

Urban Mining

– Heidelberg on the Way to Becoming Europe’s First *Circular Municipality*



Is that garbage? ‘No,’ says the city of Heidelberg – and it is using urban mining as a response to the climate crisis and the shortage of resources. © Klaus Venus

Heidelberg, Germany, June 23, 2022. Out of sight, out of mind – that is probably the best description of the way we usually treat waste. This also applies to the largest current source of waste materials: the demolition of buildings. About half of the waste which is currently disposed of in Germany is construction and demolition waste. Only a small part is recycled, and that is usually in an inferior form compared with the original use. Materials which are disposed of in construction or demolition work – such as concrete, steel, timber or plastics – usually land on waste tips or as landfill in road construction, although they are bitterly needed in new construction projects and are prohibitively expensive. The German city of Heidelberg now wants to change this. It is the first city in Europe to apply the urban mining principle in a pilot project with the title *Circular City – Gebäude-Materialkataster für die Stadt Heidelberg* (in English: ‘construction materials cadaster for the city of Heidelberg’). The project is supported by the local company HeidelbergCement AG, which is one of the largest building materials enterprises in the world.

Moreover the city uses the materials platform *Madaster*, designed by the environmental advisors of EPEA, a subsidiary of the consulting company Drees & Sommer SE.

In this pilot project, Heidelberg aims to be a pioneer in applying the circular economy to urban development and urban construction. For Jürgen Odszuck, Heidelberg's First Deputy Mayor and responsible for the departments in charge of urban development and construction, urban mining is a decisive step towards achieving the climate goals of the city: 'At the latest by 2050 we want to achieve climate neutrality and to halve the energy demand of the municipality. We can only achieve this if we start now to focus on the enormous volume of energy and resources which is consumed as a result of construction work. Urban mining must play a key role as a modern way to extract materials resources in the city.'

Jürgen Odszuck explains: 'For this ambitious project the city is cooperating with HeidelbergCement, Madaster and EPEA, which are experienced experts in the area of sustainable construction. The aim is to carry out a complete economic and ecological analysis of all of the buildings in the city, which will then be summarized in a digital materials cadaster. In future, this register will show what materials have been installed in what quality and quantity. This information can then be used, for example, to plan deposit sites and processing areas effectively and thus promote regional value creation with regional supply chains and new business models. This will reduce the dependence on imported raw materials and long transport routes.'

Buildings as Materials Depots

Basis for the cadaster is the Urban Mining Screener, developed by the environmental consulting institute EPEA. It is a program which harnesses the data for a building – such as location and year of construction, building volume or building type – in order to estimate its material composition at the push of a button. The first buildings data has already been gathered: the Patrick-Henry-Village, a former housing estate for staff of the US army, with an area of about 100 hectares, is the largest conversion site in Heidelberg. In the long term, this site will offer apartments for about 10,000 people and space for around 5,000 jobs. But it still contains 325 buildings which must be refurbished or demolished for the new estate – and the Urban Mining Screener estimates that this represents an enormous repository of raw materials. According to this calculation, the Patrick Henry Village contains approximately 465,884 metric tons of material, about half in the form of concrete, a fifth in the form of bricks and a good 5 percent as metal. In the next phase, the data of all buildings located in the city of Heidelberg will be entered into the cadaster platform.

Concept of Urban Mining Exists since Ages

'The cadaster thus offers an important basis for decisions on future neighborhood developments. In earlier centuries, people saw it as normal to use bricks and stones from old fortresses and other structures to construct churches or dwellings. After the Second World War, the 'rubble women' in Germany used destroyed buildings as urban repositories of building materials. They collected as much reusable material as possible from the rubble. In view of the climate crisis, the shortage of raw materials and the rise in the costs of energy, waste disposal and construction, we can no longer afford to neglect the recyclable treasures which are concealed in our cities,' comments Matthias Heinrich, urban mining expert at EPEA.

The total volume of raw materials in our buildings in the whole of Germany is about 15 to 16 billion metric tons, i.e. 190 tons per person. If we also take civil engineering structures such as roads into account, the volume of raw materials rises to almost 29 billion metric tons. 'So far, we have only documented a comparatively small proportion of the flow of raw materials and the material repositories which have been created as a result of construction. Here, the city of Heidelberg is now setting a good example by recording the current flow of materials and material repositories, and thus identifying the information which can be used for a systematic control of building materials,' says EPEA's urban mining specialist.

Circularity Pays off

The materials which can potentially be recycled include not only steel and plastic, but also concrete. In fact, concrete offers enormous potential because apart from water, it is the most widely used material in the world. However, its production leads to high emissions of CO₂. The manufacture of cement, which is the binder in concrete, is a process which necessarily leads to high emissions of CO₂, and so far this is technologically unavoidable. To reduce the carbon footprint, HeidelbergCement has developed a process to prolong the life cycle of all components of concrete. Thomas Wittmann, Managing Director at HeidelbergCement's subsidiary Heidelberger Sand und Kies, explains: 'Concrete is much too valuable to be disposed of in landfill sites or road substructures whenever a building is altered or demolished. Instead we want to use innovative methods to crush demolition concrete, separate it into homogeneous components and return it to the cycle of construction, based on the principles of the circular economy. In addition, HeidelbergCement is working on a process designed to use the fine particles to bind CO₂ and thus reduce emissions during the manufacture of cement.'

For its *ReConcrete-360°* project, HeidelbergCement has recently received the German Innovation Award for Climate and Environment of the year 2022. The city of Heidelberg, with its pioneering role in climate protection, offers ideal conditions for cooperation – partly also because of the large areas designated for conversion and the city's creative treatment of urban development challenges.'

Today's Manufacturers Are Tomorrow's Recyclers

Patrick Bergmann, Managing Director at Madaster Germany, is sure that HeidelbergCement focuses on a trend that is gaining momentum: 'Today's manufacturers will be tomorrow's recycling companies.' The company name *Madaster* is a combination of the words 'material' and 'cadaster'. The startup enterprise was established as a non-profit foundation in the Netherlands in 2017. Since then, the company has been offering storage and analysis of key information about real estate and its components via an online database. Among the captured data are the carbon footprint of buildings and their market value at the commodities exchange.

For implementation of the Heidelberg pilot project, the Madaster team provides the IT platform for the Urban Mining Screener, developed by EPEA. The tool enables an automated analysis of building data on the basis of all data collected about construction materials used and building components. 'In new buildings, it is relatively easy to document the ecological footprint because the data is often available in digital form. It is more difficult to document the materials in old buildings. This either requires extensive on-site research to find out what the building is made of, or we can use indirect methods, such as the procedure implemented in the Urban Mining Screener which uses estimates that are as accurate as possible,' explains Madaster's Managing Director.

Blueprint for Sustainable Construction

During the course of the year, the construction data of all buildings located in Heidelberg will be collected and added to the information already stored about the Patrick-Henry-Village real estate. In addition to details about building materials used in construction, the platform is capable of storing data on energy consumption during building operation, rental costs, and area requirements. This not only provides information about the portfolio of buildings, it also offers a solid basis for decisions about sustainable building. Heidelberg's First Deputy Mayor, Jürgen Odszuck, is convinced that this process will set a trend: 'The methods and concepts which the city is systematically putting into practice could soon also serve as a model for climate-friendly construction in other cities in Germany and Europe.'