

What potential does structural wood hold for reuse in urban housing in Liège?

A study of timber frames from the *Ancien Régime* (14th to 18th centuries)

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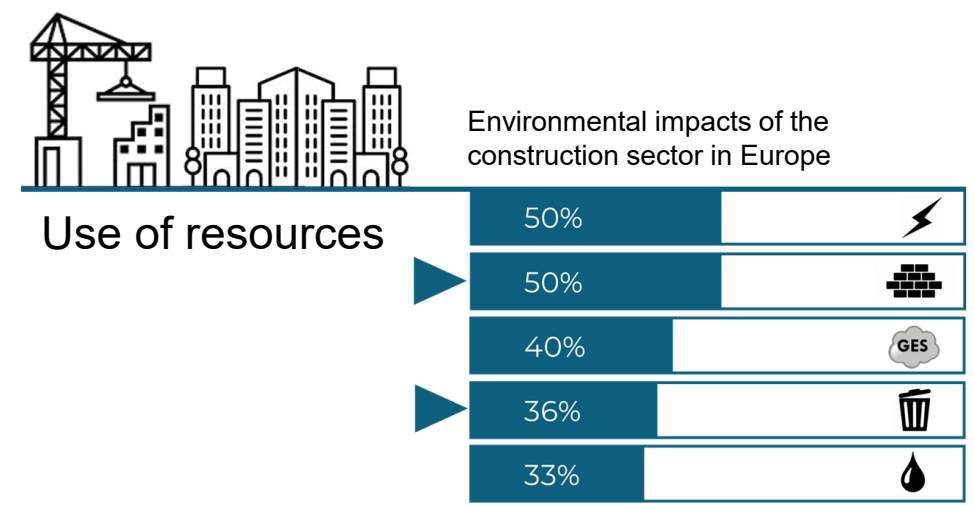
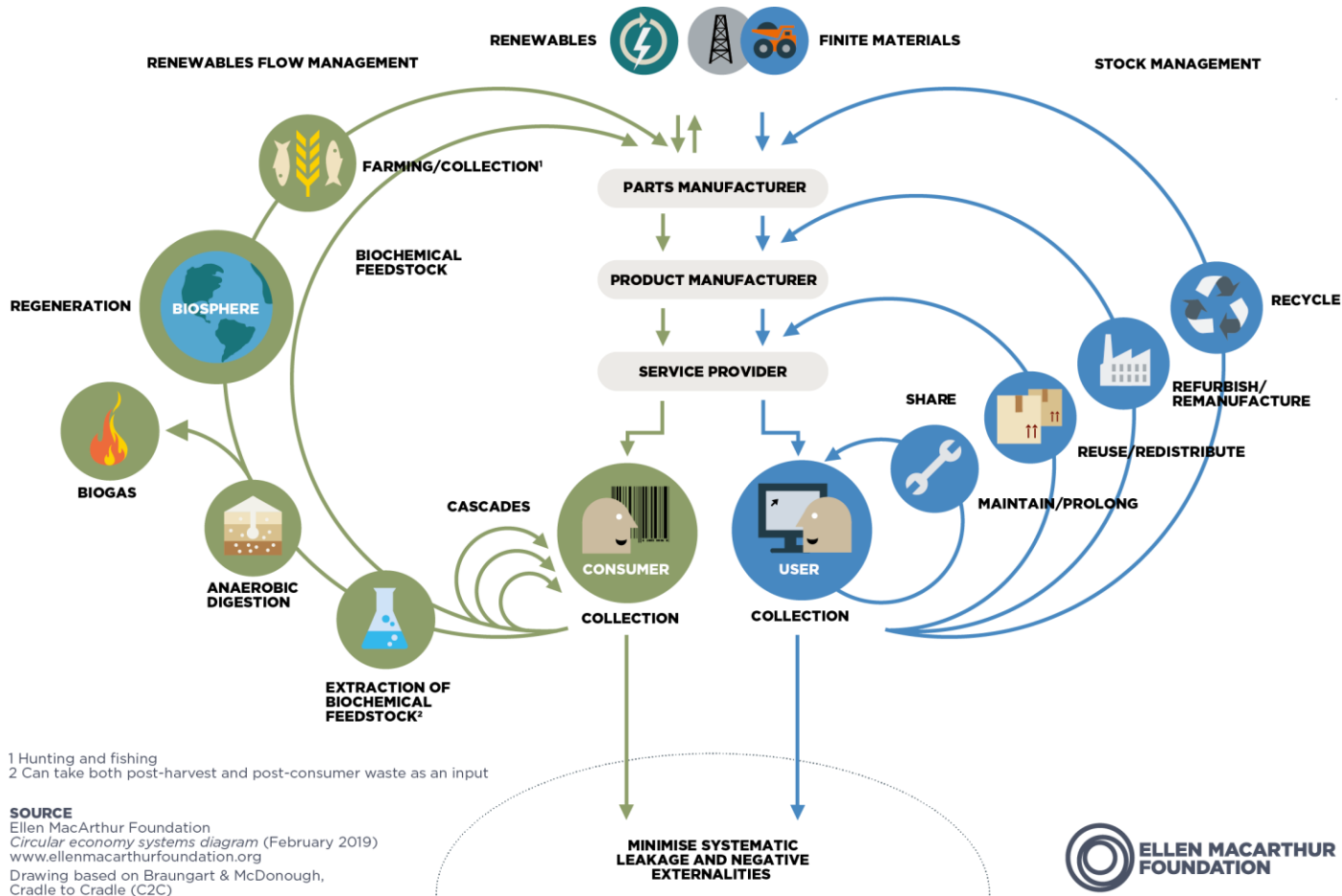
¹ Research lab ACTE, Research unit AAP – University of Liège, Belgium

Research lab DIVA, Research unit AAP – University of Liège, Belgium

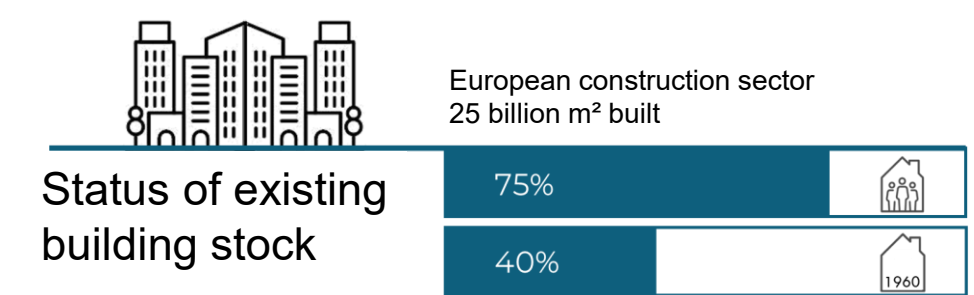


CONTEXT

Circular ambitions



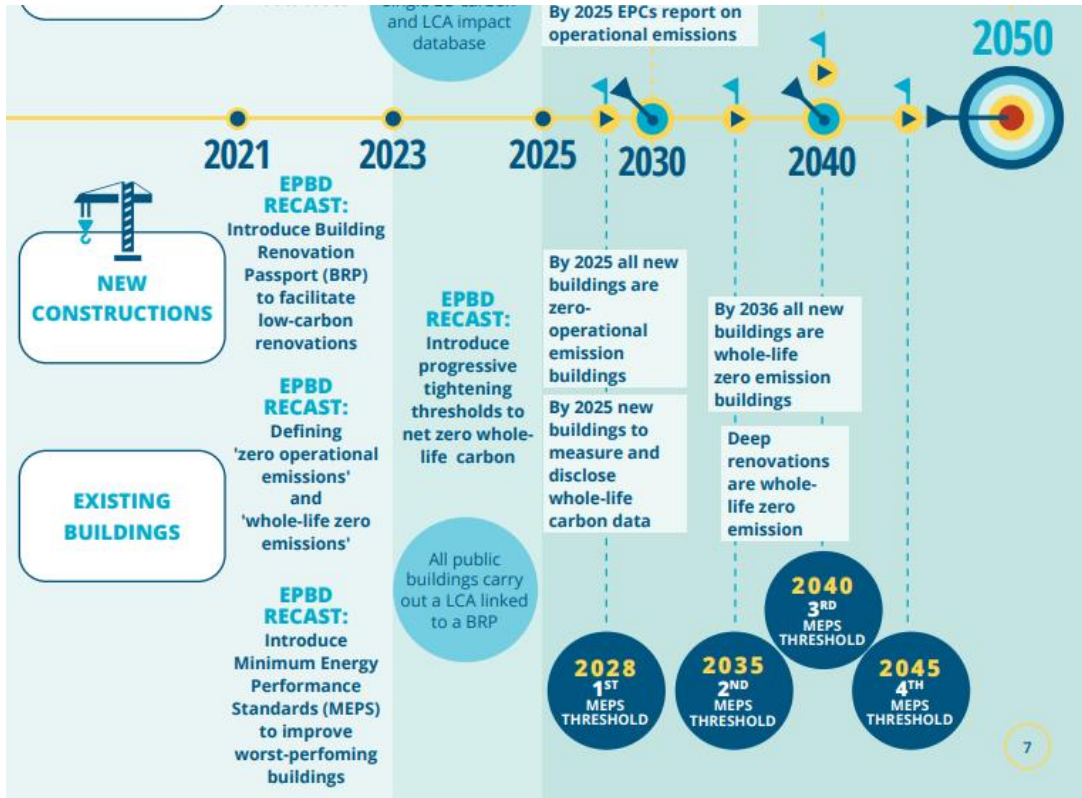
Source: Trachte S., 2023.



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CONTEXT

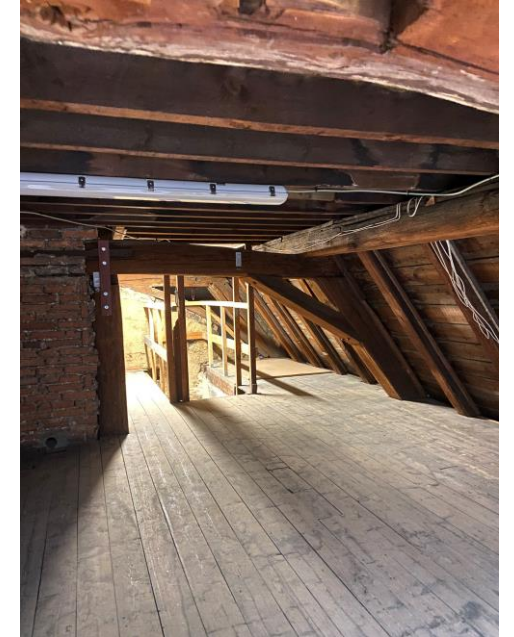
European and Walloon region's ambitions – Renovation



Source : BPIE.



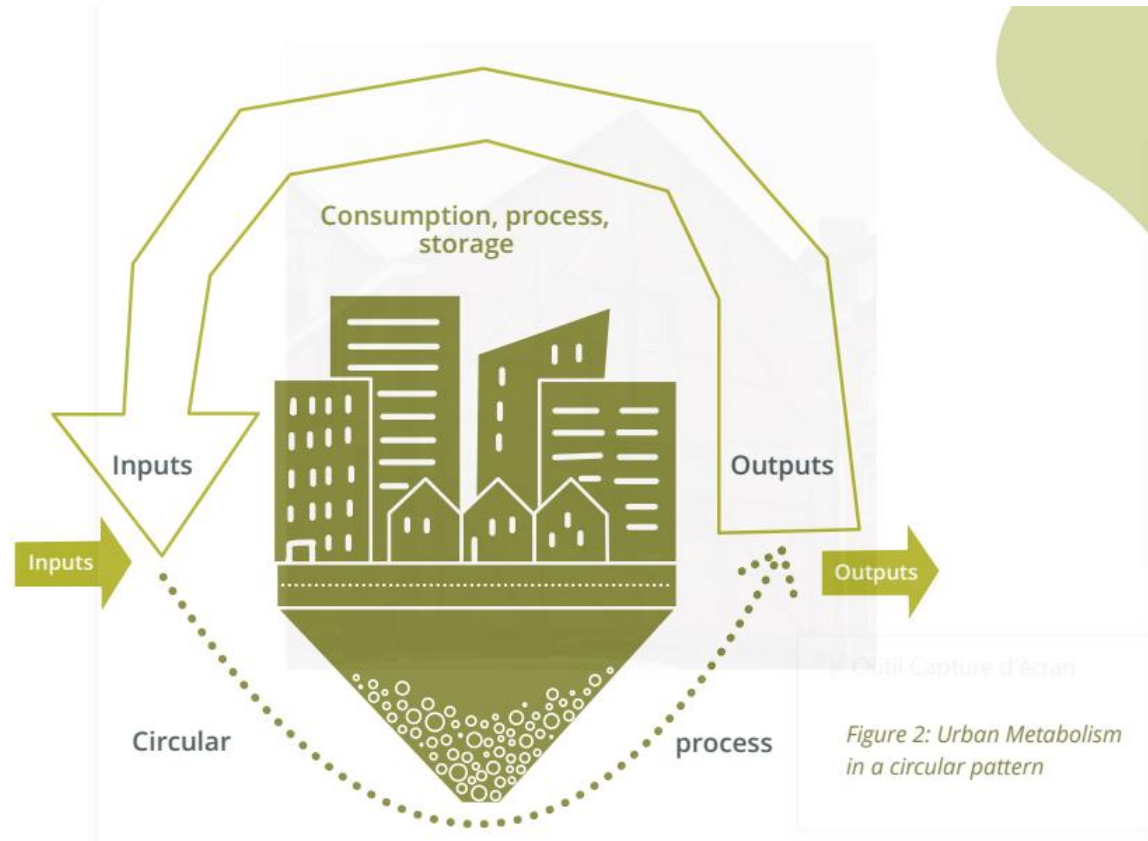
Source : Kormosh R., 2024.



Source : Noël O., 2024.

CONTEXT

European ambitions – Urban Mining



Source : Opalis.

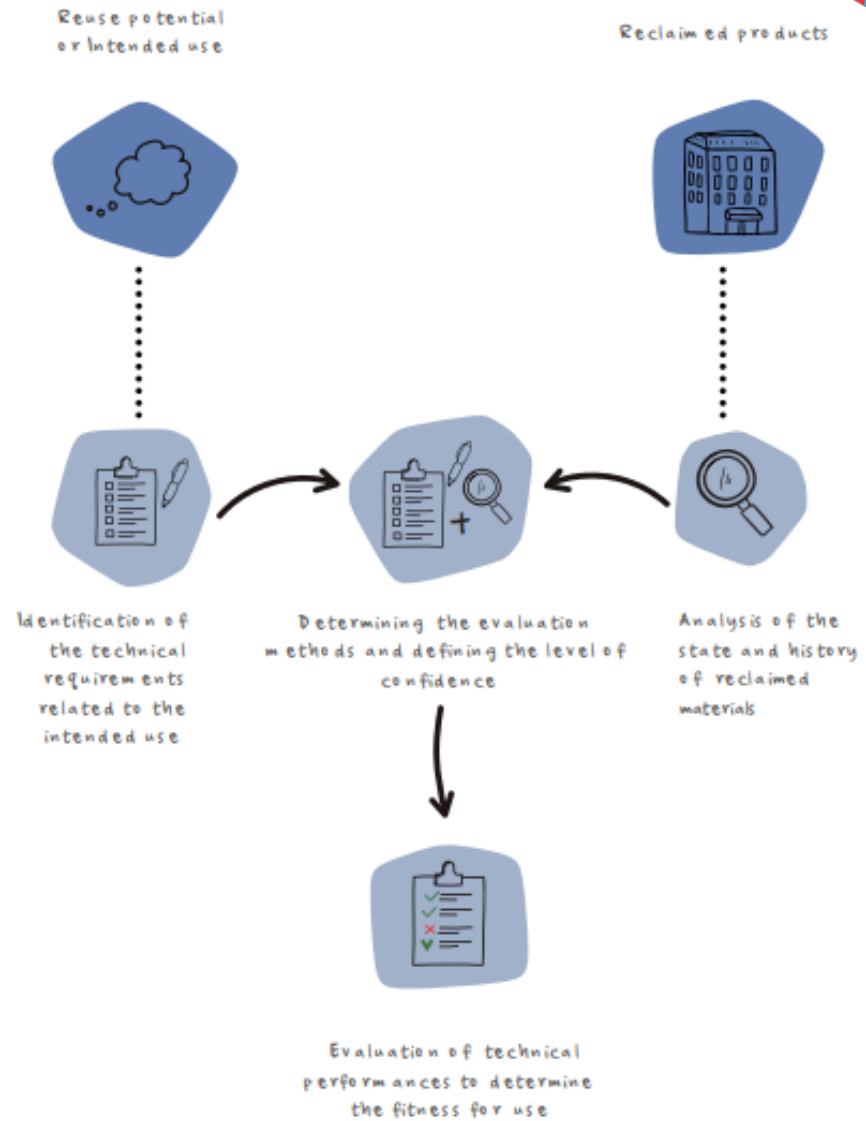
Source : FCRBE.

CONTEXT

Obstacles to reuse

TECHNICAL and LEGISLATIVE BARRIERS

- Declaration of performance
- Technical documentation
- CE marking
- Confidence in reused materials



Source : FCRBE.

OBJECTIVES

The main objective of this study is the development of an **identity card** for historic timber frames, aimed at documenting their technical, historical, and structural characteristics to support their **reuse**.

The study's methodology combines **TWO PARTS**.

1

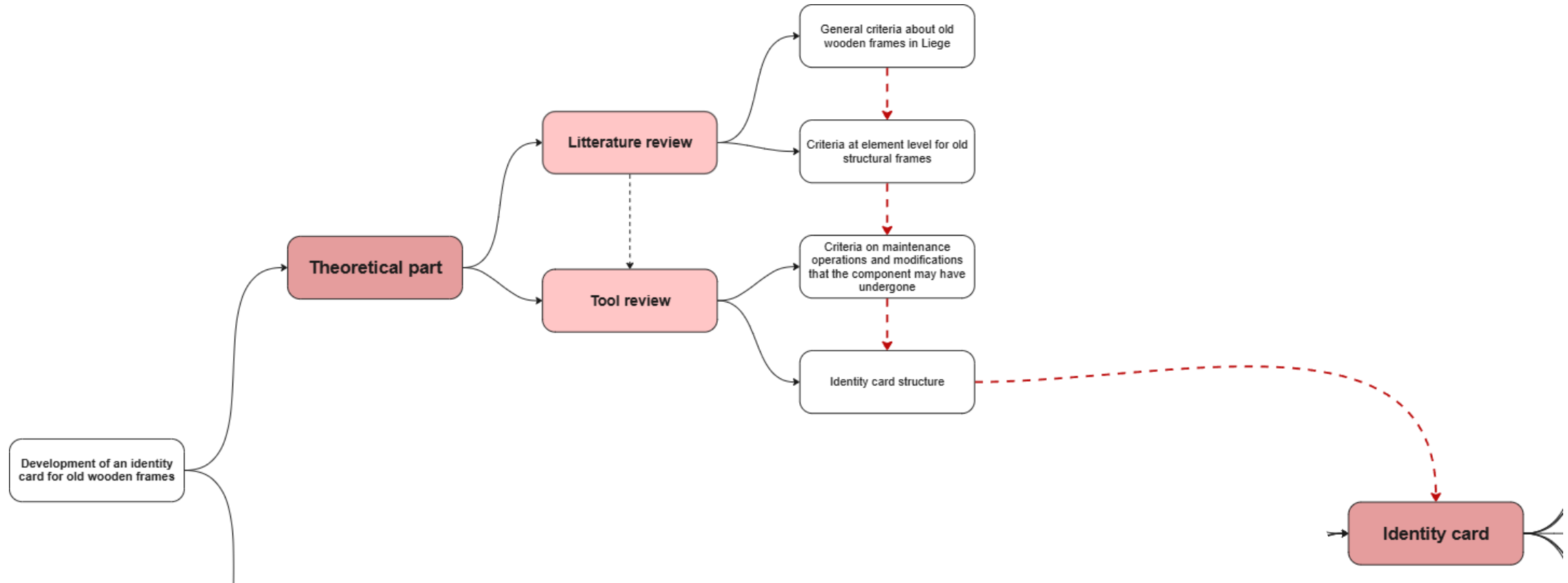
THEORETICAL PART : Information on old wooden frames, covering technical and historical building practices in Liège during the *Ancien Régime* and key data for their future reuse, was gathered using two existing tools

2

PRACTICAL PART : collect data, based on an on-site approach and the analysis of two study cases studies

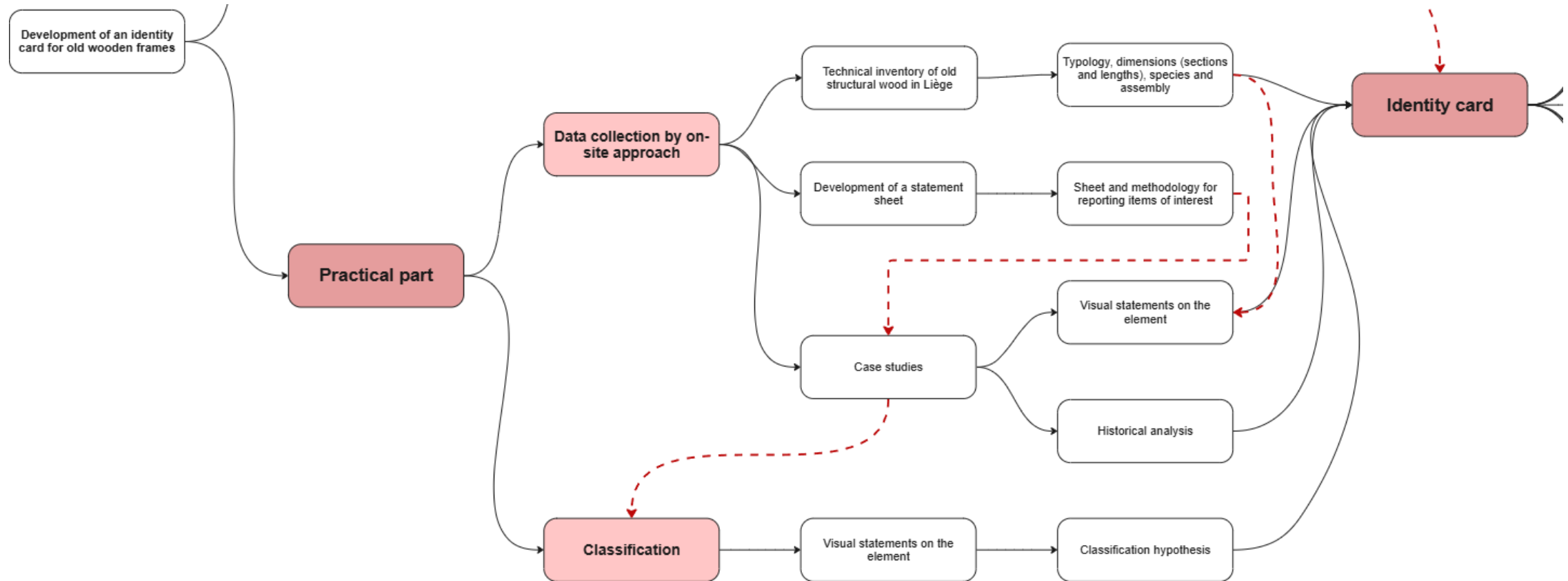
METHODOLOGY

Theoretical part



METHODOLOGY

Practical part



METHODOLOGY

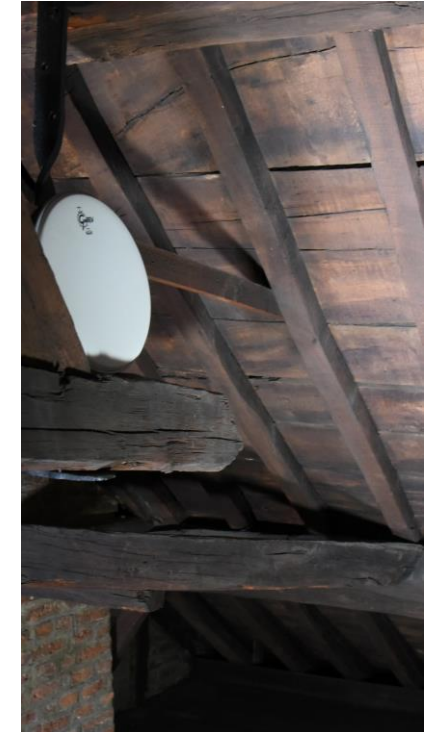
Case studies

DONCEEL HOTEL, Liège

Residential building

Oldest wooden frames/ half-timbered structures : 16th century

Wooden roof structure : 16th century, altered through the 20th century



METHODOLOGY

Case studies

PLACE EMILE DUPONT 9-10, Liège

Two former religious buildings, later residential, now listed and housing the Walloon Centre for Building Archaeology.

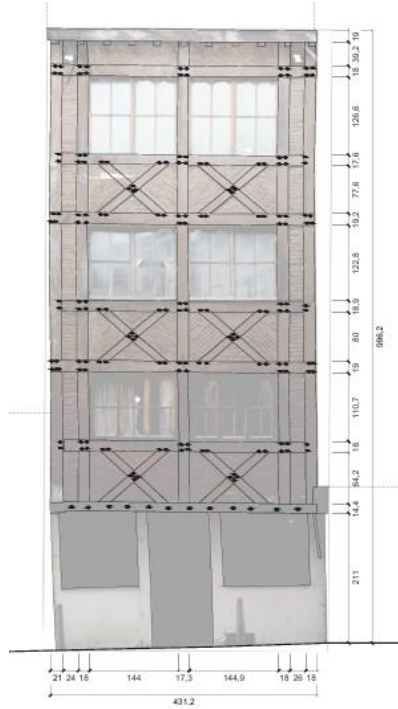
Oldest wooden frames/ half-timbered structures : 14th century and altered over the century

Wooden roof structure : 14th century

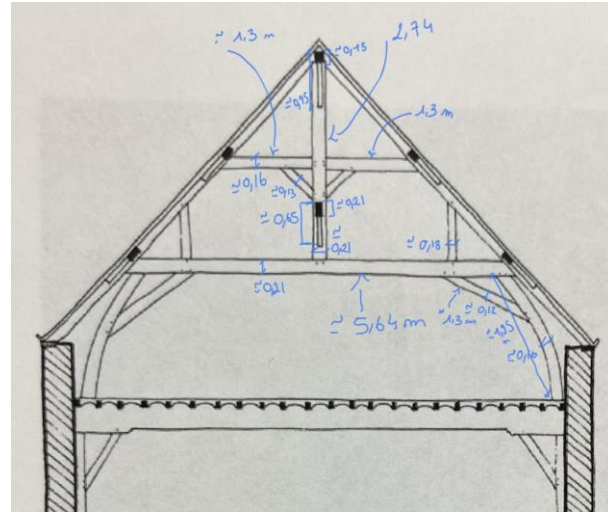


RESULTS

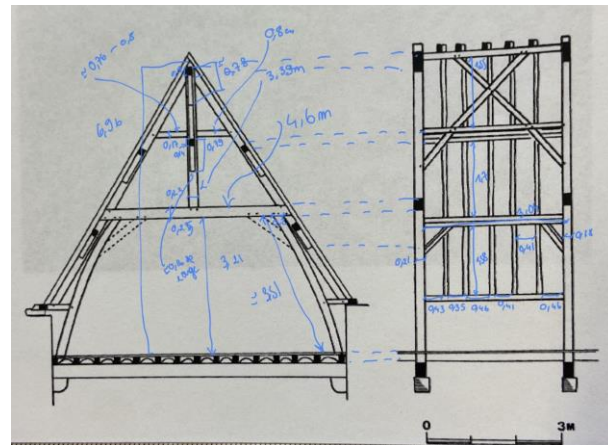
Practical part - Technical inventory



Source : Romana Kormosh (Ulège)



Source : Former Convent of the Celestine Brothers, Liège – Roof Structure



Source : 9-10 Boucherie Street, Liège – Roof Structure

SPECIES	Oak		
ASSEMBLIES	Mortise and tenon joint	Half-lap joint	Splayed scarf joint
SECTIONS AND DIMENSIONS	Rafters : 9-12 cm	Joists (wood floor) : 15-23 x 17-33 cm	King post : 21-23 cm
	Wall plate : 13-33 cm	St-Andrew's cross (half-timber frames) : 9-15 cm	Knee braces : 16-20 cm
	Posts : 13-28 cm	Purlins : 15-20 x 10-18 cm	Entertie : 12 cm
Struts : 9-20 cm	Tie beams : 21-25 cm	Diagonal tie : 12 cm	
Relieving beams (half-timber frames) : 12-24 cm	Raised tie beams : 16-17 cm		

RESULTS

Practical part – Case studies

CRITERIA	DONCEEL HOTEL	PLACE EMILE DUPONT
NATURE, TREATMENT AND DIMENSIONS	16th century, oak, high quality wood, axe and saw marks and satisfactory strength	14th century, timber frame with rafters forming trusses, oak, high quality wood, chiselling mark, satisfactory strength
HEALTH CONDITION	No chemical substances, no fungi, wood-boring insect holes and no recent damp	No chemical substances, no fungi, wood-boring insect holes and no recent damp
STRUCTURAL CONDITION	Knots, longitudinal cracks at knots and deformations: creep	Knots, longitudinal cracks at knots and deformations: creep
ASSEMBLIES AND CONNECTIONS	Mortise and tenon and half-timber	Mortise and tenon, half dovetail and whistle end with wooden pegs
COMPARISON WITH TECHNICAL INVENTORY	Rafters: similar dimensions; post: value from the lower range of the inventory; purlin: similar in width but less high and headers: narrower	Rafters: similar but much wider; centers: similar but wider and armrests: similar but wider



Source : Personal photographs of knots, drying crack and wood-eating insect holes of Donceel hotel and Place Emile Dupont, Liège.



Source : Personal photographs of assemblies of Donceel hotel and Place Emile Dupont, Liège.

RESULTS

Practical part – Classification



Source : Personal photographs of knots (1), drying crack (2 and 3) and wood-eating insect holes (4) of a Place Emile Dupont's rafter, Liège.

NATURAL WOOD DEFECTS	OBSERVATIONS	MEASUREMENTS
KNOTS	Yes, 5	1 : 1 to 2 cm 2 : 1 to 2 cm 3 : 2 to 3 cm 4 : 1 to 2 cm 5 : 2 to 3 cm
FACE CRACK	Yes, 8	1 : 70 x 1,5 cm 2 : 54 x 1 cm 3 : 110 x 0,8 cm 4 : 28 x 0,7 cm 5 : 18 x 0,6 cm 6 : 138 x 1,6 cm 7 : 20 x 1,3 cm 8 : 66 x 1,6 cm
SIDE CRACK	Yes, 3	1 : 40 x 1 cm 2 : 28 x 1 cm 3 : 38 x 1,2 cm
WOOD-BORING INSECT HOLES	Yes	circular holes between 1 and 3 mm
BOXED HEART	Yes	/

RESULTS

Identity card

CASE STUDY DATE / NAME		Place Emile Dupont 9-10 22-07-24		NOEL Ophele	
General	Building Information				
	1	Location	Place Emile Dupont 9-10, 4000 Liège		
	2	Dating	14th century but underwent major transformations in the 17th century		
	3	Typology of the building and the framework	Residential Housing - truss and purlin roof framing and paneled framing		
	4	Category	Single-family home		
	5	Description	A half-timbered house built in the 14th and 17th centuries, it underwent profound transformations during the last quarter of the 17th century during a campaign of partial reconstruction of the building and a petrification of its half-timbering, with the construction of a new north façade on the garden side. This led to a reduction in the built-up area and a raising of the roof.		
	Element Information				
	6	Nature of the element	Rafter	12	Photo/Drawing
	7	Dating	1363-1377		
	8	Localization	Garden side after truss VI		
	9	Reused material	No		
10	Status of the element	Very good condition			
11	Sections	556x14,6x13,3cm			
Contribution to the circular economy	Materiality, structural and health status				
	Materiality of the element		Health status (chemical substances)		
	13	Materiality	Wood	23 Heavy metals	No
	14	Wood species	Oak felled probably between 1363 and 1377	24 Asbestos	No
	Visual analysis of wood quality		Health status (biological substances)		
	15	Wood cutting	Strand wood	25 Mineral oils	No
	16	Wood growth	Slow	26 Fungi	No
	17	Shape of the element	Straight	27 Wood-eating insects	Yes, small beetle (circular orifices of 1 to 3mm) and lyctus (circular orifices of 1 to 2mm)
	18	Tool marks (woodworking)	Scissors	28 Humidity	No
	Structural condition (original defects)				
	19	Knots	Yes (5)		
20	Knots size	Between 2 and 5 cm			
21	Cracks (drying slots)	Yes, longitudinal			
Structural condition (wear defects)					
22	Wood deformation	No			
22.1	Wood creep	No			
22.2	Wood twist	No			
Future re-use capacity	Environmental footprint				
	29	Manufacture	Artisanal		
	30	Origin of the wood	Probably in Belgium, in the Ardennes		
	31	Energy required for transport	Low - medium: transport of wood via the Meuse by float or boat		
	32	Level of processing	Low		
	33	Life of the material	Very long		
	34	Re-use potential	High		
	35	Recycling potential	Low		
	Flexibility and adaptability				
	36	Mechanical assembly	Yes		
	37	Assembly Type	Marise and liron		
38	Assembly status	Good condition			
39	Ease of reassembly	Yes			
Visual, disassembly, warehousing					
Visual appearance		Quickness and ease of dismantling			
40	Marking	No	54 Handling equipment required	No	
41	Wear trace	Yes, upper part: presence of two wooden elements with nails, lower part: presence of nail holes and very large crack	55 Easily accessible site	Yes	
42	Sculpted wood	No	56 Sufficient space for dismantling	Yes	
43	Wood finishing/processing	No	57 Dismantling time	A few hours	
44	Presence of metal elements	Yes	Warehousing/storage		
Dismantling risks					
45	Impaired mechanical performance	No	58 Accepted humidity	Environ 22%	
46	Impaired visual appearance	Yes	59 Accepted temperature	/	
47	Health risk	No	60 Space requirements	20m³	
48	Safety risk	No	61 Cleaning	Out	
49	Load-bearing elements/dependence on other elements	No	62 Repair	Out	
Handling of disassembly					
50	Weight	/			
51	Volume	/			
52	Fragility	Yes			
53	Handling of disassembly	Yes			

Building information

Element information

Materiality, structural, health status

Environmental footprint

Flexibility, adaptability

Visual, disassembly, warehousing

Operations, dismantling

Applications, implementation

CASE STUDY DATE / NAME		Place Emile Dupont 9-10 22-07-24		NOEL Ophele	
Possibility of reuse	Operations after dismantling				
	63	Removal of secondary components	Yes, wooden elements and nails		
	64	Superficial cleaning	Yes, especially for the lower part		
	65	Drying	No		
	66	Wood classification (visual)	Probably Q-P1		
	67	Preservative treatment	No		
	68	Resizing	Probably, removal of ends that are damaged --> to check when disassembling		
	69	Planing	No		
	70	Finishes	No		
	Applications and implementation				
	71	Matching to standard dimensions	No		
72	Quantity of elements of the same type	Between 20 and 30			
Characteristics and suitability for use according to the classification of the wood obtained after visual evaluation --> criteria set out in NEN-EN 975-1 and NEN-EN 338 --> Resistance D18 (en NENm7)					
73	Flexion	18			
74	Parallel compression	18			
75	Axial traction	11			
76	Longitudinal shear	3,4			
77	Transversal compression	7,5			
78	Transverse traction	0,6			
Application possibilities					
79	Identical use			81 Non-structural use	
80	Structural use - different from the original one				

STATUS Planning Planned Under construction Built Transforming

RESULTS

Identity card

Materiality, structural and health status						
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Identity card

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Characteristics and suitability for use according to the classification of the wood obtained after visual evaluation

→ criteria set out in NBN EN 975-1 and NBN EN 338

→ Resistance D18 (en N/mm²)

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Application possibilities

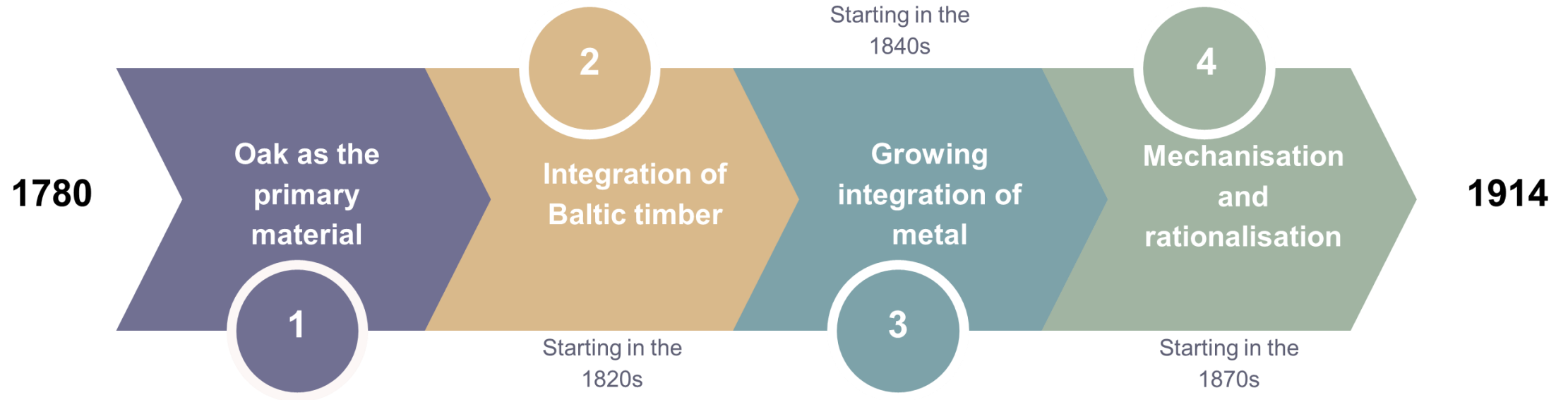
79 Identical use

81 Non-structural use

RESEARCH PERSPECTIVE

Belgian structural timber from the long 19th century (1780-1914)

Four phases in timber carpentry





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My publications