

Interreg 
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FCRBE

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**REUSE IN PRACTICE:
FROM DECONSTRUCTION
TO IMPLEMENTATION**



**GUIDE FOR
INFRASTRUCTURE COMPANIES**

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 specialised 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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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?	14
a. How can you be sure that reclaimed materials will be reused?	15
b. What are the key points when bidding for the reclamation of construction materials?	20
c. How do you collaborate with subcontractors, architects and customers?	24
d. How can construction materials be reclaimed?	25
4. How are materials prepared for reuse?	30
5. What is done with reclaimed materials, or how to get supplies of reuse materials?	34
6. How do you build with reuse materials?	40
a. What are the key points when bidding to implement reuse materials?	41
b. How do you collaborate with subcontractors, architects and customers?	44
c. How is the technical performance of reuse materials justified?	46
d. Who takes responsibility for technical performance?	50
e. How do you build with reuse materials in practice?	54
7. How are the costs of reclamation and construction with reuse materials estimated?	56
8. Conclusions	64
Bibliography	67
Annex	68



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.

The global economy is generally having larger fluctuations, with an increasingly significant range of variation. Every factor of stability should be analysed as a priority as part of a company's strategy. It is no longer a question of performing economically, i.e. being the best by investing the energy or available resources. This is no longer the primary characteristic of a company's longevity. Today, given the economic context, it is robustness and resilience that are emphasized by companies of the future. The companies that can demonstrate these characteristics will know how to reassure investors, raise enough capital to adapt, manage the influx of energy to continue their operations.

Faced with these changes and their understanding, both public authorities and building owners and developers will formulate new requirements for carrying out the construction works. Among them, the principles of the circular economy will feature prominently.

...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 designed*¹. *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 "Waste" Framework Directive 2008/98/EC [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 contractors

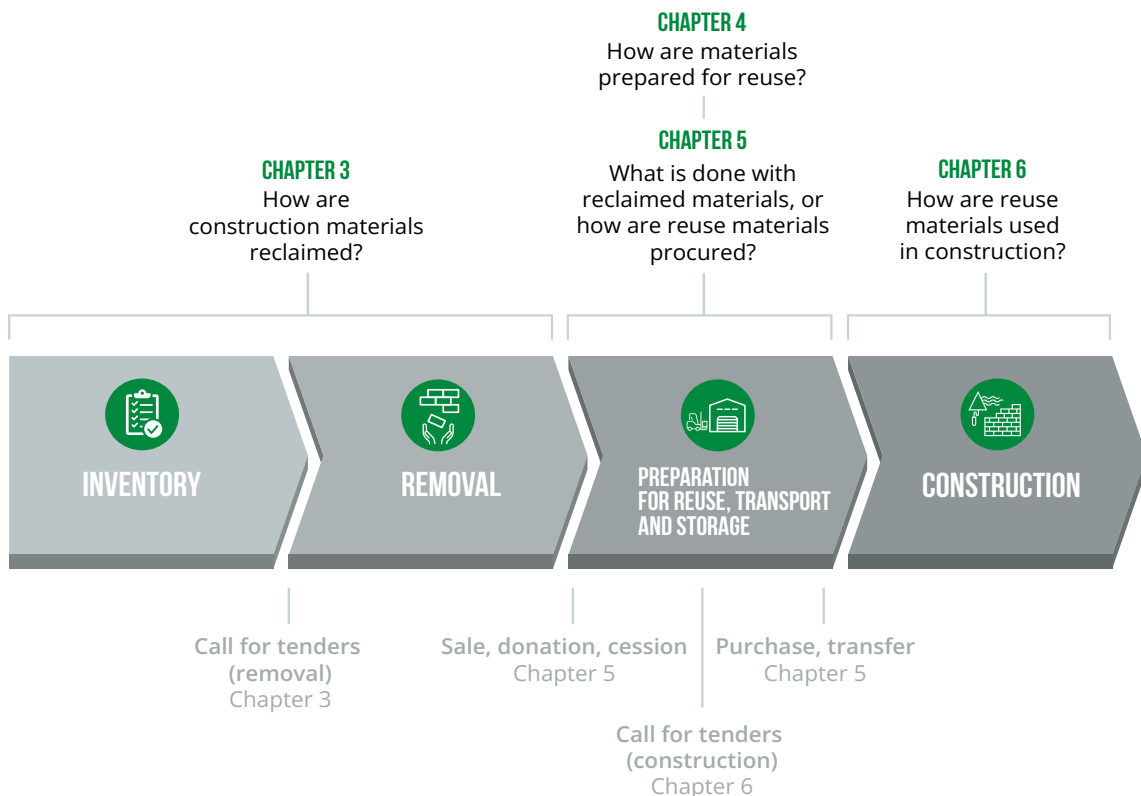
Construction companies can play an important part in this transition towards more circular practices. Their knowledge of the business and materials, their knowhow and technical capabilities are crucial assets!

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?

An infrastructure company may be entrusted with several roles relating to the reuse of materials: the removal of certain elements, for example during renovation, and construction with reuse materials. The contractor can carry out some of these tasks themselves, or subcontract them, for example to certain professionals.

This way, it is possible to intervene directly or indirectly on a considerable number of different materials. Three types of materials have been selected in the context of this guide of which the first two are the elements that are reused most frequently in current infrastructure work:

- Stone paving reused as road surfacing;
- Reuse in rail infrastructure: Ballast and other road elements;
- Reuse of complex infrastructure: bridges.

Other elements can also be reused and the lists in the following tables include some of them. Please note that while these lists include the elements that are most frequently reclaimed and reused, these lists are not exhaustive.







FURTHER INFORMATION




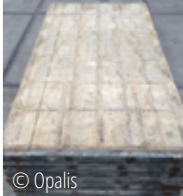
Reuse Toolkit – Material sheets









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 INFRASTRUCTURE WORK - LIABLE TO BE REMOVED OR REUSED	DESCRIPTION ²	DOCUMENTATION
<p>NATURAL STONE PAVING SETS</p>  <p>© Van Dijck</p> <ul style="list-style-type: none">  TO BE RECLAIMED  TO BE REUSED  FREQUENT ON THE REUSE MARKET 	<p>Porphyry, granite, sandstone or other types of stone paving sets are taken up available in large quantities during road works and are abundantly available on the reuse market. Often, natural stone comes from local quarries and is closely tied to European (industrial) history. There are several different formats. Different treatments are also common, such as cutting reclaimed paving sets (to give them a smooth surface more suitable for cyclists or persons with reduced mobility for example). The very long lifespan of paving sets and their versatility makes them a model for circularity.</p> <p>Belgium and Northern France are areas with a strong tradition of producing and using cobblestone sets. This trait stems from the sub-soil in these regions, rich in various materials (sedimentary or magmatic) some of which are highly resistant such as porphyry and sandstone. During the 19th century, the industrialisation of quarry operations created an entire sector based on these local resources which saw great interest that led to exports worldwide (European cobblestone sets can be found in the United States for example). This economic fabric, even though it has largely evolved, still remains rooted today in this history as the resources extracted are still ubiquitous around us and make it possible to maintain economic models that have endured despite huge economic fluctuations in recent decades.</p> <p>In recent decades, cobblestones have also often been imported from outside Europe, such as Kandla paving from India. These items are still rare on the reuse market.</p>	<p>Material sheet – Reuse Toolkit: Natural stone cobblestone sets https://opalis.eu/sites/default/files/2022-01/1.11_fr_-_pave_en_pierre_naturelle_v01_0.pdf</p> <p>Extract from the specifications natural stone cobblestone sets pave_de_reemploi_0.pdf (opalis.eu)</p>

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

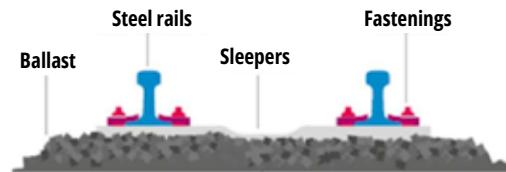
MATERIALS RELATED TO INFRASTRUCTURE WORK LIABLE TO BE REMOVED OR REUSED	DESCRIPTION	DOCUMENTATION
<p>PAVING BLOCKS AND SLABS IN CONCRETE</p>  <p>© Opalis</p> <p>↶ TO BE RECLAIMED</p> <p>↶ TO BE REUSED</p>	<p>Concrete paving blocks and slabs are only available to a limited extent on the reuse market. Few suppliers stock these items because the value is limited by the abundance of brand new equivalents available at a low price. While some merchants offer larger quantities, they tend to be random lots which have been removed with other more valuable materials. The re-utilisation of this material is generally limited to reuse on site.</p>	<p>Material sheet – Reuse Toolkit: https://vb.nweurope.eu/media/16857/ms1_fr_part2.zip</p> <p>CCTB 2023: Technical specifications for the supply (excluding materials reclaimed from the site) and the installation of exterior floor surfaces in concrete paving blocks https://batiments.wallonie.be/files/unzip/html_CCTB_01.10/Content/93-16-2-Paves-en-beton.html</p>
<p>NATURAL STONE EDGING</p>  <p>© Opalis</p> <p>↶ TO BE RECLAIMED</p> <p>↶ TO BE REUSED</p> <p>↑ FREQUENT ON THE REUSE MARKET</p>	<p>Natural stone edging has generally been extracted during the last century and worked by hand or machine. The majority of pieces are in blue stone or granite, but smaller specimens in porphyry or vitreous clay are also available on the reuse market. Different merchants cut the edging to a certain length and offer various surface treatments.</p> <p>Concrete edging is rare on the reuse market. The price for this product brand new is so low that it is difficult to compete.</p>	<p>Material sheet – Reuse Toolkit: https://opalis.eu/sites/default/files/2022-01/1.10_fr_-_bordure_en_pierre_naturelle_v01_1.pdf</p>
<p>CLAY PAVING BLOCKS (KLINKER)</p>  <p>© Opalis</p> <p>↶ TO BE RECLAIMED</p> <p>↶ TO BE REUSED</p> <p>↑ FREQUENT ON THE REUSE MARKET</p>	<p>Clay paving blocks (also known as “klinkers”) are a widely used paving material, particularly in the Netherlands. The paving blocks look like ordinary bricks, but their firing process is harder and longer, making them more robust: The average lifespan of these blocks is approximately 130 years. This fact, combined with the fact they are generally very easy to remove, makes their reuse common practice, both large scale and small scale.</p>	<p>Material sheet – Reuse Toolkit: https://opalis.eu/sites/default/files/2022-01/1.12%20FR%20-%20Pav%C3%A9%20en%20terre%20cuite%20%28Klinker%29_v01.pdf</p>
<p>CONCRETE BLOCK DRYING PANELS</p>  <p>© Opalis</p> <p>↶ TO BE RECLAIMED</p> <p>↶ TO BE REUSED</p> <p>↑ FREQUENT ON THE REUSE MARKET</p>	<p>“Steenschotten” type wooden drying panels are a real classic on the reuse market in Belgium and the Netherlands, and to a lesser degree, in France and Germany.</p> <p>These panels are first used in the concrete production industry where they are used as supports to vibrate and dry prefabricated concrete products (blocks, paving blocks, edging, etc.).</p>	<p>Material sheet – Reuse Toolkit: https://vb.nweurope.eu/media/16857/ms1_fr_part2.zip</p>

MATERIALS RELATED TO INFRASTRUCTURE WORK LIABLE TO BE REMOVED OR REUSED	DESCRIPTION	DOCUMENTATION
<p>SHIP TIMBER</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p>	<p>Ship timber (bois de navire in French or scheepsplanken, scheepsvloer or sloopshout in Dutch) is a reclaimed material present primarily in Belgium and the Netherlands. It is dismantled from port and maritime structures such as pontoons or barge holds.</p>	<p>Material sheet – Reuse Toolkit: https://vb.nweurope.eu/media/16857/ms1_fr_part2.zip</p>
<p>STEEL BEAMS</p>  <p>© Opalis</p> <p> TO BE RECLAIMED</p> <p> TO BE REUSED</p> <p> FREQUENT ON THE REUSE MARKET</p>	<p>Structural steel elements are relatively rare on the reuse market given their market value for recycling facilities, as well as the need to adapt procedures to establish their suitability for use. Pioneering projects are multiplying in recent years and have shown that working with reclaimed steel can be as cost effective as brand new steel. In view of the high environmental impact of the production process as well as steel recycling, it is all the more interesting to reuse it.</p>	<p>Material sheet – Reuse Toolkit: https://opalis.eu/sites/default/files/2022-01/2.30%20EN%20-%20Steel%20beam_v01.pdf</p> <p>A protocol, developed to facilitate the reuse of steel, has been developed in the United Kingdom by the SCI (Steel Construction Institute): https://steel-sci.com/assets/downloads/steel-reuse-event-8th-october-2019/SCI_P427.pdf</p> <p>Product sheet-application (justification of technical performances), developed by Buildwise: https://www.bbsm.brussels/wp-content/uploads/2022/07/BBSM-WP6-Fiche-produit-application-Elements-de-structures-acier-de-reemploi-VF.pdf</p> <p>Diagnostic methodology and performance evaluation, developed by CSTB: www.cstb.fr/assets/documents/cstb-guide-reemploi-des-elements-ossature-en-acier.pdf</p> <p>Guide for the reuse of steel elements in single-storey constructions within the framework of the PROGRESS project: https://www.steelconstruct.com/wp-content/uploads/PROGRESS_Design_guide_final-version.pdf</p>
<p>HANGAR STRUCTURES IN STEEL</p>  <p>© Opalis</p> <p> TO BE REUSED</p>	<p>Some companies are specialised in the reuse of whole hangars. They attempt as much as possible to directly transport dismantled structures from their original site to the new site to reduce the costs of transport and storage.</p>	<p>Material sheet – Reuse Toolkit: https://opalis.eu/sites/default/files/2022-01/1.12%20FR%20-%20Pav%20C3%A9%20en%20terre%20cuite%20%28Klinker%29_v01.pdf</p>

Rail infrastructure

The reuse of materials was common practice in the development and maintenance of rail infrastructure in France, as in the majority of European countries. Due to the significant industrialisation of rail works over the last 30 years or so, this feature has disappeared. Since the beginning of the 2000s, a series of pilot projects has been under-


taken by SNCF Réseau to redevelop reuse. The majority of European rail infrastructure companies such as Infrabel (BE) and ProRail (NL) are also committed to developing sustainability in the maintenance and renewal of their infrastructure through pilot projects and strategic plans that are currently becoming more systematic.



MATERIALS RELATED RAIL TO INFRASTRUCTURE - LIABLE TO BE REMOVED OR REUSED	DESCRIPTION	DOCUMENTATION
STEEL RAILS, FASTENINGS, CATENARIES	Products with a positive value particularly well established in recycling facilities which are in increasingly short supply in France	
Catenaries	Experimental reuse at the moment (2023) Obstacles: Strict technical and safety constraints + good valuation on the recycling market.	
Rails	There has been an internal reuse circuit within SNCF Réseau since 2008 (Rail de Réemploi Direct) via the workshops at Saulon-la-Chapelle with inspections (visual, tests, ultrasounds) and reuse via decommissioning (HSL – classic line – branch line etc.) –55% of HSL rails (very high quality and technical specification, approximately 9% of the national line) were reused in 2019 on other lines. SNCF Réseau is aiming for 7% reclaimed rails by 2026 (rapid growth, x3 in 2024) across its network. The company develops reuse practices internally via controlled decommissioning (7% target in 2026). The cost price is much less than brand new but has lower technical capacities (decommissioning). Obstacles: Strict technical and safety constraints on main lines / good valuation on the recycling market with the development of a short loop that secures supply by SNCF Réseau in Ascoval (recycled “Green rail” from 60% to 90% less polluting than brand new rail).	https://www.uselessgroup.org/sites/www.uselessgroup.org/files/chapter_16.pdf (page 15).
SLEEPERS AND BALLAST	Low value products with a high logistical cost to integrate into recycling facilities, with growing interest in reuse	
Wooden sleepers	Rare low carbon element in rail infrastructure, wooden sleepers become hazardous waste that are destined for use in energy recovery (currently being developed SNCF Réseau-Novacarb-Novawood). Reuse through downgrading exists but wooden sleepers are already only present on small passenger and freight lines. Obstacles: Waste issue (pollution) in developing reuse. Focus on energy recovery.	
Concrete sleepers	5 times more common than wooden sleepers on the French network, their economic value is closely tied to the steel contained within them. Their reuse through decommissioning is increasing but is strongly correlated with fast local availability and the logistics costs, which quickly makes reuse not competitive anymore. In 2020, dismantled concrete sleepers were reused for the renewal of a freight line (concrete sleepers coming of nearby main lines). Reuse in the context of already developed and still under development base layers for road and rail applications. Reuse is currently being developed, but is severely limited by logistical and technical costs.	
Ballast	Reuse rolled out and growing across European rail networks via different implementation processes.	

• Bridges

- The **reuse of bridge infrastructure components** has seen some development with innovative approaches.
- One example is the materials reuse competition on the Champlain Bridge in Montréal. Eleven projects were selected in 2023 to reuse different metal components in the landscaping, furniture construction, walkways, building structures, etc. It is mainly metal components of bridges which have been reused, as they are easier to extract.

MATERIALS RELATED RAIL INFRASTRUCTURE - LIABLE TO BE REMOVED OR REUSED	DESCRIPTION	DOCUMENTATION
<p>Concrete bridges</p>	<p>In the Netherlands, bridges and viaducts in concrete are currently demolished for functional and non-structural reasons in approximately 90% of cases. The average age at demolition is only 40 years, whereas these structures were designed for at least 100 years.</p> <p>The reuse of concrete bridges remains fairly experimental but several convincing experiences in the Netherlands serve as examples, e.g. reuse of prefabricated concrete beams from an existing bridge being used in new bridges. The reuse of concrete beams has proven itself to be easier than reuse of a complete bridge. Tests show, from the Ring Zuid Groningen site, that the beams extracted, at approximately 35 years of age, have a remaining life span of over 100 years.</p>	
<p>Metal bridges, pedestrian bridges and pedestrian/bike walkways</p>  <p>© https://architectuurwijzer.be/ - Joep Gosen et Peggy Totte</p>	<p>The reuse of bridge infrastructure is further developed for metal bridges, notably pedestrian bridges and bike/pedestrian walkways mainly because these are lighter and simpler to remove than large concrete or masonry bridges. The components and metal bridges are generally systematically better integrated into the reuse processes because of the already existing recycling process (positive value).</p>	



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	

Elements in natural stone are good candidates for reuse: they are resistant, have a lovely finish and lend themselves well to different uses (Rotor, 2021).

Steel beams are also good candidates for reuse. Their modular sizes, workability, durability and reversibility constitute positive factors for their reuse potential (Rotor, 2021). However, the sales price of steel for the purpose of recycling remains an attractive option, while the environmental impact is much larger for this recovery process. Moreover, it is essential that the technical performance is ensured in terms of stability.

Rail elements can also be good candidates for reuse due to their considerable volume: the length of the national network is 29,200 km in France, 3,600 km in Belgium, 2,800 km in the Netherlands, and 275 km in Luxembourg. This represents 100 million tonnes of ballast on rail tracks in France. Each year, 2.6 million tonnes of materials are removed from the French rail network during maintenance or track renewal works. Building a common market for rail reuse at a transnational level remains a complex endeavour due to the standards and characteristics often closely linked to national requirements: development is mainly on a state scale (France, Belgium, Netherlands). Nevertheless, to lower CO₂ emissions and reduce logistics costs, reuse has developed rapidly in recent years, particularly for **ballast** where the process is more developed.

Bridges are heavy and complex infrastructure constructed according to the geographic constraints of the sites. This makes their reuse on another site tricky (notably for logistical reasons), although there are projects to promote the reuse of components, notably with specific design processes (prefabrication etc.).

The reuse of **concrete bridges** remains fairly experimental but several convincing experiences in the Netherlands serve as examples, such as the reuse of prefabricated concrete beams from an existing bridge being used in new bridges. The reuse of concrete beams has proven itself to be easier than reuse of a complete bridge. Tests show, for the Ring Zuid Groningen site, that the beams extracted, at approximately 35 years of age, have a remaining life span of over 100 years.

The reuse of bridge infrastructure is further developed for **metal bridges**, notably pedestrian bridges and bike/pedestrian walkways that are lighter and simpler to remove than large concrete or masonry bridges. The components and metal bridges are generally systematically better integrated into the reuse processes mainly because of the already existing recycling processes (positive value).

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

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.

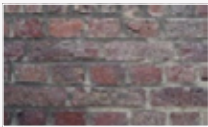


The inventory is liable to be divided into three parts. The first part gives information relative to the worksite. This part of the inventory will give among other things the contact details of the different actors. The address and nature of the building are also given. As far as possible, plans of the 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.

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.




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.

- The information that can be collected prior to removal
- will be particularly important in the case of **steel beams**.
- Notably, it will be important to collect information such as
- the type of application, as well as the production date or
- installation date of the beams to be able to evaluate their
- technical performances more easily (see 6.d).

Example: Extract of reuse inventory (basic + additional data), produced under the Kasteelplein pilot project

BASIC DATA											
Identification		Photo	Quantity		Dimensions		Weight		Location on site	Condition	Comment(s)
N°	Lot name		unit	number	unit	dim.	unit	total			
1	Solid bricks, lot 1, substructure base		m²	211.3	17/17.5*4/4.5*8	cm	Tonnes	2.66	Base bricks, houses 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22	Average general condition. Localised cracks in the bricks but also stepped cracks in the joints	These bricks are darker. Hand-moulded. Given their location, they may have a few more cracks (less aesthetic appearance). Greater care is needed for this lot.
2	Solid bricks, lot 2a Exterior		m²	528.2	17/17.5*4/4.5*8	cm	Tonnes	1109	Upper bricks, houses 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22	Good general condition. Cracks in the joints in one place but in the bricks elsewhere.	Difficult to remove one brick by hand but the bricks seem to withstand. Test another technique. External grey mortar, internal beige mortar and dirt (lime or hybrid mortar)
3	Solid bricks, lot 3 garden wall		m²	8.6	17.2/18.5*4.7/5*8/8.5	cm	Tonnes	18.06	Base bricks, houses 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22	Good general condition	On the outside: A harder layer of 1 cm but in the centre: Much more brittle -> easy to remove. Light and darker bricks. Very low density bricks, risk that they are not resistant.

IDENTIFICATION	
no.	Name of assembly / of elements
2	Solid bricks, lot 2a Exterior

ADDITIONAL DATA		
Additional photos		
		
© Buildwise		
Assembly		
Mortar: ext: grey, Int: beige		
Other		
Hand moulded bricks (?), various dimensions Important to differentiate between exterior and interior bricks.		

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.

When producing the inventory, deconstruction tests can be useful for checking the feasibility of removing certain elements for which the ease of removal can vary.

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



© Buildwise

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

Possible technical clauses

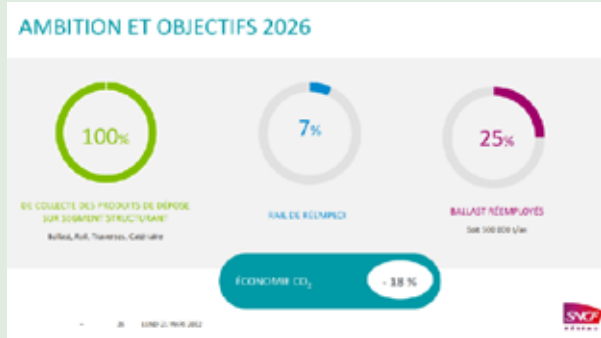
It is important to carefully read the technical clauses describing the deconstruction of the materials, because they can differ in many respects from the more conventional clauses describing the demolition work. (Rotor, 2015)

- **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?

EXAMPLE: GROWING AMBITIONS AND DEMANDS FROM PROJECT OWNERS FOR CIRCULARITY AND REUSE (STRATEGY, INVITATIONS TO TENDER ETC.) IN THE RAIL SECTOR

As companies under state ownership responsible for the maintenance of infrastructure, the European rail network management companies are motivated and pioneering in embracing circularity and reuse, all the more in a context where rail travel is increasingly promoted as one of the most sustainable, carbon free modes of travel.

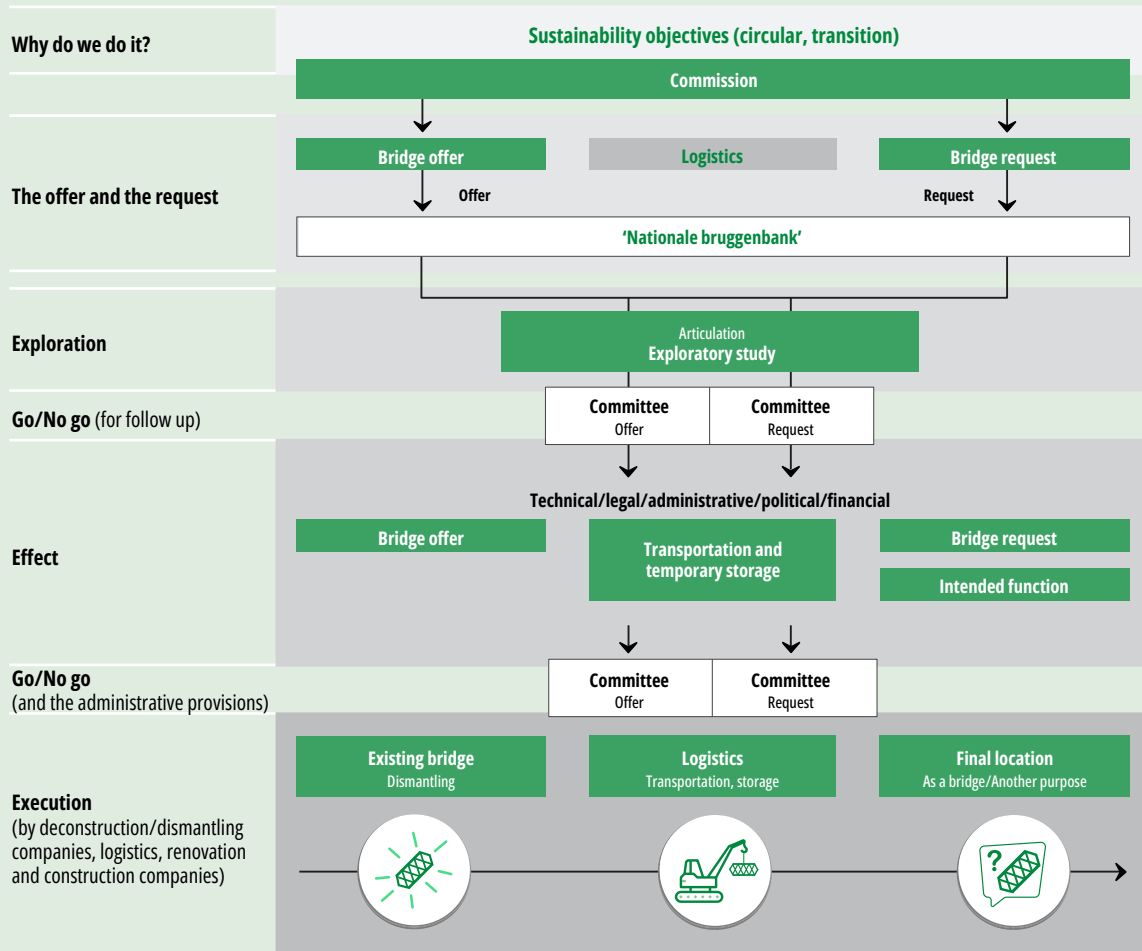
These requirements are more systematically found in invitations to tender, in the specific requirements, selection criteria as well as new public contracts specifically targeting reuse initiatives (Example SNCF Réseau: Industrial Regeneration 2025-2030, Production of reprocessed ballast at support bases, Valuation of co-products - invitation to tender published in April 2023).



© SNCF Réseau

EXAMPLE: PUBLIC CONTRACTS FOR THE REUSE OF BRIDGES

From the perspective of suppliers and buyers, the National Bruggenbank describes the process and the different stages necessary to implement the reuse of complete bridges, both for purchasers and traders. Public invitations to tender are carried out to implement the different stages of the process:



© Nationale Bruggenbank (translated into English)

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)

EXAMPLE : PARIS COBBLESTONES

The transformations carried out on the cobblestone sets by the Plateforme du Réemploi de la Ville de Paris mean a loss of approximately 10% of the materials processed. They are only done on specific request before on-site installation as the materials sources are limited. The machines are operated by employees (approximately fifteen) from private companies that have won framework contracts, awarded every 4 years. This way, the Plateforme owns its machines, in order not to have to modify the processes for each new contract, but uses private service providers trained according to individual specifications to operate the machines. This activity is integrated into the traditional recycling process for Paris cobbles: Many cobblestones have been reused, notably in cemeteries, for lesser quality, second category cobblestone sets. Some streets in Paris have two layers of cobblestone surfacing and therefore represent a double source.

EXAMPLE: THE CIRCULAR APPROACH AT MARIS

Maris reclaims paving blocks from roads and reuses them. This activity has continued in spite of a diversification in activities, to meet a constant need over time and which has strengthened in recent years.

The company answers invitations to tender for the removal of paving sets from roads during public works. It does not respond directly to public authorities but works for the contractors carrying out large infrastructure projects. In these projects, the company proposes a price to remove, transport and clean the paving sets. This approach is particular compared to other approaches (see Plateforme de Paris).

For example, the contracts concluded by Aquafin for the renewal of the drainage network and water treatment represents a significant source of demand: for the renewal of the network, road surfaces that sometimes consist of cobblestones must be broken up and rebuilt. This approach began twenty or so years ago in Belgium and will still be current twenty years from now, which makes it possible to anticipate a constant flow of supply long term.



© Maris Natuursteen

This source of supply will strengthen the stock of reclaimed paving sets. To be able to benefit from this stock, the company must offer a purchase price for the materials (the paving sets). Competing companies can submit a price and the highest price wins the contract. In half of the cases, the presence of paving sets can be predicted, the request and the pricing is therefore done in comfortable conditions. In the other half of cases, the paving sets are discovered during the works. In this case, from a regulatory perspective, the materials belong to the public authorities that put out the contact. The company carrying out the infrastructure works asks the public authorities if they wish to extract them and if the authorities decline, Maris is called upon to submit a bid within the week and organise the removal of the paving sets the following week in order not to obstruct the site.

EXAMPLE : VAN DIJCK COMPANY

Reclamation has been a traditional activity for the company.

Van Dijck only responds to public calls for tender for the deconstruction of road surface blocks. They purchase these dismantled cobblestones. As with many public tenders, the company with the best price proposal is chosen. As opposed to Maris, Van Dijck does not have its own pavers within the company but works with companies that employ pavers such as the company. The company acts as a wholesaler in stone materials such as cobblestones.



© Van Dijck

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)

FURTHER INFORMATION

Making possible the reclamation of construction materials in public buildings – this document gives a detailed explanation of the different procedures that may be applied:

[Vademecum_recuperatie_van_bouwmaterialen_Rotor.pdf \(rotordb.org\)](#)

Prepared by the CCTB, the following document is the Walloon reference for establishing quality specifications for detailing construction or renovation work considering the reuse of materials, and other things:

[CCTB download \(wallonie.be\)](#)

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.

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.

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.



HAZARDOUS SUBSTANCES AND PRECAUTIONS

Some base coatings on **steel beams** may contain hazardous substances, such as lead or asbestos. Appropriate diagnostic testing should be performed.

Careful dismantling of **metal beams** also requires the intervention of skilled trade professionals, these elements relate to the structure and may involve work at height. (Rotor, 2021) The removal technique will consist of mechanical removal or cutting, depending on the type of fixation (rivets, bolts, welding or casting into the masonry).

The dismantling of **bridges** does not require any special training on the part of the workers. Experience shows that workers accustomed to the construction (of bridges) are also capable of undertaking the dismantling of bridges without issue.

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.

EXAMPLE:

The **sets** removed on site by Van Dijck company and transported to its Mil-mort site (4.4 hectares) to the north of Liège (BE) are sorted by shape, colour and material. The reclaimed batches from sites are kept separate as far as possible to facilitate the sorting. The region of origin is also important for grouping together sets with the same characteristics. Homogeneous batches are organised into separated spaces to maintain their homogeneous shape, size and material. All types of sets are available on the site (sandstone, porphyry, Scandinavian granite, etc.).



EXAMPLE:

For **metal beams**, special attention should be paid to the traceability of components, as this may have a significant impact on the technical justification. Beams are therefore identified individually (labels, markers, etc.) in order to be able to easily retain the relevant information about them. It will therefore be much easier to create batches of beams with the same properties. Deformed beams or those showing cause for concern will be excluded.

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.

EXAMPLE : PRECAUTIONS TO BE TAKEN WHEN REUSING BEAMS

It is essential that the necessary precautions are taken during the transportation and delivery of **reclaimed beams**, notably by ensuring suitable fastening and using the appropriate equipment to load and unload. Given the size and weight of these elements, transportation may be expensive. Consequently, many professional suppliers prefer to avoid transportation and storage costs by selling the beams directly from the dismantling site (Rotor, 2021).

EXAMPLE : THE IMPORTANCE OF LOGISTICS IN THE WAAGHOOFDBRUG IN THE REUSE CASE OF WAAGHOOFDBRUG

In Leyde, the old metal bike and pedestrian bridge used from 1988 to 2015 has been temporarily stored in Leyde industrial zone, while waiting to find it a new location locally. The significant length of the bridge has made its reuse in a local infrastructure project difficult. The bridge is therefore being offered on the Bruggenbank platform. This pedestrian bridge, 26 metres in length and 2.75 metres wide (concrete foundation, steel bridge span) was finally acquired in 2020 by Radboud University Hospital.

The new owner took charge for the renovation (new timber deck) and the transportation. The bridge was reinstalled on 2021 in the grounds of the Nimègue general hospital. Despite the distance between the two cities (130km), the operation remained much more cost effective than purchasing a new bridge, notably thanks to the symbolic purchase price. The renovation of the pedestrian bridge was carried out by a long-standing Dutch hydraulic engineering company, Ban Hees en Zonen, based near Utrecht, halfway between the storage site (Leyde) and the destination site (Nimègue).



© RN7, Geert Timmer, Van Hees Groep

⁴ See section 4 for more information.

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.

Elements in natural stone can generally be stored outside. Nevertheless, the more fragile should be protected from frost.

EXAMPLE: STORAGE OF PAVING BLOCKS

Once the contract is awarded, **Maris** (BE) removes the paving sets, handles the transportation to one of its sites, cleans the blocks, processes them (cutting them in two, removing the top, etc.) and sorts them. Two important sites are used for storage: Brussels (approximately 1.5 hectares) and Heist-op-den-Berg (approximately 5 hectares). These two sites are in industrial areas, allowing for extended work hours without issues with neighbours. This geographic location makes it possible to respond to market demands, Brussels is the location for a large number of sites and Maris' main focus area is covered by the Heist-op-den-Berg site. Additionally, the Brussels site is located alongside the canal, making it possible for large containers to carry a large amount of goods at a time.



Paving block storage on site.

Source: Opalis, <https://opalis.eu/fr/fournisseurs/maris-natuursteen>

EXAMPLE : STORAGE OF BRIDGE COMPONENTS

Meerdink Bruggen stores a large quantity of reusable materials at its factory site. Storage takes up a lot of space and needs to be considered in the operation of the company. The length of storage for some elements before reuse sometimes exceeds three years. The company passes on the costs in the price invoiced to the client or project owner.

EXAMPLE: PLATEFORME DES MATÉRIAUX DE VOIRIE DE LA VILLE DE PARIS

The **Plateforme de réemploi des matériaux de la voirie de la Ville de Paris**, located in Bonneuil-sur-Marne (94), is a restoration centre for materials from public space maintenance and development sites managed by the City of Paris. Established in 1996, it covers an area of almost 4 hectares. It facilitates the collection, storage and preparation of approximately 10,000 tonnes of granite paving blocks, slabs and edging per year, and the supply of a large portion of the City's annual requirements for development projects. The Plateforme is considered a wholesaler that purchases materials that have been removed and sells the reclaimed materials to installation companies.

EXAMPLE: STORAGE OF NATURAL STONE ELEMENTS

Natural stone elements can generally be stored outside. However, the most fragile elements should be protected from frost.

*Storage of reclaimed stone elements -
Casernes d'Ixelles*

© Ekkow Photography – Buildwise



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 work sites, before their reuse. It is also possible to carry out preparation operations for reuse of the materials there.

EXAMPLE: STORAGE SPACE RENTAL

Consequently the BCCC has notably stored metal façade elements, blue stone, reclaimed bricks on behalf of the Bleton consortium and BPC, within the context of the Kanal project. These elements were transported by boat from the site to the depot held by the logistics company, Shipit, to be stored there during certain phases of the site, before being reinstalled.



© Shipit

The specific case for the reclamation of rail ballast

After prior sampling and tests on samples to judge the suitability for reuse, different collection processes follow on and complement each other:

- The deeper layers of ballast and lateral ballast, scarcely used, can be immediately valued on the track sites via **work trains that perform direct screening. This makes it possible to reuse approximately 30% of the ballast directly.**
- Additionally, processing on the support base of the remaining extracted ballast is carried out. **The main mobile installation for reprocessing at support bases belongs to and is managed by the company AFC Recycling.** The ballast remains the property of SNCF Réseau. The installation takes one week to be operational, it can process 800-1000 tonnes of ballast per day with 3-4 people. Reprocessing companies such as AFC Recycling sieve through to define the aggregate grade and washes it in order to find all the required aggregate properties. To ascertain the level of equivalence to a new ballast material. **This makes it possible to increase the total reuse level to 50-60%, sometimes up to 72% of ballast has been returned to the tracks on some sites.** Thanks to this reprocessing and collaboration with AFC Recycling, **the cost of reprocessing ballast is now less than the cost of purchasing new.**

The effectiveness and economic sustainability are closely connected to the distance of certain territories from the main quarries producing ballast. **The logistics cost on ballast can represent 75% of the overall cost.** The transport savings are therefore significant. In areas that are richly endowed with quarries, **SNCF Réseau works with quarry workers to undertake ballast reprocessing in the quarries**, using the quarry facilities. This requires certain adaptation compared to the production of new ballast but these adaptations are not generally complicated (removal of certain stages). This reprocessed ballast is then reused. Thus, areas without hard rock quarries have been prioritised for the installation of "artificial quarries" that bulk reprocess, such as Miramas or Lille La Délivrance. They can receive ballast from sites that do not have work trains (half of the 1000 km of annual track renewal).



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.



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.

- Some **stone elements** can be reused as is after a basic cleaning, while others will require additional work such as sawing, cutting and machining, finishing such as milling, sanding, buffing, chiselling, bush hammering, flaming, etc. (Rotor, 2021).
- **Metal beams** will be roughly cleaned and any mortar residues removed and any accessory components that may interfere with transportation and handling are completely removed or partially taken off (supports, connection elements, etc.). The beams may also be cut to the desired length, or machined in the workshop (tapping, welding additional elements, bending, notching, drilling, etc.). Finally, if repair is not an option, a new finish may be applied as necessary (anti-corrosion/fire protection), after removal of the previous finish (Rotor, 2021).

EXAMPLE : AUTOMATED SORTING OF COBBLESTONES

The Van Dijck company (BE) has put in place innovative mechanised methods for the reclamation of cobblestones/sets: a sorting line automatically sorts the cobblestones according to size using a camera and hydraulic pistons.

The sets are tipped into a container, then pass in front of a camera on a conveyor belt, then pistons push them off the belt into areas where they are grouped according to size. Once sorted, they are piled together by a backhoe loader. This approach makes it possible to minimise labour costs.



Automatic sorting line for paving blocks
© IDEA Consult

EXAMPLE: CASE OF THE CITY OF PARIS

The plateforme de réemploi des matériaux de la voirie de la Ville de Paris is equipped with specific installations that facilitate dirt removal, sorting and cutting of sets and edges (loader, cleaner, screening and sorting of sets, bush hammering workshop, curve saw, splitter...). Except for elements in natural stone, the plateforme de Bonneuil also reclaims metal street furniture (bins, tree grilles, posts, barriers, benches, etc.). The treatment processes vary depending on the product:

- Mosaic cobblestones (10 cm X 10 cm) are simply screened : put into a rotating screening container on a 20 tonne loader. This large spinner is loaded, lifted, and rotated on itself. The impact of the stones on each other loosens the materials adhered to them, such as sand or binders. With regard to these binders, the fact that the city can select the binders used means that the binders are eco-designed to facilitate this reclamation process. In Paris, the binders are used for waterproofing and only to a certain extent for bonding. Tests are even conducted without joints to check that the application creates connected blocks, according to expected loads, the results are considered adequate. This type of cobblestone sett is not laid in a straight line but rather in a fan pattern so they are joined together. However, in recent years these sets are not laid as much due to issues with noise pollution;
- For the other sizes, such as oblong cobblestones (14 cm x 20 cm x 15 cm) napoléon sets (18-20 cm) or King's sets (20 to over 23 cm), the aim is to improve the surface to make them smoother by cutting them, while minimising slipperiness as far as possible. This slipperiness is minimised by flaming the surfaces or working on the thickness of joints. Before treatment, the used and rounded surface is prone to slipperiness and noise pollution. During the sawing, the removal of the cap takes off approximately 2 cm of the thickness of the sett which is reused for other purposes (trim).



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.

EXAMPLE: THE LILLE-LA-DÉLIVRANCE SITE, PILOT PROJECT FOR THE CENTRE FOR REUSE INNOVATION OF RECLAIMED RAIL MATERIALS

Lille-la-Délivrance is one of three demonstrator sites launched by SNCF Réseau to develop reuse in the management of its infrastructure (along with Beaune and Miramas). Support base for the LGV-Nord works, since 2022 it has been home to a Centre innovant d'Ecologie Territoriale [Regional Ecology Innovation Centre], creating a strong link between reclaimed railway and deconstruction materials for the BTP. Eventually, the centre will facilitate the reuse 95% of reclaimed rail products. It brings together, in addition to SNCF Réseau and the Team2 competitiveness cluster, a partnership of SMEs, big companies and research laboratories. Some 3.8 million Euros have been mobilised, of which 1.5 million is a State-Region subsidy. The development of regulations (greater circular economy – recycled or reused materials) and the presence of SNCF Réseau (important public actor, guaranteeing significant flow, commitment) have made it possible to encourage investment by large private companies in the sector. It is a pilot project, in an area committed to the circular economy (Roubaix, 0 waste city etc.).



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.

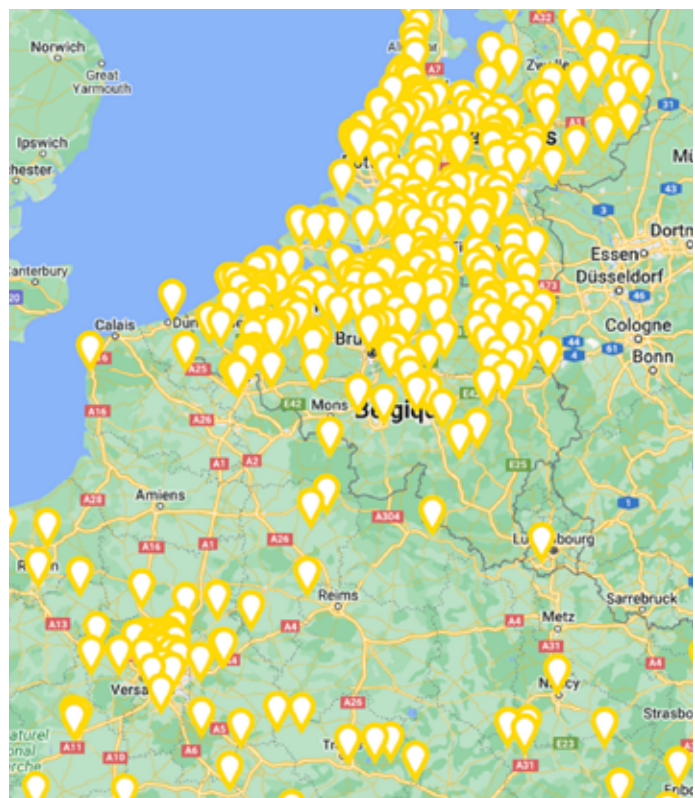
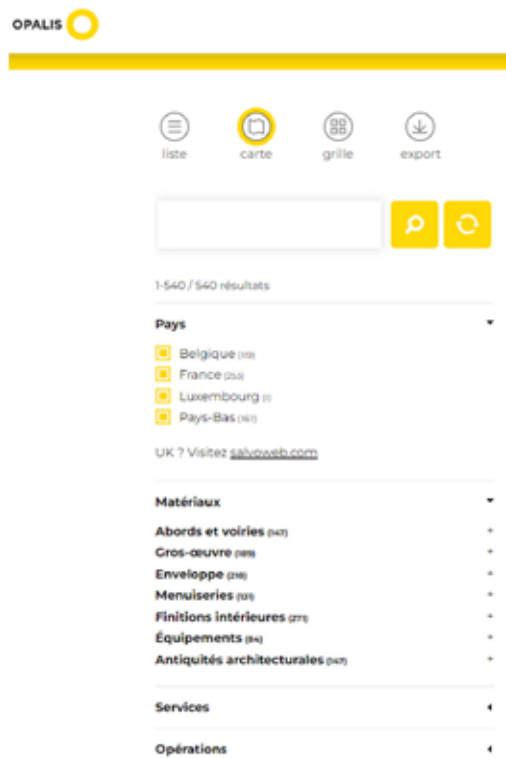
■ **Professional suppliers**

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.



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

■ 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 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.2ememain.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

EXAMPLE: MARKETPLACE FOR REUSE BRIDGES IN THE NETHERLANDS



In the 1980s, the Royal Haskoning DHV engineering company had the idea to create a marketplace for bridges, based on the successful example of the Kiesterzijl swing bridge, installed in the 1950s using a reclaimed bridge from another region where it had been originally installed in the 1920s (traditional reuse for cost reasons). After a decrease in demand over the years, the Bruggenbank was relaunched following a request from a municipality looking for an existing bridge that could be reused. The number of offers was so significant that the platform was relaunched. The current offer concentrates on auxiliary bridges and pedestrian or bike bridges as well as other infrastructure elements (beams etc.). This redevelopment is in

line with the national objective that the construction sector should be energy neutral in 2050 (as described in the Agenda Construction, roadmap for bridges). However, some of the 40,000 bridges in the Netherlands do not meet the current increased traffic intensity and loads. Bruggenbank demonstrates that the bridges offered and their installation have a lower cost price than the construction of a new bridge in most cases.

In 2021, the Dutch Bridge Foundation and AMROR (Amsterdam – Rotterdam - Rijkswaterstaat) established the Nationale Bruggenbank, responsible for developing a public trading platform connecting offers and requests for bridges at a national level as well as improving existing knowledge of sources and requirements nationwide.

Clients are generally public entities, but occasionally companies or residents/cooperatives but who have practical knowledge in terms of transportation and realisation. It should be noted that there is a significant issue in the storage of this type of reuse project, with significant volumes and complex logistics.

A reuse guide is freely accessible (in Dutch only)⁷.

⁷ <https://www.nationalebruggenbank.nl/wp-content/uploads/2021/03/20607-RWS-AMROR-handleiding-bruggen-16PS.pdf>

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 (hEN⁸ or EAD⁹) 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.

⁸ 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.

⁹ The European assessment document is a harmonised technical specification for products that are not covered or not fully covered by the harmonised standards.



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 contracts

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 materials¹⁰. 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 marking¹¹.
 - 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-fundamental¹²) 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 this¹³.

- 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 provider¹⁴.
 - 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.



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.

www.opalis.eu/en/materials

¹⁰ The question of justifying the technical performance of reuse materials is further developed in 6.c.

¹¹ See section 5 for more information.

¹² The reuse materials must satisfy the same requirements as new materials for all regulatory requirements and/or related to user safety and health.

¹³ 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.

¹⁴ The operations of preparation for reuse are described in 4.

EXAMPLE : TECHNICAL CLAUSE FOR CERTAIN CHARACTERISTICS OF CONCRETE PAVING BLOCKS

In addition to aesthetic considerations, certain requirements related to the fitness for use of the materials can be specified in the technical clauses. In the extract of CCTB 2023 (Cahier des Charges Type du Bâtiment [Type of Buildings Specifications]) set out below, certain characteristics must be determined for concrete paving blocks.

93.16.2 Concrete paving blocks¹⁵

DESCRIPTION

- Definition/Includes

It concerns the supply (excluding materials reclaimed from the site) and the installation of exterior floor coverings in concrete paving blocks.

- Important comments

For permeable paving, refer to elements 93.16.2r Concrete paving blocks, supplement for porous concrete paving blocks until 93.16.2t Concrete paving blocks, supplement for paving blocks with drainage openings.

MATERIALS

Concrete paving blocks are new (by default)/for reclamation

(Either by default)

New:

These are prefabricated concrete paving blocks that meet the provisions of the standards [NBN EN 1338] and [NBN B 21-311], dimensional deviations are limited to 2 mm. The contractor submits a sample, technical data sheet and declaration of performance (DoP) for the material for approval by the project author and the project owner.

Concrete paving blocks are at least 28 days old when delivered construction site, unless specifically declared otherwise by the manufacturer.

(Viz.)

Reuse :

This relates to reclaimed paving blocks as an alternative to new paving blocks. Materials reclaimed on site or as proposed by the contractor and subject to the approval of the project author (a minimum of ten representative samples of the reclaimed paving block).

The reclaimed paving blocks are delivered loose (by default)/in dump bags/on a pallet depending on the variety (type, format, texture, colour).

The paving blocks come from the same lot (by default)/can come from a maximum of *** different lots/can come from different lots.

Acceptable aesthetic imperfections on the visible faces of the concrete paving blocks:

- Cracks of less than 0.2 mm in width with a length of less than 1 (by default)/2/3/*** cm
- Chips or splinters of less than 1 (by default)/2/3/*** cm
- Maximum mortar residues: none/10% (by default)/20%/*** %
- Maximum asphalt residues: none/10% (by default)/20%/*** %
- Maximum motor oil marks: None (by default)/10%/20%/*** %

Reclaimed paving blocks that present visible asphalt or mortar residue are distributed evenly across the surface to be paved.

Depending on the setting for which the paving blocks were sold, some broken pieces may have been included in the lot as ½ or ¾ format (adjustment pieces). The selection does not contain pieces smaller than a half paving block.

(...)»

¹⁵ https://batiments.wallonie.be/files/unzip/html_CCTB_01.10/Content/93-16-2-Paves-en-beton.html

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,
- ...

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 defined¹⁶.

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.

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

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.

PROJECT EXAMPLE: REUSEBRUG FLORIADE IN ALMERE

The municipality of Almere (as the project owner) wanted circular construction of a sustainable bridge. However, its town councillors were not exactly sure what this involved. For this reason, the municipality launched a tender process for construction teams.

As the contractor, Meerdink was part of the construction team that put forward a design for a bridge built from reusable components: the Reusebrug. As Meerdink had already benefited from some experience in the reuse of construction elements in bridge structures, the company participated as a specialist in the consultation meetings. At the start of the project, Meerdink coordinated the search for reusable materials. Meerdink's knowledge of the method, time frame and essential sites for finding materials, as well as practical knowledge specific to the task were intrinsic to the success of the reuse project. The architects set to work with the materials available and Meerdink also contributed to the bridge design. The construction of the bridge itself was the final phase.

Further information regarding Meerdink: Meerdink works mostly as a general contractor but in this project Meerdink was a subcontractor for the company Dura Vermeer. Meerdink specialises in the construction of bridges. Wood and steel are the new or reclaimed materials with which the company mainly works. The Floriade bridge is the 20th bridge project in which Meerdink has employed reusable materials in the construction.

Further information regarding this project:

The Floriade site which neighbours Archerpad in Almere saw the circular construction of a bridge over 80 metres long. This bridge offers a panoramic view over Weerwater, the Floriade cable car and adjacent land.

The main structure is composed of recycled concrete beams as well as recycled steel beams and tubular piles. The main beams come from an old pedestrian bridge crossing the A27 motorway. The bridge deck, seats and railings were made from azobé and oak wood, a reusable hard wood.

Project manager: Municipality of Almere

Architects: Arc2 architecten (Gert-Jan de Jong, Eric Goldhoorn)

General contractor: Dura Vermeer

Sub-contractors and supplier: Meerdink Bruggen (provision of wooden railings and L beams in concrete)

Year: 2021

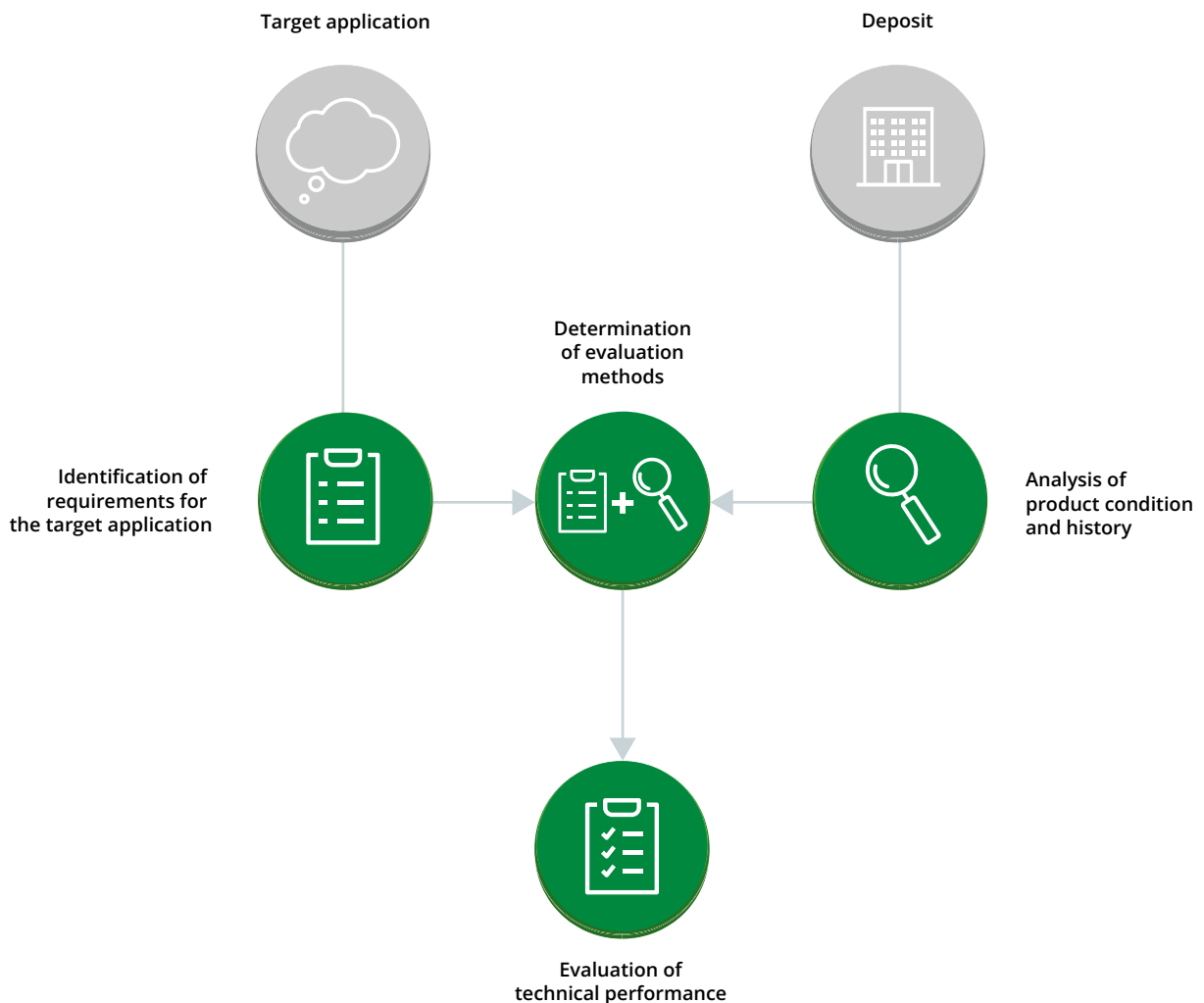
An increasing number of construction companies are appointing “Circular Economy” or “Reuse” managers who are responsible for coordinating the specific operations relating to reuse and who build the knowledge and experience within the company through projects.

Construction team work

To promote cooperation in construction projects, the Netherlands often applies a construction team work formula. In such cases, all parties meet from the start of the design process to work on one project or another. This cooperation presents a major advantage in incorporating in advance the skills of the contractor in the design process, making it possible to handle technical issues more specifically during the meeting, along with planning and cost estimation. Moreover, communication flows more easily between the partners in the construction team and at an earlier stage than is the case when the contractor only becomes involved at a later stage in the process.

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.

■ 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:

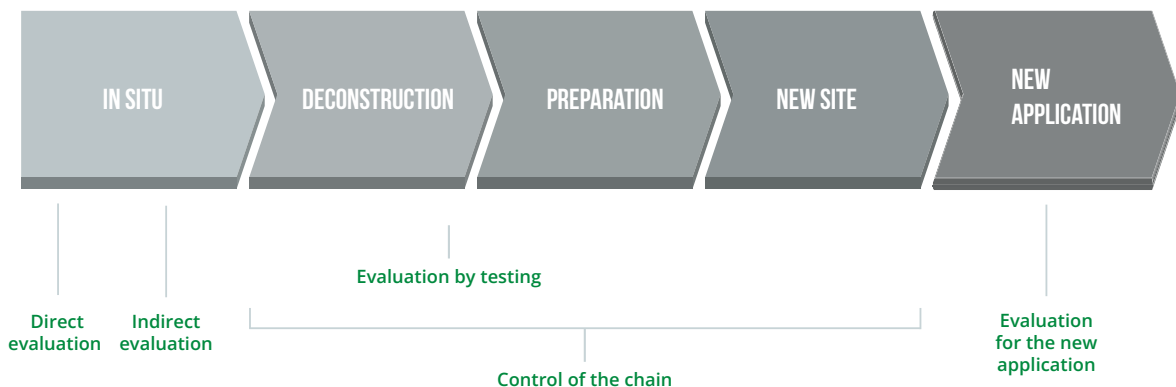
- concerns the product as it is, its implementation and maintenance, and its initial application;
- can be documentary (issues of drawings, data sheets, specification, etc.), historical (year of construction, methods used, etc.) or visual;
- concern the initial characteristics of the products (likely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

EXAMPLE: TESTS AND CERTIFICATIONS FOR THE BALLAST WITHIN THE CONTEXT OF RAIL INFRASTRUCTURE

An example of the certification and test process was performed internally by SNCF Réseau which manages and coordinates its network, supported by various research groups. The first experiments at the beginning of the 2000s were not financial viable due to the process used. Eventually, the project was relaunched in 2018 with a partnership to redevelop the reprocessing process. This resulted in a new approach that combines works trains reprocessing part of the ballast and reprocessing on support bases which allows for a supply of reclaimed ballast on the site two days later, D+2. This process is developing fast, with the support bases around the sites (SNCF Réseau real estate or public or private with temporary occupancy), and more widespread bases such as Lille La Délivrance or Miramas: Artificial quarries with available stock for larger sites. It is thanks to this process that the LGV-Nord site received 100% of its supply of reused ballast.

While the initial trials have mainly been carried out on services lines or freight lines, with a distribution of 1/3 reprocessed ballast, 2/3 new, various tests over several years have shown that the reused ballast has equivalent capacity of new ballast. Indeed, having already been used once, the less solid and poorer quality parts of the ballast have already come loose and only the better quality ballast is therefore reused. Based on the results of these tests, the restrictions on reuse have been largely based internally: Restrictions and exception requests relating to the use of reused ballast have gradually disappeared entirely within the SNCF Réseau (2023). Reused ballast is used and certified in an equivalent fashion to new ballast.



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

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.¹⁷” The certificate is broken down by typologies of materials, currently taps, sanitary fittings, technical sub-floors and guard rails.

EXAMPLE: STRUCTURAL ELEMENTS IN STEEL

A protocol has been developed in the United Kingdom by the SCI (Steel Construction Institute) to facilitate the reuse of steel.

To fall within the framework of this protocol, reuse is limited to certain applications for which high ductility is not required (structures subject to wear, synthetically analysed structures that stand on plastic hinging, load-bearing structures subject to seismic loading). Moreover, older applications are also restricted. Consequently, this means that a good knowledge of the past history of the product and its application will be required. Information collected during the inventory shall therefore be kept safely. The protocol will include steel that has not been subjected to wear (excluding certain applications such as travelling cranes), which has remained within its elastic range, without significant loss of thickness due to corrosion, that has not been exposed to fire and that was erected after 1970¹⁸.

In this protocol, different types of evaluation methods are combined to verify certain performances. For example, to assess the strength (yield point and tensile strength), the protocol provides for a non-destructive test (correlated hardness test) on all elements making it possible to verify the homogeneity of the lot as well as to determine the steel grade, to later perform a destructive test on a sample only¹⁹. The design itself is also modified, notably by the proposal of a higher safety coefficient during calculation of the buckling strength.

If the suppliers of reclaimed materials are not able to provide sufficient information, notably on the origin of beams and their previous application, the structural engineer will decide to compensate for the lack of information with more conservative assumptions on the technical characteristics of the steel and/or conduct additional tests (Rotor, 2021).

Within the context of the Mundo Lab site at Louvain-La-Neuve in Belgium, 120 reclaimed metal beams, representing a total of 68 tonnes of steel, were reused. A period of 6 months was allocated to establish the properties of these beams. Each of the beams was identified and labelled with a unique number that was used to reference the test results as well as the past history of each element.

Different evaluation methods were implemented by the structural engineers in order to evaluate the performance of the elements. Notably, samples

¹⁷ www.safetyincircularity.be

¹⁸ From this date, steel is considered covered by the design principles of modern standards: EN 10025 and 10219.

¹⁹ This method, proposed by SCI, nevertheless involves a certain amount of risk in our opinion. It does not seem sufficient to establish a characteristic value. Statistical tests make it possible to establish greater confidence in the performance of an element. According to the standards, 3 tests are necessary to establish a characteristic value.

have been taken from each beam to ascertain the composition, which has an impact on the weldability. An important lesson learnt from this project is the need to change the sampling tool for each element in order to avoid cross-contamination and skewing the results!



Chantier Mundo Lab in Louvain-La-Neuve, Belgium

FURTHER INFORMATION

The procedure developed within the framework of the BBSM FEDER project was applied to different products linked to an application, for example for structural elements in steel: www.bbsm.brussels/wp-content/uploads/2022/07/BBSM-WP6-Fiche-produit-application-Elements-de-structures-acier-de-reemploi-VF.pdf

8 guides (relating to bricks, wooden industrial structures, steel structural elements, external woodwork, flooring, suspended ceilings, natural stone façade cladding and clay roof tiles) were published by CSTB, describing the different stages of reuse evaluation, including the identification of performances to be assessed according to the field of use and the associated methods of proof. One concerns steel structural elements: www.cstb.fr/assets/documents/cstb-guide-reemploi-des-elements-ossature-en-acier.pdf

A protocol, developed to facilitate the reuse of steel, has been developed in the United Kingdom by the SCI (Steel Construction Institute): https://steel-sci.com/assets/downloads/steel-reuse-event-8th-october-2019/SCI_P427.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

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?

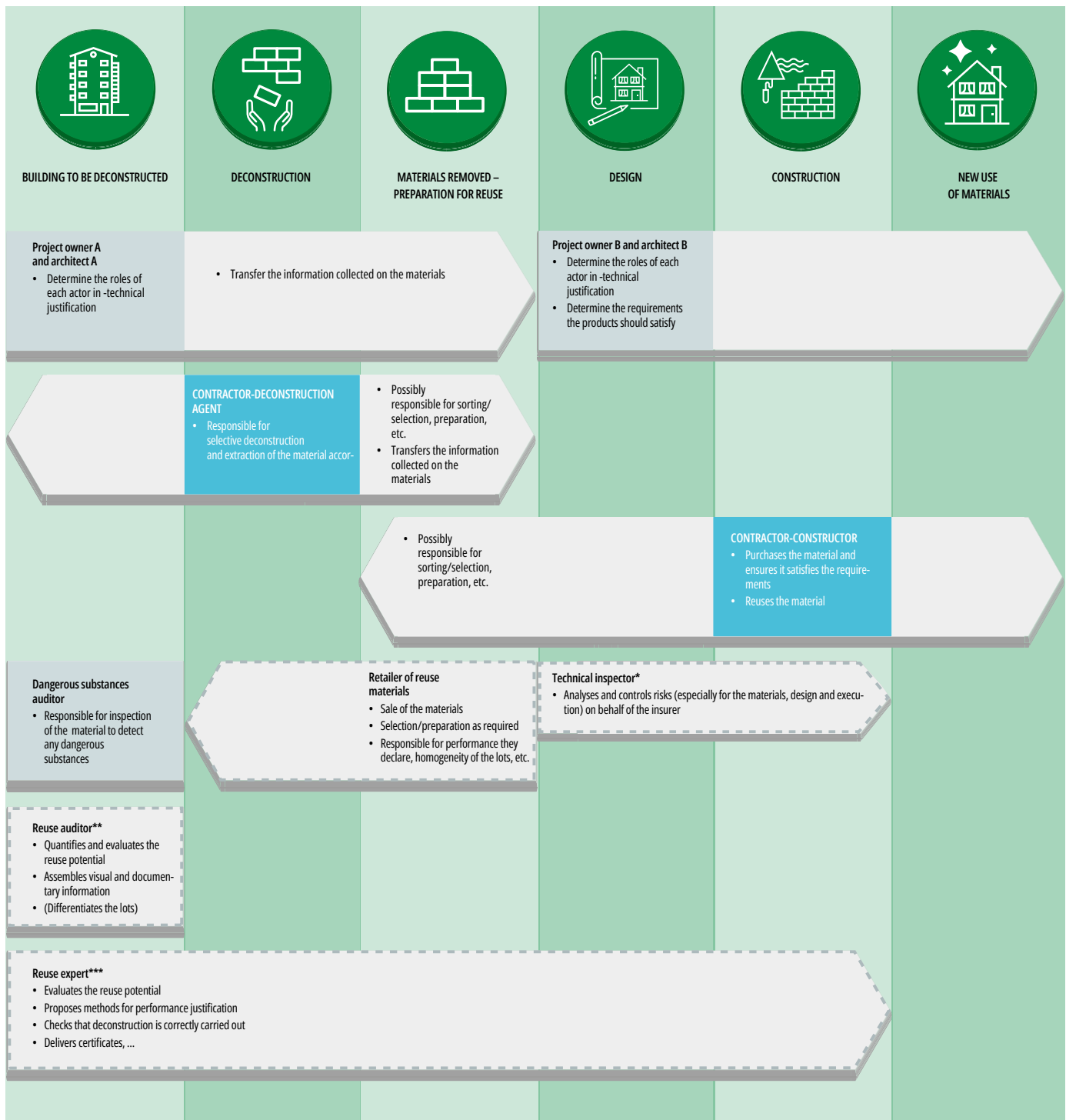
As described in 6.c, a whole series of actions, undertaken by various stakeholders, including contractors, are liable to have an influence on the process and results of the justification of technical performance, especially:

- 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.)



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 blue 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.

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.

■ 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 offices²⁰, 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 office²¹, 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.

^{20,21} As indicated in 6.c, definition of the role that control offices can take can vary according to countries.



FURTHER INFORMATION

Within the context of the Interreg FCRBE project, a booklet was created relating to the technical performance evaluation of materials. Notably, it tackles the subject of responsibilities in the technical justification of materials: https://www.nweurope.eu/media/15541/bookletfcrbe-2_fitness_for_use.pdf

The topic of insurance was covered in further detail within the framework of the FCRBE Project. The results of this study are available on 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 Common Ground consultancy published a research report relating to the insurability 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).

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.

- In the case of **metal beams** for reuse, a minimum length
- may be specified, rather than an exact length, as the
- sections can easily be cut to the desired length at a later
- stage (Rotor, 2021).

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.

EXAMPLE: INCLUSION OF PAVING METHODS

Thanks to the integration of reuse and paving activities, the expertise of the company Maris (BE) has made it possible to identify the key factors for success when laying paving blocks.

- Reclaimed paving blocks have difficulty withstanding the breaking and acceleration of heavy vehicles such as buses. In addition, the use of reclaimed blocks is not recommended for frequent bus transits. Thus, the reuse of paving blocks is not recommended for roads with frequent heavy vehicle traffic;
- The paving blocks allow for surface water infiltration if they are laid with infiltrating binders (such as porphyry granulates or sand) and may limit the requirement for water outlets (which leads to the installation of larger drain sizes for example). They are particularly suitable for surfacing car parking spaces alongside the road or on pedestrian pathways. In this case, the rainwater infiltration capacity is increased and resilience to climate change (extreme flood events) is increased, that favour the reuse of paving blocks;
- 70% of rocks in the world are sedimentary and 30% magmatic. Sedimentary rocks often have a flat surface and are only cut on 4 sides to produce a paving block. In an effort to reduce costs, they are laid horizontally. This method leads to deterioration after several years whereby the fragile sections of the top will come away naturally. To mitigate against this, historically the blocks were laid along the structural lines vertically, so that if one paving block cracked, it would remain supported by the other blocks without loss of material. Savings made on the cut today can impair the quality of the material in the long term. In the latter case, traditional sets are more resistant to wear and tear. Even if they are polished, they will remain structurally more durable. Their intrinsic qualities favour reuse.

These approaches seem simple but they are not always known by project owners and contractors. As Maris is often a subcontractor for construction companies, it is difficult for the company to convey this message throughout the value chain.

MORE INFORMATION: NEW APPLICATIONS FOR PAVING ELEMENTS

Attention was paid to reuse, both for the same purpose as originally used but also for a different use (which is sometimes referred to by the term "re-utilisation") which should not be overlooked in complementing economic models and broadening business markets as required. To this end, the site sheet for reuse materials for the plateforme de la ville de Paris includes detail on the potential uses for road surfacing materials. The sheet can be found here, these elements have not been included in this guide which covers reuse but they are worth noting: http://www.professionnels-pierre-seche.com/userfiles/files/FFPPS_fiche_chantier_Paris.pdf

EXAMPLE: THE RESURGENCE OF TRADES TO INCREASE THE PERFORMANCE OF RECLAIMED SURFACES

According to the experiences of companies such as Van Dijk (supplier of reclaimed sets) and Deferm (installer of reclaimed sets), it is the presence of a street mason on site that makes it possible to lay reclaimed sets and therefore increase the rate of reuse. A street mason is a worker who shapes the sets, cuts them and adjusts the pavement edges from the initial stones or reclaimed sets. A street mason completes specific training and only works independently after several years of experience in the field. Street mason training is still available but fewer and fewer young people pursue it as a career. This method makes it possible to ensure high quality surfaces and greater resistance to wear and tear and cartage. This collaboration, that can be done internally within a company or between two different companies, is therefore a key factor for success.

EXAMPLE: ECO-DESIGN PRACTICES TO FACILITATE THE REUSE FOR BRIDGES

The "Circular Viaduct" project in Kampen (NL) in 2018 is a circular bridge in concrete with prefabricated elements (project produced by Consolis Spanbeton and Van Hattum & Blankevoort): This viaduct with concrete elements that interlock like "Lego bricks" can be taken apart and reused.

In a similar vein, we can also cite the experimental Swiss project Re:Crete, a pedestrian walkway of 10 metres built using reclaimed concrete blocks from walls to be demolished.



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).

The cost of the supply or the profit realized on sale however is not the only factor to consider when carrying out the cost-

benefit analysis of a reuse operation. The following pages include a non-exhaustive list of criteria to be considered.

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.

Estimated selling prices for reused materials

Estimated selling prices for reused materials These stages may require engineering firms and construction companies to adapt their skills to the expected growth in reuse over the next few years, in order to meet the needs of local authorities in particular. The guide draws particular attention to the fact that the distribution of costs and risks, particularly in invitations to tender and contracts with contractors, must be carefully studied. Numerous technical constraints, additional financial costs and legal responsibilities must be taken into account in these infrastructure re-use projects, which, while becoming increasingly common in the Netherlands, are still fairly experimental, even if they are set to become more widespread in the coming years in the various European countries.

The figures below, from material sheets produced under the FCRBE project during 2019-2021, can help establish a price offer for **the removal** of certain materials. These sheets also give indicative prices (ex-tax) **for the supply** of the materials below. These prices vary according to the condition, model, and quantities available.

In the context of the Mundo Lab site in Louvain-La-Neuve, although the time required for the studies had been longer, the total cost related to the supply and preparation of reclaimed beams (notably including the purchase, technical justification through tests, as well as preparation) was found to be more or less the same as the purchase cost of new beams, even slightly less. As the price of steel is highly variable however, this difference in cost can also fluctuate.

STEEL PROFILES		SALE PRICE OF REUSE MATERIALS ²⁰
HEA profiles	HEA 100	€18/ml
	HEA 200	€40/ml
	HEA 300	€75/ml
HEB profiles	HEB 180	€50/ml
	HEB 220	€70/ml
	HEB 300	€120/ml
IPE profiles	IPE 120	€10/ml
	IPE 240	€26/ml
	IPE 360	€50/ml

Reuse paving sets

The price of reclaimed paving sets (without installation) is more or less of €50/m². These prices are largely less than new paving sett prices which range between €100 to 110/m² as the raw material used for new paving sets currently. This situation will probably not continue if the demand for second hand materials were to increase in the years to come.

²² The price of reclaimed steel elements can fluctuate greatly according to the evolution of the commodity market (notably the demand for recycled steel).

RAILWAY BALLAST

By 2026, **SNCF Réseau** has the target of 25% of the ballast used for maintenance of railways being reclaimed ballast. Unlike other reclaimed track materials, reclaimed ballast is also used on high performance lines: in **2022, 100% of the fresh ballast used for the regeneration of the LGV Nord-Est** was reclaimed ballast (300,000 tonnes over 28 kilometres). This reuse of 30,000 tonnes was **three times less expensive than brand new ballast, representing a saving of €900,000** in 2022 through not purchasing raw materials (including higher logistics costs on areas with limited access to quarries) and a short and optimised logistical operation on support bases that created significant savings.

THE SPECIFIC CASE OF BRIDGES

As the reuse of bridges is a complex and developing practice, there is still insufficient data on the costs and financial benefits of reusing bridges. Partly due to the lifespan, the financial model which underpins the reuse is still difficult, particular for entire bridges. The majority of current experiences where the costs are shown to be less than brand new items, are based on very low purchase prices (based on the cost of materials for example), even free of charge or a token amount on condition that the item is reused for a relevant and sustainable purpose (for a similar use). The higher prices of raw materials and energy are seen as an economic opportunity to develop the practice of reuse. Dismantling and removal remains on average slightly more costly than demolition (the contractor gains no benefit from the materials made available such as the steel and concrete). Among the additional costs related to a reuse project, we can also note:

- More complex research on the spatial and technical integration and transportation;
- Adaptation of the bridge in a new location;
- Construction/Adaptation/Use of a temporary storage site;
- Geotechnical research that may be required to reinstall the bridge using cranes or other equipment;
- Management and maintenance during the “new phase of life” (the question of whether the costs are higher essentially depends on the new function of the bridge)
- Risk reserves

The **reuse of metal pedestrian bridges on the Zwicky Sud real estate project in Zürich** where two site footbridges were purchased by a residents association and reused in the residential architectural project to connect two apartment blocks. The **reasonable cost of purchasing the footbridge (price based on the cost of materials and transportation) and this reuse made it possible to create this connection**, given the resources of the association were limited. Reuse made it possible to offer a development option that was more difficult to envisage on the new market.

EXPERIENCE OF MEERDINK BRUGGEN

Projects based on the reuse of materials are generally slightly more expensive than new constructions. However, reusable materials are relatively cheap. On the other hand, the processing of these materials following dismantling is costly due to the significant amount of energy needed to bring the items to a condition that allows for their reuse. The high prices that we see today are principally due to the cost of labour.

As a general rule, professionals consider that the reuse of materials in the construction of small bridges does not involve any increase in price. However, for larger projects, one should bear in mind the fact that the cost of bridges built using reclaimed elements is 30-35% higher compared to the cost of a new construction. This significant difference lies in the fact the costs inherent in the collaboration of the construction team (when the contractor is involved at an earlier stage of the design process) and the design (longer) are higher. Moreover, finding sources of reusable materials with a view to completing larger scale projects also takes additional time.

The creation of an internal bank of materials makes it possible to save time and make economic savings in the long term. Currently, Meerdink Bruggen is able to ensure, from its own stock, the provision of materials required for the completion of small scale projects. But the price in the short term for these supplies is not insignificant.





8.

Conclusies

Current obstacles

In spite of the elements indicated in the introduction that push for the strong integration of circularity in economic models, it is clear that this approach is not yet widespread. Several reasons can be put forward.

The regulations, put in place to monitor the risks as they appeared, have become very burdensome, both from a legal and organisational perspective. The regulations are complex, difficult to grasp and make any innovation almost impossible. A struggle begins between the need to lead projects that must industrialise quickly and manage the risks of new untested circular business models. The example of paving blocks is striking: over the last ten years, those involved in the reuse of paving blocks have had to comply with European, national and regional regulations that apply to brand new materials. Yet, while it is easy to prove the traceability of paving blocks from quarries, how is it possible to determine the origin of paving blocks laid several decades or even centuries ago? While these paving blocks have proven their worth in terms of quality.

Among the main obstacles identified by the stakeholders (in addition to the need for information) in rolling out circular models, at the top of the list is the high price of a material and generally of a construction project when it is circular. And this is the case even though a very small number of clients are prepared to pay this additional cost, especially in an inflationary economic environment. Under these conditions, developing the concept of circularity in construction is proving very tricky. Also on this point, the carbon border tax, by raising the price of imported materials, could make reclaimed materials more competitive. Brand new materials produced in Europe will also be subject to increases in price as the CO₂ emission quotas granted to European industries will also gradually decrease with the roll out of the carbon border tax.

Expected developments

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 then to allow for this and to prepare the various steps in advance.

Several actors can intervene between removal and construction and **the scope of the mission** entrusted to 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.

In the medium term, a way to keep costs down and for clients

On 13 December 2022, the European Union voted to apply the carbon border tax from 1 October 2023. In practical terms, a host of activities that produce significant amounts of greenhouse gases (including the production of cement, screws and bolts for example) will no longer be able to sell their products in Europe without paying a tax to compensate for their environmental impact. On 18 December 2022, the European Union also announced the gradual end of carbon quotas for various industries that produce in Europe, notably in construction.

These decisions will require companies (inside and outside the EU) to pay for their GHG emissions. Currently, one tonne of cement produced emits for global production standards 1 tonne of CO₂. The price of CO₂ has already gone from less than €30/t prior to 2020 to approximately €90/t in 2022 and for the first time passed €100/t at the end of February 2023. With the end of carbon emission quotas, industries will have to incorporate these costs (and their differences) into their economic models. Two solutions are possible to limit an increase in costs related to the increase in the cost of carbon: Promote the lowest carbon import channels, or replace the most carbon emitting materials with reclaimed materials that emit less GHG.

This approach will become increasingly important as the price of carbon increases while the quotas decrease. While the construction sector is currently not affected, it is highly likely that it will be in the future, in order to achieve carbon neutrality in Europe by 2050. Indeed, carbon taxes are now concentrated on raw products but to be fully consistent, they will have to shift to processed products.

A company will therefore have to integrate/generalise the solutions explored in this report in order to ensure its survival.

The comparison between European circular products and linear imported products will be more favourable to the former. For circular materials that emit less CO₂, these

were still compared to linear materials produced elsewhere in the world and imported to European markets. The information on the product, even though this is increasingly regulated, does not always make it possible to identify the environmental impacts of the company that manufactured it. Thus, Indian or Chinese paving blocks were compared with Belgian paving blocks only on their prices. The carbon tax will end up being imposed on these imports increasing the prices of imported paving blocks, at least on those that cannot demonstrate that similar criteria have been observed to those applicable in Europe (demonstration which will of course increase the costs). Consequently, the choices will once again be in favour of circular materials and local supplies. Having anticipated this development, key players will be able to capture this new market. As the circuits are very different (identification of sources, transformation with support of the social economy, reverse logistics, decentralised storage, new distribution channels...) it will require significant effort to reinvent and respond to demand.

Faced with this very fast and highly impactful regulatory change at every level, including the level of small companies, companies that anticipate this cannot escape the changes, but can adapt in time. This is the entire purpose of the guide, by promoting reuse and re-utilisation of materials, activities are much less impacted by these regulatory developments.

Over the long term, an obligation

Under European regulatory pressure, an increasing number of companies will be subject to the carbon market. Economic players will therefore be forced to evolve towards greater decarbonisation and the circular economy will be an increasingly important lever.

As soon as regulations become restrictive, economic players, using the strength of their adaptability and already conscious of the challenges and emergencies to come, will deploy solutions, to structure and develop the sector. Using the example of stone once again, we must not forget that these are monuments from a bygone era, that were used as "quarries" to build contemporary buildings for society and the new economy through the reuse of stones. Over history, there are many examples, with Roman monuments (the Colosseum in Rome served as quarry for the construction of buildings in the period following the fall of the Roman empire), fortified castles, ramparts, etc.

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.

Bibliography

1. **Susie Naval, Rotor.** FutuREuse. Produit ou déchet ? Critères pour le réemploi. 2021.
2. **Rotor vzw/asbl.** FCRBE - Reuse Toolkit - Seuil en pierre naturelle. 2021.
3. **FCRBE** - Reuse Toolkit - Poutrelle en acier. 2021.
4. **Rotor** - Vademecum recuperatie van bouwmaterialen. 2015.
5. **Billiet, Lionel et Seys, Sophie.** Extraire les matériaux réutilisables de bâtiments publics. Des produits à démonter dans le cadre d'un marché public de services, d'une vente ou d'une donation, A.P.T. 2016/1. pp. pp. 1-25.
6. **Heirbaut, S. N. et Van Dyck, K.** Onderzoeksrapport Verzekerbareheid Circulair Bouwen. 2023.
7. **Interreg FCRBE** - D1.5 Workshop n°1 : assurance et réemploi - meeting minutes. 17 novembre 2022.
8. **Interreg FCRBE** - D1.5 Workshop n°2 : assurance et réemploi - meeting minutes. 29 mars 2023.

Annex: Analysis methodology used for this report

In order to determine the challenges for construction contractors on the reuse of materials in infrastructure, the analysis has been conducted in 3 stages:

1. Definition of the specific scope of analysis: 3 case studies have been selected from the different types of reuse observed in the infrastructure sector, relating to public space and traffic infrastructure that may, on many points, draw parallels and link with the construction of buildings. Technical network infrastructures (recipients etc.) were not studied. Indeed, their technical specificity leads to undeveloped reuse practices or that may be distanced from traditional construction and more difficult to generalise. The scope of analysis is focused on reuse and the most illustrative case studies, excluding recycling or processes that transform the raw material too much (notably in-situ recycling etc.).
2. Based on these elements, three types of infrastructure have been selected to cover a large range of reuse practices and to have a broad perspective on the sector in which reuse practices are developing:
 - a. Paving blocks, reclaimed elements that are key in the planning of public spaces and roads
 - b. Rail infrastructure, with particular attention on the reuse of ballast and rails to a lesser degree
 - c. More complex infrastructure: bridges (reuse of elements or as a whole)
3. Bilateral discussions: Following definition of the scope, 8 actors were met to outline the case studies and identify the challenges; (See table)
4. Analysis of challenges: At the end of the discussions, the data collected was organised in order to draw out the main challenges in a clear and concise way.

STRUCTURE`	TYPE	BRIEF DESCRIPTION
Van Dijck (BE)	Company	Reclaimed paving block wholesaler and stone producer
Maris (BE)	Company	Reclaimed paving block wholesaler, stone producer and paving block installer
Plateforme réemploi Paris (FR)	Public centre	Restoration centre for materials from public space maintenance and development sites, managed by the City
SNCF Réseau (FR)	Public company – Project owner	French rail network manager – Partial realisation of maintenance, construction and renewal of infrastructure (in collaboration with private companies) – Internal Research and Development Hub
Team2 (FR)	Competitiveness Cluster	Competitiveness Cluster for Environmental Technologies Applied to Materials (TEAM2) that develops research and industrial applications in the field of eco-technology, eco-materials, recycling and pollution control.
Infrabel (BE)	Public company – Project owner	Belgian rail infrastructure manager
National Bruggen Bank (NL)	Association – Public platform	Public trading platform created to develop the reuse of bridges in the Netherlands – diagnostic assessment of infrastructure/support/connecting owners and potential buyers
Francis Tourneur and Benoit Missonet	Independent and member of the non-profit organisation, ASBL Pierre et Marbre	Experts in the technical characterisation of materials