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The Alnatura Campus

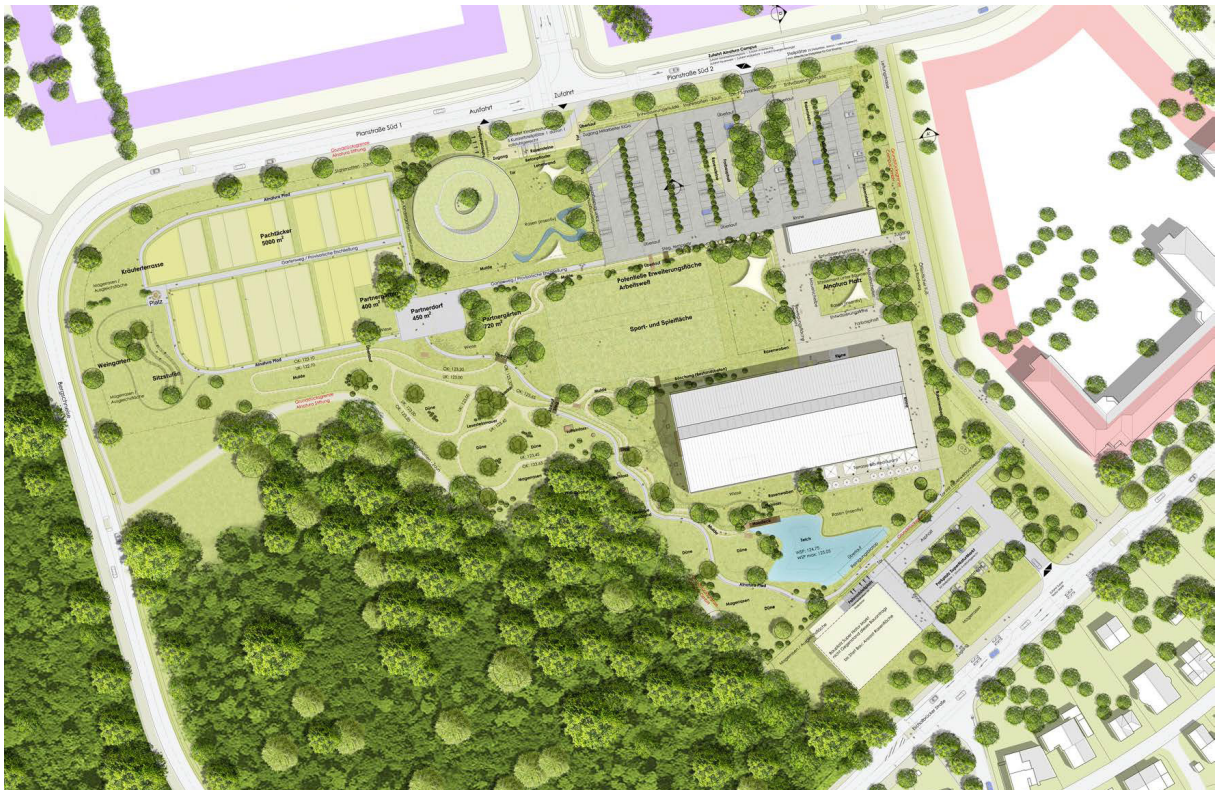
01 The Alnatura Campus

The Alnatura Campus opened in early 2019 and marks the beginning of the redevelopment of a large military site at the southwestern periphery of Darmstadt. Formerly a US Army base, the 47.7 hectare site of the Kelley Barracks was returned to government ownership and its subsequent redevelopment was the subject of protracted debate. Before the organic food producer Alnatura could use part of the area for the construction of its headquarters, the sandy soil of the site had to be cleared of contamination. This marked the beginning of the redeclaration of the site as a business park.

From the very beginning, the company's motto "Sensible for mankind, sensible for the earth" was a central tenet of the architecture competition, and it served as a guiding principle throughout the building's design and execution.

The heart of the new Alnatura Campus is the main headquarters building, the so-called "Alnatura Arbeitswelt". The placement and orientation of the individual buildings on the campus was carefully determined according to microclimatic aspects. They are aligned to optimise the use of the daylight and to benefit from each other by exploiting the synergies of the respective uses. In addition, the design aimed to radically simplify the construction and production processes so that the buildings are not only energy-neutral but also resource-neutral. By using renewable building materials such as wood and earth, as well as other recyclable materials, the construction and overall ecological balance is virtually climate neutral.

The main office building, the "Alnatura Arbeitswelt", is located at the centre of the campus and directly adjoins a foot and cycle path at the front of the building.



02 Site plan

The building is oriented in an approximately north-south direction, turned by 12° to align with the northern boundary of the site and ensure continuity with the urban planning of the development area to the north. To the south lies the restaurant terrace and adjoining outdoor areas around the pond. The northern end has a space for events and delivery bays and offers the potential for a future extension to the building.

The Alnatura Campus is intended as more than just an attractive work environment: it is also a place of learning and meeting for the people of the region. Embedded in the dune-like landscape of the campus is a timber bicycle park, a nature garden for children, an orchard, 5000 m² of publicly-let organic allotments, a school garden belonging to Darmstadt Montessori School, raised beds, a pond, herb gardens and a small amphitheatre fashioned out of broken concrete slabs of the former tank training area. The Alnatura demonstration garden is open from sunrise to sunset.

A climate-friendly concept

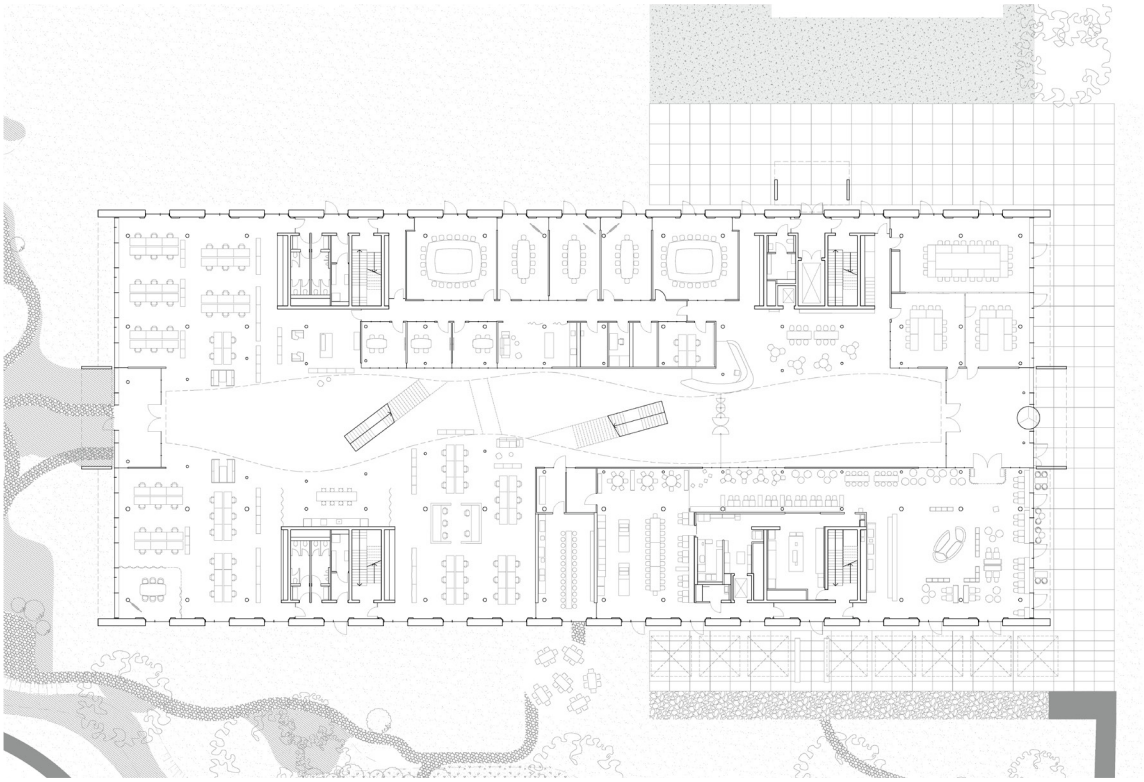
On a 5.5 hectare plot, a new building has been created that embraces the principles of holistic, sustainable architecture. The new Alnatura Arbeitswelt is not intended as an imposing company headquarters but as a welcoming, inviting space that is open to the environment, to people and to new ideas. The building's design is the product of an interdisciplinary planning process led by our architecture office, haascookzemmrich STUDIO 2050, in collaboration with the energy planners Transsolar and the structural engineers Knippers Helbig.

On passing through the spacious main entrance, one is greeted by an expansive view of the entire atrium space with its curving levels, lofty timber roof and light suffused interior. It is the antithesis of a conventional office building. The entire ground floor is a communicative space and informal meeting place for visitors and employees alike and the skylight and glazed ends of the building let in so much daylight that one almost feels as if one is out in the open. The varying degrees of openness and transparency of the building and its skin are part of the low-tech concept of the building.

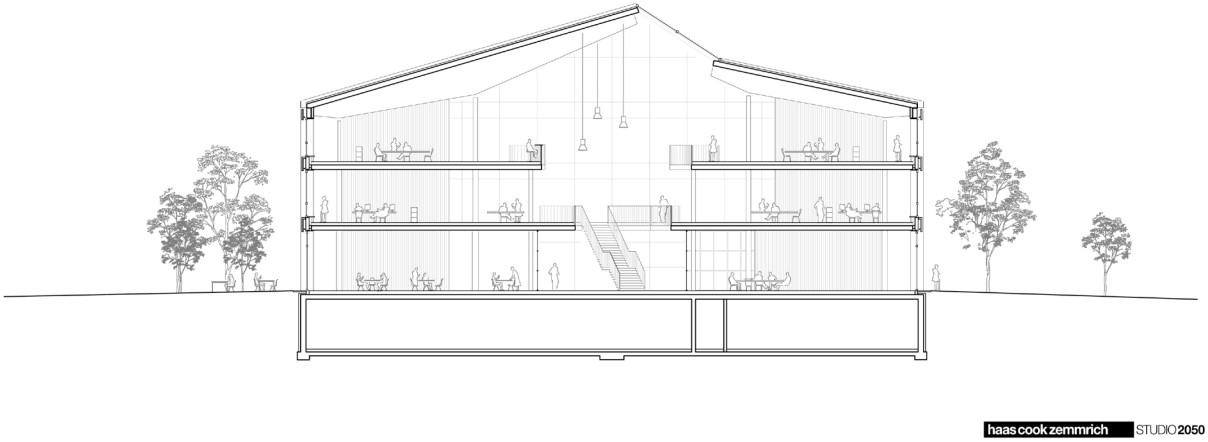
The building's materials complement the brightness of the interior. Wood, earth and exposed concrete give the building a natural, honest, unpretentious and friendly feeling.

In terms of its organisation, the building is divided into a north and south side by an atrium running the

length of the building. Stairs and bridges criss-cross between the two sides, linking the floors and various work areas. An asymmetrical roof spans the entire building above the work areas and atrium, its two pitched roofs separated by a long linear skylight at its apex. Four structural cores containing the necessary escape stairs, toilets and other ancillary spaces structure the interior and also stiffen the structure of the building. The two long sides of the building to the north and south are an alternating pattern of monolithic rammed earth walls sections and timber glazing elements. The two end walls at the east and west ends are fully glazed mullion-transom facades that afford expansive views of the forecourt, the woodland to the west and the organic demonstration garden.



03 Ground floor plan, ~1:750



04 Cross section looking towards the window, ~1:500

05 The central atrium

The atrium – A workshop for ideas

The atrium is the nerve centre for everyone in the building – an open, active and varied space that exerts a special fascination regardless of which level one is on. At the western end, the tall pine trees of Darmstadt's Westwald serve as a backdrop visible through the glazed facade.

The flowing curves of the upper levels inject an element of playful lightness into the otherwise rigorous clarity of the large interior. Together with the stairs, bridges and walkways connecting the different areas, they enliven the interior and enrich the experience of the space. The roof inclines above contain the atrium without constricting the space.

The "Arbeitswelt" – Compact volumes with an open central axis

The transition between the public reception areas and the internal areas, such as the conference centre and its supporting functions, is fluid and seamless and corresponds to the building's overall open concept.

The "Arbeitswelt" is an interconnected network of work spaces distributed across the three floors of the single large interior. The bridges, stairs and walkways connect the different levels and link up networks of paths that define horizontal and vertical "neighbourhoods". This open arrangement allows the 400 workplaces in the building to be effortlessly interconnect-

ed while affording employees numerous different kinds of work scenarios. By breaking with the dogma of rigid offices structures and separate rooms, the company can reconfigure the workspaces as needed.

To facilitate inter-disciplinary teamwork, one needs not just swift connections between different sections but also places where one can meet and exchange ideas. To this end, open "kitchenettes" exist on all floors that serve as meeting areas, although not of the usual kind. Various configurations of armchairs, sofas and wooden tables create relaxing and inviting settings for casual, stimulated or concentrated discussion.

The workplaces within the Alnatura Arbeitswelt are anywhere and everywhere. Alongside traditional desks, staff can opt to sit at worktops along the atrium railings, in seating niches between the rammed earth wall sections, or on the wooden deck adjoining the lily pond. Flat organisational hierarchies complement the open structure of the building. The building and campus are for the staff and provide all manner of spaces – be they in the restaurant, at a meeting point, in a conference room or in the office landscape – for stimulating and flexible working patterns.

Each of these work areas presents a different spatial situation. More private work areas for concentrated work, such as the alcoves, adjoin more public areas without the need for separating doors. Where necessary acoustic curtains can be drawn to separate off particular areas. And every workplace also has a view, whether of the atrium, out of a window or the vast glazed west end of the building.

The ecological balance – Emission-free energy supply and energy-efficient construction

A resource-neutral building

In keeping with Alnatura's ecological orientation, the company's new headquarters need to be forward-looking and low-tech. It should consume as little energy as possible and make optimum use of local renewable energy sources. The interior needed to have a good indoor air climate, but also sufficient thermal comfort. Special emphasis was also given to a simple and energy-efficient system.

We worked together with Transsolar Energietechnik GmbH to simulate different energy models from an early stage in the planning process. Using dynamic thermal building simulations and daylight simulations, we could investigate the performance of various concepts and optimise thermal and visual comfort. The aim was to construct a high-performance building with maximum natural ventilation, low energy consumption and optimised interior comfort, using natural materials wherever possible.

Building orientation and illumination

The placement and orientation of the building were carefully determined according to microclimatic aspects. For the best possible natural illumination, the building is oriented north-south allowing even north light to enter through the linear skylight along the roof and minimising undesirable solar heat gain.

06 Conference room in the atrium

07 Conference room at the glazed end wall

The 10,000 m² of office space is spread across the three floors with storey heights of 3.5 metres and 4 metres on the ground floor so that daylight can penetrate right down to the lower office areas. Bright surfaces and light-coloured flooring contribute to creating a pleasant daylit working atmosphere.

All the windows have individually controllable glare and solar protection and on the sunny south side of the building, there is a natural climate buffer in the form of a pond that benefits the microclimate in summer. The "tibits" restaurant is located here, making the most of the sun, and a cluster of tall pine trees provides additional shading in summer. The incidence of sunlight is also used to generate electricity via a 480 m² large photovoltaic system on the roof.

On the north side are rooms that require high air exchange rates and benefit greatly from the cooler environment, including the conference area on the ground floor.

The west and east ends of the building are designed to be transparent, providing a view of the two worlds that connect the campus: the natural woodland surroundings of the Westwald to the west, and the built environment and the city to the east. Both these aspects come together in the Alnatura Arbeitswelt.

Energy concept

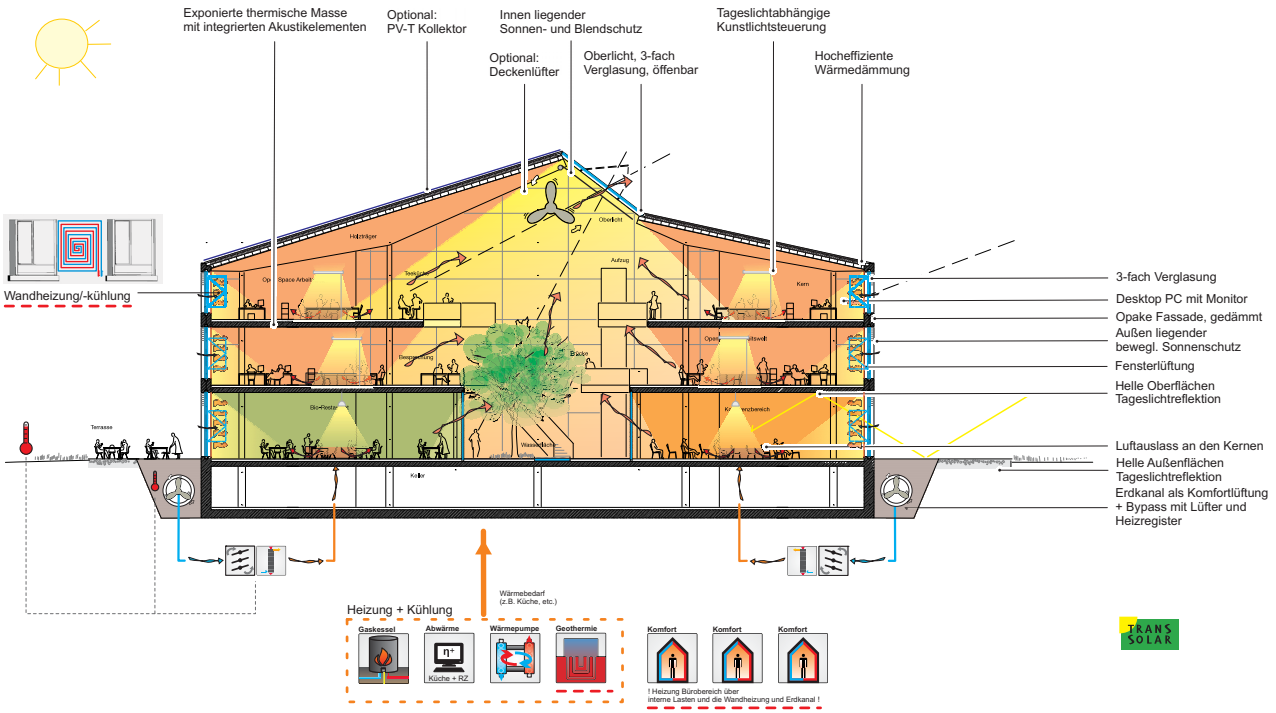
Natural ventilation – Fresh air from the forest

One of the initial planning objectives was to naturally ventilate the building year-round to obviate the need for resource-consuming and maintenance-intensive air conditioning and ventilation systems. The woodland to the west of the site offers an ideal source of cool fresh air. Evaporation of moisture from the surfaces of the leaves has a natural air-conditioning effect. Fresh air for the building is drawn in via two intake towers at the edge of the woodland and transferred via an underground duct to the building. The soil temperature remains more or less constant at the average temperature of the region and thus preconditions the inflowing air, warming it in winter and cooling it in summer. The fresh air is fed into the building via the structural cores and employs the chimney effect to draw air into the building, causing it rise up to the skylight. In the event of unusual weather conditions, thunderstorms or temperature inversions, fans can be activated inside the ducts. Aside from this natural ventilation cycle, people can also open the windows individually as needed.

Heating concept – Earth to the rescue

The pre-conditioning of the fresh air supply via the earth ducts means that the supplementary heating and cooling demand of the building is very low. In

08 The energy concept



addition, the thermal retention properties of the massive rammed earth walls and concrete ceiling slabs helps maintain a stable indoor climate by balancing out temperature fluctuations. On hot summer days, the tall space and the evaporation cooling effect of the rammed earth help avoid the build-up of pockets of heat in the office areas. The 69 cm thick earth walls provide enough mass to obviate the need for mechanical cooling in summer.

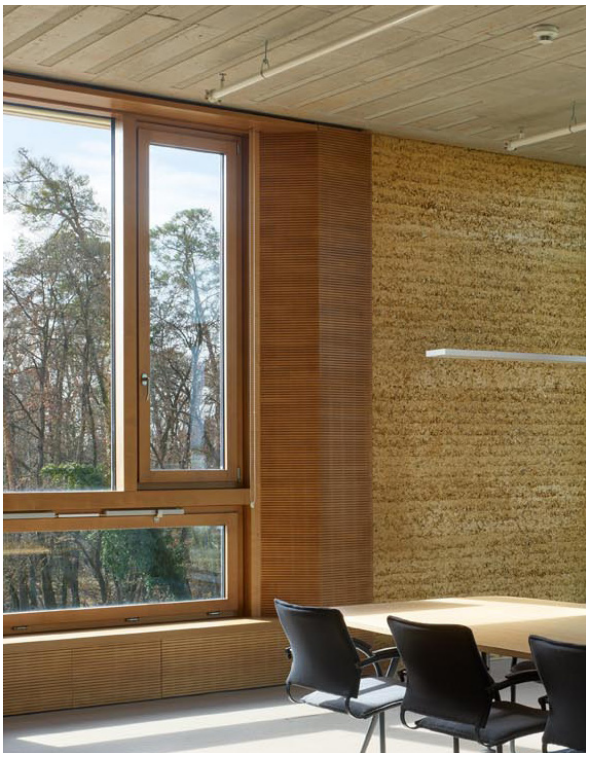
In winter, however, some additional heating is needed. An effective means of space heating is via heat radiation. To this end wall heating coils were incorporated into the rammed earth walls, fed by hot water from regenerative sources such as geothermal probes or waste heat recovery from the kitchen installations.

Water cycle

The extremely dry summer of 2018 once again demonstrated the importance of rain. Likewise, the increasing incidence of prolonged dry spells alternating with sudden heavy rainfall is a further indication of continuing climate change. The Alnatura Campus therefore makes very conscious use of water and rainwater. The terrain is modelled to lead water away from the building via streams and channels into an underground cistern with a capacity of more than 1000 m^3. Similarly, the roof drainage system also channels water directly to the cistern. The water is used for watering the school gardens and allotments and as grey water for the building.

Acoustics – A particular challenge

Most visitors are pleasantly surprised how subdued the background noise of the large open interior is, despite its considerable size. Its acoustics are more reminiscent of much smaller spaces. The large interior made it important to reduce the reverberation of undesirable sounds but at the same time acoustic panels or suspended ceilings could not be used without impairing the thermal regulating effect of the walls and ceiling slabs. A special solution was therefore developed that employs absorber strips embedded directly into the concrete ceiling soffits. The cellular structure of these prefabricated elements effectively refracts sound waves, significantly reducing noise levels. Along with this innovation – developed by the Fraunhofer Institute – the wooden slats lining the underside of the timber roof play an important role in scattering sound waves.



09 Acoustic timber window surrounds

The timber window surrounds and micro-perforated panels lining the structural cores dampen sound transmission in the vicinity and the open-pore structure of the rammed earth wall also contributes to the excellent acoustic properties of the building.

External skin – The rammed earth facade

For the external walls, an innovative rammed earth walling system was developed in cooperation with Martin Rauch and Transsolar. Sections of rammed earth wall measuring 3.5 × 1 m were prefabricated and then stacked and assembled to form 16 wall segments, each 12 m high. It is also the first time that geothermal wall heating has been incorporated into rammed earth walls. As no general building approval exists, a special building exemption was required from the building control authorities. This in turn necessitated additional material tests, hygrothermal simulations and compressive strength tests during on-site production.

A further special feature is the incorporation of core insulation into the rammed earth segments, which were prefabricated directly adjacent to the construction site. 17 cm of recycled foam glass gravel insulation was incorporated between a 38 cm outer layer and a 14 cm inner layer of rammed earth. Each seg-

ment is 69 cm thick and has a U-value of 0.35 W/m²·K. The 12 m high rammed earth wall sections are self-supporting and only anchored back to the floor slabs to keep them in place. A formwork system designed for in-situ concrete casting was used for ramming on site, with additional reinforcement to withstand the significantly higher pressure.

The rammed earth material was sourced from the Westerwald, with additional vulcanic gravel from the Eifel and recycled material from the Stuttgart 21 railway tunnel excavations.

The principle of rammed earth production is simple, but in practice requires a feeling for the material as well as proficiency with formwork and compaction technology.

Rammed earth is a monolithic end product with a density comparable to that of concrete and has both excellent natural thermal retention and humidity regulating properties.

To counteract the surface erosion, horizontal erosion barriers made of earth and trass lime were integrated every 30 to 60 cm. Like river engineering works they diminish the power of the water flow, thereby minimising erosion.

Thanks to the durability of the material as well as its excellent humidity regulation and thermal storage capacity, a building of high value and longevity has been created. The material is not pigmented and thus does not fade, and as the surface remains free of algae or moss formation, there is no need to clean or maintain the facade. After an initial degree of light surface erosion, the solid particles of the material are revealed, limiting further erosion.

Mechanical damage or abrasion can be repaired using the same material. In the interior, the hygrothermal properties of the material benefit the indoor room climate and bind odours and pollutants. The porous structure of the rammed earth wall also serves to scatter noise, improving the acoustics of the adjacent office areas. As such, the wall is both simple and honest, an impression it will retain for decades.

Together with Lehm Ton Erde (Martin Rauch), the German Federal Environmental Foundation DBU, and the Technical Universities of Munich and Darmstadt, an innovative external wall structure made of 100% renewable building materials has been created that requires only approx. 30% of the grey energy of a conventional facade over its lifecycle (production, installation, maintenance and demolition – see Embodied Energy and Embodied Carbon with Lixcel).

10 Setting the first prefabricated rammed earth element of a wall section on the wall base

This is far and away better than other natural products such as timber or fired bricks.

Conversion in pure form – Back to nature

The conversion of the former US Army barracks involved breaking up sealed surfaces and returning them to nature. Old roadway slabs were broken up on site and recycled, for example as seating steps, as edging for waterways or as gravel filling material. The old concrete slabs were, however, retained for the statutory parking spaces.

Alongside the various measures already mentioned, for example the use of renewable and natural building materials such as wood and earth and of recycled and reusable materials, many smaller, barely visible decisions also helped contribute to making the Alnatura Arbeitswelt a climate-neutral building. The insulation of the underground cellar, for example, is made of recycled foamed glass. The result is a highly versatile building that employs natural materials, is efficient in its use of resources, maximises natural ventilation and illumination, reduces energy consumption and optimises the indoor comfort for its users. The use of ecologically friendly building materials reduces the construction's impact on the environment and improves the overall ecological balance. Likewise, avoiding the use of materials that contain pollutants

11 Inner face of the rammed earth elements with integral wall heating, core insulation and window rebate

or produce emissions both reduces the cost of their proper disposal and the risk of health problems for the building's users.

The mix of regenerative energies (photovoltaics, geothermal energy, rainwater cistern) and climate-ap-

12 The building shell with the assembled prefabricated rammed earth sections

propriate construction methods has reduced the building's energy demand to about one third of the level stipulated in the current Energy Saving Ordinance (EnEV). The sum of all these measures employed in the design of the Alnatura Campus led to the project being awarded the platinum certificate by the DGNB German Sustainable Building Council in March 2019 and the German Sustainability Award 2020 in November 2019.

Energy-extensive, healthy construction – A DBU research project

Research in the construction sector over the past few decades has focused on reducing the energy demand during the building operation phase. While this has resulted in buildings that have a very low energy requirements during operation (e.g. passive houses), it does not consider or factor in the energy consumption necessary for the building's construction. Buildings have ever more technical installations and more materials. The Alnatura Arbeitswelt chose a different path by prioritising the choice of suitable materials in its sustainability evaluations. Alongside the energy consumed for the building's operation, the planning process also considered the resources required for construction, maintenance and demolition. This new, holistic approach is seen as being of exemplary character and was funded by the German Federal Environmental Foundation DBU. By evaluating the grey energy consumption from an early stage, the design was able to develop resource-saving solutions for the individual components of the Alnatura Campus.

In cooperation with Prof. Thomas Auer and his assistants at the Technical University of Munich, planning parameters have been developed that will also help future projects to become resource-neutral. The evaluation of the research results and the specific advantages of natural building materials will be published together with five other landmark projects in summer 2020.

Image credits

Photos: Roland Halbe (architecture)
Marc Doradzillo (construction site)
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Energy concept: Transsolar Energietechnik GmbH

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13 Alnatura Campus at dusk