

Digitally mapped heritage for circular demolition and construction

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Heritage buildings and sustainability go hand in hand. Yet it is not an easy task to draw up an inventory of the materials in a historic building and then deconstruct them effectively. In order to achieve this ambition in the restoration of the outbuildings at Hof Ter Laken, Kempens Landschap could count on the support of a whole range of digital tools from the Digital Deconstruction project.

A magnificent avenue of lime trees forms the entrance to the vast estate grounds that surround Hof Ter Laken in Booischot. The park that extends to 30 hectares includes a castle in the neo-Flemish Renaissance style and a set of outbuildings. The outbuildings feature a coach house, former living quarters, a centuries-old glasshouse, an aviary and an former bakery. In 2018, Kempens Landschap purchased the park and its buildings, together with the municipality of Heist-op-den-Berg from the De Gruben family. "This is precisely the purpose of Kempens Landschap: buying up valuable

sites, restoring them and giving them a new function", says Tine Van den Broeck, project coordinator at Kempens Landschap. "On the one hand, this new purpose must create added value for the community. But on the other, it also needs to generate income to reach an economic equilibrium. Once it will be renovated, the castle will provide heritage accommodation for groups of up to 30 people. The outbuildings will host a brasserie with reception room and meeting facilities. The estate itself will be opened to the public for walking and cycling and a communal vegetable garden will be created."

PRINCIPLES OF CIRCULAR DEMOLITION AND CONSTRUCTION

But before any of that can happen, the castle and outbuildings will first undergo restoration. With full respect for the site's historical heritage, of course. But Kempens Landschap also makes the effort to go as

far as possible to make the process sustainable within those boundaries. "Because we have an exemplary role to play", she continues. "Heritage is already sustainable at its core, because we don't just demolish things – we want to preserve them. However, as in this project, when the demolition of certain buildings is necessary, we always want to carry out those works sustainably. We aim for maximum material reuse when restoring the buildings. So, when we were given the opportunity to participate in the Digital Deconstruction project, we did not hesitate for a second. Thanks to the project, we applied the principles of circular demolition and construction to the works on the outbuildings."



60 m³ of hand-formed bricks are kept separately on-site to be reused later in the new construction.

INTELLIGENCE OF THE SOFTWARE TESTS

The purpose of the Interreg NWE 'Digital Deconstruction' project – in which Belgian, Dutch, French and Luxembourg partners are all working together – is to develop and put together digital tools that a building owner can use to opt for the most sustainable solution in terms of building demolition



Roof tiles recovered manually, cleaned, packaged and stored, ready for reuse.

tion and material reuse. The digital tools developed within the project framework are of course intended to be tested in the field. At the start of the project, the partners therefore searched for pilot projects in the participating countries. Although the outbuildings on the Hof Ter Laken estate did not initially qualify for the project in terms of surface area, their historical character made it all the more interesting. "The walls of historic buildings are not always straight or the same thickness everywhere," explains Eléonore de Roissart from Buildwise. "This pilot project was therefore the ideal starting point for testing the digital tools to see how well they can accommodate these variations." Buildwise is one of the partners in this Interreg NWE project.

3D SCANS FOR A 3D MODEL

The first tool used at the Hof Ter Laken site was a 3D scan. This scan laid the foundation for a 3D model - or digital twin - of the building. Such a model was of interest and value, enabling both the architect and the contractor to fall back on it when needed, as well as to share information and to draw up specifications, etc. Benedikte Dewaele, architect at the Erfgoed en Visie architectural and design practice, explains the two methods used in this project: "Typically, 3D scans involve placing a camera in the centre of a room", she says. "That way, spaces are mapped one by one and converted into a point cloud model. For a structure the size of the outbuildings, this would have taken a day's work using the traditional process. But the innovative feature of the 3D scan carried out by project partner BIM-Y is that their scanner is placed in a sort of backpack with which someone walks around the building. The mobile camera scans



Digital tools such as 3D scans are used to make a virtual tour of the building, take measurements and for more efficient communication and collaboration

the environment using LIDAR technology and simultaneously takes 360° photos. As a result, the whole scan only took 2 hours, which was a significant timesaving. Taken on its own, this gain in time did come at the expense of accuracy. But for demolition work, not everything has to be down to the last millimetre."

"A conventional 3D scan would have taken a day's work. Now it took only two hours."

LOOKING FOR MATERIALS WITH A REUSE POTENTIAL

Based on these virtual 3D images, a Reversible Building Information Model (Reversible BIM) was created. It analyses how and in what order the various building elements can be dismantled. A score is then calculated for each element to establish the possibilities of reuse. “To tell us which materials were easy to dismantle and reuse – and in what order we needed to proceed with the demolition”, recounts Lander De Belder, project assistant at Kempens Landschap. “But here, purely because of the historic nature of the building, we came up against limits. By testing this model against practice and checking what was effectively

reusable for each material, the reverse BIM results turned out to be a bit too optimistic. Of course, these are interesting findings to feed back to the developers of the digital tool, allowing the model to be adjusted on this basis. Working with U-Mine, we drew up a materials inventory. This inventory described each material in detail, with photos, dimensions, etc. Following the same concept of a demolition inventory, but considering reuse as a second life. Ultimately, choices were made based on this inventory: which materials are still valuable for other projects? And what should better be demolish and disposed of?”

THREE TIMES AS LONG

Once the preparatory work was over, it was up to the team from the contractor, PIT, to carry out the demolition of two of the outbuildings. Project manager, Pieter-Jan Emmerechts: “For us, it was an absolute bonus to have a complete 3D model of the building. Having a visualisation such as this makes it easier to make a realistic estimate of what is required.” The biggest challenge for PIT was to proceed with a sufficient level of care so that the materials could be recovered. “That required us to dismantle the structure in a targeted way.

We also needed to pay close attention to sorting the materials. A distinction had to be made between 3 valorisation types: reusable materials, the recyclable fractions and waste that are destined for a sorting and recycling facility. So there were no big machines razing everything to the ground, but a manual demolition in which each brick could be dismantled and cleaned individually. It’s an approach that took three times as much time, but resulted in lots of materials that will be of value in the restoration.”

TOWARDS GREATER CIRCULARITY

In the end, the outbuilding provided 150 m² of roof tiles, 60 m³ of handmade bricks, 360

m² of wooden structures, 25 m² of valuable floor tiles and 6 windows and doors.

“150 m² of roof tiles, 60 m³ of handmade bricks, 360 m² of wooden structures, 25 m² of valuable floor tiles and 6 windows and doors can be reused on-site.”

All these can be reused on-site. Another 225 m² of roof tiles, 75 m³ of bricks, 110 m² of wood, 358 m² of floor tiles, 500 m² of timber floors and 10 windows and doors were collected at the site and sorted for recycling. To give an idea of the economic value, average prices for reused hand-formed bricks lie between 0.3 and 0.6 euro each. Kempens Landschap hopes to begin the renovation next year and to incorporate almost all of the reusable materials. "Only then will we be able to weigh up the additional cost of such a selective demolition process against the costs avoided through reuse (purchase of new materi-

als and waste management). We also had the good fortune to have sufficient storage space at the site to store the materials. So at least that cost does not need to be included in the economic analysis. The more favourable the figures, the sooner such a demolition will be repeatable. But for us, the Digital Deconstruction project is an interesting experience anyway. It's all in line with the sustainable vision we endorse at Kempens Landschap, to move towards greater circularity and CO₂ savings, even in the heritage sector", concludes Van den Broeck.



The restoration of the Hof Ter Laken outbuilding is part of the Interreg Digital Deconstruction project. From left to right, Pieter-Emmerichs from the contractor, PIT, Benedikte Dewaele from the Erfgoed en Visie architectural and design practice, Tine Van den Broeck and Lander De Belder from the building owner Kempens Landschap and Eléonore de Roissart from Buildwise.