and 14th centuries
Emile-Dupont Square

Case 02 - protected
16th century
Saint-Léonard Street

Case 03 - protected
16th century
Mont St Martin Street

Case 04
17 and 18th centuries
Constitution Blvd

Case 05
19th century
Saint-Laurent Street

Case 06
19th century
Trou Louette Street

Step 3 – Estimation of renovation waste flows
Based on three renovation scenarios varying the percentage of demolition and complying with the Walloon U-value requirements.

Walls	Scenario 1	Scenario 2	Scenario 3
Rear Façade	Removal of external finishes External insulation and new finishes	Removal of external finishes Window bay enlargement (30%) External insulation and new finishes	Complete demolition of the rear façade New façade with wood frame
Pitched Roof	Removal of the roof covering (for reused) and the lathing Insulation between rafters, rain-barrier membrane, new lathing, water vapor and internal finishes	Removal of the roof covering, the lathing and the wooden structure (30%) Insulation between rafters, rain-barrier membrane, new lathing and covering, water vapor and internal finishes	Removal of the roof covering, the lathing and the wooden structure (50%) External insulation, rain-barrier membrane, new lathing and covering, water vapor and internal finishes

Scenarios for the rear façade and pitched roof of the study case 5

Step 4 - Digital method development for rapid data acquisition
Digital tools and artificial intelligence are used to enhance data collection, processing, and analysis, supported by semi-automatic methods and machine learning techniques

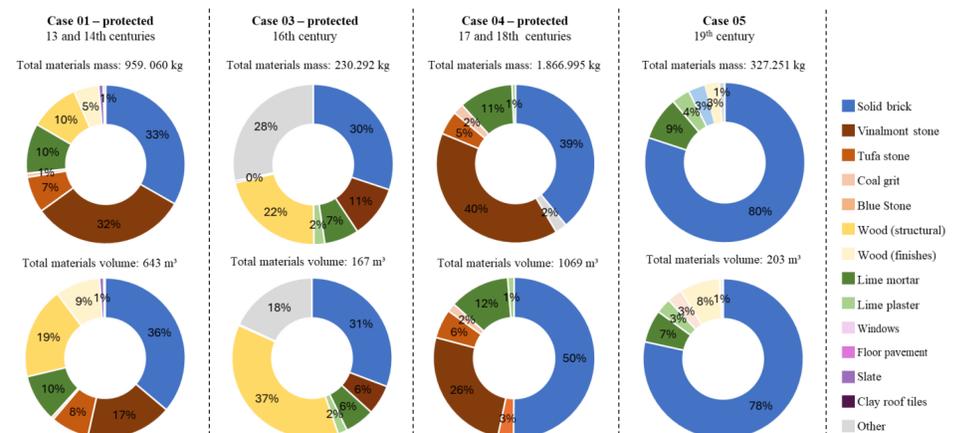A first data acquisition protocol is being tested based on the bourgeois terraced house (case 5)

under development

3. Results

Inventories offer a comprehensive assessment by both material type, wall typology (figure 1) and overall building scale (figure2).

Internal façade
Materials distribution in mass (kg)

Internal façade
Materials distribution in volume (m³)

Whole building
Stones distribution in mass (kg)

Whole building
Stones distribution in volume (m³)

- Vinalmont stone
- Coal grit
- Tuffa stone
- Solid brick
- Lime portar

Figure 1: Study case 01, Materials deposit of the internal façade and natural stones deposit of the whole building.

Existing materials deposits: brick masonry is the dominant material, especially in 19th-century buildings (case 05). In pre-19th-century cases, locally sourced natural stone (cases 01 and 04) and structural wood (case 03) also widely used. In all cases, lime mortar and plaster account for about 10% of the total mass and volume.

Case 01 – protected
13 and 14th centuries
Total materials mass: 959. 060 kg
Total materials volume: 643 m³

Case 03 – protected
16th century
Total materials mass: 230.292 kg
Total materials volume: 167 m³

Case 04 – protected
17 and 18th centuries
Total materials mass: 1.866.995 kg
Total materials volume: 1069 m³

Case 05
19th century
Total materials mass: 327.251 kg
Total materials volume: 203 m³

- Solid brick
- Vinalmont stone
- Tufa stone
- Coal grit
- Blue Stone
- Wood (structural)
- Wood (finishes)
- Lime mortar
- Lime plaster
- Windows
- Floor pavement
- Slate
- Clay roof tiles
- Other

Figure 2: Materials deposits in mass and volume analyzed in four study cases

Waste flows

For protected buildings (case 03), renovation is typically less invasive, generating mostly finishing material waste, mainly wood and lime plaster (scen. 01 and 02), and structural wood in scen. 03. In contrast, for 19th-century and non-protected buildings (case 05), scen. 01 yields similar waste flows, while scen. 02 and 03 produce more varied waste, with brick as the dominant material.

Case 03 – protected
Renovation scen.01
Total materials mass: 7.179 kg
Total materials volume: 7,9 m³

Case 03 – protected
Renovation scen.02
Total materials mass: 14.447 kg
Total materials volume: 14,23 m³

Case 03 – protected
Renovation scen.03
Total materials mass: 16.687 kg
Total materials volume: 16,5 m³

Case 05 – non protected
Scen.01 – waste flows
Total materials mass: 3.928 kg
Total materials volume: 4,6 m³

Case 05 – non protected
Scen.02 – waste flows
Total materials mass: 17.295 kg
Total materials volume: 12,5 m³

Case 05 – non protected
Scen.03 – waste flows
Total materials mass: 56.982 kg
Total materials volume: 36,2 m³

Figure 3: Waste flows generated by renovation scenarios, cases 3 and 5