



REUSE IN PRACTICE: FROM DECONSTRUCTION TO IMPLEMENTATION



**GUIDE FOR
WOODWORKERS**

This guide is intended for contractors active in interior finishing work. It is part of a series of guides introducing the practices of reclamation and reuse of materials. These guides aim to answer the main questions raised by contractors when they reclaim and reuse materials on their worksites.

The guides are available on the website of the Interreg NWE FCRBE project <https://vb.nweurope.eu/fcrbe>. The complete collection covers the following professions: general contractors, wood workers, interior finishing, roofers, demolishers, and companies specialized in infrastructures.

To enable only one guide to be consulted per trade, part of the text is common to all the guides. The parts specific to each guide are indicated by dots or boxes.

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<https://vb.nweurope.eu/fcrbe>

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PARTNERS



Contents

1. Introduction: What is reuse and why is it important for contractors?	4
2. What construction materials can be reclaimed and reused?	8
3. How can construction materials be reclaimed?	12
a. How can you be sure that reclaimed materials will be reused?	13
b. What are the key points when bidding for the reclamation of construction materials?	18
c. How do you collaborate with subcontractors, architects and customers?	20
d. How can construction materials be reclaimed?	21
4. How are materials prepared for reuse?	26
5. What is done with reclaimed materials, or how to get supplies of reuse materials?	30
6. How do you build with reuse materials?	36
a. What are the key points when bidding to implement reuse materials?	37
b. How do you collaborate with subcontractors, architects and customers?	40
c. How is the technical performance of reuse materials justified?	41
d. Who takes responsibility for technical performance?	46
e. How do you build with reuse materials in practice?	48
7. How are the costs of reclamation and construction with reuse materials estimated?	50
8. Conclusions	56
Bibliography	58



1.

Introduction:
What is reuse
and why is it important
for contractors?

A new context...

The construction sector is experiencing change. It is having to adjust to new challenges such as climate change, scarcity of natural resources or even price volatility on the market for materials.

The construction and the use of buildings are themselves responsible for significant consequences for the planet and its resources. In the European Union, they represent 50% of the extraction of all materials, 33% of water consumption, 40% of energy demand, 36% of greenhouse gas emissions, and 38% of the waste generated.

With these changes and the growing awareness in mind, the regulatory context will be adapted, as both public authorities and clients will formulate new requirements for carrying out the construction works. Among these, the principles of circular economy have a significant place, and the reclamation of materials and reuse will be increasingly encouraged, and in some cases even mandatory.

Contractors who have already adjusted their practices before the coming into force of these new requirements will thus benefit from a competitive advantage.

...and new practices

In the area of construction, the circular economy is based on the application of many practices:

- Maintaining and refurbishing existing buildings (rather than demolishing them and rebuilding new ones).
- Reclaiming the materials before being cleared during demolition work and reusing them in new structures.
- Using sustainably managed materials of natural origin (in order that these resources have time to be renewed).
- Constructing buildings that can be adapted to changes of use over time (by applying techniques of reversible assembly).
- Better management of demolition waste to recycle it more and the use of materials containing recycled materials.
- Etc.

In this guide, we will concentrate on the questions of reclamation and reuse of the materials.

Before going any further, it is important to define what is meant by the term **reuse**, as against **recycling**. The definition of reuse is as follows: *any operation by which products or components that are not waste are used again for usage that is the same as that for which they had been designed¹. Reuse refers to a practice where a construction element that has been carefully extracted from a building during demolition or refurbishment work is being reused in a new context. During this process, the elements are preserved in an optimal way. Reuse differs from recycling as recycling implies recourse to mechanical or chemical processes with a view to converting an element to restore its status of raw material.*

In francophone countries and regions, the initial term “reuse” has sometimes been translated as “**reemployment**”, and sometimes as “**reuse**”. For example, in France and in Luxembourg, the legislator distinguishes “reemployment” and “reuse”. In this case, reuse is used when the good concerned is checked in the “waste status” box (Naval, 2021). In Belgium, the two terms are generally taken as synonyms. In this guide as well, no distinction will be made.

Finally, the literal definition of reemployment implies “usage that is the same as that for which they had been designed”. However, it may be considered that as soon as reuse of the material is certain, its holder can dispose of it as they wish, and of course staying in compliance with the law. In this guide the term ‘Reuse’ is used for both situations: where the element is reused for its **initial use** as well as where it is reused for a **different use** than for which it was designed for.

FURTHER INFORMATION

The booklet Products or waste? Criteria for reuse produced as part of the FCRBE project describes further the key concepts of waste, reuse, and preparation for reuse. It also explains why “change of use” is a practice compatible with reuse.

https://vb.nweurope.eu/media/15538/bookletfcrbe-4_waste_product.pdf

¹ Directive-cadre “Déchets” 2008/98/CE [1] - Art 3.13

Reuse has the advantage of contributing to significantly reducing impacts on the environment caused by the building sector. Reusing materials is firstly preventing the production of avoidable waste. It is also about avoiding the impacts that stem from the production of new materials, which can be considerable. Reuse also enables reduction of the extraction of raw materials, stimulates local economies, and conserves the patrimonial value of the materials.

What is changing for contractors

The idea of reclaiming materials and reusing them is of course not new and many companies already practice reuse, occasionally and even, for some, recurrently. The generalization of this approach however has several challenges. It is also accompanied by some changes for companies, including the following:

No more “all in the bin”

Today, during a demolition or renovation, much potentially reusable material continues to be thrown into the bin along with the rest of the waste. It is often the profitability (speed) or spatial restrictions (there’s not enough room on site) that explains this waste. The absence of explicit request from project owners in calls for tenders also plays an important part.

However, new habits are finding their place:

- Performance of **pre-demolition reuse audits**
These are studies generally ordered by the project owner and most often performed by external consultants. These identify material lots with a high reuse potential in buildings (or parts of buildings) planned to be converted or demolished. These studies are sometimes coupled with a forecast of the waste flows generated by the demolition. This listing enables the planning of suitable treatment for the reclaimable lots (e.g. their removal in advance).
- **Prior cleaning work**
Increasingly, demolitions are carried out in separate phases, to ensure specific treatment for the different materials making up a building. This approach helps to ensure better treatment of the outgoing materials, by favouring high quality reclamation and recycling sectors.
- Missions of **careful removal for reuse**
Calls for tender increasingly include services for the careful removal of material lots to ensure their reuse (on the same site, or elsewhere). For these lots, bidders must plan, budget, and carry out careful removal and suitable conditioning. In some cases, they also have to ensure re-circulation of the elements (transactions with

professional buyers, transport to a storage place, etc.).

- **Reclamation objectives**

A growing number of calls for tender will integrate reclamation objectives. These can be expressed as minimum reclamation thresholds (e.g. 80% of a surface in porphyry blocks). Potentially, they can also be the object of an assignment criterion: bidders then agree to achieve reclamation rates that they determine themselves and based on which they are compared with their competitors.

Other supply sources

Increasingly specifiers will plan for reused materials in their projects. Accordingly, companies must ensure the supply and/or use of these materials. Companies then have to get supplies from sectors alternative to new product dealers: via professional suppliers, online adverts, or simply by reusing lots reclaimed on the same site (reuse in situ) or on other sites.

New ways of preparing price offers

Integrating the logic of material reclamation and reuse can impact the way price offers are prepared.

The circular economy highlights a new model of value creation based on maintaining existing resources in circulation. Unlike the conventional economy, which is based on the sale of goods to generate higher value, which induces fast cycles of consumption and renewal, the circular economy is based on extending the lifetime of goods already present. In particular, the reuse of building materials favours local work of specialized demolition, restoration and reuse of existing materials, rather than the extraction of virgin resources, the industrial production of new materials and their transport over long distances.

So what does this change for contractors?

- The **cost of reuse materials**. The price of reuse materials on the professional market can differ from the price of new materials. They can be more or less expensive than new materials according to their age, rarity, and what they are compared with!
- For materials reused on site or reclaimed from other sites, the price of the material can be virtually zero. Indeed the materials are already present. However, the **cost of the operations needed for their reuse should be estimated precisely**: removal, cleaning, careful conditioning, storage, transport, performance studies, etc. Experience allows these amounts to be accurately established.

A new role for companies

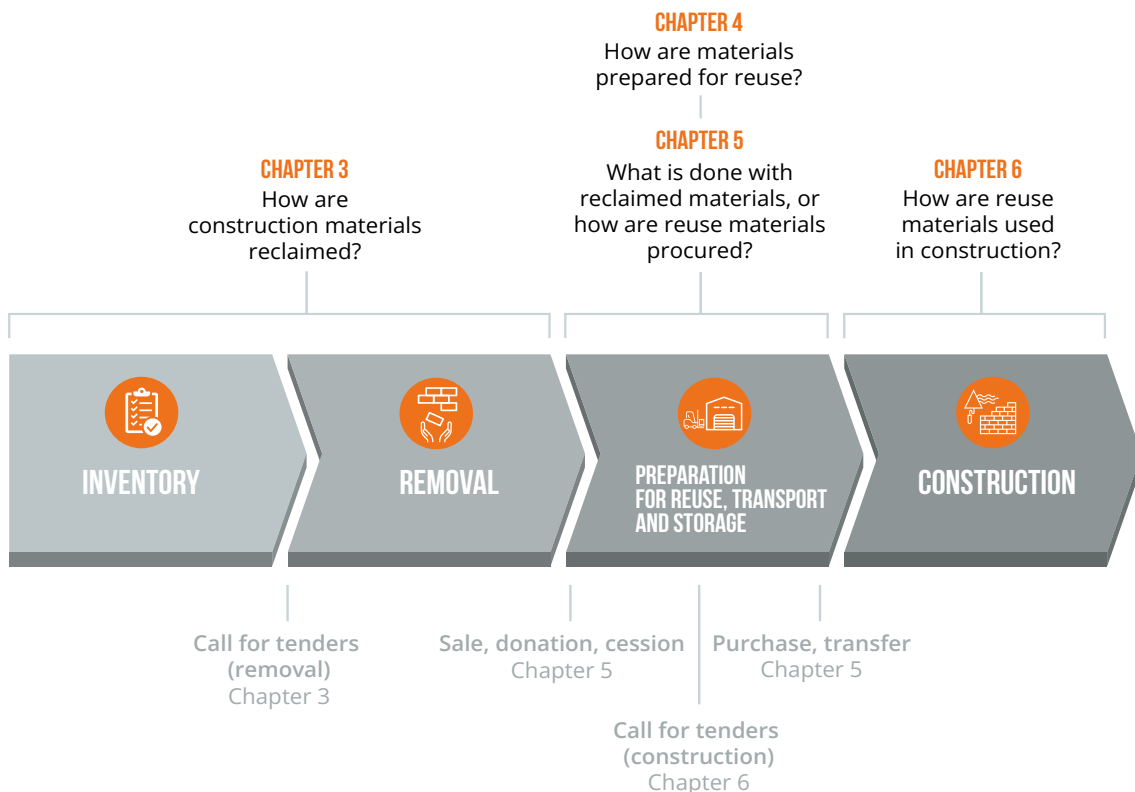
Construction companies can play an important part in this transition towards more circular practices. Their knowledge of the business and materials, their knowhow and technical capabilities are crucial assets!

Here are some ideas for companies to become a driving force in the adoption of reuse practices:

- Drawing the attention of project owners and architects to the possibilities of **reclaiming materials on other worksites**. By their position and operation, companies of the construction sector have privileged access to the sources of reusable materials which other interveners do not have.
- Developing and managing an **internal stock** of materials reclaimed during demolition work, which can be proposed for reuse on other work sites.
- Developing **privileged partnerships with local companies** specialized in the reclamation and resale of certain types of materials, to propose reliable reclamation and reuse solutions to customers and to answer customer demands.

- **Diversifying services**, be established on the market as a company that offers advice about material reuse, as well as solutions for deconstruction, renovation and/or sustainable construction, for example.

This guide aims to supply the answers to the main questions that entrepreneurs can have when they think about adopting practices of reclamation and reuse of materials. It is based on current knowledge in this field. The guide addresses the various key steps, in a practical way such as identification of the reuse potential, the removal processes, preparing materials for reuse, and the construction phase. It also covers aspects related to resale or supply. More theoretical aspects such as calls for tender, collaboration and the establishing of price offers will also be dealt with. Moreover, the guide deals with justification of the technical performance, responsibility, and insurance questions.





2.

What construction materials
can be reclaimed and reused?

- Wood workers may be entrusted with several roles related to material reuse: the removal of certain elements, for example during renovation, and construction with reclaimed materials. The contractor can carry out some of these tasks themselves, and subcontract some of them, for example to certain professionals specialized in reuse.
- It is possible to intervene directly or indirectly on a considerable number of different materials. The materials to be covered in this guide are those related to wood working (structural elements and wood support, exterior and interior wood fixtures, interior wood stairs, wood finishes, etc).
- The following materials can be subject to reuse. Caution, while it covers the elements most often reclaimed and reused, this list is not exhaustive.










FURTHER INFORMATION














Reuse Toolkit – Material sheets





A collection of 36 material sheets have been produced under the FCRBE project. They aim to gather the information currently available likely to facilitate reuse of the materials products of construction. Some information will be reproduced in this guide, but do not hesitate to read these very complete data sheets for more information about the materials to be reclaimed or reused!

https://opalis.eu/sites/default/files/2022-02/FCRBE-All_sheets_merged-EN.pdf

MATERIALS RELATED TO WOOD WORKS LIABLE TO BE DISMANTLED OR REUSED	DESCRIPTION ²	DOCUMENTATION
<p>TRUSSES, BEAMS, RAFTERS, ETC.</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> TO BE REUSED</p> <p> FREQUENT ON THE REUSE MARKET</p>	<p>These products can be found with demolition contractors who remove roofs, floors and other wooden structures. The wood is generally sorted and denailed. The terminology used for these products varies from one region to another. In general it refers to solid wooden elements with rectangular cross-section from buildings of the 20th century. Elements such as old beams (oak) can be found at specialised dealers. Their rustic old aesthetic distinguishes them. Beams, usually oak, can be centuries old, decorated or have irregular shapes because of their age. Also their technical qualities can be outstanding.</p>	<p>Material sheet – Reuse Toolkit: Solid structural wood with rectangular cross-section https://opalis.eu/sites/default/files/2022-01/2.10_en_-_reclaimed_rectangular_section_solid_structural_timber_v01_1.pdf</p> <p>Methods of diagnosis and evaluation of performance, developed by the CSTB: https://www.cstb.fr/assets/documents/cstb-guide-reemploi-des-charpentes-industrialisees.pdf</p>
<p>LAMINATED WOOD</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> TO BE REUSED</p>	<p>Laminated wooden elements (BLC) are made by superimposing and gluing lathes of planed wood. These elements are liked for their mechanical properties, lightness, ability to cross large spans and the variety of geometric shapes this technique enables. In general they can be found with various demolition contractors active in reclamation.</p>	<p>Material sheet – Reuse Toolkit: Laminated wood elements https://opalis.eu/sites/default/files/2022-01/2.11_en_-_glued_laminated_timber_structural_elements_v01_0.pdf</p>

² Most of the descriptions come from the website opalis.eu.

MATERIALS RELATED TO WOOD WORKS LIABLE TO BE DISMANTLED OR REUSED	DESCRIPTION	DOCUMENTATION
<p>WOOD SHUTTERING, STEENSCHOTTEN TYPE</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> FREQUENT ON THE REUSE MARKET</p>	<p>"Steenschotten" type shuttering is a true classic on the reuse market in Belgium and the Netherlands and, to a lesser extent, in France and Germany. The first application of these panels is in the concrete industry where they are used as supports for the vibration drying of prefabricated concrete blocks. Once disqualified for this use, the rectangular panel, often made of azobé, douglas or larch, can be used for many other applications (exterior). They are particularly wanted for terraces.</p>	<p>Material sheet – Reuse Toolkit: Steenschotten type wood shuttering https://opalis.eu/sites/default/files/2022-01/1.30_en_-_timber_formwork_panel_steenschotten_type_v01.pdf</p>
<p>WOOD (TROPICAL) FROM MARINE STRUCTURES</p>  <p>© Opalis</p> <p> TO BE REUSED</p>	<p>Hard tropical wood was and, to a lesser extent, is still widely used for many maritime applications: naval constructions, mooring posts, pontoons, piling, etc. Azobé is often used for these purposes, and to a lesser extent other wood species like Douglas fir. Azobe is naturally very resistant to moisture and high loads. It is perfectly suited to exterior use while other applications are also possible. Reclaimed marine wood is well represented on the Netherlands and Belgian reuse market.</p>	<p>Material sheet – Reuse Toolkit: Ship wood (azobé) https://opalis.eu/sites/default/files/2022-01/1.31_en_-_ship_timber_v01.pdf</p>
<p>BARNWOOD</p>  <p>© Opalis</p> <p> TO BE REUSED</p>	<p>Barnwood has also experienced considerable popularity in recent decades. Barnwood generally means wood planks from the demolition of old farm barns, mainly imported from Eastern Europe and North America. Aged and weathered this wood is very stable and solid. It has a very special aesthetic. Often lots of barnwood also have some historic importance, because the wood comes from primary European and American forests.</p>	<p>Material sheet – Reuse Toolkit: Barnwood https://opalis.eu/sites/default/files/2022-01/2.70_en_-_barnwood_v01.pdf</p>
<p>BEAMS (OAK) CUT IN PLANKS</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> TO BE REUSED</p>	<p>Some suppliers cut reclaimed beams (often oak) to make planks for all sorts of applications. Unlike reclaimed planks, these freshly sawn ones show less patina. However, they enable free fixing of new dimensions – and ensure their stability.</p>	
<p>EXTERIOR FIXTURES</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> TO BE REUSED</p>	<p>Windows and doors can be relatively recent elements, from the demolition or transformation of recent buildings, or older elements. The more recent can possibly be reused as exterior elements, provided their performance can be verified, especially thermal, or as interior separation elements. The older, which can be found with or without their glazing, are generally reserved for interior arrangements or for the restoration of old buildings. Some suppliers of reuse doors and windows also offer metal or wood shutters. These are generally reused in projects of old building restoration or decoration.</p>	<p>Removal handbook: https://reuse.brussels/chassis-et-seuils-de-fenetre</p>

MATERIALS RELATED TO WOOD WORKS LIABLE TO BE DISMANTLED OR REUSED	DESCRIPTION	DOCUMENTATION
<p>INTERIOR DOORS</p>  <p>© Opalis</p> <p>↩ TO BE RECLAIMED</p> <p>↩ TO BE REUSED</p> <p>↑ FREQUENT ON THE REUSE MARKET</p>	<p>The ease of removing doors explains their abundance on the reuse market. There is a great variety of styles and origins, but doors with old solid wood panels represent much of the market, followed by exterior doors. Recent interior doors (like doors with inner structure made of chipboard or honeycomb) are only rarely reclaimed. Doors are rarely sold with their original frames, as these are difficult to remove, store and reassembly. Some retailers make new frames suited to old doors.</p>	<p>Material sheet – Reuse Toolkit: Solid structural wood with rectangular cross-section https://opalis.eu/sites/default/files/2022-01/3.20_en_-_interior_door_-_panelled_wooden_door_v01.pdf</p> <p>Material sheet – Reuse Toolkit: Fire doors: https://opalis.eu/sites/default/files/2022-01/3.23_en_-_interior_fire_doors_v01%20%281%29.pdf</p> <p>Removal handbook: https://reuse.brussels/parquets-et-planchers</p>
<p>INTERIOR STAIRS</p>  <p>© Opalis</p> <p>↩ TO BE RECLAIMED</p> <p>↩ TO BE REUSED</p>	<p>In general timber stairs can be removed, especially if they were assembled without adhesive. Stringers, steps, risers, banisters and handrails can be disassembled and reclaimed. However this operation requires excellent preparation and good coordination. For small size stairs, it is often easier to reclaim them in one piece – and it is like this that they are sometimes found at some dealers.</p> <p>Also available are interior stairs in cast iron or steel, straight or spiral, usually sold as spare parts.</p>	
<p>FLOORS AND PANELLING</p>  <p>© Opalis</p> <p>↩ TO BE RECLAIMED</p> <p>↩ TO BE REUSED</p> <p>↑ FREQUENT ON THE REUSE MARKET</p>	<p>This category includes wooden floors and panelling with a first life as interior finishing and which are sold to be reused as such. Old wooden floor and wall coverings are often reused, mainly for their looks and for the quality of these products. These, especially, are a true classic on the reuse market and are popular throughout western Europe.</p> <p>Other wooden elements, from other applications, can also be used for interior applications.</p>	<p>Material sheet – Reuse Toolkit: Solid wood floors https://opalis.eu/en/materials/parquet-and-panelling</p> <p>Removal handbook: https://reuse.brussels/parquets-et-planchers/</p>
<p>PANELS</p>  <p>© Opalis</p> <p>↩ TO BE REUSED</p>	<p>This category groups different types of construction and layout materials that come in panel shape. They are mostly found with demolition contractors who reclaim them on their own worksites. They can also be found with suppliers who offer a new life to the more recent generic materials – some of whom make workshop spaces available.</p> <p>These can be wood derived panels, HPL panels, or plaster panels.</p> <p>These elements do not have the typical patina of reused timber planks or old bricks, for example. They are generally sold as is, with no other treatment.</p>	

The background of the slide is a photograph of a construction site. In the foreground, a worker wearing a white hard hat and a dark jacket is looking down at a set of blueprints or a large sheet of paper. In the background, a tall construction crane is visible against a bright sky. The overall scene is in a warm, orange-toned color palette.

3.

How can construction materials
be reclaimed?

A. How can you be sure that reclaimed materials will be reused?

Before starting their deconstruction, it is essential to carry out an evaluation of the reusable elements and the non-recoverable elements. The first thing is to evaluate the potential for reuse. Also the demountability can be tested at this stage. Then, elements with proven potential can be added to a reuse inventory. At the same time, it is important

to clearly define the ambitions of the project in terms of reuse. Various partners to the project can contribute to the different tasks whose execution is generally supervised by the architect or the project promoter.

Who takes the initiative?

Before any reuse, one or more actors have to take the initiative. Their motivations can be multiple. The table below gives a view of some of their motivations, which can vary from one project to another.

INITIATOR	MOTIVATION
Project Owner / Customer	Wants certain elements to be reused and requires this in calls for tender
Public Authorities	Implement reuse through political initiatives aimed at achieving climate and environmental objectives
Architects / Design Office	Can ask to reclaim certain elements with the aim of reusing these in a new project
Demolition companies	Are liable to dismantle certain elements easily (and without additional costs) and/or have opportunities for certain materials
Construction companies	Plan their reuse in new projects
Dealers	Purchase or take back certain items that are economically attractive for resale
Producers	Recover their products. Their reclamation enables repairs or improvements and the remarketing of their products

Evaluation of the reuse potential

Before starting deconstruction of materials for their reuse, it is important to know their potential for reuse. The evaluation of their potential is carried out in two complementary ways:

- **By analogy with frequently reused materials**

The frequent reuse of a given material means that the probability of successful reuse is high in this context and that the value attached to this material is significant. Section 2 gives a view of frequently reused materials.

■ **Supporting criteria**

Various factors can affect, positively or negatively, the reuse potential of the materials. The impact of the different criteria varies from one project to another. Some factors are liable to make reuse harder, but never fully exclude the possibility to reuse. Sometimes it is a matter of getting off the beaten track to find an inventive reuse solution of a material whose potential seemed limited at first. The following factors are developed in the *guide devoted to reuse inventories*³.

+	-
Removability and simplicity of deconstruction	Health and safety risks
Good condition	Poor condition / damage / disintegration
Quantity (large)	Out of fashion
Considerable environmental benefit	New more interesting materials
High value (authenticity, historic interest, etc.)	Strict technical requirements
Economic value	High recycling value
Possible logistics	
Homogeneity and standard dimensions	
Management of risks	

• A material whose reuse has not been novel for ages, wood is available from various retailers of reuse materials. The reuse of oak beams or floors has been commonplace for some time. Also, the reuse of resinous wood is progressing as shown by the reuse of plywood and solid wood beams and planks. Finally, fixtures are also reused as part of new projects, whether for the same application or not.

• The method for estimating the reuse potential of wood beams differs from that used to evaluate planks or fixtures. These wood pieces share the need to be removable without great difficulty and, preferably, with maximum efficiency. For floors, the fixing method should be checked: nailed, glued or floating floor? For beams, check if the removal of large pieces is viable and, as required, decide on suitable equipment. The use of certain gripping tools risks damaging the fibrous structure of the wood and making it unusable. At this stage, you can evaluate if manual removal is viable and profitable.

• When removing wood beams for a new structural application, the potential for reuse can be estimated visually. For example, attacks such as rot and insect infestations will have a harmful impact on their structural integrity. When reusing beams in a non-structural role, they should satisfy aesthetic requirements. Take a decorative oak beam. While it does not have to satisfy any structural requirement, this beam has to be in good condition. In this context, rotten elements cannot be reused. However, insect infested beams can still be used, but only with restricted infestation and subject to previous eradication of the insects.

• For wood floors, their reuse potential depends on their removability and their commercial value. Moreover, you should allow for the operations required to make any reclaimed floor reusable. The general condition of the elements making up the floor is also an influence.

• For fixtures, a distinction should be made between windows, doors and stairs. As regards windows, you should allow for the energy performance currently required. With older windows, look for less demanding applications. Window dimensions can influence their reuse potential, the same goes for doors. For doors, a distinction should be made between different types. On the reuse market, panel doors now represent certain value. This also goes for flat doors, exterior doors and fire doors. Fire doors are often removed before their useful lifetime ends. The fire safety requirements they have to meet can be an obstacle, but a less demanding application will facilitate reuse. The possible reuse of wood stairs usually means their complete removal from the building. In such cases, their dimensions and removability affect their reuse potential. (Rotor, 2021)

³ <https://vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/news/fcrbe-guides-extraction/>

- The reuse market for solid wood beams and plywood joists is not recent. Similarly, solid wood floors are quite easy to put to new uses. However, the reuse potential of wooden windows and doors depends on their assignment. In the case of reuse as part of an application subject to many technical requirements (e.g. fire safety, thermal capacity), their possible usage will stem from essential preliminary research. Otherwise, the doors and windows in question will be usable as part of less demanding applications (in cascade).

Elements whose reuse potential seems poor at first can nevertheless find a new assignment as shown by the new office of the «Ferme des Possibles» located in Stains, in France. Four kilometres away, a series of social dwellings benefitted from a dynamic renovation. The parties concerned decided to replace the existing windows with other fixtures with greater thermal insulation capacity. Apart from the lack of compliance of these windows with the new standards and regulations, their wood frames had traces of lead paint. However, despite all these contraindications, a new assignment has been found for them. These fixtures helped to create a light facade in wood and glass resulting from the combination of collected, cleaned and renewed panels. Based on a project conceived by Bellastock, the fixtures company «Depuis 1920» undertook to produce prototypes in its workshops before carrying out the assembly on site of these elements in August 2019. (Bellastock, 2019)



© Bellastock

Reuse inventory

An inventory is defined as a list of relevant information of the various elements. By definition, a reuse inventory only lists the elements whose reuse potential is significant. A crucial step, establishing a reuse inventory tells designers and building owners about the opportunities offered to them, sends information to the market and

tells demolishers which elements to dismantle. Finally, looking forward, this inventory also has some potential for surveillance and monitoring of the quantities.

It is best to develop the inventory as early as possible. For example, establishing it can even be carried out during the use phase (in such cases, elements that disappear when moving should be considered) or when the building is empty.

Establishing the inventory can be entrusted to various actors. Normally, when a contractor is set to carry out the deconstruction of certain elements, the inventory will already have been established by the project owner, architect, consultants or a specialized company. Moreover, it can be useful for the contractor in question to produce a reuse inventory themselves. They can establish it according to their ambitions. And carrying out a personal analysis and estimation of the reusable or not materials can be useful.

Establishing this reuse inventory will be done when visiting the worksite. For this some arrangements should be made. A preparation antecedent to the site visit is worth considering. Moreover, it is worth thinking of submitting certain elements to possible deconstruction tests (see below) and as required, looking out for hidden defects. It is also worth having a camera and the required PPE. Apart from the practical aspect, nothing prevents a prior examination of the existing documents related to the building. Drawings, data sheets (FR: fiche technique de produit) and other documents for getting a more precise idea of the reuse potential.

Execution of the measurements required will be done when visiting the worksite. Taking clear photos of the elements having certain reuse potential allows colleagues, partners or potential buyers to get a precise idea of the situation. Submitted to deconstruction tests will be the elements for which some uncertainties remain as to the type of attachment (e.g. glued, dry, etc.) or the deconstruction techniques applicable. For elements whose performance is yet to be fully demonstrated, samples can be taken when visiting the worksite. In such cases, it is important to use clear marking to indicate the original position of the samples taken in the building. When visiting the site, it is important to show some curiosity, in safe conditions. In other words: It is worth examining materials under the covering plaster, unless they contain asbestos.

The inventory is liable to be divided into three parts. The first part gives information relative to the worksite. This part of the inventory will give among other things the contact details of the different actors. The address and nature of the building are also given. As far as possible, plans of the building are also added. All information about the machinery and equipment present (e.g. crane, lift, etc.) can help potential buyers estimate the workload involved should they have to carry out deconstruction themselves.

DWELLING LOCATED IN MALINES

The following inventory was established for a terraced house located in Malines. Built during the second half of the 19th century, this building was recently enhanced with a ground floor extension. Because of the age of this house, it was suggested that the structure of the floor would be made of wooden beams. To check this assumption, a hole was made in the plastered ceilings. Having found the presence of wooden beams, the parties concerned were able to check their quality and measure the cross-section. Also, measurement of the beam spacing would have given their number.



BASIC DATA

Identification		Photo	Quantity		Dimensions		In situ placing	Condition	Observation(s)
N°	assembly name		unit	quantity	unit	dim.			
1	Wooden beam Lot 1		m ²	14	mm L*W*H	4.200*58*158	First floor above living room	Good condition, small sawn notch	Removable screwed join
2	Wooden beam Lot 2		m ²	6	mm L*W*H	4.200*58*158	Extension made at rear under flat roof	Good condition (quite recent due to renovation)	Embedded in brick wall

The second part is in the form of a database table. Minimal information for each element is given in this table. Identification, photo, quantity, dimensions, weight, condition and location of the elements in the building are liable to be listed here. The deconstruction tests and their results, the

existence of any sectors, the dismantling phase, the fact that the element in question is already dismantled or that the buyer awaits the supply constitute additional information liable to facilitate the search for opportunities.

IDENTIFICATION

no.	Assembly name / lot
2	Wood beam lot 2

ADDITIONAL DATA

Additional photos



Assembly

Attachment made using screws and metal accessories

Other

Sawn notch 20 mm

The third part consists of an additional sheet. The information it contains will be even more detailed. Here documents can be added such as data sheets, more detailed photos, possible environmental benefits, possible applications, etc. The third part is optional. The relevance of this part will depend on the materials and ambitions.

Deconstruction tests

For a deconstruction test, it is useful to check the fixing method of a given element, the dismantling of this element and the most appropriate dismantling procedure. Moreover, an estimate of the deconstruction time can also be made. Finally, an estimate of the expected loss rate can be given. This is the percentage of the materials which, despite their reuse potential, are not reusable because of damage suffered during their deconstruction.

Definition of ambitions

The inventory's degree of detail can vary according to the ambition of the requesters.

The inventory can consist of a quick version, with little detail. This version will above all be used to produce inventories of the best-seller or high value materials. The aim is often to sell or give them away. General ambitions are more limited. Of course, if additional information is requested, the inventory can be completed.

Establishing a more detailed inventory requires additional information. This essential addition is due to high expectations, associated with a future clear goal or with possible reclamation of materials whose reuse is less current. Even when verification of technical properties is required, the inclusion of extra details and existing documentation (e.g. data sheets) is an advantage.

Carrying out a reuse inventory can be an iterative process. It is sometimes more interesting and economical to start with a less detailed inventory. Later, details (such as specific dimensions) can be added if the market demands it.



FURTHER INFORMATION



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r : "A guide devoted to establishing a reuse inventory has been written under the Interreg FCRBE project. This [link](#) gives access to this guide combined with a model divided into three separate parts for consulting these documents.

Digitization and the use of digital tools in the construction sector are developing and are considered one of the main steps towards a more efficient and productive construction sector. Tools like «reality capture», scanning technologies, artificial intelligence, BIM models, applications and material databases also have the potential to help the sector to shift towards the circular economy. For example these tools can help us to produce reuse inventories.

A report produced under the FCRBE project describes how digital tools can support the production of reuse audits: https://vb.nweurope.eu/media/17603/fcrbe_digital-tools-for-reuse_final-version_compressed.pdf

The Interreg Digital Deconstruction project has also published many publications on this subject: <https://vb.nweurope.eu/projects/project-search/digital-deconstruction>

B. What are the key points when bidding for the reclamation of construction materials?

Types of contracts

There are two options for calls for tender covering the reuse of materials. It can be a performance obligation (ad hoc procedure) wherein the project owner requires certain quantities or percentages. Services, sales or donations can lead to establishing a public contract combined with a performance obligation. Or it can be an obligation of means requiring the contractor not to spare any effort for reuse.

- In the case of a public contract for **services**, the parties concerned focus on the deconstruction process. The materials used in this context do not usually have high value. The project owner assigns the contract to the bidder who agrees to dismantle the greatest quantity and the greatest variety of materials listed in the inventory. In return, the project owner pays a set amount to the assignee.
- In the case of a **sale**, the deconstruction process is secondary and the value of the materials is often higher. In this case, each article of the inventory will be sold to the highest bidder.
- In the case of a **donation**, the deconstruction process is also secondary and/or the value of the materials is higher. Each article will be given to the bidder able to take the greatest quantity.
- In the case of **obligation of means**, the bidder is required to spare no effort to reuse. This method holds less risk for the contractor. For example, certain technical problems can justify the absence of reclamation of a given material. (Rotor, 2015)

What can be asked ?

According to the destination of the reclaimed materials, various activities will be included in the contract in question. For in situ reuse, the parties concerned will focus on the process of deconstruction and storage on site. For the deconstruction of elements for sale, donation or reuse on another site, the parties concerned can also be invited to evaluate the interest of the market, to look for opportunities and to establish a reclamation report.

A *reclamation* report is defined as a document giving a view of the reclaimed materials. This control tool for the project owner's use will be submitted to them prior to payment of the last tranche. Moreover, this tool also constitutes a practical means of communication of the results obtained. The reclamation report gives the quantity of materials reclaimed and will be accompanied by a description and photos. This report will also be accompanied by a

description of the steps taken to find opportunities as well as any supporting documents. (Rotor, 2015)

Possible technical clauses

It is important to carefully read the technical clauses describing the deconstruction of the materials, because they can differ in many respects from the more conventional clauses describing the demolition work. (Rotor, 2015)

- **Characteristics of the materials to be reclaimed**
What are the characteristics that the material in question must satisfy to be reusable?
- **Method of deconstruction and required information**
How does the deconstruction procedure take place? Do certain elements merit being paid special attention or treatment? Are dangerous substances present?
- **Sorting and selection**
Is the contractor responsible for sorting and selecting the reusable materials? Based on what parameters are the lots divided? Which elements are refused?
- **Clearing of non-reusable materials**
Do the non-reusable materials have to be cleared into separate bins? Is there, for certain materials, a direct opportunity which authorizes recycling as new materials?
- **Cleaning and preparations required before any reuse**
Is the contractor responsible for cleaning the materials? Which materials require cleaning? How should they be cleaned? What other operations have to be carried out? What is the final desired result?
- **Transport, storage and conditioning**
Should the materials be transported? What packaging method is to be applied? Against what risks should the materials be protected? Who is responsible for the storage? Where is the storage area located?
- **Ownership**
To whom do the materials belong after deconstruction?
- **Evidence and traceability**
How should the activities targeting reuse of the materials be documented? Which are the documents that the contractor should be able to produce?

Loss rate

In the case of a public contract concluded at the end of the ad hoc procedure, the parties concerned set a quantitative goal. This means that the parties concerned here will reclaim a set quantity or percentage of the recovered materials. In this respect, that a significant part of these materials will become unusable during the deconstruction process must not be ignored. This is what the loss rate covers.

Should a loss rate be communicated by the project owner, it is recommended to understand the situation well to confirm this estimate or request that it is revised as required. The deconstruction tests provide a more precise idea of the situation. It is useful to entrust their execution to the project promoter. As contractor, it is important to carry out the verifications required. If no deconstruction test has been carried out, it is recommended to take the required percentages with a pinch of salt.

In the absence of loss rate communication, there are some options. Either the parties concerned ask the contractor to carry out a deconstruction test for estimating the loss rate, or the contractor offers to carry out a deconstruction test to evaluate this loss rate and the margin of error, or the contractor must show that they have used all the means and techniques necessary to reclaim a maximum of elements in a satisfactory condition. (Rotor, 2015)

Who do the materials belong to?

According to the destination of the materials, the provisions of the following are liable to be contractually decided:

- The removed materials remain the property of the project owner
- The contracting authority remains the owner of the materials listed in an appended inventory.
- Unreserved materials stored on land become the property of the contractor during their reclamation
- The removed materials become the property of the contractor. This is also current practice as part of conventional demolition work. (Rotor, 2015)

EXAMPLE OF QUANTIFIED REUSE GOALS IN A DEMOLITION/CLEARING MARKET

Contracting authority: SERS

Strasbourg (France), 2020 – 2022

6.2. Environmental commitment

6.2.1. Reuse commitments

Declares to have read the CCTP and its article



POUR ALLER PLUS LOIN

« Vade-mecum pour le réemploi hors-site » - ce document présente une explication détaillée des différentes procédures susceptibles d'être appliquées :

[http://www.vademecum-reuse.org/Vademecum_extraire_les_materiaux_reutilisables-Rotor.pdf.\(rotordb.org\)](http://www.vademecum-reuse.org/Vademecum_extraire_les_materiaux_reutilisables-Rotor.pdf.(rotordb.org))

Le CCTB (Cahier des Charges Types du Bâtiment) est la référence wallonne en matière d'établissement de cahiers des charges public permettant de spécifier les travaux de construction ou de rénovation. Il propose notamment des clauses types pour le démontage de certains matériaux.

<https://batiments.wallonie.be/home/iframe-html.html>

"Prevention of waste: Reuse" giving the contractor's reuse targets. Agrees to comply with the minimum mandatory reuse rates:

- 80% of number of radiators type 1.1 and 1.2
- 50% of volume of framework wood (roof area)
- 50% of area of wall earthenware type 1"

These targets have been defined from the inventory of reusable materials and is based on the quantities estimated therein.

Example of targets to be set by companies answering the call for tenders

Contracting authority: SERS

Strasbourg (France), 2020 - 2022

"Agrees, in compliance with its bid, to achieve the following reuse rates:

- ___ % of number of radiators type 1.1 and 1.2 (80% minimum),
- ___ % of volume of framework wood (50% minimum),
- ___ % of area of wall earthenware type 1 (50% minimum),

Others (type & quantities to be stated):

_____ » (Bellastock, 2019)

Examples of possible technical clauses:

- Wood beams that have been in contact with asbestos must be tested, using adhesive samples, to detect any contamination. If this test is positive, the contaminated beams should be eliminated.

- No reuse should be made of rotten or insect infested wood beams and they must be put away from sound beams to prevent any contamination.
- Beams should be distributed into different lots according to their cross-section.
- Any wood component damaged on removal must be cleared into a separate bin for recycling. This provision also applies to beams that do not satisfy the selected criteria.
- Wood beams should be stored in the dry and above the ground, ensuring that they have enough ventilation (no covering of the beams). Beams should be stacked, allowing sufficient space beneath for loading on a forklift truck. Lathes should be placed between the beams.

C. How do you collaborate with subcontractors, architects and customers?

Material deconstruction for its reuse still faces many challenges. Sometimes there is not enough time or no destination has been found for the dismantled materials. It is therefore essential to collaborate from the outset with the different parties concerned. The following advice may improve the conditions of this collaboration:

Rapid establishment of contacts

The reclamation and reuse of construction materials is not yet current practice for many construction actors. Activities and procedures different from the activities in everyday projects are unknown for many. Qualitative communication, transmitted opportunely, has crucial importance in this respect.

The meticulous deconstruction of a building takes more time than traditional demolition. According to the planning of the site, contact should be made on time with certain project partners. It is important to let the project owner know what time is needed for deconstruction of the planned elements. The other actors should also be told when it is convenient to carry out the deconstruction of certain elements. Finally, the fact of informing at an early stage the potentially interested parties lets them get a more precise idea of the materials whose opportunity outlooks are real. Section 5 gives some ways to help identify the actors liable to be contacted for this purpose.

For the deconstruction of materials for reuse, traceability is a matter of importance. Traceability is defined as the capacity to verify information relative to the life (previous) of the materials. Relevant information concerning their production and previous application can help the reuse process. Therefore, it is recommended to make contact rapidly with the former owners of the building, the actors involved in its construction or the producers of the materials concerned.

Moreover, it is important to let the subcontractors, workers, etc. know clearly the method of distribution into lots of the materials considered.

In the case of reuse, control of the chain constitutes an important aspect. In the present case, control of the chain is based on the experience and expertise of the actors brought in to carry out deconstruction of the materials and to differentiate between the good and bad elements. If it is a matter of a new method of deconstruction or an element whose treatment the intervenors concerned have no experience of, it is recommended to seek the advice of specialists and to communicate, with supporting demonstration, the appropriate work procedure to the people present on site.

Satisfactory agreements

As shown in section 3.b, the clauses should precisely describe the elements whose deconstruction is required and to identify the people to whom the responsibility falls for certain tasks such as deconstruction, sorting, storage, transport, etc. Ownership and responsibilities should also be detailed. It should also be ensured that the information supplied in the specifications is sufficiently detailed. If not, it is recommended to contact the specifier before submitting a bid.

Who has responsibility for worksite safety?

In the case of deconstruction of elements for their reuse, the disappearance of certain factors which previously ensured the user's safety was not at all unusual. For example, the removal of staircases and windows increases the risks of falling and the removal of lamps increases the risks of exposing electrical wiring. Moreover, their deconstruction is often entrusted to different parties : the former owner wants to conserve certain elements, the neighbour is interested in a particular piece, a reuse organization has its eye on certain elements, etc. The presence of these different actors on a worksite can lead to dangerous situations, but who is responsible in the event of a problem?

It is always the site manager who is responsible for ensuring safety by keeping the worksite in a satisfactory state of cleanness and ensuring the supply of collective protective equipment (e.g. device for protection against falls).

If the worksite is placed under the direction of a contractor, the latter takes responsibility for safety and obviously, any injury and damage inflicted on persons.

If the worksite is placed under the direction of an individual, the latter takes responsibility for any accident due to a badly maintained worksite. If the accident considered is related to the nature of the work (e.g. presence of dust in eyes following the performance of a drilling operation), the family insurance will intervene. In this case, responsibility largely depends on the situation.

Adapted work companies

Formerly called and social workshops, adapted work companies may be asked to contribute to support the reuse process. While their personnel may not enter the «normal» job circuit, they can provide a significant contribution at several levels of the reuse chain. Many tasks including deconstruction, sorting, cleaning, preparation and conditioning of the reusable materials may be entrusted to adapted work companies.

Again, clear agreements are crucial to ensure smooth cooperation. For example, agreements are best made around price. The work rate of a custom company may be slower than that of regular workers. A price based on the effective time can then increase, so sometimes a price per piece is chosen. In addition, agreements around the region in which they work and the flexibility of working hours are also important.

DECONSTRUCTION OF A DWELLING IN VINKT

Lippens Infra collaborated with HuisMus to dismantle the roof of a house in Vinkt. For the dismantling of the wooden framework, HuisMus called on Labeur, an adapted work company. While most of the materials can still be recycled after their mechanical destruction, their deconstruction requires more manual work. As these operations sometimes go too far for demolition companies, their partnership with an adapted work company constitutes a good solution. The Labeur staff carefully dismantled the roof quite safely so that the wooden beams could be reused by HuisMus as part of a new project.



© HuisMus & Labeur

D. How can construction materials be reclaimed?

Deconstruction

The deconstruction of a building can start while it is still in use and continues to the end of its demolition. If the building in question is empty, or even still in use, its owner can already carry out the deconstruction of certain simple non-structural elements. Contractors specialized in the sale and/or deconstruction of buildings can also themselves engage in these deconstruction operations, with or without the assistance of an adapted work company. They can also give their advice on the procedure to be applied or indicate the elements they are interested in. Since the demolition process is often intensive and limited in time, it is best to carry out the deconstruction of as many elements as possible before the start of demolition properly speaking. The deconstruction of structural elements can only be planned during demolition. In general the demolition company takes on this operation, but there is nothing to prevent specialized companies or adapted work companies from taking part.



FURTHER INFORMATION

The 36 material sheets developed under the FCRBE project describe further the techniques habitually used and best practices for the removal, sorting and storage of the materials. They are available using the following link: https://opalis.eu/sites/default/files/2022-02/FCRBE-All_sheets_merged-EN.pdf

The website reuse.brussels also describes in detail the various operations needed for removing certain materials.

The deconstruction method differs from one element to another. The execution of a deconstruction test helps determine the best deconstruction method for any element (see section 3.a). The parties concerned can also seek the advice of specialists or consult certain data sheets. After having identified the most suitable deconstruction method, it is important to share it with the people present on the worksite.

During any deconstruction, you must also consider the possible presence of dangerous substances. You must not carry out the deconstruction of materials before having carried out an asbestos inventory (and for dangerous substances) and the neutralization of any dangerous substance.



DANGEROUS SUBSTANCES AND PRECAUTIONS

As regards wood, lead, copper, chrome, arsenic, PCPs and certain crucial germicides are some of the dangerous substances liable to be found in the composition of paints, fireproofing products and preservatives. Their concentration in wood and their residual harmful effect are difficult to evaluate without lab testing. Therefore, it is recommended to remain prudent if in doubt. Similarly, the release of dust when sanding or sawing wood pieces requires compliance with appropriate safety measures. (Rotor, 2021)

Watch out for asbestos! In the case of construction or renovation of buildings between 1945 and 2001, the probability that it contains asbestos cannot be ignored. (OVAM, 2021) When asbestos is near wood, there may be a risk of contamination. An asbestos inventory must always be made before removing elements or a removal test carried out. If in doubt, do not hesitate to consult a specialist. Then certain adhesive samples help to evaluate the presence (and concentration) of asbestos on the wood surface.

Removing wood floors

- The first removal operations of parquet or wooden floor elements are the same, whether a floor is glued, nailed or floating parquet. After removing the skirting boards, the first plank or slat to be removed should be selected.
- As this plank or slat risks suffering serious deterioration, it is recommended to choose a less important one.
- Once it has been removed by a chisel, hammer, saw or multipurpose tool, you can remove the other flooring planks or slats with care.
- Individual nailed planks are removed by hammer and crowbar. The planks of floating floors can be released quite easily. With glued parquet or floors, the planks or slats can be released individually and successively with a hammer and wood chisel releasing them laterally. In such cases, it may be necessary to clean off the bottom side of these flooring planks and slats. For the grooves, a cutter can be used and a wire brush for other surfaces. (Rotor, 2021)

A. Traditional parquet or strip flooring



B. Floating and glued parquet



Sorting

For the deconstruction of elements, the first step consists in sorting out the non-reusable elements. However, the reusable elements will be distributed into various lots. A lot is defined as a set of elements whose properties are homogeneous. One lot will be composed of bricks of the same colour, wooden beams from the same application or doors with identical dimensions. The following factors enable these lots to be differentiated one from another:

■ Types of elements

It is useful to make a distinction between different types of elements. For example, wooden beams and steel beams will be grouped separately; but a replacement window produced by another manufacturer will be part of a lot different from that of the windows mounted in the building when constructed. Certain aesthetic characteristics can also influence the constitution of lots.

■ Location in the building

A different place in the building can also require the constitution of separate lots. Interior and exterior doors will be separated into two different lots.

■ Application

Elements whose application differs in a building will be distributed into separate lots if their prior use is likely to have affected the properties. Steel beams subjected to dynamic loads are put in a lot different from that grouping other steel beams subjected to static loads.

■ Influencing factors

During their previous application, elements of the same type can have been affected in different ways. Bricks making up the south-west façade are liable to have been affected more by the weather conditions than bricks making up other façades. A leak, minor deterioration, residues of other substances or other forms of contamination can also justify the distribution of the elements in question between different lots, or even discharge them as non-reusable elements.

In the case of the distribution of elements between several lots, it is important that their provenance is and remains traceable. Marking per element or per lot ensures traceability. The reference to their provenance can be based, for example, on coding combined with indications supplied on the corresponding drawing.

Transport

In some cases, specific regulations can apply to the transport of reclaimed materials. To know what they are, you should first determine if the reclaimed materials are to be qualified as “products” or “waste”. In general, “reusable construction materials should be considered as products (and not waste) when circumstances demonstrate a high probability of reuse (for example: careful removal for reuse, presence of solid market, short storage time, contract between the holder and the user of the materials, specifications of materials comparable to those of other products on the market, etc). It is up to the competent regional authorities (and not the holder of the materials)



to confirm this interpretation case by case and in concreto, according to the circumstances specific to each case» (Billiet & Seys, 2016/1). There are also different cases for which the materials will be well reused, but will nevertheless involve the waste case, for example when the logistical process of treatment in several steps before reuse is not certain⁴.

If the reclaimed material is considered as «waste» under the regulations, it must then comply with the regulations of its region or country in terms of approval and registration as a waste transporter.

Storage

An important factor of reuse lies in the suitable storage of the materials. It often happens that immediate reuse of the materials in question is impossible or getting hold of reuse materials because of unavailability. This is why suitable storage constitutes a crucial step in the reuse process.

The storage place depends on the destination of the materials. In the case of material reuse in situ, you should identify, on the site or nearby, a suitable place for its storage. Materials to be reused ex situ will be stored on the other site or, as required, on an intermediate site. Materials dismantled but awaiting a new project have to be stored for longer, whether on the contractor's premises, in those of a reuse organization or on a site devoted to this usage.

The storage of materials on a worksite is often time limited. The precise storage method depends on the material in question, but certain basic principles generally apply. For example, certain materials should be sheltered from the weather during their storage. Any shelter should also be secure. Make sure that the storage does not interfere at all with the activities carried out on the worksite and that it presents no risk for the people present on the site. In this respect, a good solution is to assign a bounded area (covered) for material storage, if the worksite allows this. If space is restricted, the material in question can be stored in an existing building. Provided that the building can ensure its integrity until reuse. In the case of storage in the cellars of a building whose waterproofing is doubtful, some materials will become damp, or even unusable.

If the reclaimed materials are not yet the subject of any new project, they should be stored on a temporary basis. In such cases, you should not conserve materials whose reassignment is very uncertain. For long term storage, it is even more important to protect materials sensitive to the weather than for temporary storage.

When the contractor does not have enough storage space, on the worksite, in their depot or that of the project owner, temporary storage space can be hired, like that offered by a consolidation centre. For example, the **BCCC** (Brussels Construction Consolidation Centre) allows the temporary storage of reuse materials coming from deconstruction worksites, before their reuse. It is also possible to carry out preparation operations for reuse of the materials there.

Wood planks and beams

Planks are liable to be stored horizontally on pallets or stacked in a box pallet (for shorter ones).

Make sure that they are correctly banded and protected from exterior moisture. To control the moisture of the wood, a heated environment and good ventilation (temperature near 20°C and relative humidity between 40 and 65%) prevent any future distortion. Tongue and groove planks should be stored groove to groove. It is recommended to avoid stacking planks too protruding, as their weight risks distorting them. Use support elements or large size pallets to prevent this kind of distortion. These plank lots can be film wrapped, but check that the wood can still breathe. (Rotor, 2021)

Wooden **beams** are ideally stored on crosspieces together with spacers for maintaining gaps between the different elements. These beams can be stored sheltered from the weather or in a heated environment to control the level of moisture. In regions with a dry climate, beams can be stored outside, on large racks with sufficient space left between them. Adequate ventilation is also required for wooden beams. (Rotor, 2021)



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⁴ See section 4 for more information.

Fixtures

It is recommended to store **doors** and **windows** on suitable shelves, stacking them on their long or short edge and giving them suitable protection such as partitions or strips and foam corners. When storing doors and windows on their long edge, make sure to keep the lock at the top. If the frame is reclaimed, make sure that it suffers no distortion. These elements should be stored sheltered from frost, moisture and the weather. (Rotor, 2021)

When the contractor does not have enough storage space, on the worksite, in their depot or that of the project owner, temporary storage space can be hired, like that offered by a consolidation centre. For example, the BCCC (Brussels Construction Consolidation Centre) allows the temporary storage of reuse materials coming from deconstruction worksites, before their reuse. It is also possible to carry out preparation operations for reuse of the materials there.



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4.

How are materials prepared for reuse?

Unlike new materials, reclaimed materials often require the execution of some operations before being reusable in a new project.

Firstly, certain materials will need prior cleaning. Before any reuse certain materials have to undergo deep cleaning for aesthetic, hygienic or safety reasons. Cleaning can also be required for practical reasons, such as the removal of the mortar adhering to bricks or tiles before any reuse.

Second, it can be necessary to remove, apply and/or to replace coating or paint. For some materials, these operations are only done for aesthetic purposes. For other materials, these operations are done for health reasons, if a worrisome substance comes into the composition of

the original coating or paint. Moreover, these operations can also be done in order to preserve the material, like the sustainability of wood.

Third, the new application is liable to require dimensions different from those of the initial application. To meet this requirement, elements like tiles, doors, metal profiles, wood parts, etc. should be sawn to size. Also, it may be that elements such as the nails used in the previous application have to be ripped out.

Finally, it may also be necessary to revise the elements to be reclaimed and, as required, to arrange for the supply of missing elements. For example, heating appliances, technical installations or sanitary equipment.



DOES THE MATERIAL REMAIN A PRODUCT OR DOES IT BECOME WASTE DURING THE OPERATIONS OF SORTING, CLEANING, TREATMENT, ETC?

To avoid the regulatory implications related to the qualification of **waste**, it should be certain (and preferably planned) that the elements will be reused.. For example, if the material is reused on the same site, if it is reused on another site belonging to the same owner, or if it is transferred to another actor for future reuse. However, in circumstances where the material is considered waste because of circumstances such as abandonment, an error or a logistical process of treatment in several steps before reuse is certain, the elements are categorized as **«preparation for reuse»**. The material is initially classed as waste, but it recovers its product status as soon as reuse is guaranteed (Naval, 2021).

Reclamation materials can nevertheless go by operations of cleaning, sorting, treatment, cutting, etc, before being again used, without having the status of waste! In this document we have chosen to use the terms «preparation for reuse» to describe all the operations of sorting, cleaning, treatment, etc, without taking account of the product or waste status of the material.

According to their condition and type, **reclaimed wood elements** are liable to undergo various treatments before being reused. In general, specialised suppliers have the necessary expertise to carry out certain operations themselves, but it sometimes happens that wood is sold untreated and in its original condition. In such cases, the buyer has responsibility for the required treatments. (Rotor, 2021)

Here are some possible treatments:

■ **General:**

- Removal of metal elements: If not done during dismantling, nails, screws and other metal parts should be cleared using suitable tools such as pliers or pneumatic punch. This laborious operation is essential for preventing any damage of the machines used in later operations. A metal detector can be used to locate metal objects.



© Rotor DC

- Surface cleaning: This operation is done by brushing, sanding or sand blasting, as required. Each of these processes has a direct impact on the outer appearance of the planks.
- Sawing and cutting to length: Wood parts can be cut to specific length and widths. Damaged ends can be sawn.
- Removal of adhesive residues: According to the type of adhesive and the degree of adhesion, adhesive residues can be cleared using a planer or hand tools such as a plane or knife.

- Drying: The drying of wood depends on its moisture. In general, the drying of wood is done naturally in a hangar having suitable storage methods ensuring proper spacing of the planks, no contact with the ground and satisfactory ventilation and heating of the premises. In some cases, artificial oven drying will help reduce and stabilise the moisture.
- Repair: If necessary, wood pulp or epoxy resin can be used to repair cracks and minor holes, e.g. old joint holes. Mechanical interventions, like the addition of pieces and reinforcement, are also possible.
- Insecticide treatment: In the case of risk of woodworm infestation, the affected planks must be cleared away and the other pieces of the lot impregnated preventively. Different types of treatments, such as immersion, spraying, coating, autoclaving and heat treatment, can be used according to the standards and recommendations that apply to the species in question. It is recommended to call on a professional, especially if the wood in question has already been treated or already has a finish coating.
- Fire resistance: As necessary, planks are subject to a specific treatment to improve fire reaction performance. Finishing treatments that are sound and environmentally friendly should be used.
- Process for improving the durability of wood for exterior applications; the heat treatment of wood also risks having a harmful impact on its mechanical properties. This treatment is mainly applied to cladding elements.
- Finish: For the finish of these elements, they can be left in raw state or covered with a finishing coat (varnish, wax, oil, stain or paint), according to the planned application.

■ **Treatments specific to planks**

- Edge cleaning: Straight edges and grooves and tongues are liable to be encrusted with adhesive residues or with stubborn impurities. They should be cleaned carefully using wood chisels to avoid any complication with later fitting.
- Planing: This operation can be required to repair the wear layer, remove residues of adhesive or equalise planks with significant differences of thickness. Because of the diverse stresses suffered by slats of parquet over their life, some parts are liable to have more pronounced wear than others. If planing one or both sides helps to maintain constant thickness, allow for the tongue and

groove assembly of these planks to preserve their compatibility. After planing, the wear layer should have minimum thickness of at least 2.5 mm to provide the treated planks with a long lifetime and enable the execution of any renovation.

- Complete machining: This work includes sawing, planing and possible milling of the planks to adjust the tongue and groove assembly method or to realise chamfers. Planks that have undergone complete machining are usually considered «ready to fit».

■ Operations specific to fixtures

- Plenty of specialised dealers have a fixtures workshop enabling various operations on wood door leaves. These operations can include the following: correction or reduction of the dimensions of the leaves, retouching crosspieces, replacing damaged panels, surface repairs, new frame production, change of opening direction, application of rebate seal, edge smoothing, milling of hinge and lock openings, drilling of latch holes, etc. However, it is important note that elements in wood pressboard are not always suited to these operations.
- The replacement of fittings is not always easy. Replacing missing hinges is relatively easy, if complying with load specifications such as maximum weight per element, door width and number of elements per door. However, it is much more difficult to replace any original handle or lock that is missing or unusable. Nevertheless, some specialised dealers can repair these elements by using original pieces or copies of old models. The cost of such replacements depends on the quality of the fittings and equipment used. It is strongly recommended to conserve any defective element to facilitate replacement.

■ Operations specific to beams

- Classification of the wood: With the reuse of wooden beams for a structural application, it is important that the wood still satisfies the requirements of this new application. Section 6.c elaborates on how to deal with questions on the technical matters. A first visual examination already gives an idea of reuse potential as part of a new structural application. Factors like rot and insect infestation will affect the wood's structural integrity. Bowing a wood piece can reveal creep which makes it improper for any new structural application. Wooden beams subject to compressive forces on removal using a gripping tool will have a damaged fibrous structure and loss of strength. Finally, cracks, slots and holes from a previous application also add to the factors liable to affect the wood's bearing capacity.



FURTHER INFORMATION

The 36 material sheets developed under the FCRBE project describe further the techniques habitually used and best practices for the preparation for reuse of the materials. They are available using the following link: https://opalis.eu/sites/default/files/2022-02/FCRBE-All_sheets_merged-EN.pdf

The website reuse.brussels also describes in detail the different operations needed to prepare certain materials for reuse.



5.

What is done with reclaimed materials, or how to procure reuse materials?

There are several **possible destinations for materials reclaimed by contractors**. It is important to analyse the different possibilities to make sure, even before removal, that the materials will have a chance of finding a buyer. The reuse potential will only be confirmed (or overturned) if the product is effectively reused in a project! It is useful then to check for the existence of a demand (or to create the opportunity) for this material.

Materials can be reused on the same site, on other worksites of the same contractor or of the same project owner, resold to other contractors or individuals, resold to professional suppliers, given to associations, etc.

Similarly, these different sectors can be used by companies responsible for **procuring reuse materials**, as an alternative to new product dealers.

- **Professional suppliers**

Only in North West Europe are there more than a thousand companies specialized in the sale of reclaimed materials. They reclaim and offer different types of materials, from the oldest and specific to the more recent and standard. Some ensure careful conditioning

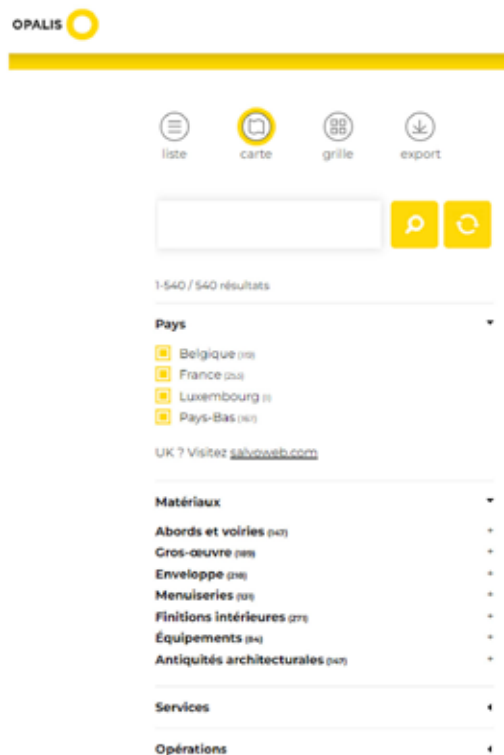
of the elements such that, for the contractor, their installation is not really different from a new product. Above all it is a matter of expanding one's address book and including local retailers! Some of these companies have online marketplaces, giving a quick idea of the materials they are selling.

Some professional suppliers carry out removal of the materials, while others accept taking on already removed materials. It is a matter of contacting these companies to discuss their conditions for acceptance: accordingly, they can take in materials freely, purchase them, or even offer a deposit-sale service.

The directories Opalis.eu⁵ and Salvoweb.com⁶ make it easy to find professional suppliers in one's region.

- **Lots reclaimed on site**

When buildings are to be renovated, converted or rebuilt, you can find materials liable to be reclaimed and reused in new arrangements, on the same site. In some cases, preparatory work may be necessary: cleaning of mortar remains, sizing, sorting of elements according to their dimensions or condition, etc. This work can be



⁵ <https://opalis.eu>

⁶ <https://www.salvoweb.com/salvo-directory>

Salvo directory

The world's best and most comprehensive architectural salvage directory online since 1995. Find your local salvage yard and specialist businesses dealing in architectural salvage - reclamation - decorative - garden - antiques plus craftspeople - reclamation friendly designers and architects.

1 000 results found in 33ms



3A Roofing Ltd



AB Reclamation Ltd



Abacus Stone Sales



REGIONS

Argentina
Australia
Austria
Belgium
Canada
China
Czech Republic
Denmark
Egypt
Estonia
Finland
France
Germany
Greece
Holland
Hungary
India
Ireland (Rep.)
Israel
Italy

done on the worksite, or elsewhere. The same goes for storage of the elements, according to the space available on the worksite.

■ Specific lots

In some cases, specific lots will be identified by the project owner and/or the architects to then be removed and reused in a given worksite. For example, this can be materials still installed to be removed in another building, or again materials which will have been purchased beforehand by the sponsor. These cases can be accompanied by specialized consultants and tailored approaches. Sometimes a temporary storage place will have to be defined.

■ Online ads and platforms

For some years, digital platforms announcing lots of reclamation materials (still in place or already removed) have been multiplying. They can provide a useful source of supply, but also a means for finding professional or private buyers.

Some of these platforms are pretty generalist, free to access and have a large audience, such as <https://www.zememain.be>, <https://www.marktplaats.nl>, etc. Others are more specific and only target construction materials. In general they have a more limited and specialized audience. They can be free or operate with a commission on sales.

Here are some examples of these platforms in Belgium, France and the Netherlands:

- The [page of the Plateforme des Acteurs du Réemploi in Brussels](#) : this Facebook page aims to be self-managed by its users.
- [Backacia](#), Paris: marketplace for reuse materials and equipment in the construction sector.
- [Cycle Up](#), Paris: a digital platform (sellers/buyers) for all actors of the building sector (project owners, contractors, architects, builders, demolishers, etc.).
- [Excess Materials Exchange](#), the Netherlands: digital market where companies can exchange their surplus materials.
- [Oogstkaart Markplaats](#), the Netherlands: web platform which makes reuse materials available for sale or purchase and targets companies of the construction and building sector

■ Partnerships

Sometimes, certain deconstruction and construction companies set up a collaboration aimed at circulating the construction materials deconstructed by one, to provide a source of materials for the other. This symbiosis allows them to have a better idea of the demand, and of the stock of materials becoming available.

■ Donations

When the materials have little value or when the stakeholders want to for different reasons, reclamation materials can be given away. Donations can be made via the various sectors listed below, and to organizations with social and/or environmental aims.

For example, in France, the site <https://donnons.org> enables donations of construction materials and other

things. In Belgium, the *Resources* federation makes available several collection points for construction materials in Brussels and Wallonia. The *Matériauthèque* of Tournai is on this list. It collects, removes (in certain special cases), stores and the sells reclamation materials at low prices.



Matériauthèque of Tournai, Belgium

© Buildwise

If demolition companies are interested in the deconstruction of certain materials, it is because of their reuse options. Mainly operating in Brussels and surroundings, the De Meuter company is an example of a demolition company heading towards reuse for many reasons. Sometimes, the reclamation of certain materials must be carried out separately, at the client's request. On other occasions, it's the demolition company that choose the reclaim materials, because of the very high cost of disposing of them in landfill sites. Moreover, the company gets compensation covering the removal and storage of certain removed materials. At the other end of the chain, many construction companies strive to reuse materials. Examples: Democo, a major Belgian general contractor, and HuisMus, a small Ghent region contractor. These two construction companies regularly collaborate with De Meuter. They have engaged in the removal and reuse of raised floors, plywood beams and insulation materials.

When De Meuter prepares a demolition, it sends photos of potentially reusable materials to its contacts in the construction world. Construction companies answer these notifications by showing their interest or not in the proposed materials. If these materials interest any of them, the parties concerned conclude various agreements covering any compensation and the assignment of liabilities regarding deconstruction and transport of the materials. These questions vary from one material to another. This recurring cooperation helps assess the interest these companies show more informally. The demolisher also has the assurance of developing a commercial niche and the construction companies are sure of disposing removed materials of quality. Finally, the demolisher has the guarantee that the materials will be reused and not abandoned in some depot.

Detail on the sale of reuse materials and CE marking

CE marking is a regulatory requirement to legitimize the marketing of many construction products in Europe, especially those for which there is a harmonized European standard (hEN). With the development of the market for reuse materials and the revision of the CPR (Construction Products Regulation), the question of extending this requirement or not to reuse materials is currently on the agenda. In the revision of the CPR, reuse products are explicitly included. You should keep up to date on the changes in this matter!

However, the Construction Products Regulation, in its current version, does not yet specify if reuse products have to follow or not the same rules as new construction products. The subject is currently left to the interpretation of the countries. Meanwhile, Belgium has chosen the following approach, based on different cases:

- **If there is a harmonized technical specification (hEN⁷ or EAD⁸)** that applies to the construction products in question, for a well-defined planned use, **and that the reuse product is sold for this planned use**. In this case, the CE marking and a declaration of performance should be required. However, it is still worth clarifying the situation for this case, because it seems complicated to apply all the content of the harmonized standards to the reuse products. Indeed, the evaluation methods included in the harmonized standards assume, in general, continuous mass production of many almost identical products. In general it will not be possible to assume that the same goes for reuse. The products often have deviations (for example, impurities, slight damage...) Moreover, the requirements related to the quality control procedures are generally suited to the controls performed during production and/or in a production installation, in plant. Of course, this is not always the case for reuse.

An ETE (European Technical Evaluation) has already been delivered for reuse bricks, on a voluntary basis. A harmonized standard already existed for these new products, but was considered non-applicable to reuse bricks.

- **When a harmonized technical specification (hEN or EAD) applies** to construction products for a defined planned use, but the reuse product is **sold for a different planned use**. In this case, CE marking / a DoP is not necessary. However, it is worth saying that this different planned use could also be an application covered by a harmonized standard, which leads back to the previous case.
- **When a harmonized technical specification (hEN or EAD) applies** to the construction products, but that **the reuse product is not sold**, but removed and used by the same contractor in another structure. In this case, CE marking / a DoP is not necessary.
- **When the construction product is not covered by a harmonized technical specification (hEN or EAD)**. In this case, the CPR does not apply and CE marking and a declaration of performance will not be requested.

⁷ These are harmonised standards for proving that products or services comply with the technical requirements of the corresponding European legislation. They describe the methods and criteria for evaluating the performance of construction products corresponding to their essential characteristics, and the control of production to be carried out in plant.

⁸ The European assessment document is a harmonised technical specification for products that are not covered or not fully covered by the harmonised standards.



The background is a photograph of a construction site, showing a large concrete structure under construction. A large, white, torn-paper-like shape is overlaid on the top half of the image, containing the text. The overall color palette is dominated by the orange and red tones of the construction site.

6.

How do you build with
reuse materials?

While it sometimes requires additional steps or research, each contractor is capable to reclaim or reuse building materials. As described in 5, the process for procuring materials has to be adapted. The call for tenders for the supply and use of the materials can also differ from a conventional call for tenders, whether in the form of the contract, or its contents. As mentioned in section 4, in some cases, preparation of the materials for reuse will be required, or deemed necessary. This section also covers frequently asked questions about the absence of data sheets, justification procedures for technical performance and questions on distribution of the resulting responsibilities. Advice for improving collaboration with all the construction actors is also given, before dealing with the question of construction in practice, as well as questions on time and cost for the supply and use of the reuse materials.

A. What are the key points when bidding to implement reuse materials?

Calls for tender for using reuse construction products can – and should – differ from calls for tender for using new products. Just as for new materials, there are different contract types and they have an influence on the contractor's role. However, they can differ by their content, which sometimes specify the additional operations required to enable reuse of the materials, and be adapted to the nature and constraints related to the reuse materials.

Types of contract

Just as for new materials, different contract types enable the use of reuse materials. They each have their specifics which can have an influence on the formulation of a reuse objective and its realization. They can be contracts of work, of Design & Build, contracts of acquisition of material lots, framework agreements of reuse directed work, or even of "reuse lots".

In practice, there are two scenarios:

- Either the contractor is responsible for the supply of the reuse material lots. They then have to procure it according to the technical clauses established by the project developers and the project owner.
- Or the lots are already present, because they are part of the original building, because they were removed in a previous work phase, or because the project owner already procured them on their side. In this case, the issues will then involve the use and any steps prior to this.



FURTHER INFORMATION

Reuse Toolkit – Procurement Strategies
Integrating reuse in large scale public projects and public procurements
https://www.nweurope.eu/media/16916/wpt3_d_2_2_procurement_strategies_20220208.pdf

This document, also produced under the Interreg FCRBE project, aims to provide tools to project owners and specifiers to help integrate material reuse in their construction and renovation projects.

Solutions of fallback, flexibility and alternatives

According to the types of material, provisioning in reuse products is not always ensured, whether for example because of unavailability of the target lot at the right time, or for damage caused during removal. So it will be important to check that the specifications provide for the possibility of using alternative products, whether other reuse material, or new material. These fallback solutions can take different forms:

- Mandatory or free technical options
- Unit price lists
- Re-examination or substitution clauses
- Variants
- Negotiating procedures

Technical specifications

Technical specifications for the supply and use of reuse elements should differ from those for new materials. Before offering a price, it can be useful to check that the specifications include no clauses contradicting the specifics of the reuse materials, and that all the operations required are clearly explained, otherwise it is necessary to request precisions from the specifier.

- As it is currently developed, the normative framework for construction materials describing how the technical performance of the materials have to be evaluated and declared is not always directly applicable to the case of reuse materials⁹. It will be useful to make sure that the technical specifications take account of this particularity and do not set requirements impossible to reach for reuse materials.
 - The clauses cannot require a **CE marking** for reuse materials as things stand. Indeed, today, apart from exceptions, reuse materials do not have CE marking¹⁰.
 - The clauses should also not require **classes of quality** which are not suited to the nature of the reuse materials, as well as **too specific characteristics**, unsuited to fluctuations of the offer of reuse materials. You should ensure that sufficient choice or room for movement have been left on the definition of certain (non-fundamental¹¹) characteristics of the materials, such as:
 - margins of tolerance (e.g. dimensions),
 - aesthetic and defect aspects,
 - variations of hues and colours,
 - ...
 - The **methods of use**, especially assemblies, appliances or modes of composition, should correspond with the qualities and specifics of the reuse materials.
 - In many cases, the way of justifying and evaluating the technical performance of new materials is not suited to the case of reuse materials. The specifications should be checked for this¹².
- It will also be useful to check that the **operations or results expected** by the specifier are clear.
 - Generally, in the case of a lot supplied by the project owner, the operations expected (especially preparation for reuse) will be specified, as the specifier knows the condition of the material. For

example, they will specify that cleaning or sorting have to be carried out, if not already done by another service provider¹³.

- For a lot that is to be supplied by the bidder, the bidder should ensure that the expected results are sufficiently described in the technical specifications; the operations to be carried out depend on the lots that will be selected on the market.

For instance, in the extract of CCTB 2023 (Standard Building Specifications) given below, certain characteristics have to be determined.

41.21 Wooden entrance doors

“For a door purposed to being reused, the door is sanded and receives plugging with paste. When profiles are deteriorated, this is repaired with paste, by injection, by replacement of part of the profile. In the absence of analysis of existing finishing products or description of the original finishes, requires protection measures including wearing PPE (suitable for toxic products) such as goggles, mask and protective gloves. Preparation of the worksite also includes separations and isolation to prevent the propagation of pre-treatment dust in other accessible areas of the construction.”

41.21.1a Wooden entrance doors

“Reuse:

It concerns demounted doors (by default) / ***

If the door comes from the same worksite, it is reconditioned via: process submitted to the project owner (by default) / replacement of seals / replacement and reinforcement of hardware / replacement of drainage devices (water evacuation) / ***

A test door is submitted to a test bench to achieve the following performance:

- The class of mechanical strength is : no required performance (by default) / M1 / M2 / M3 / M4 in compliance with [STS 53.1], §53.1.4.2.2
- The class of endurance is : no required performance (by default) / f1 / f2 / f3 / f4 / f5 / f6 / f7 / f8 according to [STS 53.1] §54.1.4.2.4
- Thermal insulation is < 1.5 W/m²K in compliance with [STS 53.1] §53.1.4.3.1

⁹ The question of justifying the technical performance of reuse materials is further developed in 6.c.

¹⁰ See section 5 for more information.

¹¹ The reuse materials must satisfy the same requirements as new materials for all regulatory requirements and/or related to user safety and health.

¹² The question of justifying the technical performance of reuse materials is further developed in 6.c. Our position is that while reuse materials must satisfy the same requirements (basic) as new materials, how to justify and declare their performance should be able to differ.

¹³ The operations of preparation for reuse are described in 4.

- The class of airtightness is : no required performance (by default) / L1 / L2 / L3 / L4 in compliance with [STS 53.1] §53.1.4.3.3”

24.24 Wood framework

Strength

(...)

The mechanical quality of woods is in conformity with the design assumptions. For reuse elements, this conformity is justified on the basis of [NBN B 16-520] or [NBN EN 14081 series] or another process to be validated by the project owner bases on the acceptability criteria of 02.42.1 Acceptability criteria.

Species & Quality of the wood

(...)

For reuse elements, the initial treatment is only considered if it has a fitness declaration . If the elements do not have this declaration, treatment by brushing, spraying or dipping is carried out on wood whose class of durability is not sufficient, according to whether it is reused in situ or not.

Traceability of materials

In order to prove the effective reuse character of the elements concerned, documents supplying information on the traceability of the materials can be requested from the contractor. These can be:

- Invoices from reuse material suppliers,
- Photos of the material in its original site (for reuse on site or from worksite to worksite),
- Information on any operations of preparation for reuse and reconditioning,
- ...

Information on different steps can also be requested from the contractor for technical justification of the materials:

- Information on the origin of the material and its initial application,
- Information on the conditions of transport and storage,
- Information on any tests of fitness for use the material has undergone
- Information on any operations of preparation for reuse and reconditioning,
- ...

The label «Truly Reclaimed» being developed by the organization Salvo Ltd. under the FCRBE project aims to attest that a product or lot of materials really comes from demolition work. Further information at trulyreclaimed.org.



FURTHER INFORMATION

In Belgium, some 70 clauses enabling the specification of certain reuse materials have been included in the CCTB 2022 (Cahier des Charges Type du Bâtiment), used for public contracts (and some private) in Wallonia. These leave the choice between new or reuse materials to the specifier, and have been adapted in their requirements to facilitate the reuse of materials.

batiments.wallonie.be/home/iframe-html.html

The Opalis website also makes available extracts of the specifications for certain materials.

opalis.eu/en/materials

B. How do you collaborate with subcontractors, architects and customers?

It is often shown that the key to success of innovative operations lies in good collaboration between all the actors involved. Construction with reuse materials, while common before industrialization of the production of construction materials, can now again be considered as innovative in relation to the current organization of the construction sector, mainly adjusted to using new materials. The definition of everyone's roles and responsibilities can sometimes change and so it will be necessary to ensure good communication with all the stakeholders.

Collaborating with the project authors and project owners

Some contract types like Design & Build or consortiums can facilitate reuse operations by getting the various construction actors round the table as early as possible, enabling upstream preparation and the search for solutions meeting everyone's concerns, whether technical, economic or administrative. However, it is also possible to ensure good collaboration as part of more conventional contracts.

As defined at the section's start, it is necessary, before offering a price, to make sure that the clauses defined by the project developers and the project owner are well suited to the particularities of the reuse materials, whether the definition of the nature and the scope of the work, the expected results, or the room for movement and possible alternatives. The responsibilities concerning justification of the technical performance should also be sufficiently defined¹⁴.

If the other stakeholders are open to discussion and if the type of contract allows it, the contractor can also forward their knowledge of the materials and practices in the field and make proposals, whether suggestions on the choice of reuse materials, more suited use techniques, or the production of a mock-up to ensure the expected result.

Collaborating with professional suppliers

It is useful to improve knowledge of the stocks and type of reuse materials present on the market by contacting professional retailers, when responding to a call for tender, and thereafter, or even beforehand, to ensure the availability of the materials long term. It is also possible to ask them to update on certain opportunities, related to reclamation of the materials wanted.

Suppliers can also provide a series of information important for good worksite preparation. They can state if the materials are ready to use and what services can be offered. They can also supply information on the nature and provenance of the materials, advice for implementation, and possibly say if they can provide guarantees for the materials.

Collaborating within the company or with subcontractors

It is important to make sure that actors in the field, whether company or subcontractor workers, know the specifics of the reuse materials to be installed. This can require making them aware of the importance of the circular economy and more particularly reuse, training on possible operations of preparation for reuse to be carried out, and specifics of storage, handling, or implementation, and the performance of tests or mock-ups to ensure that the expected result can be achieved and is well communicated to everyone.

In some cases it will be necessary to seek out specialists, or to get additional information about materials less well known in the company. For example, this can be marks different from those to which the workers are used/trained, old materials that require specific techniques, or old or unknown materials for which the accessories have to be replaced.

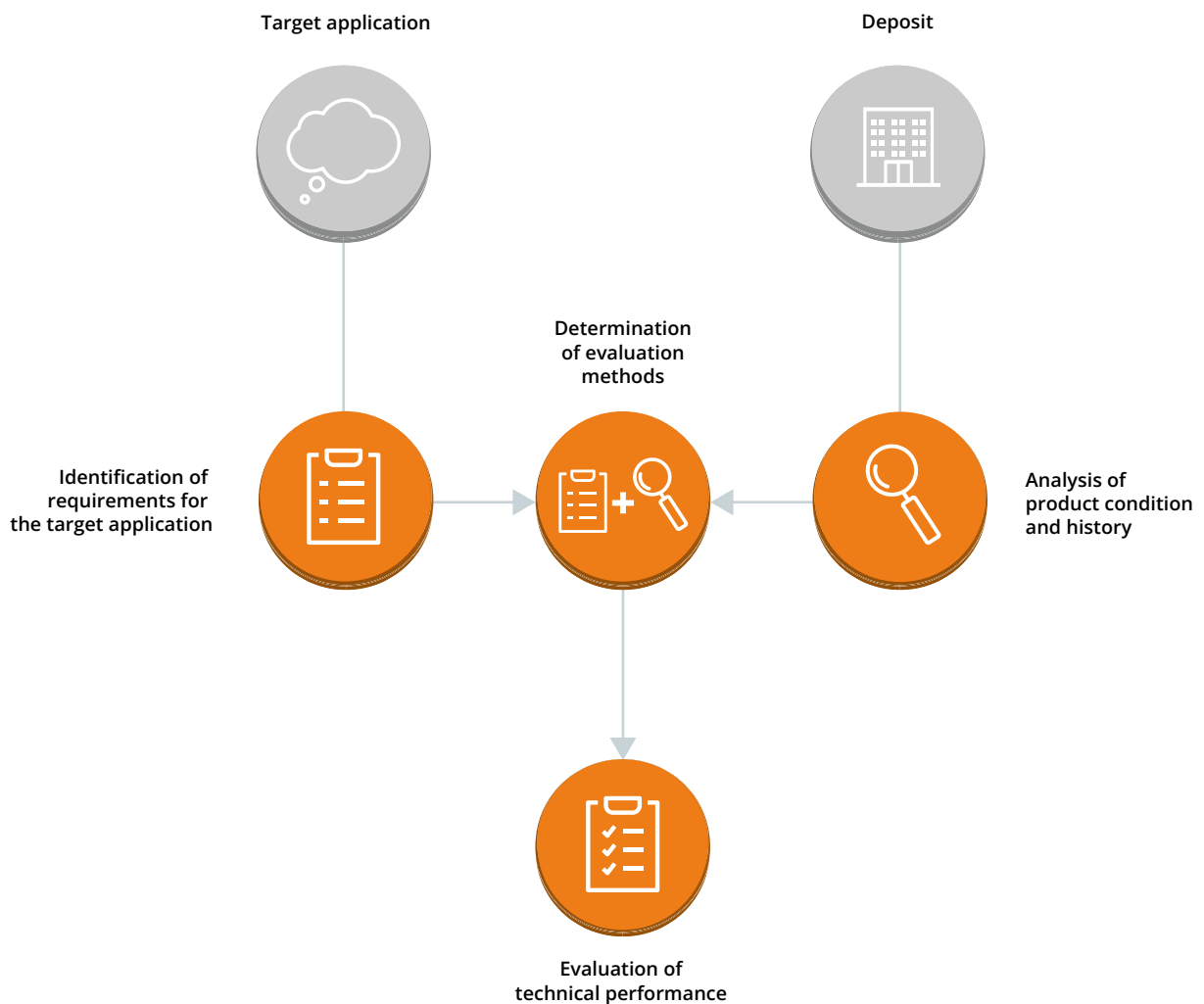
¹⁴ 6.d develops the question of responsibilities in justifying the technical performance of reuse -materials.

C. How is the technical performance of reuse materials justified?

One of the hindrances to the reuse of construction materials and components lies in the difficulty of justifying their technical performance. Unlike new products, reuse materials are not mass produced in a controlled environment and information about their properties is often lacking. However, they must have performance meeting the same regulatory requirements as new products to demonstrate their fitness for use. However, the way of measuring and declaring this performance should be able to differ. If construction actors have to put the same trust in reclamation products as new products, it is necessary to develop new methods for demonstrating their performance. It is also possible to increase trust in reuse actors through the development of certificates recognizing their knowhow.

Justifying technical performance based on a procedure related to the product

To counter the uncertainties related to the technical performance of the materials, a procedure for justifying it has been developed. Its aim is to propose different ways of evaluating and justifying the performance of reuse elements. It intends to be applicable to all cases (reuse in situ, supply from professional retailer or not, just-in-time reuse, etc.) and to all materials. There is a theoretical basis, for which certain evaluation methods have yet to be developed. The procedure is based on two concepts, the target application and the available material stock, and entails four steps.





FURTHER INFORMATION

The procedure summarised below is further developed in the following documents:

Under the FCRBE project, Buildwise and the CSTB issued a booklet describing a theoretical approach for justifying the technical performance of reuse materials: https://www.nweurope.eu/media/15541/bookletfcrbe-2_fitness_for_use.pdf

This procedure was also developed under the BBSM FEDER project (Bati Bruxellois Source de nouveaux Matériaux). It can be downloaded using the following link: www.bbsm.brussels/wp-content/uploads/2022/07/BBSM-WP6-Cadre-technique-des-materiaux-de-reemploi-VF.pdf and was summarised in this article: www.buildwise.be/fr/publications/articles-buildwise/2020-01.07

■ Identification of the requirements related to the target application

Like for new products, it is necessary to identify the future application of the reuse products, in order to define what requirements have to be satisfied. This application can be the same as or different from the initial application.

Two types of requirement related to the future application can be set:

- fundamental requirements, required legally and/or which are necessary so that the material is fit for the use it is intended for, given the health and safety of the persons concerned throughout the lifecycle of the structure. These are characteristics of mechanical strength and stability, reaction to fire, hygiene, health, environment and, as required, accessibility or acoustics.
- additional requirements, which are not fundamental and are specific to a project. They are determined according to the target application and/or the wishes of the project owner. For example, the dimensions or colour of a product or the wear resistance of a floor covering. According to the target usage, the project owner can be more tolerant about the requirement level of any additional performance.

■ Analysis of the condition and history of the products

As part of this procedure, a «deposit» is defined as a set of materials or elements found in a defined area and having characteristics and history in common. The concept of history is important in the reuse context of a material or component, in so far as it can have influenced its original characteristics. This step aims to bring together a maximum of information about the original product in place, and can be carried out at the time of the reuse inventory (i.e. preferably before removal).

The information collected:

- concerns the product as it is, its implementation and maintenance, and its initial application;
- can be documentary (issues of drawings, data sheets, specification, etc.), historical (year of construction, methods used, etc.) or visual;
- concern the initial characteristics of the products (likely to have been modified), or current characteristics.

Special attention should be paid to the traceability of the information gathered, so that it remains associated with the corresponding products during removal and the later steps.

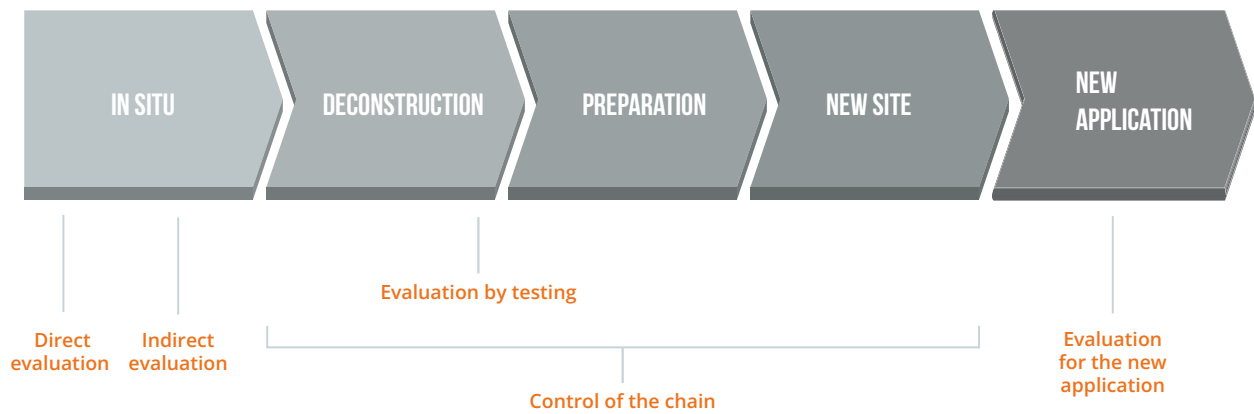
■ Determining the evaluation methods required

The list of requirements related to the target application is compared with the information collected about the products. The evaluation methods required are determined according to the level of detail required for performance evaluation (depending on the basic or additional nature of the requirements), the information available about the product, and the type of product.

It is also possible to define in this step other strategies to increase the level of trust in the products, if it is not possible to evaluate their performance sufficiently accurately. Design strategies (over-dimensioning, etc.), limitation of applications (less demanding applications), or an adapted business model (plan maintenance and replacement of materials as required) can be envisaged.

■ Evaluation of technical performance

Three main types of evaluation methods enabling verification of the technical performance of reuse materials have been defined: direct evaluation, indirect evaluation and evaluation through testing. Two innovative methods are also proposed to reinforce user trust in reuse materials: control of the chain, and evaluation during the new application. These different evaluation methods can offer different levels of trust, and can sometimes be combined. They can be performed at different times, when the product is still in place, during removal, preparation for reuse or storage, and when the product is reinstalled.



■ **Direct evaluation**

If the performance wanted can be checked visually or via non-destructive technical means, it can be directly validated, when the product is still in place, or when it is removed. This is the actual performance of the material.

■ **Indirect evaluation**

Some performance can be evaluated from information related to the initial or historical performance of the product which was collected during the documentary inventory. It can either be justified, or be gathered from the sheets or other technical documents, always considering the historic data collected.

■ **Evaluation through testing**

As for new products, tests sometimes have to be performed on reuse materials. However, the following two points should be noted. Firstly, standards for new products often describe test methods aimed at evaluating their technical performance. However, the proposed methods are not always suited to reuse products and have to be adapted. Then, the application of a different statistical approach is sometimes required, since the test protocols are based on standardized production and not on a deposit.

■ **Control of the chain**

In addition to product evaluation, control of the chain for reclamation, preparation and reuse can also be considered. The accent is then no longer placed on precise performance evaluation of the products, but on the procedures and skills that enable their reliability throughout the operations of preparation for reuse to be increased. In this way, elements whose performance is likely not to reach the level of requirement demanded can be eliminated during the control process by a practitioner who has the knowledge and experience needed to eliminate defective elements.

■ **Evaluation during the new application**

With the project owner’s agreement, some requirements can be evaluated once the product is implemented. For example, the homogeneity of the colour of reused carpet slabs can be evaluated after they have been laid on their new site. However, this method is riskier, because the product may not suit the project owner so that the process has to restart.

This procedure, still in the theoretical stage, however, provides a framework for thinking for developing methods of performance justification suited to reuse materials.

Relying on certificates to increase trust among reuse actors

Another approach consists not in evaluating the product itself, but in recognizing the skills of the actors responsible for the operations of removal, treatment and storage of the reuse materials.

In Belgium, the control office SECO has developed the “Safety In Circularity” certificate, which aims to increase trust in the ability of reclamation actors to offer reliable reuse materials. This certificate aims to “supply proof that the company which the project owner, architects and contractors are collaborating with controls the internal processes related to reclamation and re-marketing of construction materials. This certificate also recognizes the company’s ability to declare information reliable for the materials concerned.¹⁴” The certificate is broken down by typologies of materials, currently taps, sanitary fittings, technical sub-floors and guard rails.

¹⁵ www.safetyincircularity.be

In this section, we describe certain points of attention and recurring subjects. This document does not describe all the requirements and methods of evaluation, which are detailed further in the documents referenced in the box at the section end.

In the above procedure, distinction should be made between the basic requirements and the additional requirements. Requirements relative to user health and safety are an important part of the basic requirements.

Different requirements and regulations apply to products, chemical components and **volatile organic compounds (VOC)**¹⁶. While VOC emissions from the wood itself are minimal, prior treatment using products containing them cannot be excluded. These products aim to preserve the wood, by coating it with a fireproofing product, etc. VOC emissions usually reduce over time.

In the case of normal interior applications, wood is rarely treated with preservatives. However, for certain specific applications, the risk of the presence of dangerous substances is higher. You should remain vigilant. If the wood elements come from exterior applications and if they previously had insufficient natural durability (mainly resinous wood), it is very likely they would have been treated.

While these operations are carried out with suitable protective equipment, the sanding and planing of wood allow any finishing products to be partially removed, except for oils and polish. Floor coverings treated using fireproofing products must be covered with a film of finish (like varnish) to prevent any direct contact with the

skin and mucous membranes. Some types of coating, such as alkyd resin varnish, can reduce emissions of formaldehyde. However, the application of some finishing products (such as amino lacquers or adhesives) risks increasing emissions.

Apart from the basic health and safety requirements, the parties concerned are liable to impose certain requirements for stability and mechanical strength, dimensional tolerances, etc. Various additional requirements should also be allowed for. These requirements can cover the type, shape, dimensions, any finishes, moisture, etc.

Many other requirements and evaluation methods can apply to these materials and are not listed in this document.



FURTHER INFORMATION

The procedure developed under the BBSM Feder project was applied to solid wood floors: www.bbsm.brussels/wp-content/uploads/2022/07/BBSM-WP6-Fiche-produit-application-Parquet-en-bois-massif-de-reemploi-VF.pdf

Different guides, including three on industrialised wood frameworks, on exterior wood fixtures, and on floors, have been published by the CSTB, describing the different steps of a reuse diagnosis, including identification of the performances to be evaluated according to the use field and the associated methods of proof.

- Industrialised wooden framework: www.cstb.fr/assets/documents/cstb-guide-reemploi-des-charpentes-industrialisees.pdf
- Exterior wood fittings : www.cstb.fr/assets/documents/cstb-guide-reemploi-des-menuiseries-bois-exterieures.pdf
- Floor : www.cstb.fr/assets/documents/cstb-guide-reemploi-de-parquets.pdf

The 36 material sheets developed under the FCRBE project list the technical characteristics established in the European standards corresponding to these materials. They are available using the following link: https://opalis.eu/sites/default/files/2022-02/FCRBE-All_sheets_merged-EN.pdf

¹⁶ For example, European standards and directives restricting emissions of formaldehyde and the use of certain harmful substances in the production of wood floor coverings. The REACH regulation imposes certain restrictions on the presence of dangerous substances in construction materials, while the directive on wood preservation restricts the use of pesticides. In Belgium, the Royal Decree sets several emission thresholds for VOC in interior -spaces.

D. Who takes responsibility for technical performance?

When a **new** product is integrated into a construction project, several stakeholders, such as the project owner, architect, contractor and the manufacturer or supplier of the product perform well-defined actions to comply with the national standards and regulations in force. Their responsibilities concerning justification of the technical performance are well defined. In particular, the manufacturer or supplier must provide accurate information in the data sheets, to guarantee conformity with the planned use and to signal any hidden defects.

For the **reuse** of construction materials, the situation is changing. Professional suppliers of reuse materials will not always be involved, and in this case, they rarely communicate and guarantee the technical performance of these materials. They may guarantee visual consistency and certain aesthetic characteristics. Other actors then will be responsible for the performance justification of reuse materials.

Who is responsible for the technical justification of reuse materials?

As described in 6.c, a whole series of actions, undertaken by various stakeholders, including contractors, are liable to have an influence on the process and results of the justification of technical performance, especially:

- Carrying out pre-demolition and reuse inventories
 - Collecting relevant visual, documentary, historical data
- Removal
 - Technical specifications describing the expected results and any removal methods
 - The removal itself, in a selective manner and according to appropriate methods (to conserve the properties of the material)
- Sorting, selecting materials
 - Technical specifications describing the expected results and any processes
 - Sorting and selecting the materials themselves
- Cleaning, preparing for reuse, conditioning, storage, transport
 - Any technical specifications describing the methods, conditions or expected results
 - Carrying out these operations themselves, performed appropriately (to conserve the properties of the material)
- Monitoring the evaluation procedures of technical performance
 - The proposal or specifications for the evaluation procedures of technical performance

- Giving advice on the proposed procedures
- Evaluation of performance itself (different possible methods, see 6.c)
- Implementation of the materials
 - Technical specifications describing the technical requirements, and implementation methods
 - Any design strategies and risk management
 - Selection of the materials meeting the technical requirements
 - Installation itself
- Traceability and transfer of the information collected during the different steps mentioned above

These tasks, depending on the project, may sometimes be carried out by different actors. In some cases, other specialists may be involved, such as reuse auditors or reuse experts, who may also have a role in performance justification. The scheme below illustrates at which point the related tasks and responsibilities can be distributed variably according to projects. It will then be important that the roles are well defined for each actor so that the responsibilities are clearly identified.

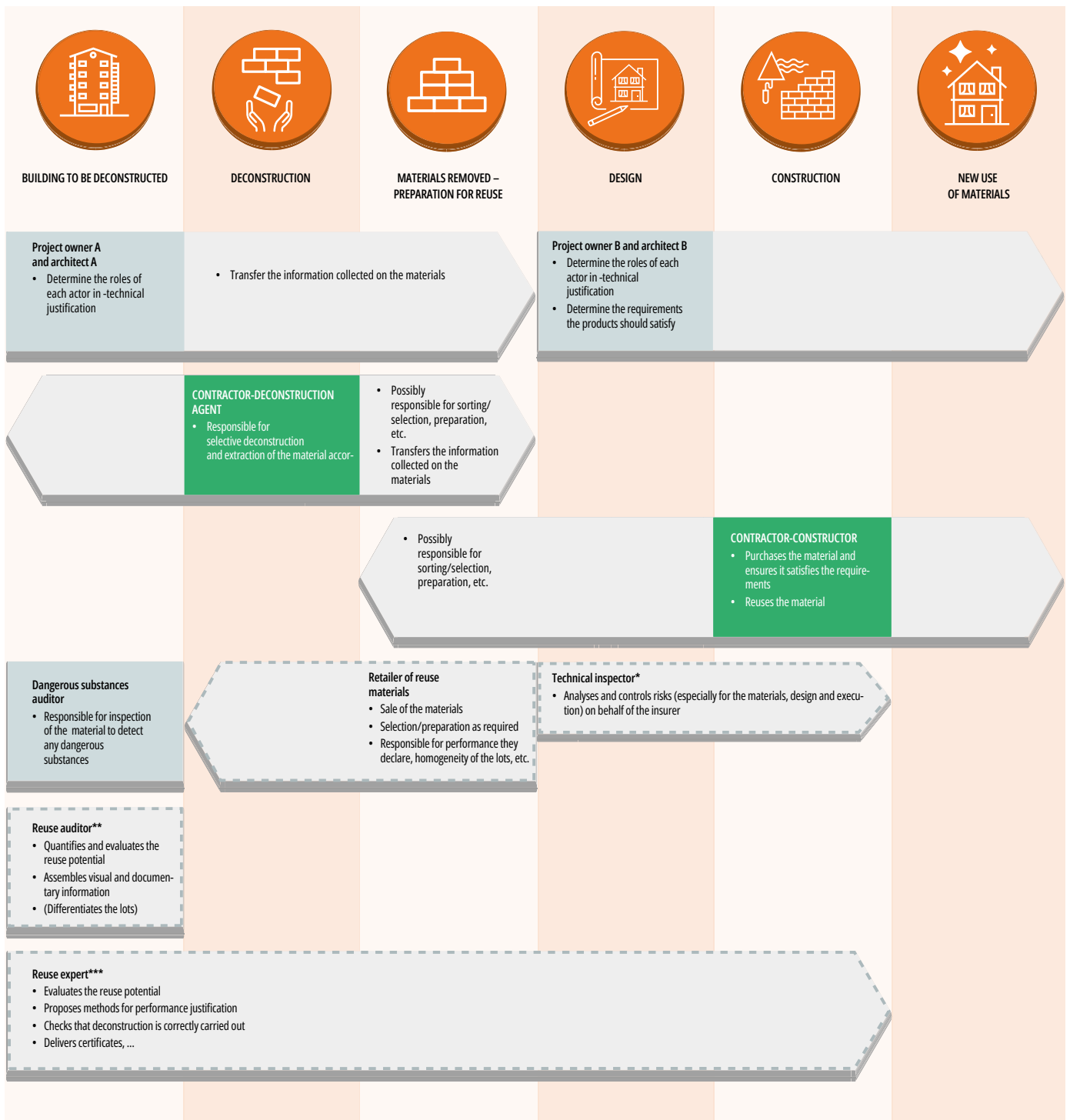
(See chart on next page.)

Managing risks and insuring the reused materials

Insurability is sometimes considered one of the main brakes to the reuse of construction materials, as this practice is still little developed and the quality framework is not yet adapted. Several types of insurance can be concerned when the insurance of reuse materials or related work is required. For example, this can be insurance for professional liability, decennial liability, control, worksite all-risks, or fire (Heirbaut & Van Dyck, 2023). Contractors are expected to be insured for their decennial liability. Several actions can be set up to remove the obstacle of insurability and have reuse practices insured as required.

■ Understanding the methods of one's insurance and talking to one's insurer

Each insurance policy includes conditions or exclusions. It is important for contractors to be informed about the methods of their insurance, because certain stakeholders may not be insured or not know their cover. (FCRBE, 2022). Talking to insurers and brokers is essential, and, while the premiums sometimes have to be adjusted for the practices considered as risky, it is often possible to negotiate the insurance conditions. Indeed, if the insurer is not informed and damage appears, this can result in partial or total loss of cover and rejection of the liabilities for the insured.



Roles and responsibility during the process of technical justification of the reuse materials

LEGEND:

On light grey ground: Stakeholders not necessarily involved in the process

On dark grey and green ground: Stakeholders generally involved in the process

* According to country, the missions of technical inspectors can vary:

In France, some building types must be submitted to technical inspection to ensure their quality and strength. By taking part in the analysis and control of the risks, they facilitate insurability for complex cases (especially reuse).

In Belgium, insurers can require an independent inspection performed by a control office. Other mission types can also be entrusted (especially by POs) to control offices (such as missions of certification, technical inspection and advice), some of which are given under this diagram in the "Reuse expert" boxes.

** In France, since 1 January 2023, significant building demolition and renovation operations are subject to the requirement for a diagnosis (inventory) called PEMD (products-equipment-materials -waste), enabling the PO to know the potential for reuse, recycling or other valorisation of the building. The diagnosis agent can be led to specify or at least propose specification possibilities for the reuse materials, which requires decennial insurance.

***Reuse expertise is still a function being developed. This function can go to design offices, architects, or control offices (in some countries) being specialised in the technical justification of reuse materials, or other actors emerging on the market and proposing suitable services.

Identifying the risks

The project team should identify the risks related to the reuse practice, which can be done by referring to a general quality framework (if available), and by involving other professionals in construction, such as project owners, architects, design offices, inspection offices¹⁷, contractors, research organizations, knowledge centres, etc (Heirbaut & Van Dyck, 2023).

■ Managing risks

According to the identification of the risks incurred by the construction team, the project team can then decide if it is necessary or not (if not things for which insurance is mandatory) to take an insurance for the reuse practice in question, according to the risk management strategies set up (FCRBE, 2022), (Heirbaut & Van Dyck, 2023). There are several approaches according to the perceived risks:

- Coverage of the risks by the project owner, who finds them acceptable. An insurance is not taken (if not mandatory).
- Delegation of the risks to the contractor, to a subcontractor of the contractor, or to a supplier, who accepts bearing the risk, by means of additional guarantees (e.g. materials will be replaced if defective). An insurance policy is not taken out (if not mandatory).
- Resolution of the risks by adapted design (for example by adapted design or by evaluating performance). An expert or another stakeholder may be asked to take on part of the liability.
- Negotiation with the insurer to modify the terms of the insurance (negotiation of the premiums). A control office will monitor the elements.
- The choice of an alternative which does not have an insurability problem.

■ Controlling the risks

The insurer's main concern is to identify whether the risks are controlled by the project actors and what are the financial issues. This will enable validation of whether the reuse practices can or cannot be insured, and under what conditions. They will be receptive to different ways of ensuring the quality of the reuse practice (Heirbaut & Van Dyck, 2023):

- Satisfying a general quality framework (if available), such as standards, technical approval, quality labels, technical specifications, quality certificates.
- Satisfying an external quality framework, such as evaluation by an expert, a certification organization or a control office¹⁸, evaluation through test reports performed in accredited labs, etc.
- Satisfying an internal quality framework, by proving internal knowledge and skills, or by demonstrating that processes are set up to reduce the risks.



FURTHER INFORMATION

As part of the Interreg FCRBE project, a booklet has been produced on evaluating the technical performance of materials. It covers the subject of responsibilities for the technical justification of materials: https://www.nweurope.eu/media/15541/bookletfcrbe-2_fitness_for_use.pdf

The subject of insurance has been further developed as part of the FCRBE project. The results of this study are available on the website of the Interreg FCRBE project : <https://www.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe>

Seco Belgium nv/as and the advice bureau Common Ground have published a research report on the insurance of circular constructions, with the support of Vlaanderen Circulair:

<https://www.common-ground.eu/wp-content/uploads/2023/02/20230216-VlaanderenCirculair-eindrapport-WEB.pdf> (only in Dutch).

^{17, 18}

As indicated in 6.c, the definition of the role that control offices can take may vary according to countries.

E. How do you build with reuse materials in practice?

After their preparation and reconditioning (see 4), most reuse materials can be implemented in ways generally similar to new materials, thus requiring the same skills from contractors. However, it should be noted that in some specific cases, their installation can require special knowhow and require certain specific precautions. In general, you should refer to European and national standards for the products and to best practices in force (or installation standards).

Firstly, it is crucial to check that the elements intended for reuse have been **correctly prepared**, that they are in **good condition** and that a **margin of additional materials** has been planned. It will be necessary to plan for sufficient surplus of reuse materials, even more so if the supplier is not able to guarantee absolute homogeneity or good condition of the lots. This surplus must also be planned for any cutting out (as for new materials), and to ensure later replacement or repair of some parts.

Some old materials can require **techniques or knowhow** that are not always current among artisans of the construction sector. In these cases, it can be necessary to involve specialists or to train personnel in the field. Additionally, **compatibility** between the reuse materials and the other construction elements can also raise issues. In some situations, it can be necessary to adapt the other materials for good overall compatibility.

The use of unusual materials, specific brands or for which information is missing can also require **awareness, training or the development of new skills**. For example, some professionals can be used to working with specific brands and then have to be trained to install the products of other brands. It is also possible that installation manuals are missing, which can require **preliminary research**.

It can be necessary **to adapt the methods of use** to take account of the particularities related to reusing materials, especially because of some uncertainty about their characteristics, such as less precise dimensions or greater tolerances than those for new materials.

Finally, as far as possible, it is recommended **to plan for the removability** of elements during construction, which will facilitate their later reuse.

Moreover, the direct reuse of wood without having to work it to a precise thickness enabled serious labour savings. However, the carpenters have to be more wary of cuttings when sawing the beams to length.

HOUSE LOCATED IN BOEKHOUTE (BE)

To build a house in a timber frame construction, the parties concerned decided to employ reuse materials as much as possible. To build the exterior walls, the parties chose to fit reclaimed planks and plywood joists. After determining the dimensions required by the engineer, the contractor sought out wooden elements to satisfy these requirements. For the walls, the contractor found slightly thicker wood planks. The dimensions of the plywood joists were also slightly larger than those required for the project. The use of reclaimed beams with just larger dimensions meant integrating an additional safety factor that the engineer accepted.

To increase the chances of finding the offer available on the market, one idea is to accept different lots of tiles or carpet slabs to distribute them in an organised way in the building, or, to make a patchwork in some spaces. Of course this should not harm the overall performance, and you should check that all the lots satisfy the technical requirements and have similar characteristics.



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7.

How are the costs of reclamation and construction with reuse materials estimated?

It is often heard said that deconstructing rather than demolishing, or constructing with reuse materials rather than with new materials costs more. However this is not always the case. Clearly this depends on the types of materials, and on many other factors.

You should, to offer a correct price for a call for tenders, or to propose a reuse alternative to a project owner, carry out a cost/benefit analysis of the reuse.

For this you should clarify what steps have to be carried out by the company. For example, will it be necessary to prepare the materials for reuse or will this be done by the supplier? It is also important to compare comparable things,

especially for construction with reuse materials, allowing for example the quality of the materials and the patrimonial value. Thus, it is not relevant to compare the costs of solid oak reuse parquet with those of new glue-down parquet.

In the case of purchasing materials from a supplier, or for reselling materials after deconstruction, it is generally the **cost of the supply** (or the **profit related to the sale**) that will be the main factor to tip the balance. The price of reuse materials on the professional market can differ somewhat from the price of new materials. Reuse materials are not a watertight category. There are several cases:

POINT OF COMPARISON: CURRENT NEW MATERIAL	EXAMPLES	CONSEQUENCE FOR REUSE
No current equivalent	Old materials, rare or depleted materials, materials with high cultural value...	The prices of reuse elements on the market tend to be high.
New equivalent rather expensive	Technical equipment, high-performance materials, top end materials...	The price of reuse elements on the market is often comparatively less expensive (but additional steps may be necessary before implementation).
Cheap new equivalent	Low level materials, mass produced industrial materials...	The reuse elements are generally more expensive and not competitive (except special cases).

Le coût de la fourniture ou le bénéfice réalisé à la vente n'est cependant pas le seul facteur à prendre en compte lors de la réalisation d'une analyse coûts/bénéfices d'une opération

de réemploi. Les pages suivantes comportent une liste non exhaustive de critères à considérer.

The general costs and benefits from removal to reuse

COSTS

Labour (specialized)

In some cases, removal, preparation or installation of reuse materials (specific or old, for example) can require specialized skills or knowledge from contractors. This can entail extra costs related to training or the subcontracting of qualified personnel. Some project owners themselves require these costs to be estimated, by asking for separate prices for the supply and fitting, in order to identify any substitutions during the work (e.g. a lot of new materials replaced by reuse). This enables greater transparency between companies and their customers.

Adaptation of processes and practices

Whether careful removal, preparation for reuse or construction with reuse materials, these operations can require adjustments in the processes and practices of construction and demolition companies. This can include changes in the planning, coordination, logistics and even the practices of deconstruction and implementation. The adaptation of these processes can entail extra costs, such as consultation expenses to optimize the processes or adjustments of existing work methods. Research and tests about methods of removal, preparation or implementation adapted to the materials can also be necessary.

Additional logistics

The costs related to logistics sometimes have to be paid by the contractor company, if it is responsible for storage and transport. These costs vary according to the types of elements (dimensions, fragility, etc.). If the materials do not immediately find a buyer after their removal, or if they are acquired before construction, (e.g. if an opportunity occurs) it can be necessary for the contractor to store them. This can lead to extra costs related to the transport and hiring or storage places.

Justification of the technical quality of materials

Before implementing reuse materials, it is sometimes necessary to justify their technical performance, to match the requirements of the specifications and to ensure the reliability and durability of the materials. Some evaluation requires few means, while others can be more costly, like the performance of lab tests. It can also be necessary to engage a reuse expert, a design or control office to specify the procedures to follow. Justification is generally required at the time of construction, but some steps and information can (and should ideally) be required when removing and preparing for reuse.

Traceability requirements

Some proofs of origin of the materials, and the steps they employ can be required from the contractor, for different steps (reclamation of materials or supply of reuse materials). Administrative work then has to be carried out to gather these proofs.

BENEFITS

Development of skills

Working with reuse materials can require specific skills for the reclamation, preparation, evaluation and installation of these materials. By encouraging workers to acquire these skills, the company can gain several advantages:

- opening to commercial opportunities in the future.
- acquiring a competitive advantage in calls for tender that value relevant experience or which set reclamation and reuse targets.
- anticipating regulatory changes which increasingly stress circular practices.

Service diversification

The experience and skills acquired can allow a company to diversify its services. It can be able to offer solutions for deconstruction, renovation and/or durable construction, give advice about the reuse of materials or even position as an expert in the field of durable construction. This can lead to new sources of revenues and to competitive differentiation on the market.

Company image valorization

Durable environmentally-friendly construction is increasingly valued by customers and consumers. By opting for reuse materials, a (de) construction company can improve its image as a socially responsible company. This can attract customers sensitive to these values and new projects.

Costs and benefits specifically linked to careful disposal

COSTS	BENEFITS
<p>Identification of the reuse potential and searching for buyers If the reclamation of the materials is at the initiative of the contractor, they will have to evaluate whether the elements have a potential for reuse, and resale (if targeted). Then it will be necessary to produce a reuse inventory and consult the reuse market to find buyers. This can entail additional costs related to the time spent on these activities.</p> <p>Removal time and labour The reclamation of reuse materials can require more time and labour than conventional demolition. You must proceed with care to remove and reclaim materials without damage. This can entail additional costs for labour and project planning.</p>	<p>Sale of reclaimed materials In the case of selling reclamation materials, if the materials belong to the contractor responsible for their removal, they can get the benefits from selling off the materials. Some can be sold to specialised suppliers, to project owners or other companies. The sale price will vary according to many factors, in particular market demand.</p> <p>Reduction of waste management costs By removing and reclaiming materials, the company reduces the amount of waste produced, which can result in substantial savings in the costs of waste management.</p>

Costs and benefits specifically linked to preparation for reuse

COSTS	BENEFITS
<p>Sorting and preparation for reuse Before being reused, reuse materials must be sorted, cleaned and possibly repaired, treated or reconditioned. Sometimes, it is necessary to search for or produce missing or worn components. These activities can entail additional costs for labour, equipment and time. They will be either in the charge of the company doing the removal and resale, or in the charge of the company doing the construction.</p>	<p>Value of the work According to the circular economy model, the value produced is no longer just linked to the resale value but more to the impact on the management of resources and the work carried out. So it is possible to find benefits by anticipating circular models where it is no longer the extraction of materials producing goods which creates prosperity, but rather the work used to conserve existing goods.</p>

Costs and benefits specifically linked to construction with reuse materials

COSTS

Searching for materials and coordination

Searching for and locating reuse materials can take time and require additional efforts. This can produce indirect costs such as extra work hours, watching to remain aware of the arrival of lots on the market, travel costs or consultation with specialists to find the required materials.

Adjustments and adaptations of materials

Reuse materials can require adjustments or adaptations to integrate them correctly in the project. Even after having been prepared for reuse, some types of material can require additional adjustments, such as cutting, modifications or adjustments to ensure their compatibility with the other construction elements, which differs from certain new materials that can be ordered "tailor-made". This work can affect the time required for implementation.

Insurance and liability

When reuse materials are being used in construction, there can be additional considerations in terms of insurance and liability. Insurers can evaluate differently the risks related to using these materials, which can entail higher premiums or specific requirements for insurance coverage.

BENEFITS

Reduction of procurement costs

In some cases, reuse materials can be obtained at lesser cost from specialised suppliers. If the materials are obtained from another worksite, the balance can also be more interesting than purchasing new materials (to be calculated according to the costs-benefits related to removal and preparation for reuse).

In the case of reuse in situ, the procurement costs can even be considered as zero.

Reduction of transport costs

Reuse generally makes no sense (environmental and economic) unless it is carried out at local level. Reuse materials are often available locally, which reduces the transport costs associated with procuring new materials. This can produce extra savings, in more isolated regions or large-scale projects requiring a large amount of materials.

Reduction of long-term maintenance costs

If the company is also responsible for maintenance of the materials, it can also gain benefits at this level. Certain high-quality reuse materials can also be durable, even more durable, than some new materials. By using quality reuse materials, a construction company can reduce long term maintenance costs, because these materials have already been proven in terms of resistance and durability. This can produce significant savings by avoiding or reducing frequent repairs or early replacement of materials.

Other factors influencing the cost

Other factors will also have an influence on the company's costs and benefits:

- The presence of very specific requirements, or inversely of **allowed flexibility** in the clauses, can affect the difficulty or not of procuring reuse materials, or to remove and sort them.
- **The size of the lots** of materials can have an impact on the costs. On the one hand, large quantities can allow the contractor to save time thanks to economies of scale on a series of tasks. On the other hand, this can be a challenge for the company which has to procure homogeneous lots of materials.
- **The company's experience** in reuse material can affect the related costs. A company which is starting in reuse must devote more resources to finding best practices, to training and coordination, unlike an experienced company which also benefits from a well-established network. It should be noted that the time required in

the first experiences of reuse do not necessarily reflect the time required afterwards. As the company acquires experience and develops its skills and networks, the processes become more efficient, thus reducing the related times and costs.

- **The potential for future replicability**, which depends on the type of operation and the material concerned, can motivate a company to invest time and resources.

Detailed analysis of the benefits and costs specific to each project is therefore essential for making an informed decision on reclamation and construction with reuse materials and making a correct price offer. This estimate can be refined as the company acquires experience.

- The analysis of a selective sample (2019-2021) of the reuse market in Western Europe (Belgium, France, the UK and the Netherlands) has allowed certain indicative prices to be determined. These prices vary according to the model, condition and quantities required.
- For beams, reuse material dealers generally prefer pieces from 2.4 to 2.8 m long because they are easier to find. Lengths larger than 4 m often entail invoicing with additional cost. Their finish (planed or not) also risks influencing the price.

- For planks, some finishes like their rendering or not risk influencing their price. Also their length and moisture play a role.
- For fixtures, their cleaning or not (pickling), type (solid, hollow) and aesthetic properties are the main influencing factors. (Rotor, 2021)
- To make an estimate of the price of elements not listed below or to obtain more recent prices, the reuse markets on line can be consulted.

TYPE	ESTIMATED PRICE
Crosspieces 60 x 160 mm	3.5 €/ml
Crosspieces 80 x 240 mm	8.5 €/m
Resinous wood crosspieces (60 x 160 to 80 x 200 mm)	4 to 10 €/m
Old spruce framework beams	560 €/m ³
Old pine beams	350 €/m ³
Old oak beams	700 to 2.350 kg/m ³
North American barnwood: Oak planks	80 to 170 €/m ²
North American barnwood: Resin wood planks	80 €/m ²
European barnwood Oak planks	65 to 110 €/m ²
European barnwood Resinous wood planks	35 to 100 €/m ²
Wood fire doors	50 to 70 €/piece
Wood panel door: With single panel	30 to 60 €/piece
Wood panel door: Panels from start of 20 th c	100 to 200 €/piece

8.

Conclusions



Reclamation or construction with reuse materials requires an adaptation of the practices of construction companies. Several key points can facilitate this transition:

Reuse of materials often requires a longer **a period of preparation**, mainly related to the search for buyers or suppliers and longer deconstruction times. It is essential to allow this in the planning and to prepare the various steps in advance.

Several actors can intervene between removal and construction and **the responsibility** of the contractors can vary. It is a matter of checking that the mission entrusted to one's company has been clearly defined by the project owner and being aware of the various implications, such as logistical issues, preparation for reuse or verification of fitness for use.

Good collaboration between the various actors involved will greatly facilitate the operations. It is essential to establish solid partnerships and to favour early open communication between the stakeholders. This helps to share knowledge, identify best practices and solve any problems collectively. With experience, the company can create its network with other reuse actors: professional suppliers, and other construction or demolition companies. This will especially facilitate the sale or search for materials.

While this can require initial time and effort, it is important to consider the reuse of materials as an **investment for the company's future**, given the coming regulatory changes. It is crucial to learn from one's own experiences, and to contact other actors of the field who can provide their assistance and services.

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