



Hay&Clay

08.12.2022 Oslo

GREEN DESIGN STRATEGIES

POTENTIALS OF RAMMED EARTH CONSTRUCTIONS

Stefanie Grün

Associate | knippershelbig | Stuttgart, Berlin, New York

22

years

3

locations

90

employees

483 (112)

projects (timber projects)



Stuttgart (2001)

Tübinger Straße 12-16 , 70178 Stuttgart | GER



New York (2009)

75 Broad Street | NY 10004 | USA



Berlin (2014)

Zehdenicker Straße 21 | 10119 Berlin | GER

knippershelbig | project overview



Trumpf Smart Factory, Chicago 2017, Barkow Leibinger



KiTa-Baukasten Frankfurt, 2014, Birk und Heilmeyer



Wilhelmshaus Stuttgart, 2017, LRO Stuttgart



Sportzentrum Belair, Luxembourg, 2010, Auer und Weber



Staatsoper Berlin 2017, HG Merz



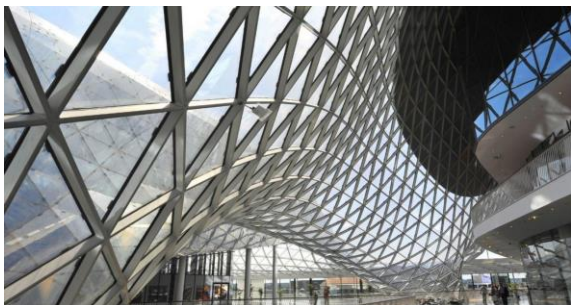
Collier Memorial, Cambridge, 2015, Hoeweler+ Yoon



Holzbrücken Landesgartenschau 2019, Remstal
knippershelbig und Cheret Bozic



REWE Pilotmarkt, Wiesbaden, 2021 ACME, London



My Zeil Frankfurt, 2009, Studio Fuskas



National Veterans Memorial, Columbus, 2018
Allied Works Architects



Peek & Cloppenburg, Köln, 2005, Renzo Piano



The Cradle, Düsseldorf, 2022 HPP Düsseldorf

knippershelbig | earth material



Quelle: Große Moschee von Djenné – Mali, 14th century (© Aline Gsell)



Quelle: Zentrum von Agadez – Niger, 14th century (© Alfred Weidinger)

knippershelbig | earth material



Quelle: Alte und neue Moschee von Dandaji – Niger, 2018 (© James Wang, Mariam Kamara)



Quelle: Alte Moschee von Dandaji – Niger, 2018 (© James Wang, Mariam Kamara)



knippershelbig | earth material



Quelle: Lehmalkultur, Jean Dethier, Edition Detail (© CRAterre)

knippershelbig | earth material



Quelle: Haus Rauch, Schlins (© Beat Bühler, Martin Rauch)



Quelle: Ricola Kräuterzentrum, © Markus Bühler

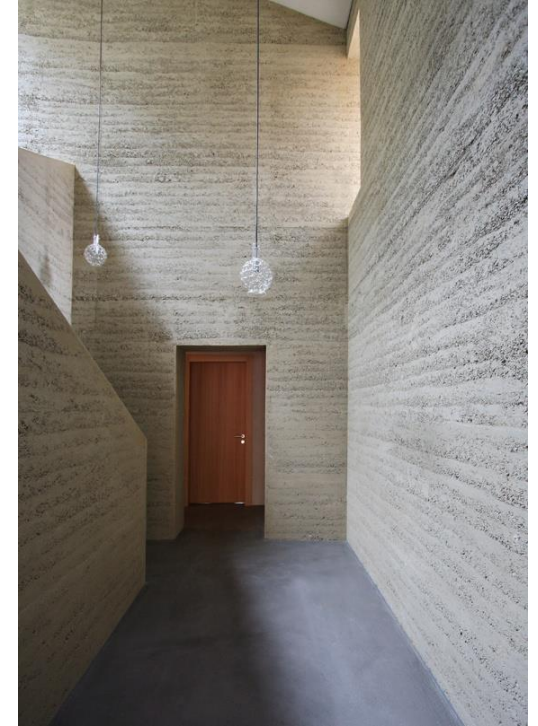
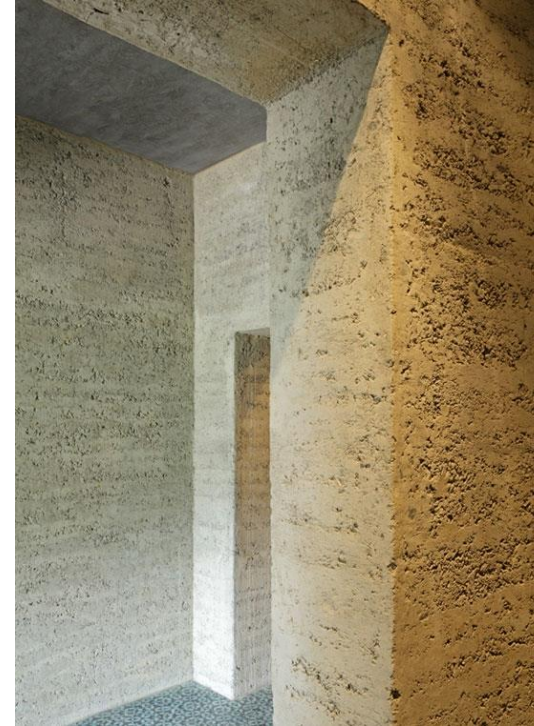
knippershelbig | earth material

components

- clay minerals, silty, sandy – stony aggregates

properties

- high dead weight
- air humidity absorption
- pollutent free
- availability
- shrinkage behavior
- durability
- natural look
- water soluble

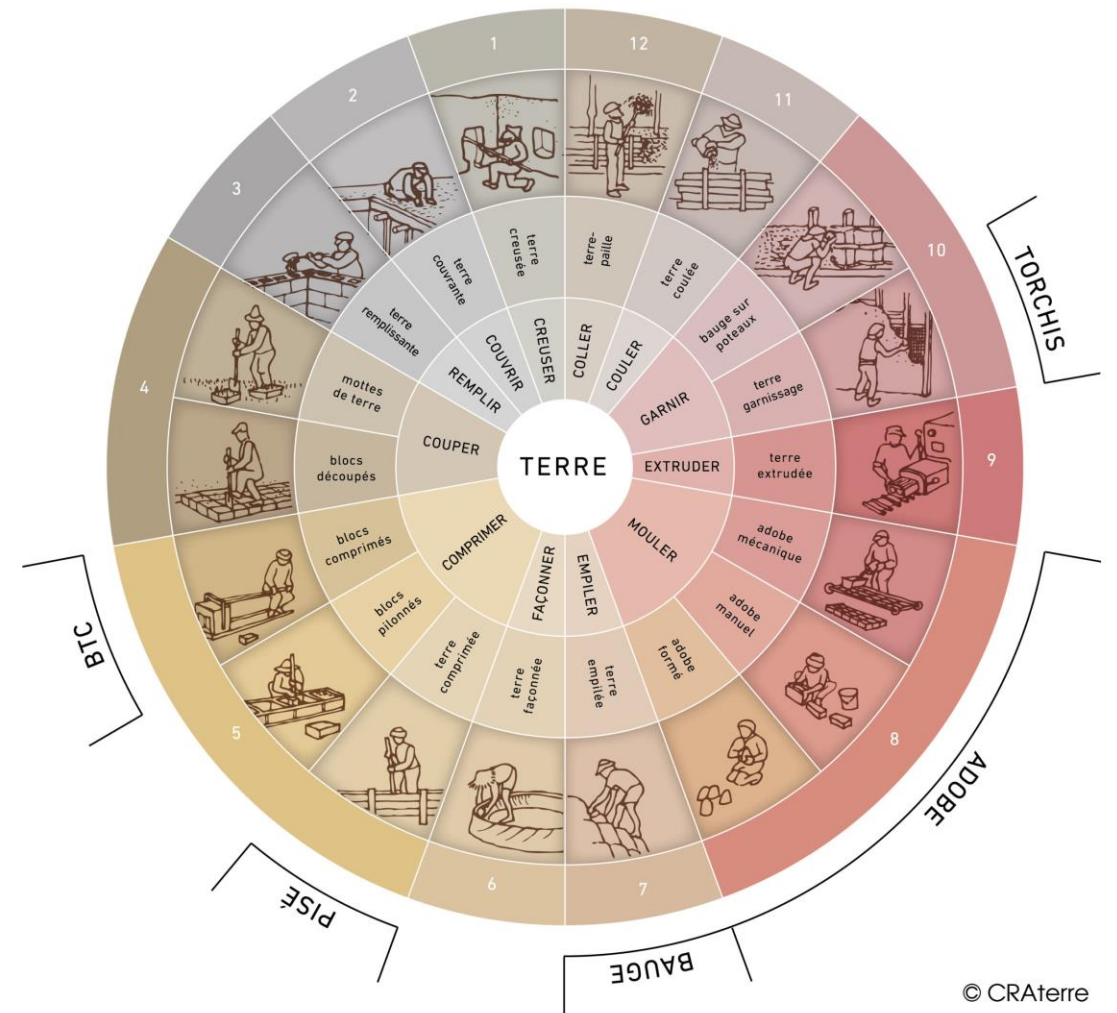


Quelle: https://www.claytec.de/de/produkte/mauerwerk_stampflehm_terrazzo/stampflehm-natur_pid383

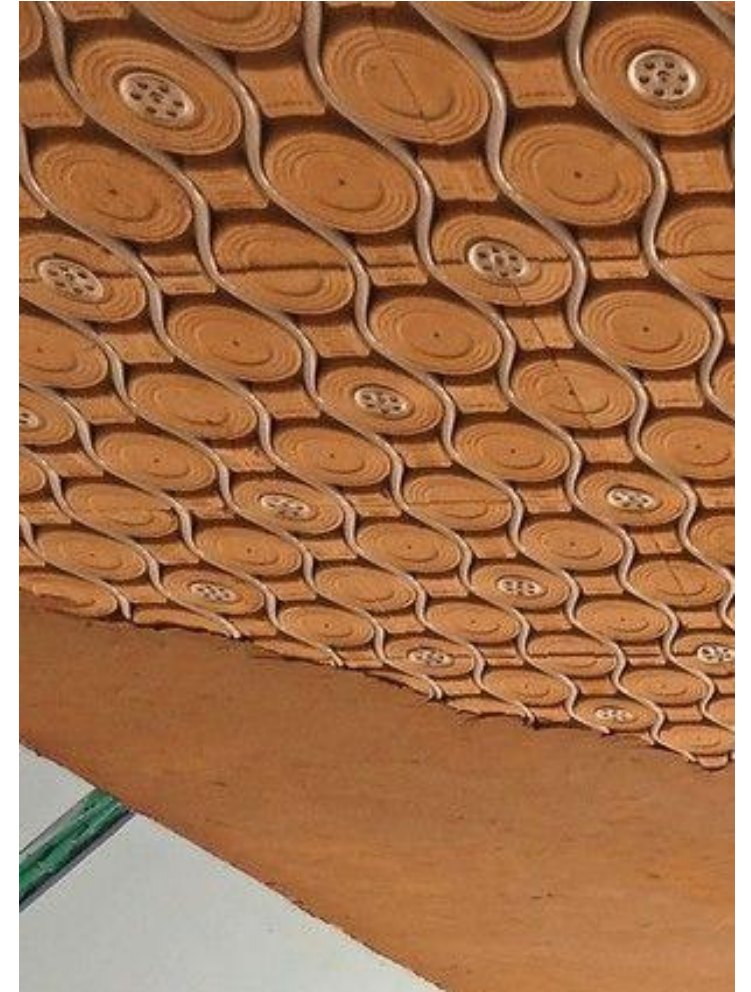
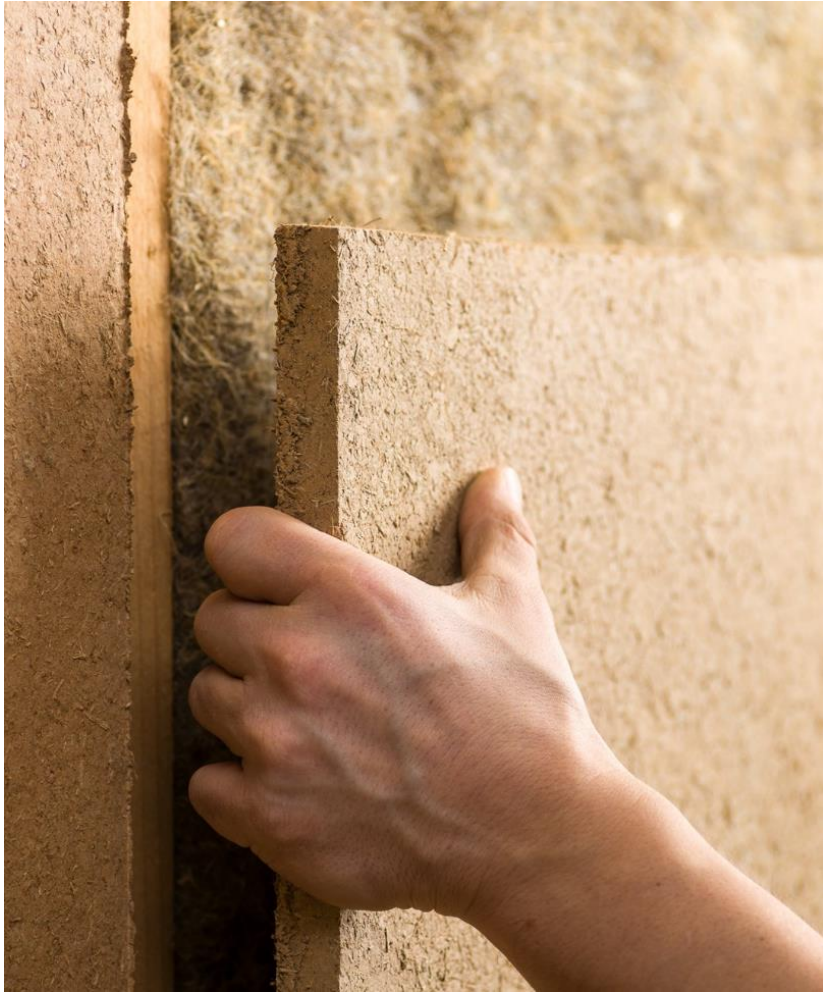
knippershelbig | earth material

building methods

- adobe (clay bricks, but air dried, not fired)
- straw clay mixture
- rammed earth
- cast earth



knippershelbig | earth material products



Quelle: ArgillaTherm

knippershelbig | earth material

disadvantages

1. non-standard material
2. shrinkage behavior and cracking
3. water resistance
4. psychological and cultural blocks
5. lack of education
6. costs



Quelle: Alnatura (© Marc Doradzillo)



Quelle: Haus Rauch, Schlins (© Beat Bühler, Martin Rauch)

knippershelbig | basis of design

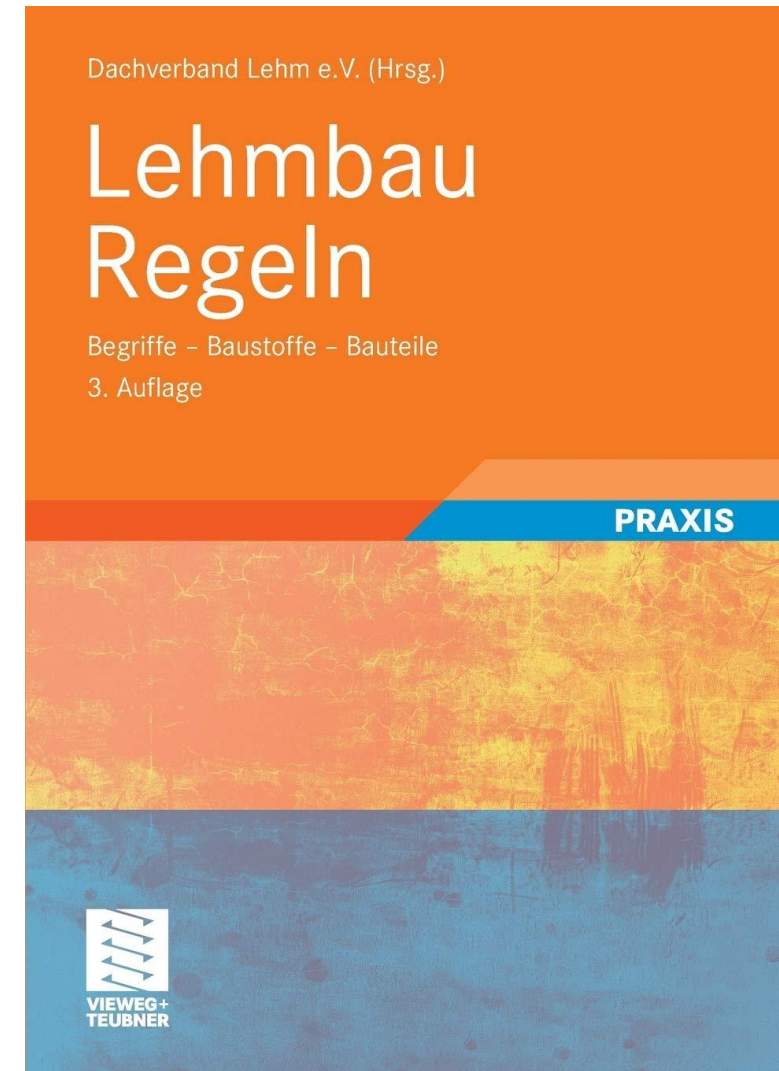
normative basis for design of rammed earth walls:

Lehmbau Regeln (Dachverband Lehm e.V.)

scope of the standard:

- building class 1 + 2
- residential construction
- maximum two full floors
- maximum floor height = 3,25m

alternative: approval procedure for a one-time approval (Zustimmung im Einzelfall)

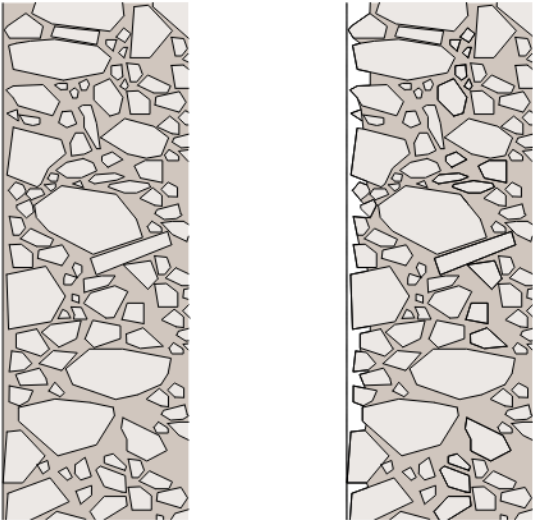


knippershelbig | controlled erosion



Quelle: METI Handmade School – Bangladesch 2005, Anna Heringer (© Benjamin Staehli)

A)



A) aggregate

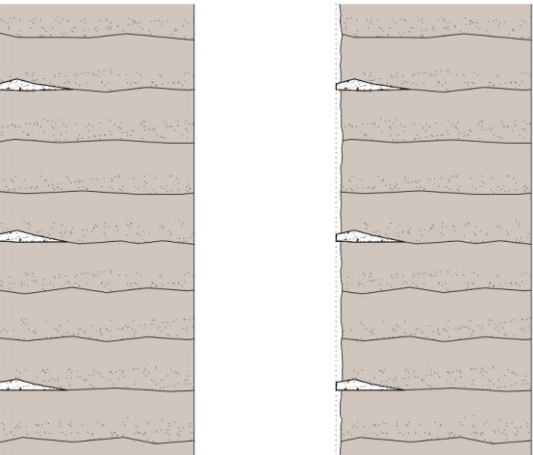
B) limestone strip

C) bricks

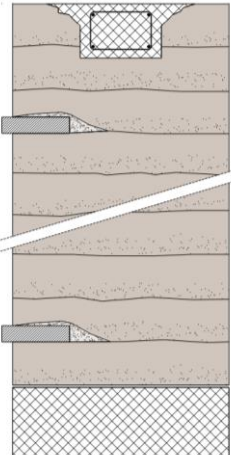
left: after completion

right: after direct weathering

B)



C)





Quelle: Gebaute Erde - Martin Rauch, Edition Detail ISBN 978-3-95553-270-3

knippershelbig | earth material

Advantages

1. humidity regulation
2. heat storage capacity
3. sound insulation
4. low environmental impact
5. material and transport savings
6. recyclable and repairable (without any loss of quality!)
7. participatory construction (encourages participation of the future users)
8. healthy
9. natural and diverse
10. durable
11. aesthetics

Quelle: <https://blog.dgnb.de/bauen-mit-lehm/>



Quelle: <https://baukultur-brandenburg.de/termin/new-european-bauhaus-awards/>

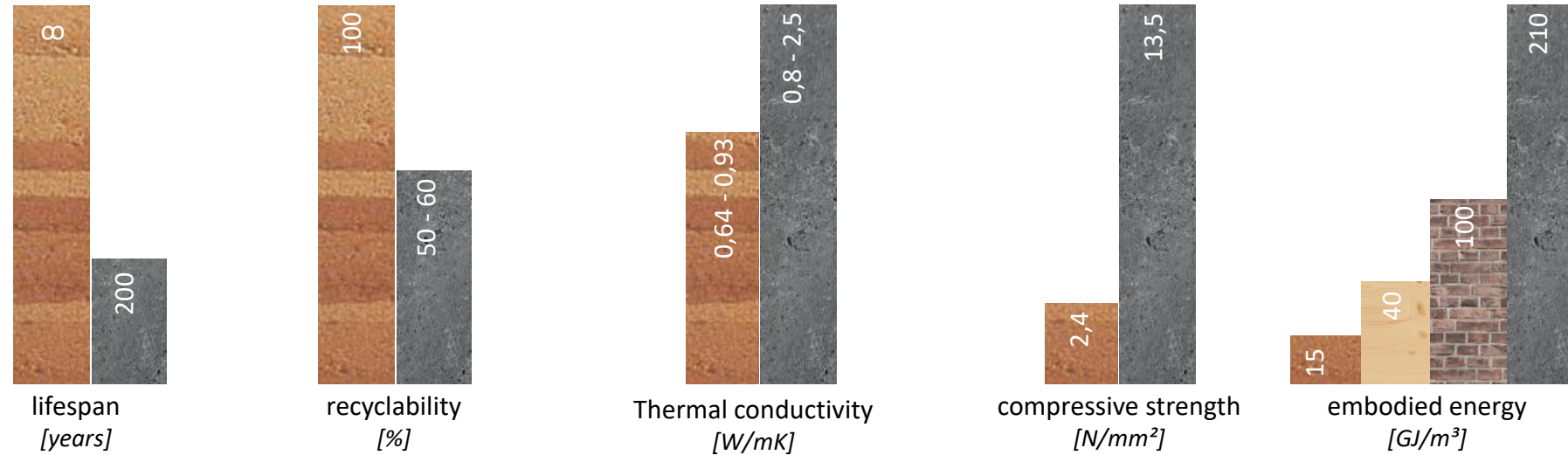


Quelle: https://www.claytec.de/de/produkte/mauerwerk_stampflehm_terrazzo/stampflehm-natur_pid383

knippershelbig | sustainability

4. low environmental impact

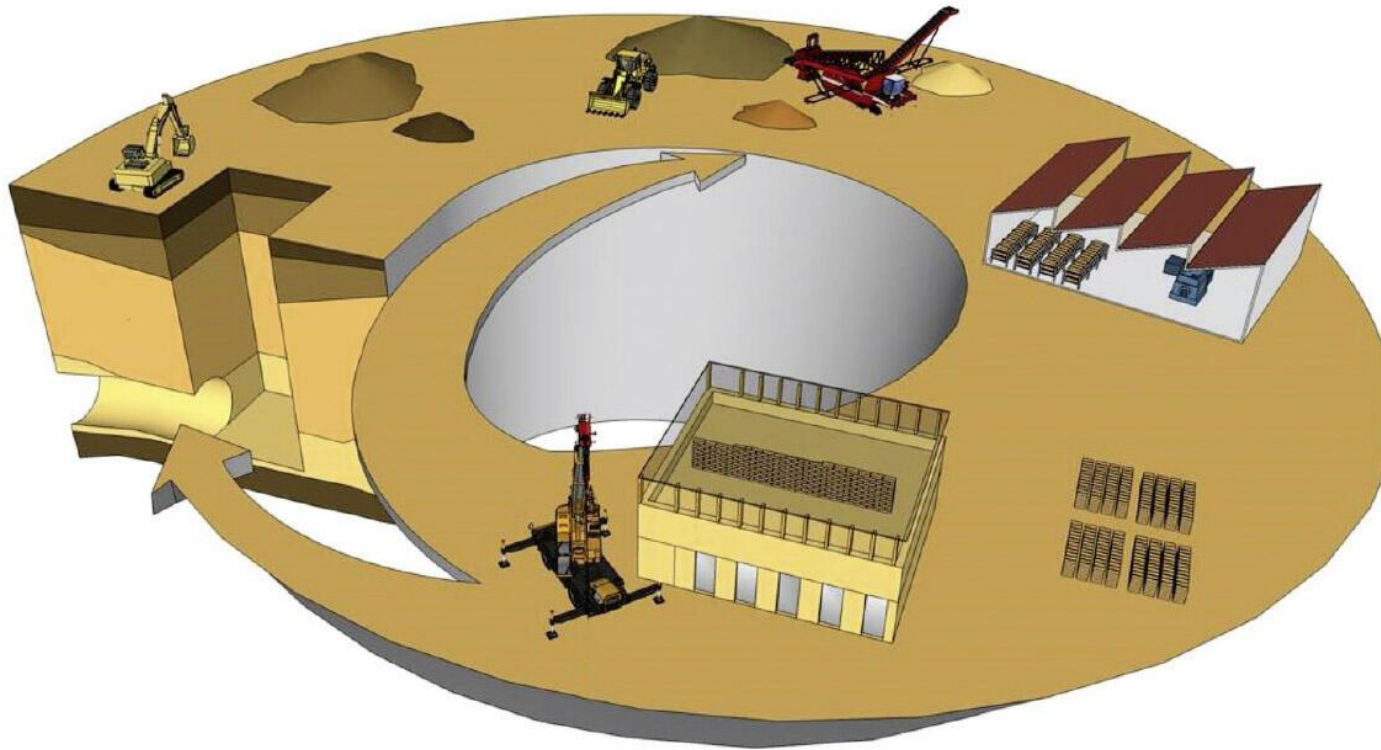
very less CO2 emissions (grey emissions)



Quelle: Upscaling Earth, Rauch, M., Heringer, A., Howe, L.

knippershelbig | sustainability

5. material and transport savings



Quelle: <https://www.wbw.ch/de/heft/atikel/leseprobe/2018-6-paris-kommt-auf-die-erde.html>

6. recyclable and repairable (without any loss of quality, the only material!)



Quelle: <https://www.dachverband-lehm.de/wissen/lehmbau-info>

knippershelbig | Alnatura Campus

project data

- location Darmstadt
- architecture: haascookzemmrich, STUDIO2050, Stuttgart (GER)
- construction company rammed earth: LehmTonErde, Schlins (AT)
- 3-story building (office, restaurant)

construction and building envelope

- concrete structure and wooden roof structure
- rammed earth facade (non-structural)

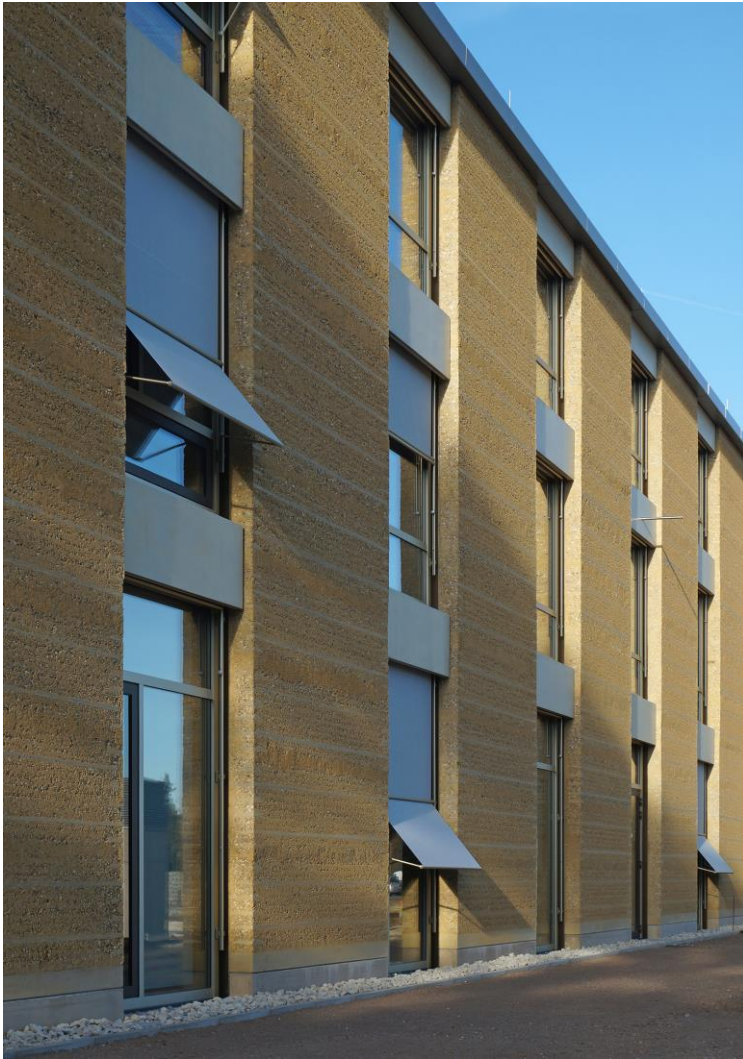
rammed earth facade

- prefabricated rammed earth elements (field factory)
- multilayer element, thermally activated
- earthquake zone 1
- one-time approval (ZiE)

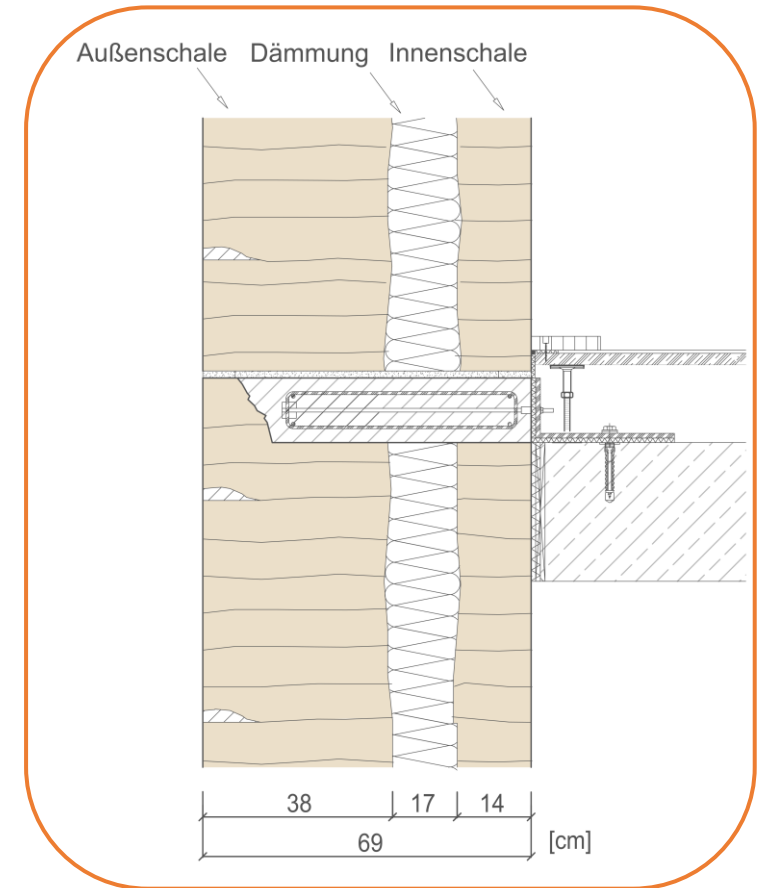
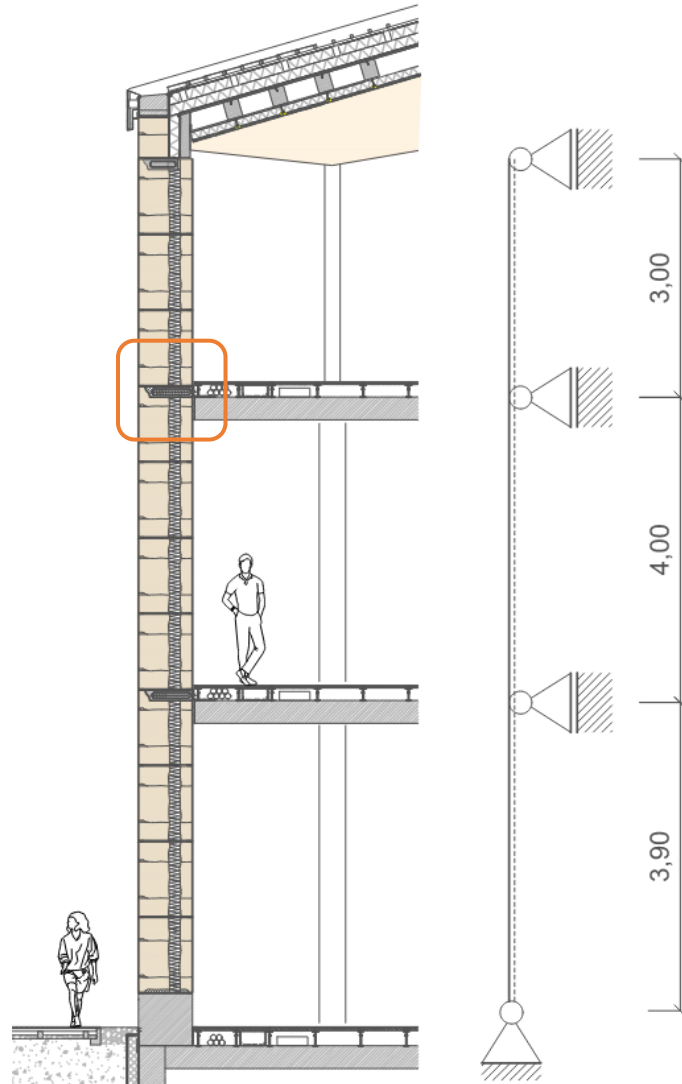


Quelle: <https://www.alnatura.de/de-de/ueber-uns/alnatura-campus/>

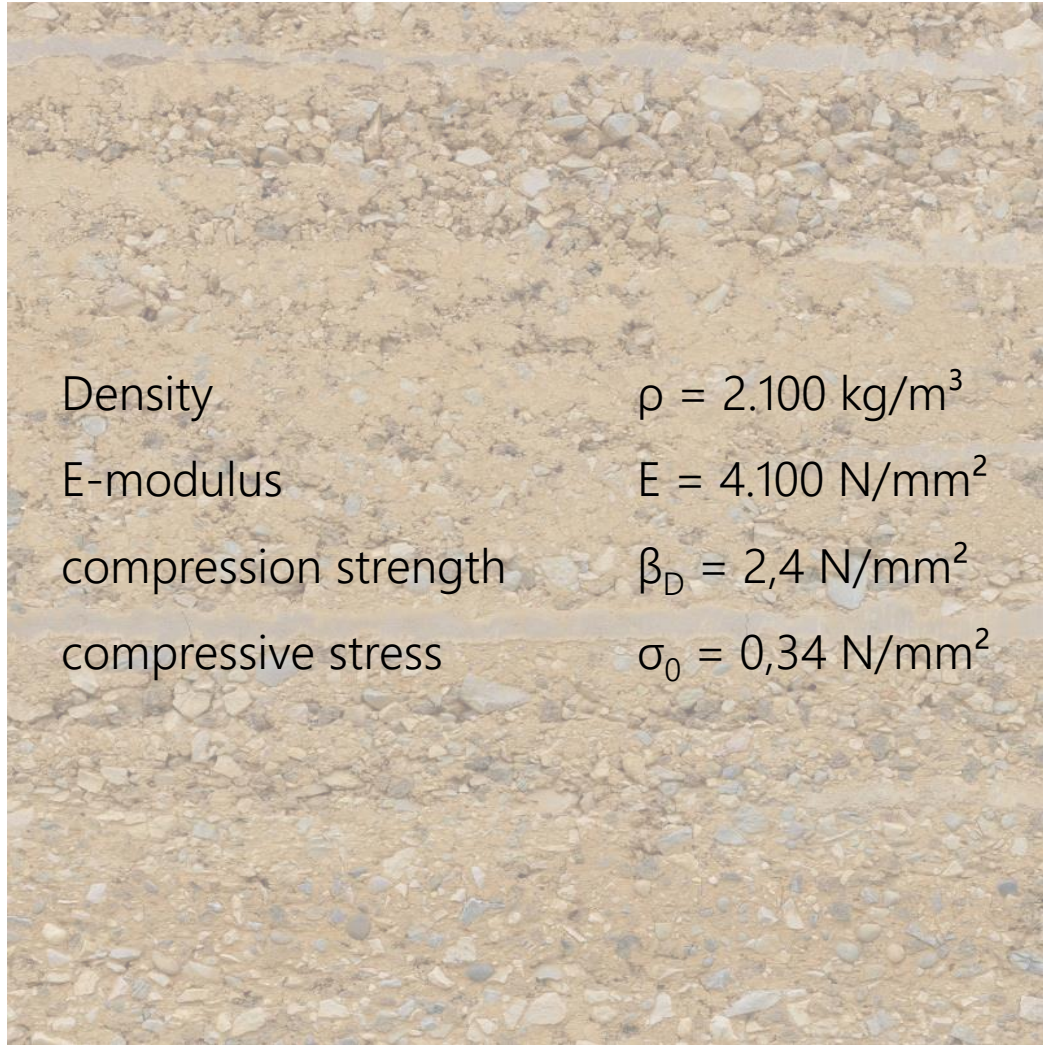
knippershelbig | Alnatura Campus



Quelle: <https://www.alnatura.de/de-de/ueber-uns/alnatura-campus/>

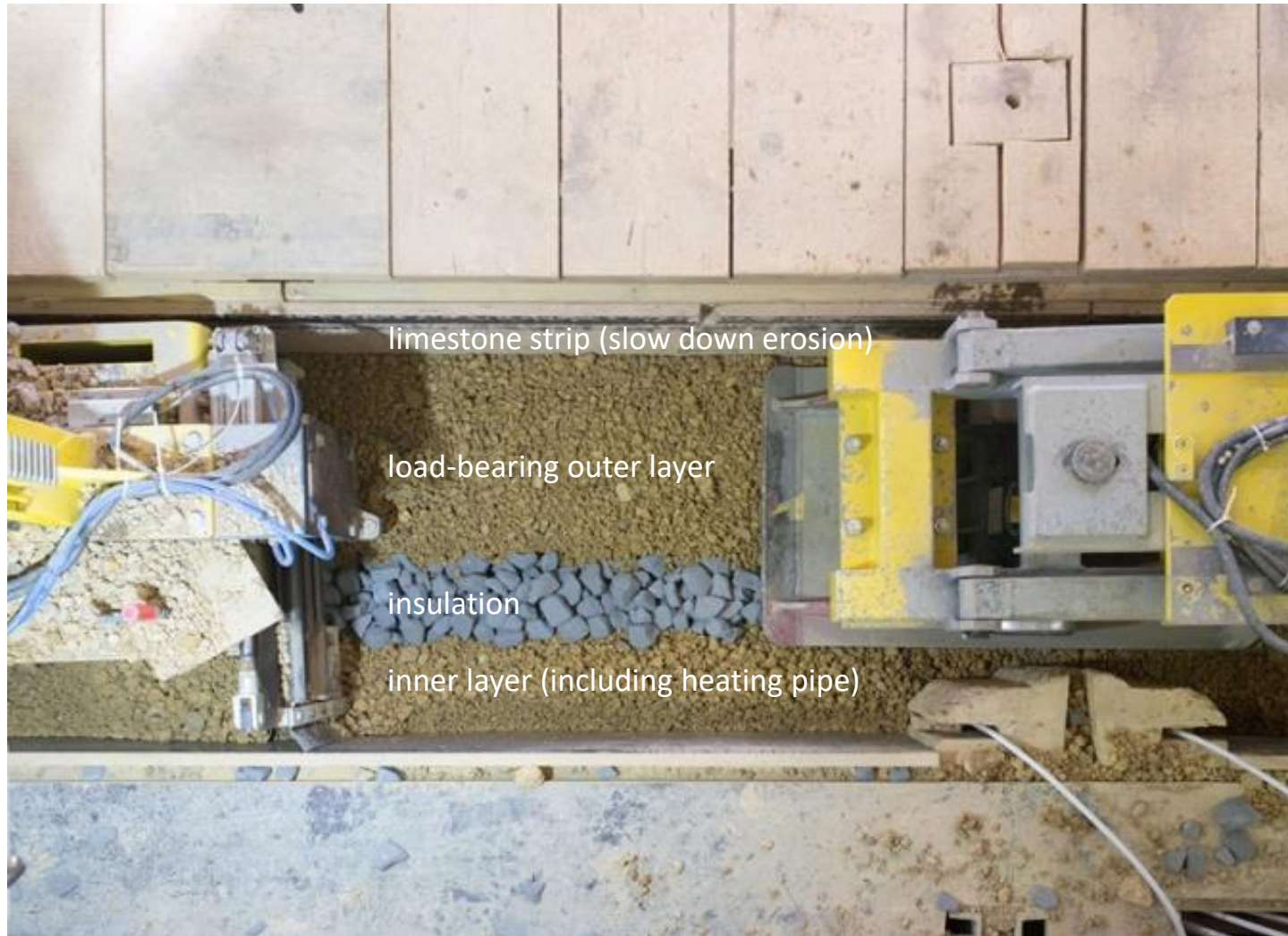


knippershelbig | Alnatura Campus

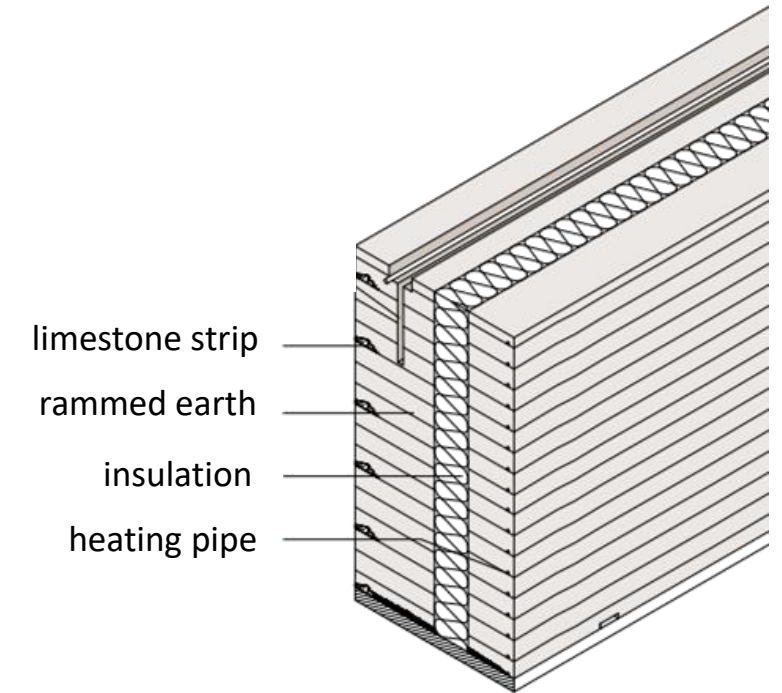


Density	$\rho = 2.100 \text{ kg/m}^3$
E-modulus	$E = 4.100 \text{ N/mm}^2$
compression strength	$\beta_D = 2,4 \text{ N/mm}^2$
compressive stress	$\sigma_0 = 0,34 \text{ N/mm}^2$





Quelle: LehmTonErde



knippershelbig | Alnatura Campus



Quelle: LehmTonErde

knippershelbig | Alnatura Campus



Quelle: LehmTonErde (© Emmanuel Dorsaz)



Quelle: Alnatura (© Marc Doradzillo)

Hay&Clay | Green Design Strategies

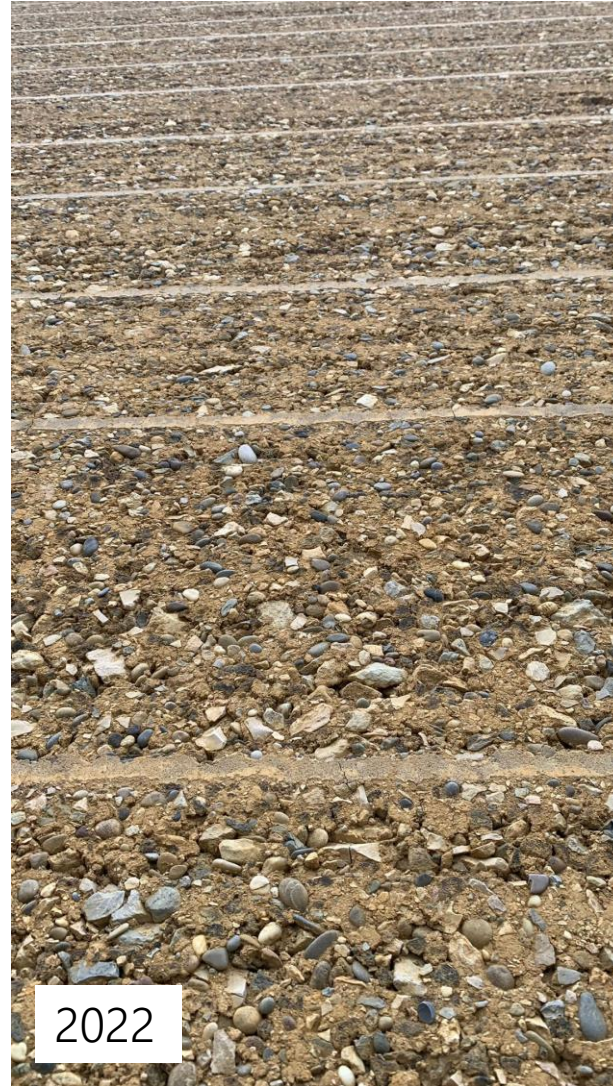


08.12.2022

knippershelbig | Alnatura Campus



knippershelbig | Alnatura Campus



knippershelbig | Alnatura Campus



Quelle: LehmTonErde



Quelle: <https://www.alnatura.de/de-de/ueber-uns/alnatura-campus/anfahrt/>

knippershelbig | NBL3

project data

- location Heilbronn
- architect: haascookzemmrich STUDIO2050, Stuttgart
- construction company rammed earth : LehmTonErde, Schlins (AT)
- 3-story building (residential)

construction and building envelope

- concrete structure
- variation study rammed earth facade

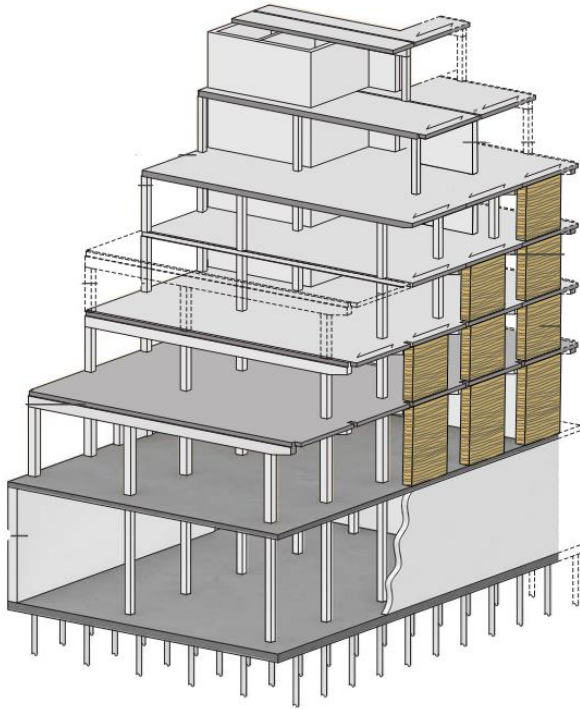
rammed earth facade

- prefabricated rammed earth elements (production hall LTE)
- one layer elements
- one-time approval (ZiE)



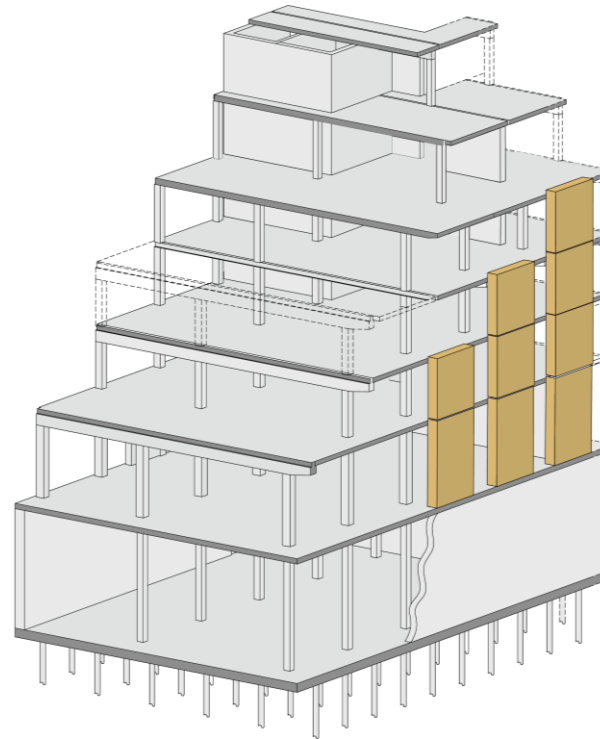
Quelle: <https://www.haascookzemmrich.com/de/news/neues-stampflehmgebaeude-fuer-heilbronn/>, Visualisierung Vizoom Barcelona

knippershelbig | NBL3



Quelle: © haascookzemmrich

Option A:
facade elements placed floor by floor

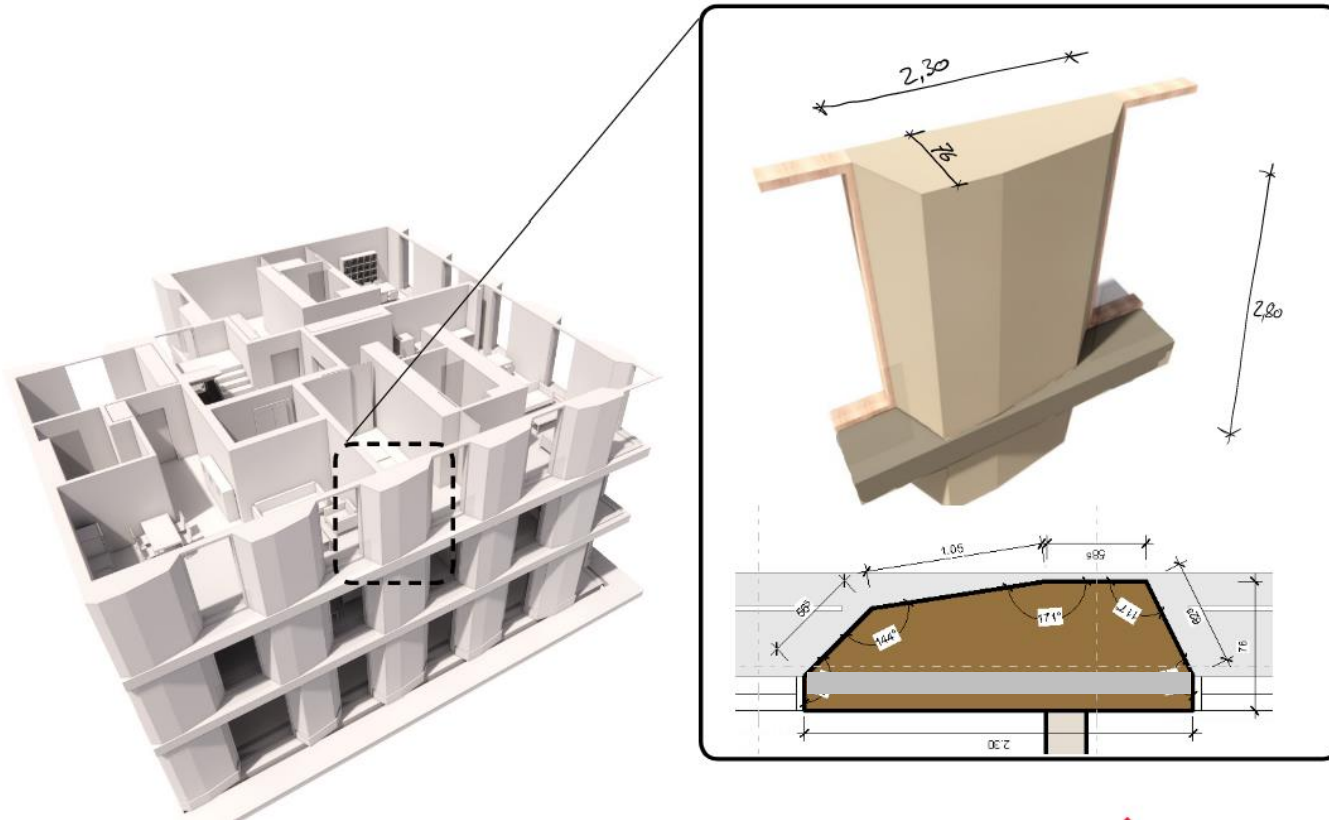


Option B:
Facade structure in front of building structure



Quelle: <https://www.haascookzemmrich.com/de/news/neues-stampflehmgebaeude-fuer-heilbronn/>, Visualisierung Vizoom Barcelona

knippershelbig I NBL3



Quelle: © haascookzemmrich



Quelle: <https://www.haascookzemmrich.com/de/news/neues-stampflehmgebaeude-fuer-heilbronn/>, Visualisierung Vizoom Barcelona

knippershelbig | Weleda Logistik Campus

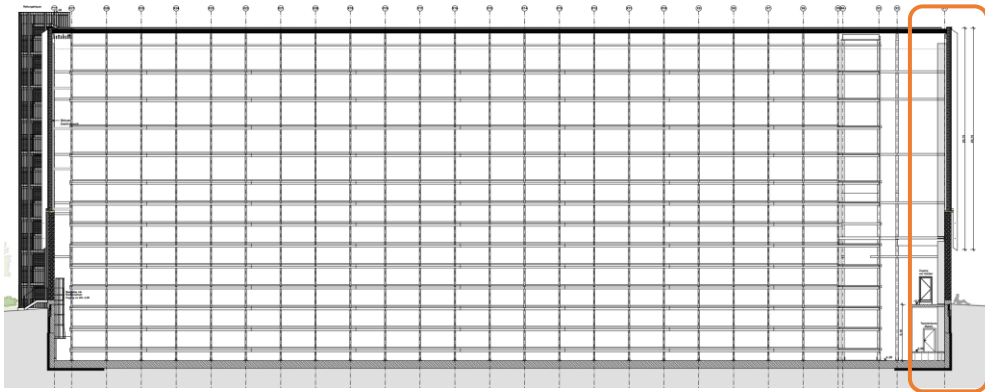


Quelle: Weleda Logistik Campus (© Weleda)

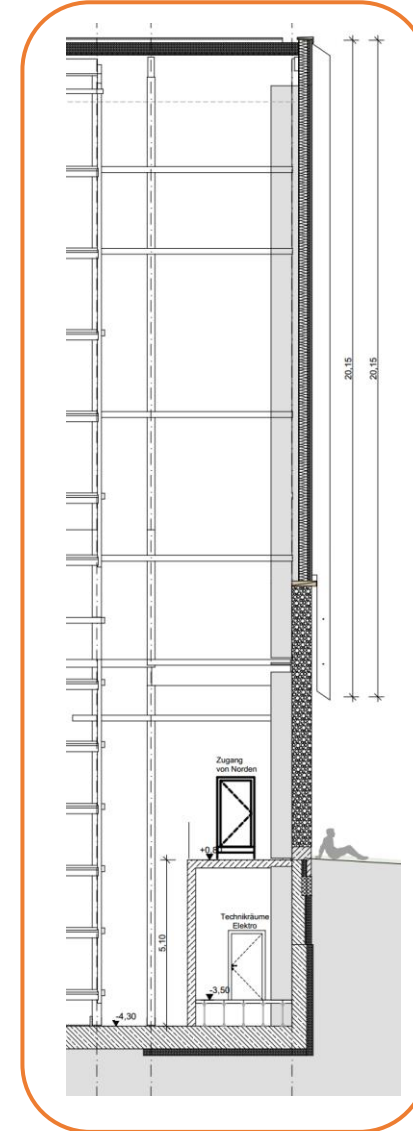


Quelle: Weleda Logistik Campus (© Weleda)

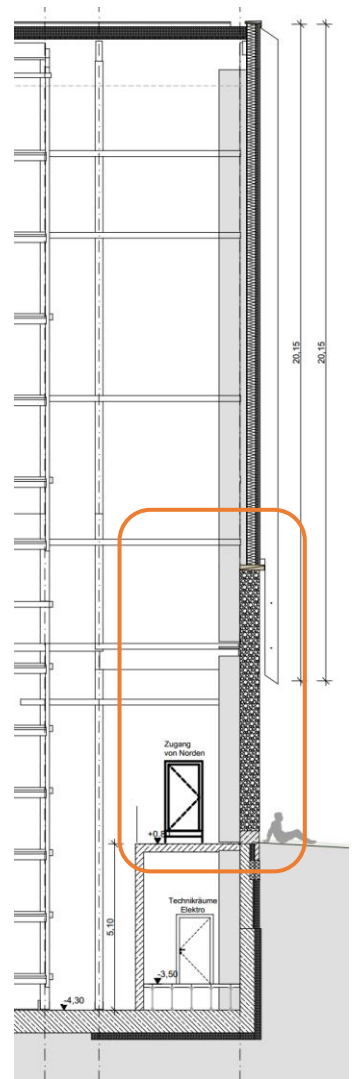
knippershelbig I Weleda Logistik Campus



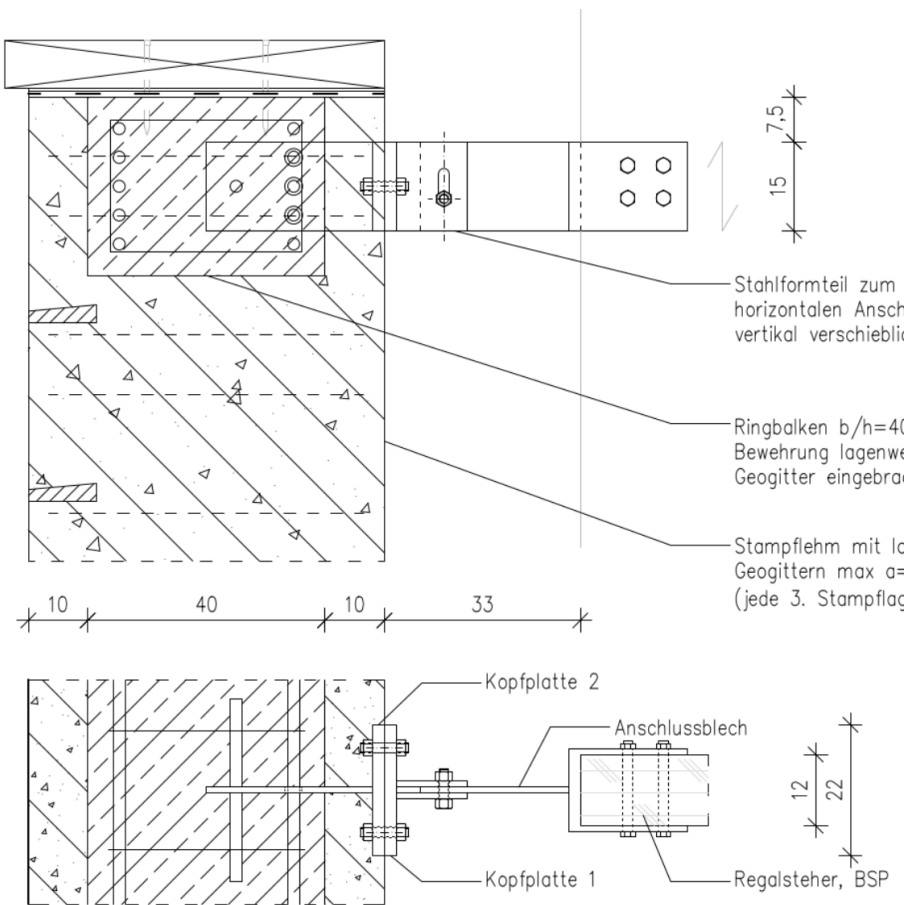
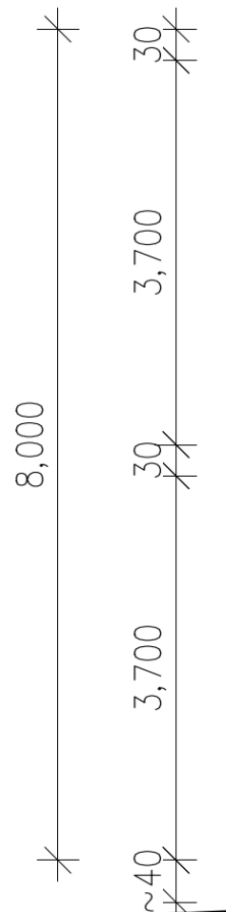
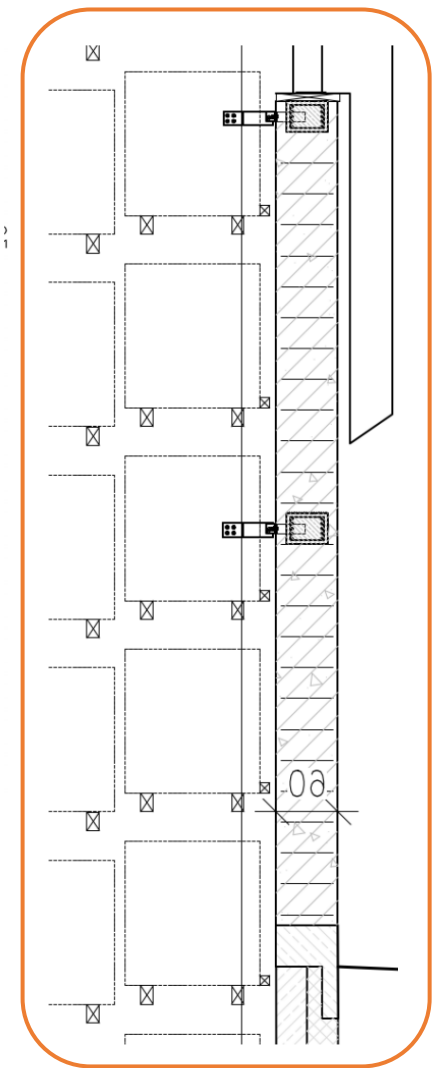
Quelle: Hochregallager, Michelgroup Architekten



knippershelbig I Weleda Logistik Campus



Quelle: Hochregallager, Michelgroup Architekten



Quelle: Ausführungsplanung Hochregallager (© ZRS Berlin)

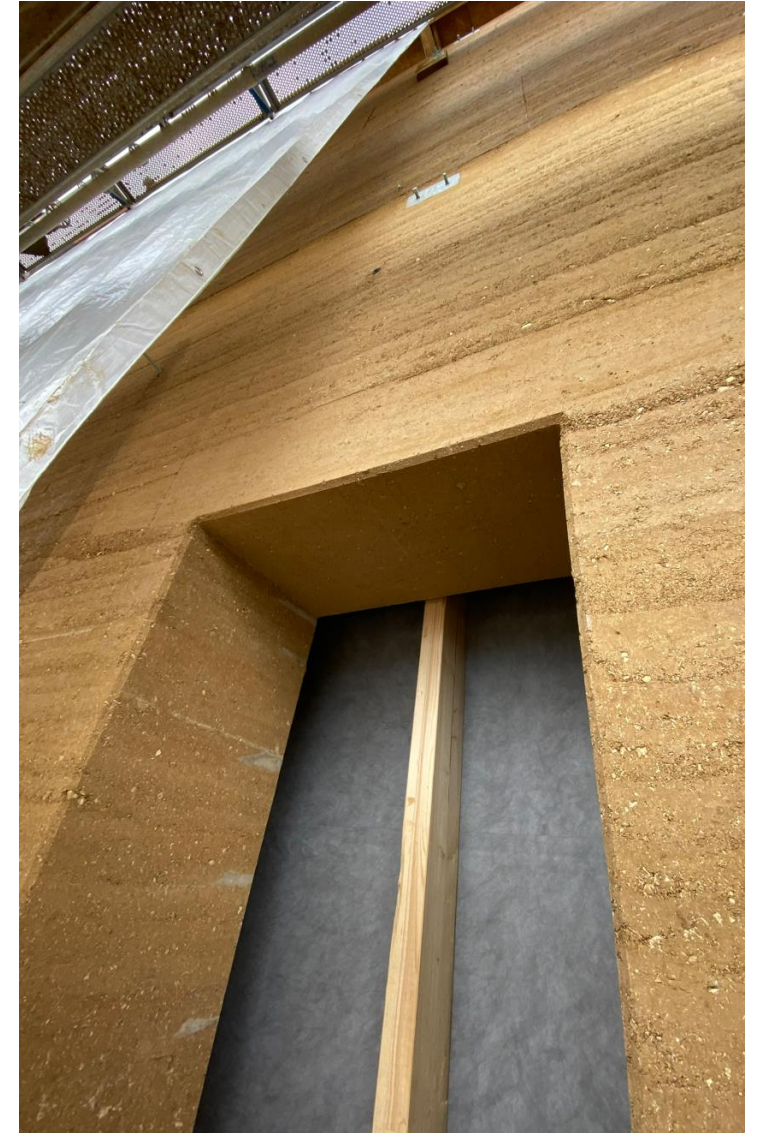
knippershelbig | Weleda Logistik Campus



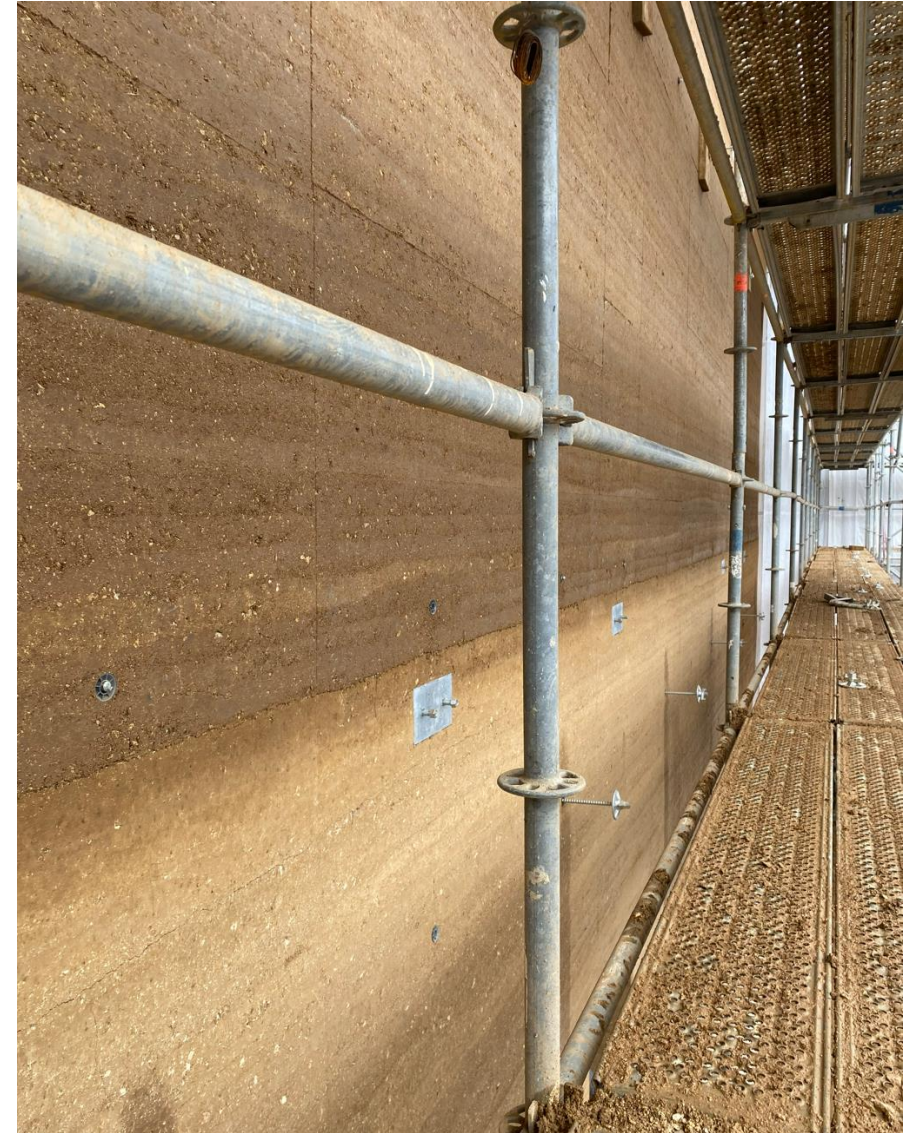
knippershelbig | Weleda Logistik Campus



knippershelbig | Weleda Logistik Campus



knippershelbig | Weleda Logistik Campus



knippershelbig | Weleda

feasibility study

- study of a noise protection wall made out of rammed earth and Weller clay
- comparison with conventional concrete and composite solutions

beneficial properties of earth

- high dead load
- porous surface



Quelle: https://baukultur-brandenburg.de/wp-content/uploads/2021/06/Raststa%CC%88tte_Stand_Februar2021_03.jpg



Quelle: Machbarkeitsstudie Lärmschutzwand an der Autobahn A14 bei Nebelin, Mittelstädt, J. et al

knippershelbig | Weleda

Advantages earth construction

- sustainable:
 - low embodied emissions
 - fully recyclable
 - short transport distances (excavated material)
- space saving construction
- naturally construction
- low maintenance
- nesting opportunities for insects



Quelle: <https://baukultur-brandenburg.de/termin/new-european-bauhaus-awards/>



Quelle: Machbarkeitsstudie Lärmschutzwand an der Autobahn A14 bei Nebelin, Mittelstädt, J. et al

knippershelbig | Biberach

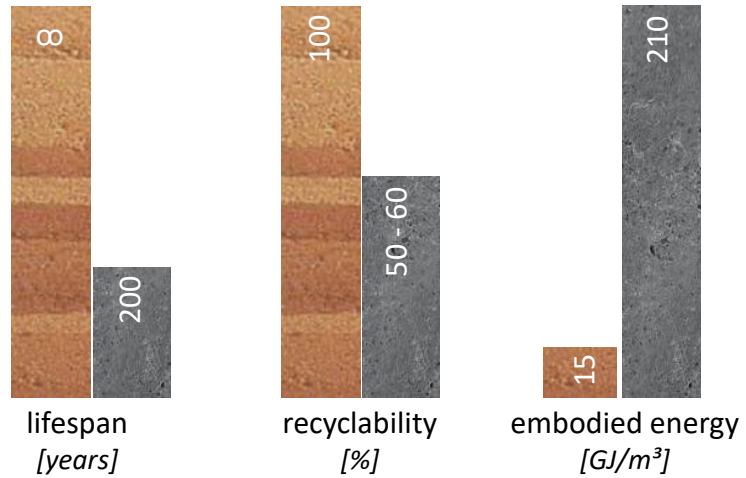


Quelle: Zentrum für bioökonomische Hybridbauweise © Bruno Fioretti Marquez



knippershelbig I summary

1. traditional construction material
2. not standardised material
3. sustainable construction material
4. widespread global abundance
5. growing interest



Quelle: Upscaling Earth, Rauch, M., Heringer, A., Howe, L.



Quelle: Lehmalkultur, Jean Dethier, Edition Detail (© CRAterre)