Deconstruction, preparation for reuse and reuse of salvaged materials on a pilot construction site in Brussels

Romnée A.1, Billiet L.2, Mahieu O.3 and Vrijders J.4

1,4 Belgian Building Research Institute, Laboratory of Sustainable Development, Brussels, Belgium, (+32) 26 55 78 37, E-Mail: ar@bbri.be – jvr@bbri.be
2 Rotor asbl, Brussels, Belgium, (+32) 494 17 68 77, E-Mail: lionelbilliet@rotordb.org
3 CFE Contracting Division, Brussels, Belgium, (+32)497 51 43 47, E-Mail: olivier.mahieu@bpc.com

Abstract

Since a few years, the construction sector is focusing on minimizing resources exploitation and waste arising on construction sites. The European Commission has highlighted prevention and reuse as key actions for waste management. The Brussels Capital-Region is a densely built region, generating more than 600 000 tons of C&D waste each year. However, most waste is exported to the other regions, due to limited availability of waste collecting and recycling plants.

This has been one of the arguments in the political engagement of the Brussels Capital-Region in favor implementing a Regional action Plan for Circular Economy, with focus on reuse (and not recycling) of construction materials, especially in renovation projects.

Within a large development project (‘eco-quartier’), a concrete experiment has been conducted on deconstruction of construction materials for reuse in the same building – originally a common demolition scenario was envisaged. Several tons of materials (wall and floor finishing) have been salvaged from a building by a deconstructor. These materials have been prepared for reuse and then sold to the owner of the site in agreement with his architects. All parties involved in the project benefited from this action since the contractor found an economic advantage compared to a conventional demolition, the deconstructor was able to employ low-skilled workers paid by the resale of materials salvaged and prepared for reuse and the architect and his client found an aesthetic and patrimonial aspect in the proposed materials good enough to reuse them on site.

The paper describes all the steps and necessary conditions to succeed in reuse in construction from the point of view from the deconstructor, the contractor, the architect and the owner. This reuse experiment is a good example of the way to apply circular economy in the construction sector.

Keywords: deconstruction, reuse, circular economy, urban mining, renovation.

Circular economy and urban mining

The Brussels Capital-Region is a densely built region, generating more than 600000 tons of construction and demolition (C&D) waste each year. Due to a lack of space availability, most waste is exported to the other regions. Moreover, due to the absence of materials producer on the regional territory, most materials are imported.

The European Directive on waste of the European Parliament and Council has highlighted prevention and reuse as key actions for waste management (EU, 2008). These key actions on waste shall apply as a priority order in waste prevention and management legislation and policy.
Given that facts, the Brussels Capital-Region government engaged in 2016 in favor of implementing a Regional action Plan for Circular Economy, with focus on reuse of construction materials, especially in renovation projects (be.brussels, 2016).

Circular economy in the construction sector has gained huge interest given that the sector has to focus on minimizing raw materials exploitation and waste arising on construction site. Among other principles regarding construction design for flexibility and development of new business models, the circular economy considers waste as resources and existing buildings as urban materials banks to mine. In practice, the circular economy minimizes the production of waste by repairing, maintaining, reusing products, remanufacturing and recycling materials (WEF, 2016).

Recovering materials from existing buildings, as expected in the concept of urban mining, can reduce the extraction of raw materials. In order to exploit our existing or future buildings in this sense and to consider them as real materials banks, different actions can be envisaged.

- The first step is to collect information on the built elements and the materials used. For existing buildings, this step can be achieved by a pre-demolition audit. It consists of a detailed record of the elements (material, quantities, dimensions, possible treatment path) and can be used for planning and optimizing deconstruction.
- Secondly, in order to be able to dispose of materials at the end of their lives or to encourage their return a new life cycle, it is essential to act at the source by the selective deconstruction of the building elements. Selective deconstruction for reuse is an objective that has to be measured according to economic (price of new materials compared to the cost of reuse materials), technical (toxicity, mechanical and esthetical properties, ease of disassembly, etc.) and variable criteria (recurrence of elements, antiques, etc.).
- Thirdly, after being carefully deconstructed, in order to really reuse construction elements, some actions have to be done to prepare elements for reuse. The preparation phase for reuse involves several steps: packaging, transport, repair, cleaning, documentation, storage, promotion and sale. Repair and cleaning are operations specific to each of the deconstructed elements for reuse that can be carried out by various chemical (solvent), mechanical (sandblasting, brushing or shot blasting) or thermal (heating or thermal shock) actions.

Case study of deconstruction for reuse

Circular economy and urban mining principles have been applied through deconstruction and reuse experiment within a large development project in Brussels. A building on the site had to be renovated and a common demolition scenario was originally envisaged. Discussions with the contractor on the environmental and economic benefit of an assessment of the reuse potential of some built elements convinced him to achieve an exemplary deconstruction in place of a demolition within the same time schedule.

The first step of the deconstruction process consists of achieving a pre-demolition (pre-deconstruction) audit in order to identify, to note down and to quantify existing elements that represent a potential for reuse in or out site. The audit was completed by a testing of deconstruction in order to confirm and to give priority to elements easily salvageable and to distinguish elements that could lead to some difficulties and loss of materials. At the end, as shown partially in Figure 1, a summary table includes a photographic report, the type of element and its location, the quantity to be recovered (in area) and the estimated total mass. On the site, approximately 6 tons of ceramic soil covering tiles, 3 tons of enameled wall tiles,
1 ton of marble window shelf and 0.5 ton of marble fireplace mantel were sure to be carefully deconstructed.

![Pre-demolition audit (partial) realized before selective deconstruction of construction elements (source: Rotor)](image)

The second step of the process consists of the deconstruction itself. Firstly, materials must be carefully dismantled from their support by the use of specific tools and techniques of deconstruction (see Figure 2, above left) (tilting chisel, gently give repeated hammer blows, etc.). Unfortunately, this stage leads to waste production given that all materials are not technically salvageable: breakage, chipping, difficulty of deconstruction, etc. On the site, approximately 50% of the estimated amount of soil tiles was lost during deconstruction.

Secondly, the materials recovered in good condition must be packed in boxes adapted to their dimensions and their transport (see Figure 2, center).

The third step is the preparation for reuse. This step is divided into many stages including the transport between the site and the warehouse of the deconstructor. Back to the deconstructor, the elements are cleaned, inventoried and studied on the historical level in order to characterize them in the best way for resale for reuse (see Figure 2, right and bottom left). The cleaning of the ceramic tiles is carried out by dipping the elements in an acidified water bath so as to remove the maximum of mortar present under the tile and on its lateral faces. The residual mortar is then removed by brushing and rinsing the elements. Historical study on the tiles revealed that some tiles were locally produced (in Belgium) during the sixties. Finally, according to this deconstruction process, ceramic tiles have been put on sale at the price of 57 €/m² (65 m² of 10 x 10 cm red ceramic tiles) and 49 €/m² (65 m² of 10 x 10 cm beige spotted ceramic tiles). In Belgium, this price is comparable to the price of a new tile top-of-the-range, but remains cheaper than identical tiles (old fashioned tiles).
Lessons learned from pilot site

All parties involved in the project benefited from this experiment:

- Deconstruction was accomplished during 16 days-men (with 5 low-graduated workers but highly skilled in finishing works) and 5 days-men of supervision works. Everybody has been paid by the resale of materials salvaged and prepared for reuse.

- Some floor covering tiles have been sold to the owner of the site in agreement with his architects (so, the reuse was applied on site). The price was higher than the conventional price of the tiles originally planned (24 €/m² for bottom-of-the-range tiles) but the owner found value added to the salvaged tiles (mainly esthetical and patrimonial) sufficient to pay to reuse them. Moreover, the quality of the salvaged tiles is higher than new bottom-of-the-range tiles.

- The contractor found an economic advantage compared to a conventional demolition since more or less 5 tons of materials, freely managed by the deconstructor, were not due to be evacuated by the demolisher.

Ideally, and it was the case in this experiment, the pre-deconstruction audit should be achieved by a ‘deconstructor’ who is aware of the demand on the market for second-hand materials. In this way, the materials are quickly identified and resold since the demand is pre-existing to the deconstruction action.

This reuse experiment is a good example of the way to apply circular economy and to support sustainable development in the construction sector: social and economic aspect was reinforced by the enrollment of local low-skilled workers, environmental benefits derived from reuse are mainly related to the preservation of the extraction of new resources and economic benefits reside mainly in the resale of valuable materials that were originally intended to be crushed and downcycled.

Moreover, for densely built region such as Brussels, depending on importation of construction materials and exportation of C&D waste, deconstruction for reuse may really support the development of local economic activities and the creation of non-relocatable employment.
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References

