Cristina Veríssimo Diogo Burnay [eds.]

Emerging voices on new architectural ecologies

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Haegi Wendls: Rethinking space and materials

Ulrike Schwantner, Dominik Abbrederis, Sigi Atteneder & Martin Mackowitz BASEhabitat, University of Arts Linz (Austria)

The way we plan and build not only shapes our settlements and living spaces, but also the lives of future generations. Which spaces can we claim and share as individuals? Which resources do we use and how will we obtain them in the future as raw materials become increasingly scarce? Construction and existing buildings are responsible for more than a third of global CO_2 emissions and energy consumption; short life cycles and enormous waste production exacerbate the situation. Change is required, and projects with a focus on reusing spaces and materials, rather than consuming ever more land and other resources, can serve as valuable examples of a new approach in the building sector.

Haegi Wendls is an extraordinary story of the conversion of a small farmstead in Vorarlberg, Austria, dating back to 1458. The building, named after its original owner, was transformed into a family home and a cultural venue for the region where gatherings, readings and concerts can take place. Most of the existing building fabric was preserved and sensitively complemented. Only natural building materials were used for the conversion, and as many parts as possible were reused from the existing structure.

The project is an example of how a group of pioneers in the field of sustainable construction joined forces and took action. It is a co-creation and construction-site experiment where university, craftsmen, architects, experts, house owners and students cooperated, bridging gaps between disciplines and areas of expertise. The project is based on a shared vision of sustainability that gives value to an existing building, to its structures and memories, but at the same time demands high-quality design new approaches on natural building materials to create a liveable atmosphere. Had it not been for this commitment, the old building would have been torn down and replaced by a new one, most likely using conventional materials like concrete and petroleumbased products.

CHALLENGES IN TODAY'S ARCHITECTURE

Climate change, and related social and economic problems, probably constitutes the peak of the current ecological challenge. The negative consequences are becoming more and more evident around the globe. Construction activities and existing buildings are main contributors to this fatal change of the climate. At 38%, the major share of global CO_2 emissions can be traced back to buildings and construction and this share has been rising significantly over the last years. Ten percent of emissions alone are due to the industrial production of building materials such as cement, steel, and glass, with cement holding by far the highest share.¹

More than 40% of all resources extracted on our planet are used for housing, construction, and infrastructure. At the same time an enormous amount of waste is caused by this sector. Construction and demolition hold a share of 25-30% of the total waste in the EU, including a wide range of valuable materials like concrete, bricks, glass, tiles, gypsum, wood, plastic, and excavated soil.² We build resource-intensively on the one hand and produce waste on the other.

Another critical aspect related to construction activity is the consumption and sealing of land. In fact, Austria is on top in the EU in terms of consumed land per capita. Urban sprawl induces traffic which, in turn, leads to increased CO_2 emissions.

1. United Nations Environment Programme (2020). 2020 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi: United Nations Environment Programme. Available online at: https://globalabc.org/sites/ default/files/inline-files/2020%20Buildings%20 GSR FULL%20REPORT.pdf. p.20. 2. Ibid. p.48.

PREPARATION CIRCULARITY OF **BUILDING MATERIALS** CONSTRUCTION DISTRI-BUTION NATURAL LA RESOURCES HARVEST WASTE BIO-BASED RESOURCES REUSE RECYCLE COMPONENTS USE PRODUCE LOGISTIC REPROCESSING SECONDARY RESOURCES TRANSPORT ENERGY INPUT MAINTENANCE TRANSPORT SELECTIVE ADAPTATION CLASIFICATION DISMANTLING SHARING SPACE EARTH RENOVATION CAN BE INVENTO REUSED OR GOES BACK NATURAL TO THE SOIL CYCLES FERTILIZATION WASTE COMPOST DUMPING BIO-BASED BURNING RESOURCES illustration by the author

Circularity of building materials, 2022 Courtesy: BASEhabitat and Ulrike Schwantner

An increase in sealed soil surfaces through the building of new developments and roads has a negative impact on food security, water storage capacity and heat generation. Thus, we should not only rethink the materials we use, but also the space we build on. The best house is the one that is not built.³

CIRCULARITY OF BUILDING MATERIALS

An important strategy to tackle these global challenges is to consider the building and its components in a circular way, so that valuable raw materials do not end up as waste after a short period of use. Basically, the consumption of new and finite materials has to be reduced, avoiding unnecessary demand through the renovation and preservation of existing buildings and by reusing their materials and components. The material cycle starts with the acquisition of resources (extraction). There are alternatives to mining and extractive processes, like bio-based materials or recycled secondary resources. Reusing components from existing buildings is another important source that requires probably more logistics but has to be a future strategy. Our existing settlements should be considered an important and growing raw material storage, especially as we are running out of natural resources.

The energy needed for transforming raw materials into building materials (preparation) should be considered as well as the distances that have to be covered until the materials end up on the construction site (distribution). When it comes to construction, the design plays an important role. We must improve our skills in applying materials according to their properties, and consider aspects such as thermal mass, regulation of humidity, natural light and ventilation. Our buildings should be designed in such a way that they can do without external cooling and heating as far as possible. Importantly, a large amount of waste is already generated during the construction process.

Furthermore, the period of use of the building materials should be extended. This can be achieved if the designs allow for the flexible use of spaces, for example, flats that can be enlarged, repurposed, or divided according to need, and thus vacancies are avoided (adaptation and sharing space). Another important aspect is to design buildings and building elements in a way that maintenance or renovation is easily possible. All this has a crucial influence on the extension of a building's lifecycle. At the end of the use, dumping and burning materials should be avoided as far as possible.

REUSE, BIO-BASED MATERIALS AND EARTH -

SUPPORTING THE RESILIENCE OF THE BUILDING SECTOR Reuse of building components in new buildings is a promising approach. Reuse should not be understood as a selective refitting of single items, but must be made possible on large scale. For it to work efficiently, components must be developed that are already designed to be reused, standardised, dismountable, and catalogued. In this way, the current effort-intensive process of reusing building materials could be routinised. Bio-based resources offer considerable potential for the building sector. In addition to well-known materials such as timber and bamboo, these include a whole range of plant fibres like straw, hemp, reed, rice husks, algae, or fungal mycelium. Most bio-based materials sequester CO_2 emissions while growing and store it while they are in use as a building material. At the end of the life-cycle they can be composted and help to regenerate soils. Bio-based materials of particular interest are those which are agricultural by-products, so there is no competition for land that could otherwise be used for agricultural food production. Hemp, for instance, can even fertilise soil while growing.⁴

Earth is another building material of particular interest in addressing climate change and resource depletion. It is an affordable building material that can be found almost everywhere in the world, it is CO₂ neutral as it can be dissolved after use, taken back to earth, and reused again and again. In most construction sites in Central Europe, the excavated material contains clay, which could be used directly or with little processing as a building material.⁵ There are very many different earth building techniques that go back to old building traditions, but which have made the leap into the present thanks to dedicated researchers and pioneers. Martin Rauch was the first to enable new dimensions with the industrial prefabrication of rammed earth elements and to build impressive buildings such as the Ricola Herb Centre (CH)⁶ or Alnatura Campus (DE). Rammed earth can serve as a load-bearing construction; light earth in combination with fibers reaches better insulation values. In addition to clay plasters and earth floors, many new prefabricated earth elements are being developed and research is done on new techniques like poured earth and 3D printing.

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United Nations Environment Programme (2020). 2020 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi: United Nations Environment Programme. p.53.

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Minke, G. (2017). Handbuch Lehmbau: Baustoffkunde, Techniken, Lehmarchitektur. Staufen bei Freiburg: Ökobuch Verlag GmbH. p.11. 6.

Sauer, M. and Kapfinger, O. (2015). Martin Rauch: Refined Earth: Construction & Design with Rammed Earth. Munich: DETAIL. p.118. Earth and bio-based materials have amazing properties. They provide a particularly comfortable indoor climate, are breathable, balance moisture and, above all, are versatile in their combination. Furthermore, earth is a material that easily allows for repairs. Despite the multi-faceted benefits, it still often associated with old-fashioned aesthetics and poor quality. *BASEhabitat* shows with its Travel Guide *Earthen Architecture in Central Europe*⁷ that earth is an appropriate building material that is compatible with contemporary design.

The transition to circularity can only succeed if different stakeholders are involved in developing and testing new solutions; product developers and retailers, craftsmen, architects, clients, and public entities that support these processes.

THE STORY OF HAEGI WENDLS

"A house has a history and future. While we are still discovering the past, finding wooden beams from the Middle Ages, we are, at the same time, designing the future of the house, without knowing where exactly it is going to take us. We are part of the story." Silvia Keckeis and Johannes Lampert, owners of *Haegi Wendls*.⁸

The existing historical building was mainly made of wood and some stone walls, consisting of crooked small rooms in the living area and a working area with stable and barn. Over the years it has been used by many different people with different professions – up to 14 people lived there at the same time. The current owners of *Haegi Wendls* have a close relationship to the house and its past. Demolition and new construction, which would have been the more common approach, was out of the question for them. They wanted to renovate the building sensitively. At the same time, it was important to them to create an *open house* as a meeting place for cultural activities and people of the community. This is how the vision of combining living in *Haegi Wendls* with an open cultural centre came about.

BASEhabitat ed. (2016). Earthen Architecture in Central Europe, Travel Guide. Linz: BASEhabitat.

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Haegi Wendles (2021). *#17. Das vollumfängliche Staunen.* [online] www.haegiwendls.at. Available at: https://haegiwendls.at/2021/08/29/17-das-vollumfaengliche-staunen.



Reinforcement of historic structure, Muntlix, Austria, 2022 Courtesy: BASEhabitat and Martin Schachenhofer

According to the conversion plans the exterior and volume of the building was to remain the same, only the roof was to be raised slightly to achieve better room heights. A large window was added in the living room. Since the existing building was made of wood, the construction continued with wood, supplemented with earth and lime as well as various fibres – all raw materials from the region.

Preserving an old structure implies many uncertainties and unpredictable challenges, therefore teamwork is crucial. In May 2020 the idea came up to carry out the conversion through a cooperation between the owner, the architects, experts in earth construction, innovative carpenters, and *BASEhabitat*, with other professionals like a structural engineer, a wood expert, and various craftsmen joining the team. Many things had to be thought through, planned, and rethought, and the goal of a construction site without waste, using only sustainable materials as far as possible, took shape.

The possibility of implementing the project together with engaged students was particularly interesting and space was provided for experimenting and mutual learning. In October 2020 the construction site experiment began, until 2021 three groups of students worked on site, in three-months construction traineeships and a summer school under the guidance of *BASEhabitat* construction site managers.



Building process with circular materials, Muntlix, Austria, 2021 Courtesy: BASEhabitat, Silvia Keckeis and Bence Szalai

THE CONVERSION IN DETAIL

Shortly after the beginning of construction it became clear that it was necessary to stabilise the foundation, a large part of the existing building had to be stripped down to its core construction and reinforced. Load-bearing wooden structures had to be protected against rising humidity. The structure was raised at certain points and concrete foundations were poured, single posts and beams were removed and replaced with new ones. Wooden walls and floors that had to be removed were restored where possible and later re-installed in other places.

The new basic interior construction was wood frame infilled with light-loam. The mix of wooden chips and liquid earth, which provides both an insulating layer and thermal mass, was filled into a lost wooden formwork. Two different techniques have been tried out, prefabricated wood-earth blocks, and a liquid mix filled directly into the formwork. Both materials, wooden chips, and earth, were easily available as a waste material of a sawmill and rest material from a gravel plant. The insulation value of lightloam depends on the ratio of earth to fibre, the material can also absorb noise and is fire-protecting. The external walls were built in the same way, and the original outer surface was preserved. By using the light-loam infill and a second wooden wall on the inside, it was possible to level out the sloping outer walls. The energy pass that has been issued for the building shows very good values.

A rammed earth floor was placed in the main room of the living area. These kinds of floors are very common in vernacular architecture around the world. By modifying the construction, more resistant floors can be created that have a strong, long-lasting, and impermeable surface.⁹ The floor was placed on a wooden substructure with a fill of capillary-breaking foam-glass, gravel and clay powder. It includes an underfloor heating system, but otherwise does not consist of anything other than a compressed mix of earth and stones, polished and sealed with a natural wax. A trass-lime floor was installed in the public area of the building – this is similar to rammed earth but more resistant for intensive use. On the upper floor, a lighter construction was required, so an earth-perlite infill and earth slabs with integrated heating pipes were applied under the restored old wooden boards.

The whole house was plastered with clay, basically applied on top of reed mats. To increase the resistance the first rough plaster was mixed with straw and cow dung that naturally contains the right mix of ammonia and casein.¹⁰ For the finishing plaster in wet areas, different additives were tested like linseed oil, carnauba wax or natural soap, improving the water-resistance of the surface. Some walls were covered with original wooden boards.

Old wooden windows and doors were restored and put in place again. The traditional façade of wooden shingles was restored with new ones. The roof covering was not changed. The original roof tiles were cleaned and reused, and some replacement tiles were bought second-hand. The students experimented with discarded roof tiles, designing a bar for the cultural venue.

In July 2022, the conversion was finished, and the cultural centre was inaugurated with the premiere of a documentary film of the whole building process. Entering *Haegi Wendls*, one can feel the special combination of old and new building elements. A light steel staircase with old wooden steps leads the visitors to the event room on the first floor in the former hayloft. The living area on

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Minke, G. (2017). Handbuch Lehmbau: Baustoffkunde, Techniken, Lehmarchitektur. Staufen bei Freiburg: Ökobuch Verlag GmbH. p.43.

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Interactions between old and new, Muntlix, Austria, 2021 Courtesy: BASEhabitat, Silvia Keckeis and Bence Szalai

the opposite side convinces with its open design and natural lighting. The materials used have a special haptic and create a particular atmosphere. *Haegi Wendls* already attracts curious visitors who are astonished by the pioneering project, which, furthermore, has encouraged other house owners to use earth and bio-based materials.

TOWARDS A SUSTAINABLE FUTURE

Coming back to the question of how to organise our built environment in a more sustainable way and which space and building materials to use, *Haegi Wendls* is an extraordinary, visionary project. It is crucial to understand architecture as a process that involves many players, and therefore recognise the need for and opportunity presented by co-operation, from sketching first ideas to the search for sustainable building materials until implementation. At *Haegi Wendls* the owners were open to adapting their ideas to the options the building was giving them, planners and craftsmen were joining their expertise in using earth and bio-based materials and the cooperation with the university added further know-how and research base to the project.

Creating buildings in a circular way, means giving the next generation the chance to re-use the buildings according to their future needs. Facing the burning global challenges caused by the construction sector, it is not about doing some small changes here and there, but radically re-thinking the way we plan and build including our approach to architecture. Projects like *Haegi Wendls* are an important starting point.

ABOUT BASEhabitat

As a studio of the Department of Architecture at the University of Art Linz, *BASEhabitat* is part of a growing community of organisations which work intensively on the global challenges connected to the built environment and is member of the *UNESCO Chair Earthen Architecture. BASEhabitat* focuses on providing young architects with the means to implement more sustainable and socially responsible design, planning, and construction processes. Studying at *BASEhabitat* includes intensive hands-on experience with sustainable building materials.

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Essays by:

BASEhabitat, University of Arts Linz

Dalhousie University, University of Oklahoma, University of Alberta, University of Arizona

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École d'Architecture de la Ville et des Territoires Paris-Est (EAVT)

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