



Combining geopolymer technologies with natural building techniques



**EESTI
MAA
EHITUS**

COMPETENCE CENTER
FOR ECOLOGICAL
BUILDING

Mikk Luht
Founding and board member



EESTIMAAEHITUS - COMPETENCE CENTER FOR ECOLOGICAL BUILDING

- Advises and connects natural building enterprises, organizations and individuals
- Offers broad educational services
- Promotes traditional and modern solutions in field of energy efficient and natural building
- Is a member of Earth Build Europe network, European straw building association and a training partner of the Estonian Unemployment Insurance Fund
- Initiates cooperation between natural building enterprises and research institutions
- Initiates and manages local and International projects, and International networking
- In 2020 opened a Training, Product Development and Competence Center for Ecological Building in Mooste Manor

FOCUS



Earth



Lime



Natural fibers



TRAINERS



MATERIAL PRODUCERS



VOLUNTEERS



BUILDERS



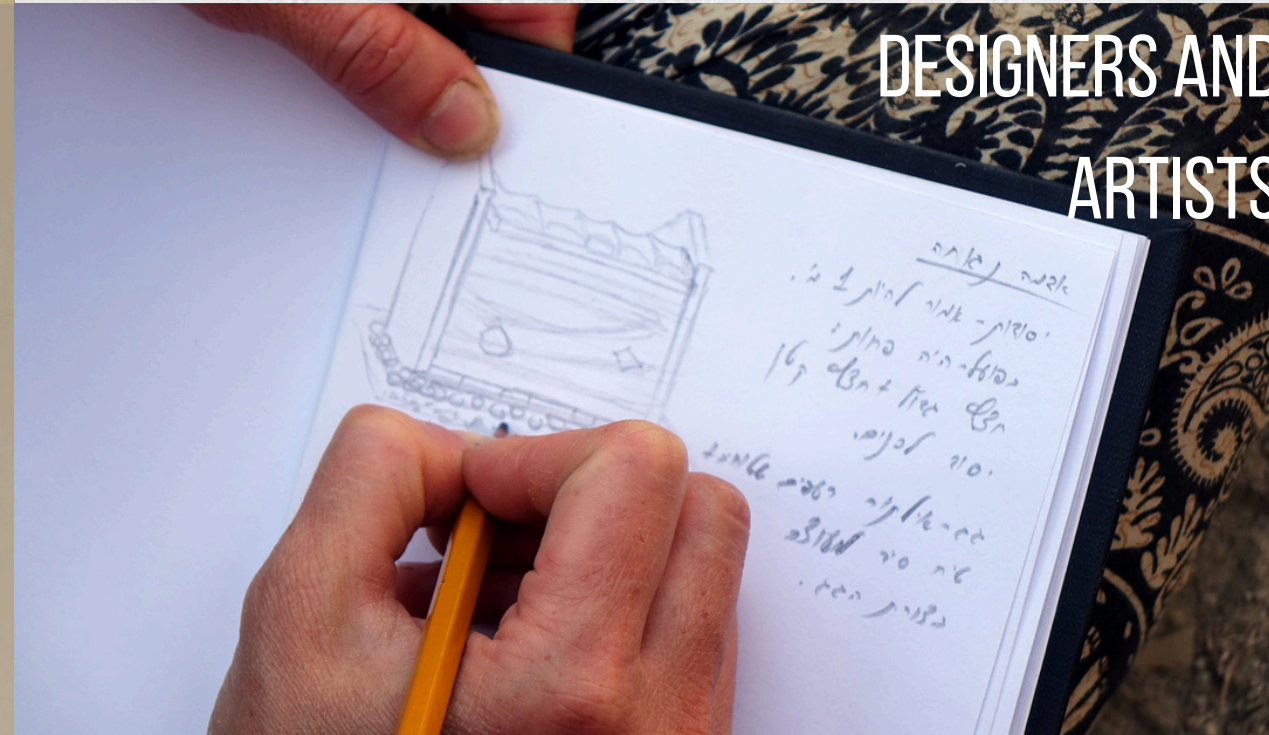
MEMBERS



FINISHERS



PROJECT MANAGERS



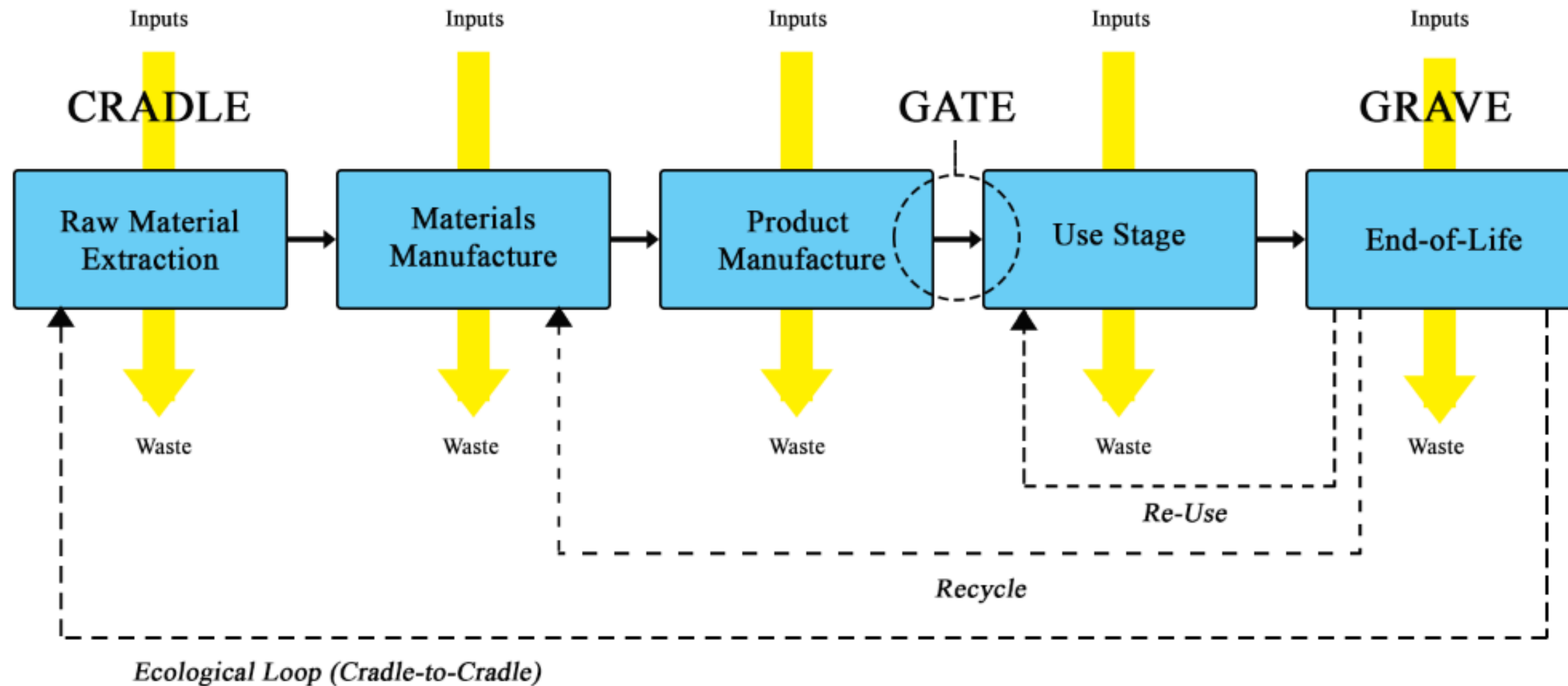
DESIGNERS AND ARTISTS



ARCHITECTS AND ENGINEERS

MATERIALS

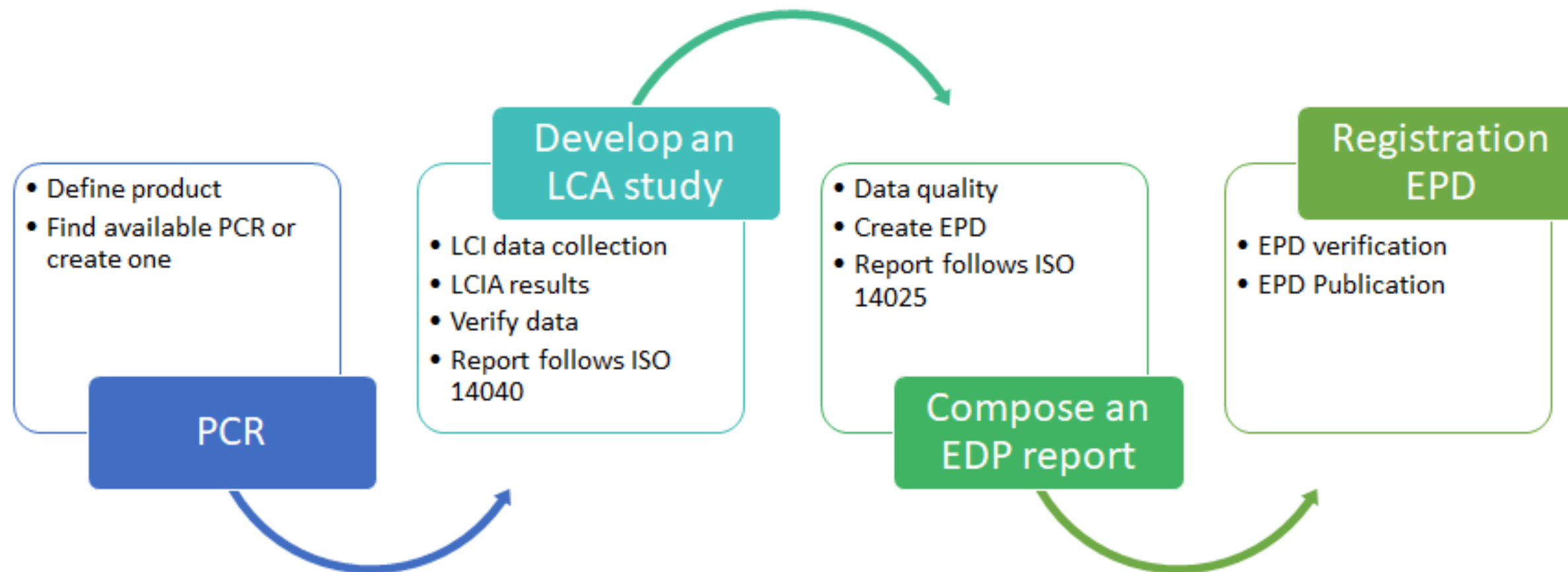
LCA - Life-cycle assessment / Life-cycle analysis
is a methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service.



MATERIALS

EPD - Environmental Product Declaration

quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.



NATURAL MATERIALS

Materials that can be used without chemical and/or thermal treatment



Clay



Sand



Natural stone
(limestone, fieldstone etc.)



Natural fibers
(wood, straw, hemp, flax, reed etc.)

ENVIRONMENTALLY FRIENDLY MATERIALS

Processed natural materials / Recycling / Industrial waste (circular economy)

Keep in mind the following when selecting the materials:

- as little energy as possible should be spent on the production and transport of the materials (primary energy content);
- as little energy as possible should be spent on the maintenance, use, renewal, or replacement of the materials (operational energy content);
- during the installation and use cycle of the materials, no compounds harmful to the environment or the indoor climate of the buildings should be released;
- the materials need to be reusable or their disposal should not harm the environment.



EARTH



Bearing constructions



Insulation



Finish

WHY USE RAW EARTH FOR BUILDING AND FINISHING MATERIALS?

Natural



100% natural, chemically and thermally untreated.

Indoor climate



Balancing the level of relative humidity in the rooms and accumulate heat.

Health



Does not contain volatile organic compounds, but can bind them, also suitable for allergy sufferers.

Sustainable



With a very small ecological footprint, recyclable and disposal safe for the environment.

User friendly



Clay is a forgiving material that allows itself to be reworked when moistened. Safe and easy installation.

Unique



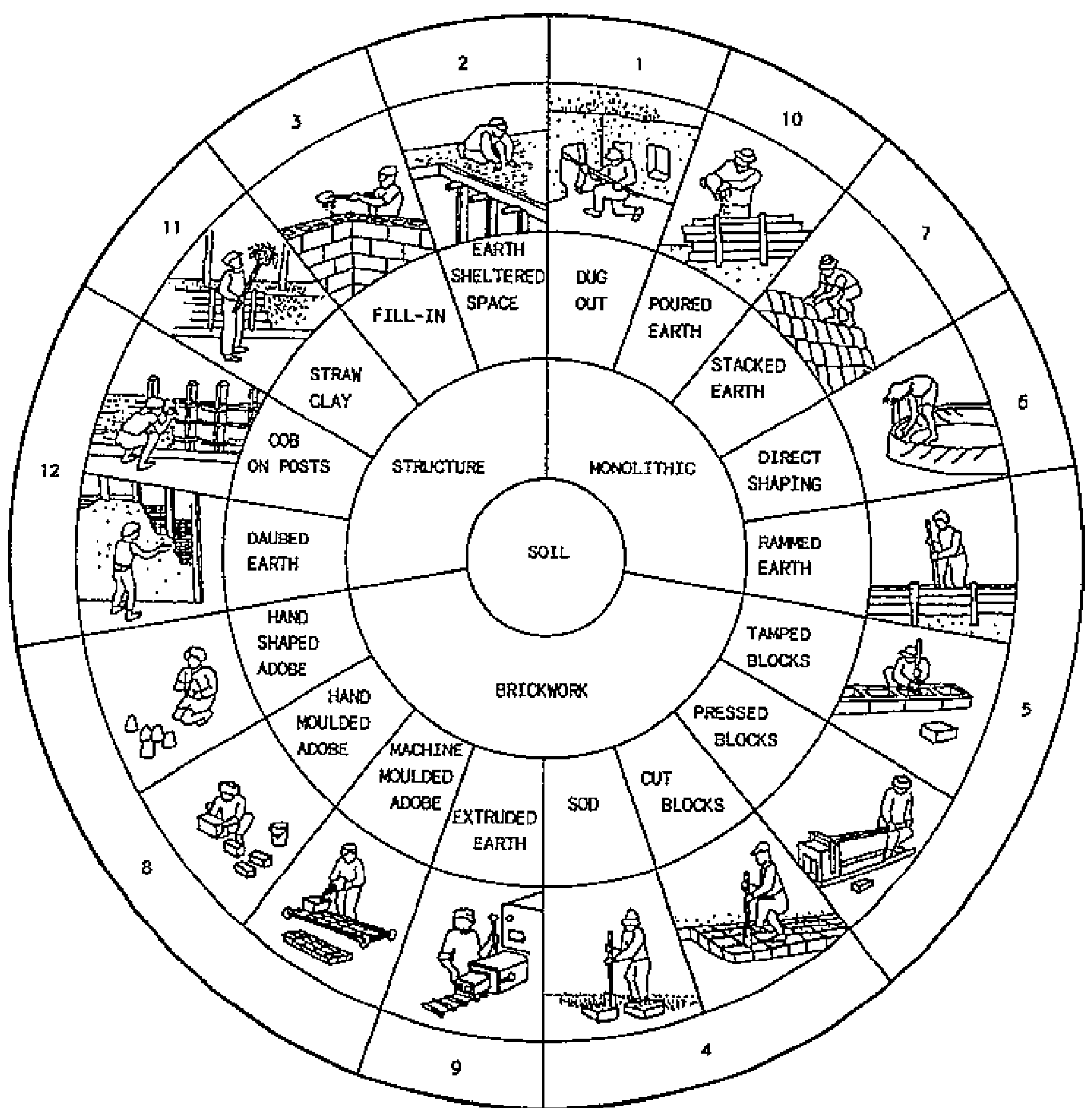
Countless possibilities for earthy pastel hues, unique textures, patterns and decorative finishing.

CLASSIFICATION

Structure

Monolithic

Brickwork



CLASSIFICATION

Light earth: up to 1200 kg/m³
With insulating properties
Requires additional
load-bearing structure

Massive earth: more than 1200 kg/m³
Thermal mass
Load-bearing structure
can be built



CLASSIFICATION

Dry



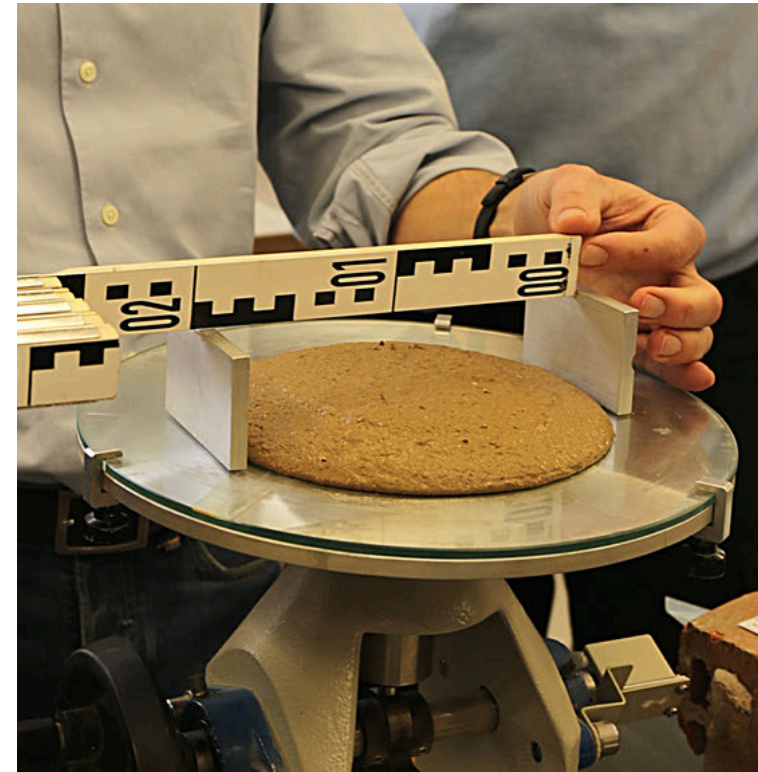
Humid



Plastic



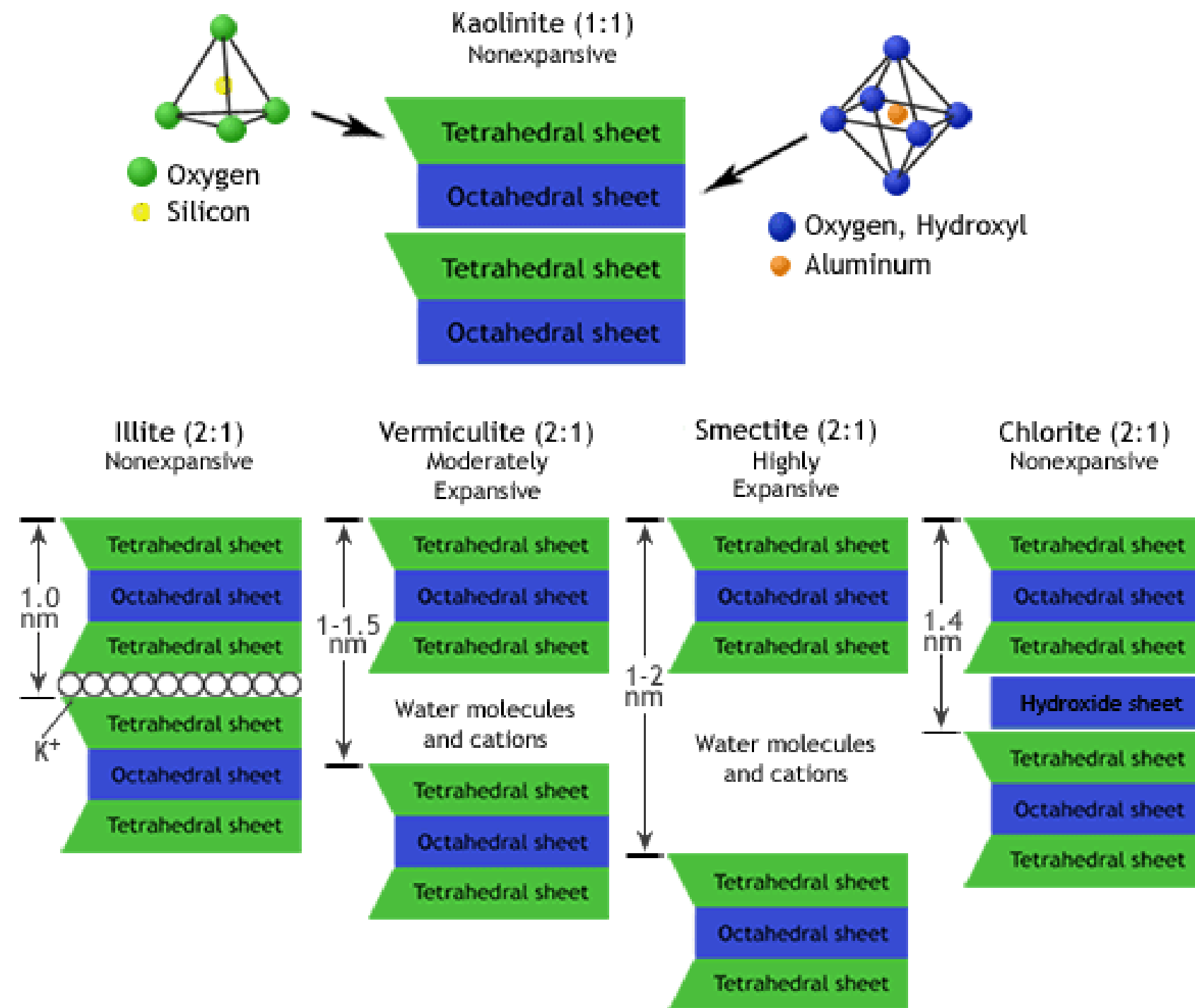
Viscous



Liquid



STRUCTURE OF CLAYS





Shibam, Yemen.
"Manhattan of the Desert"

Origin 300 AD, mainly built
after 1532.

4-8-storey buildings up to
30m high.



Ait Benhaddou, Morocco.
Ksar - fortified village.
Beginning in the 11th century,
existing buildings from the
17th century.

Movies: The Mummy,
Alexander the Gladiator, Game
of Thrones





Thousands of earth buildings have been constructed in Estonia as well. The oldest, which has survived to this day, dates back to the 17th century.



STABILIZING EARTHEN MATERIALS WITH BIOPOLYMERS

Polysaccharides



Cellulose

Starch

Natural gummies

Proteins



Casein

Enzymes

Collagen

Lipids



Drying oils

Fats

Waxes

Other



Tannins

Resins

Animal manure

STABILIZING AND COMBINING NATURAL MATERIALS WITH GEOPOLYMERS?



COMPRESSED EARTH BLOCK (CEB)



Earth/Clay



Sand/Gravel

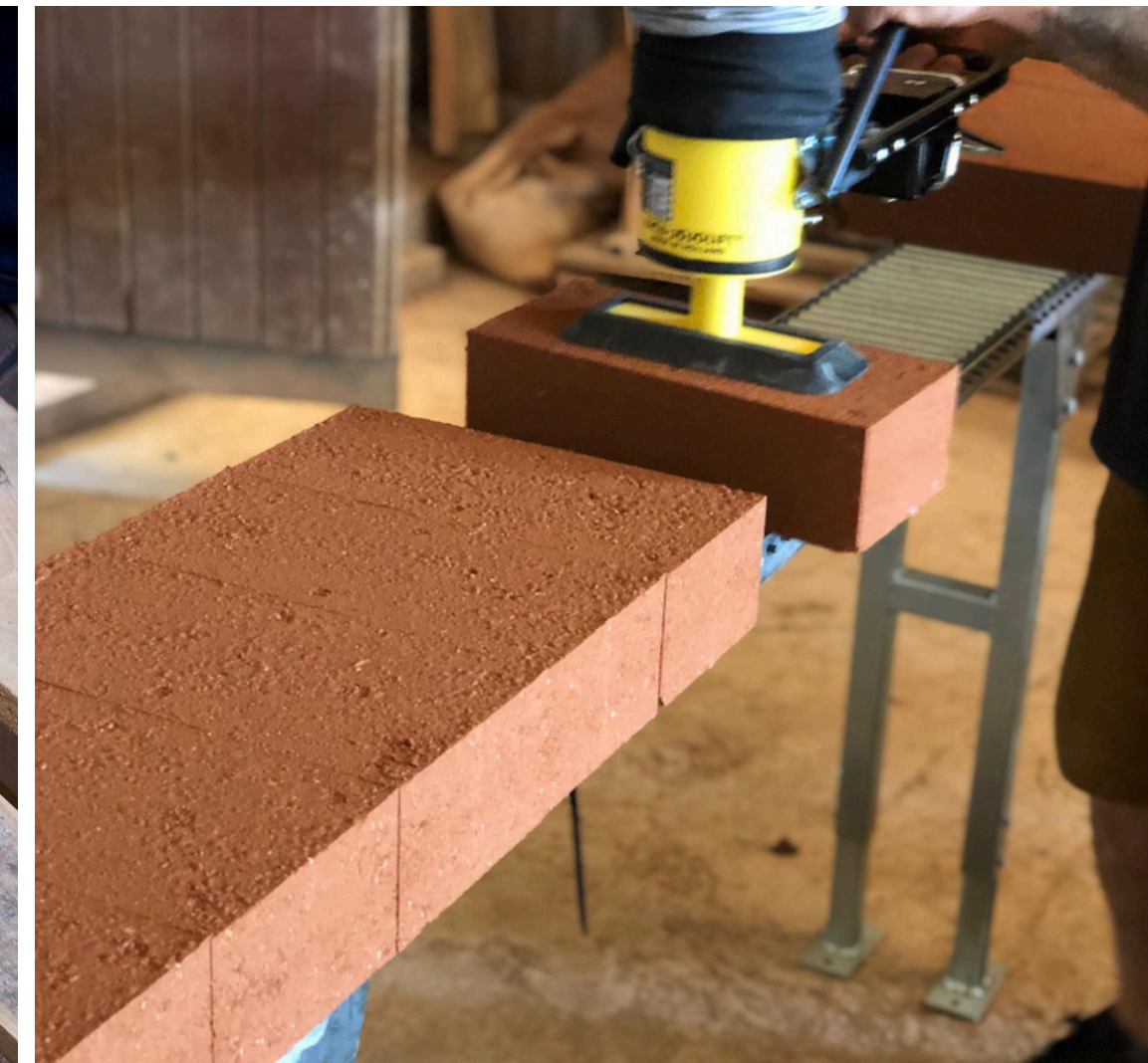


Stabilizer: organic/mineral (optional)

Raw brick produced by a mechanical or automatic press.

Density: 1800-2200 kg/m³

Mixture: humid





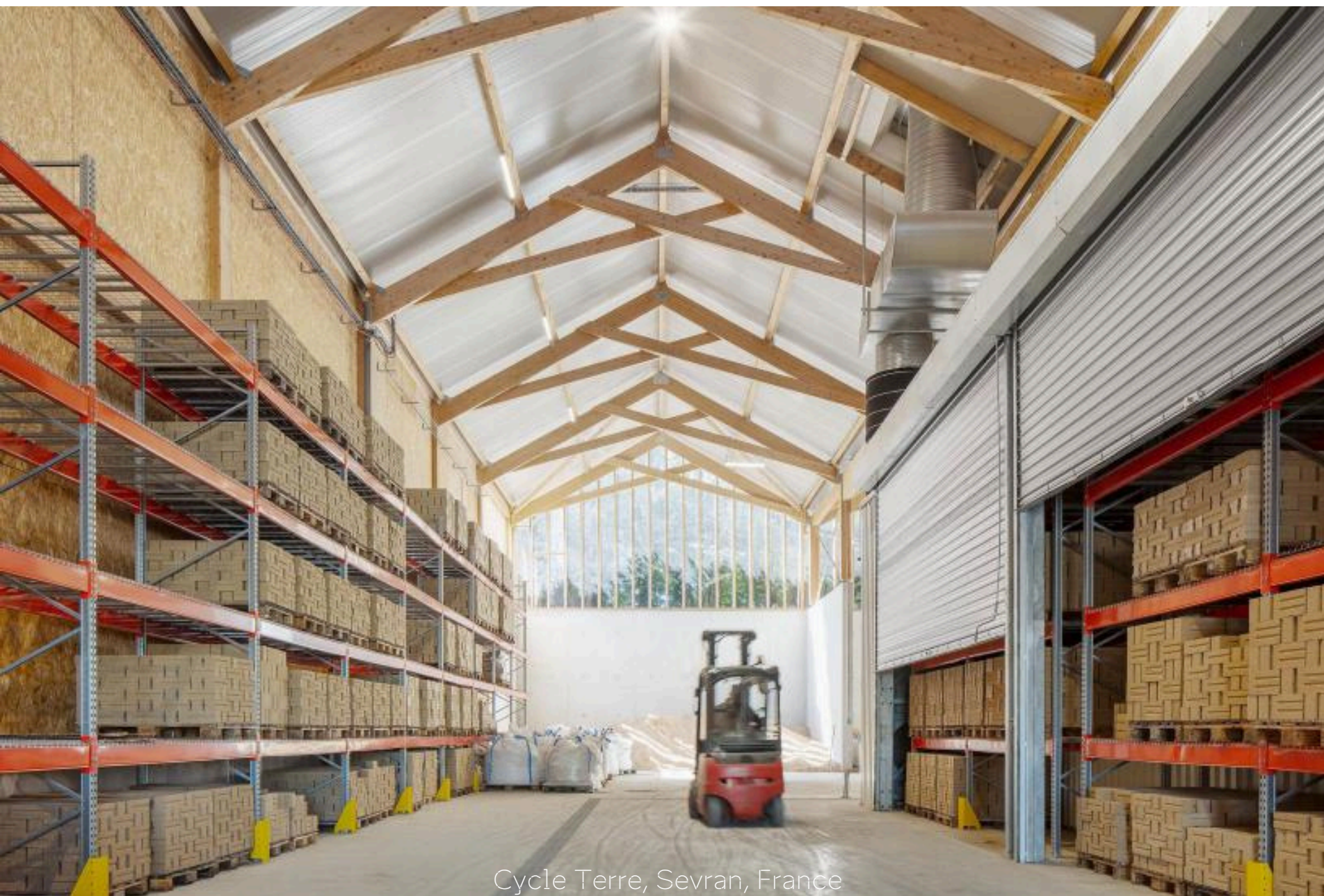
Esplan OÜ, EME building, Mooste, Estonia



BC architects & studies, Regional house, Edegem, Belgium



kuidas.works,
Exhibition: From Excavation to Elevation, Viimsi, Estonia



Cycle Terre, Sevrans, France



Oskam v/f, New railway junction Zwolle-Herfte, Netherlands

RAMMED EARTH



Earth/Clay



Rubble



Sand/Gravel



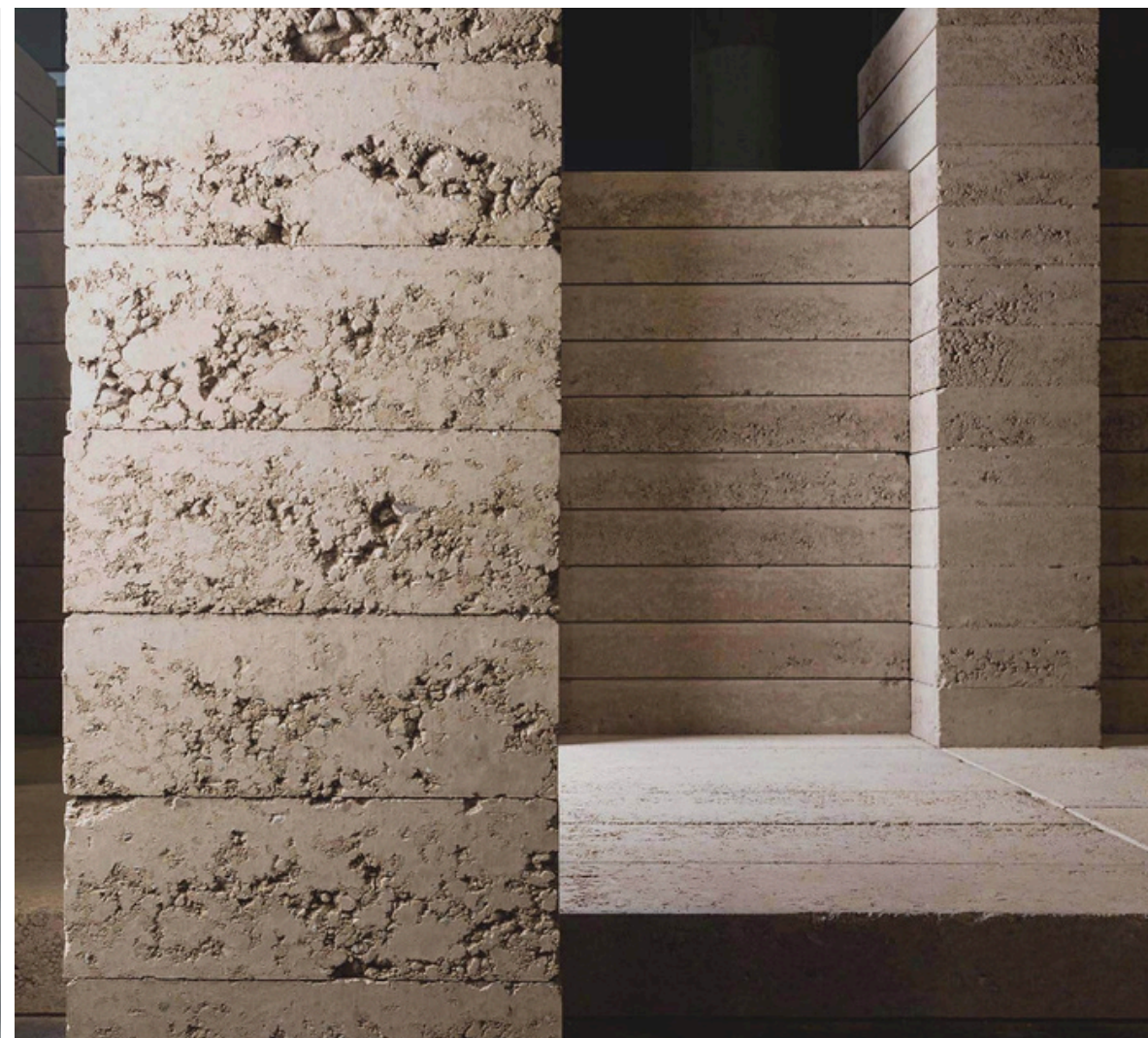
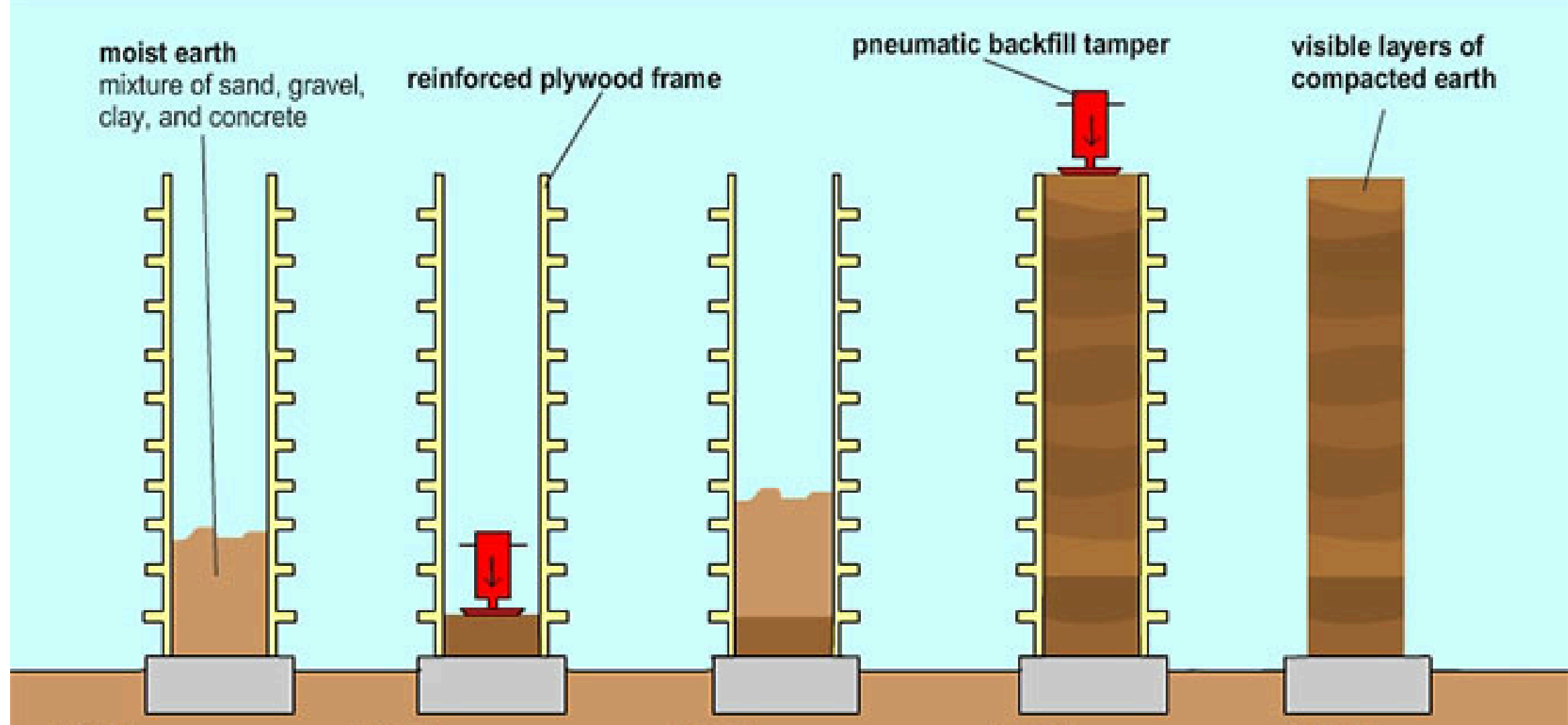
Stabilizer: organic/mineral (optional)



The mixture is tamped on the site between the formwork in layers of 10-15 cm, wall panels or blocks are pre-produced.

Bulk weight: 1700-2200 kg/m³

Mixture: humid





Rudolf Reitermann & Peter Sassenroth, Chapel of Reconciliation, Berlin, Germany



M. Gujan & C. Pally, Almens, Switzerland



Herzog & de Meuron, Ricola Herb Centre, Basel, Switzerland



Capaul & Blumenthal Architects, Cinema Sil Platz, Ilanz, Switzerland



Professur Annette Spiro, Doz. Gian Salis und Studenten, ETH Zürich, Rammed Earth Pavilion, Zurich, Switzerland



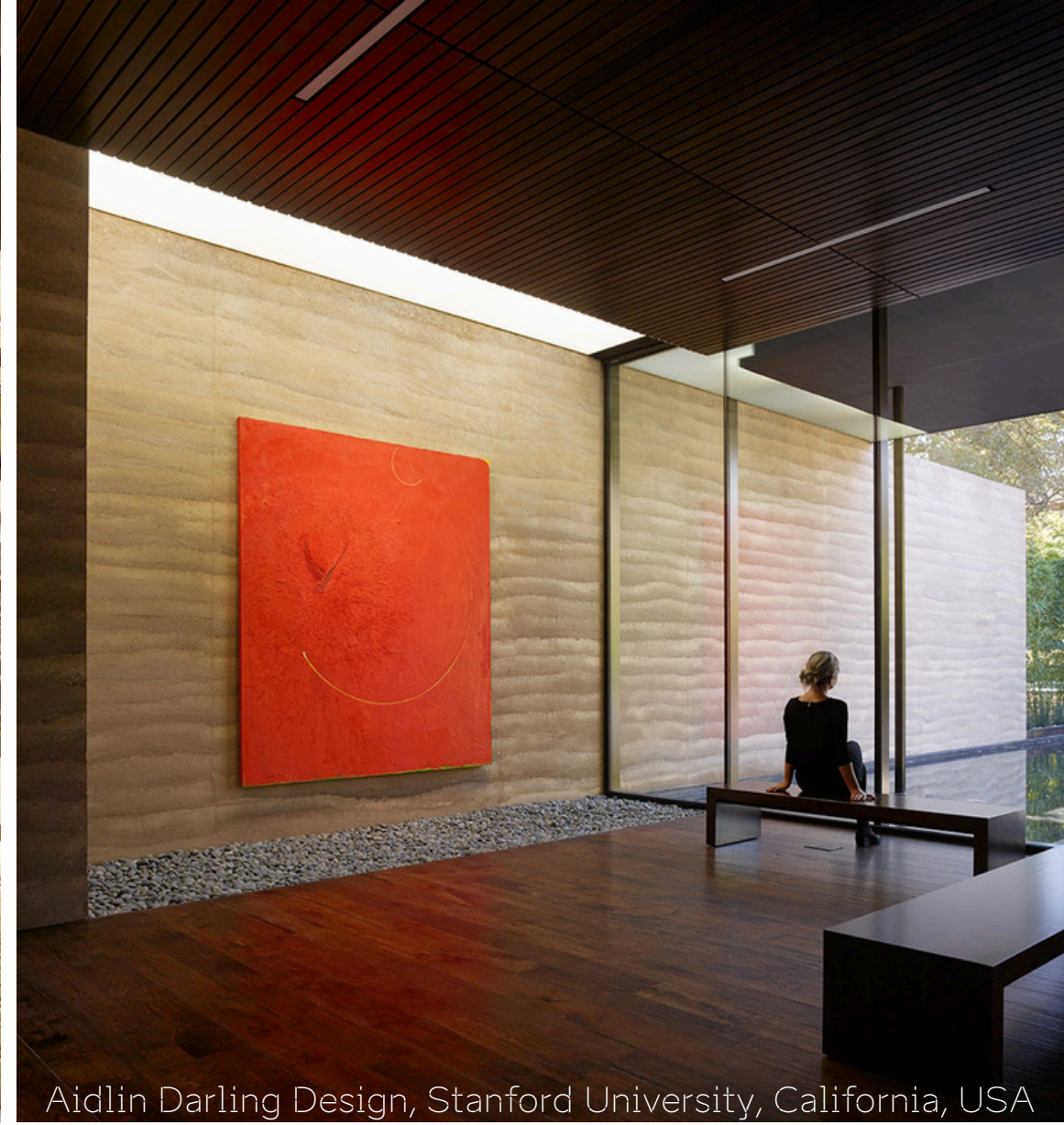
The WISE building, Center for Alternative Technology, Pat Borer & David Lea Architects, Machynlleth, Wales



Stadium Center, Santa Clara, California, USA



Vegetarian restaraunt, Baudois & Bouanich Architectes, Lyon, France



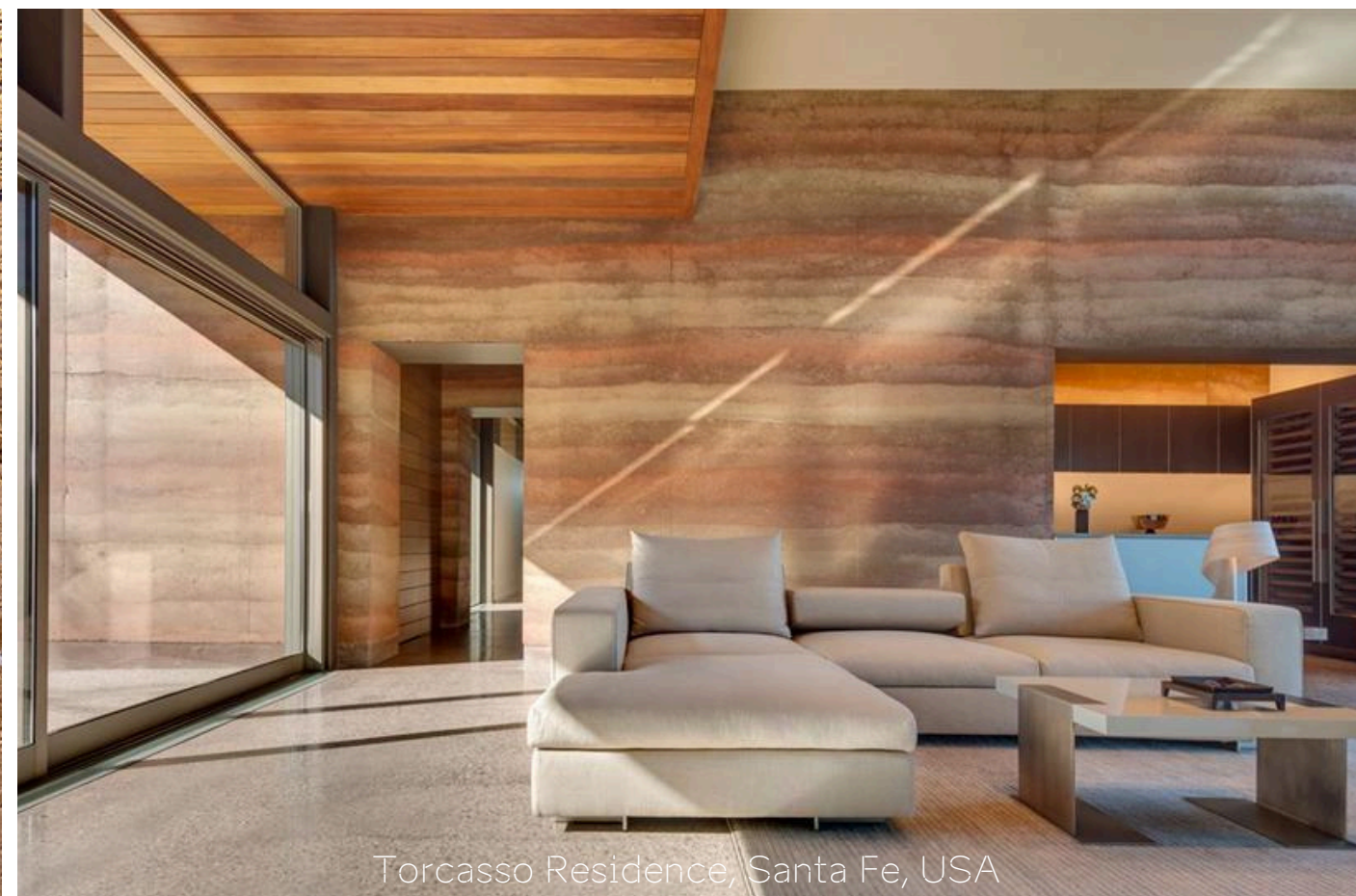
Aidlin Darling Design, Stanford University, California, USA



Kindergarten, Weimar, Germany



Vegetarian restaraunt, Baudois & Bouanich Architectes, Lyon, France



Torcasso Residence, Santa Fe, USA



kuidas.works, Restaurant O, Viljandi, Estonia



Chartier-Dalix, Office building, Saint-Denis, France



Briony Marshall, Sculptor, London



Architecture agency Joly & Loiret, Museum, Orléans, France



Chartier-Dalix, Kitchen island, Saint-Denis, France

POURED EARTH



Earth/Clay



Rubble



Sand/Gravel



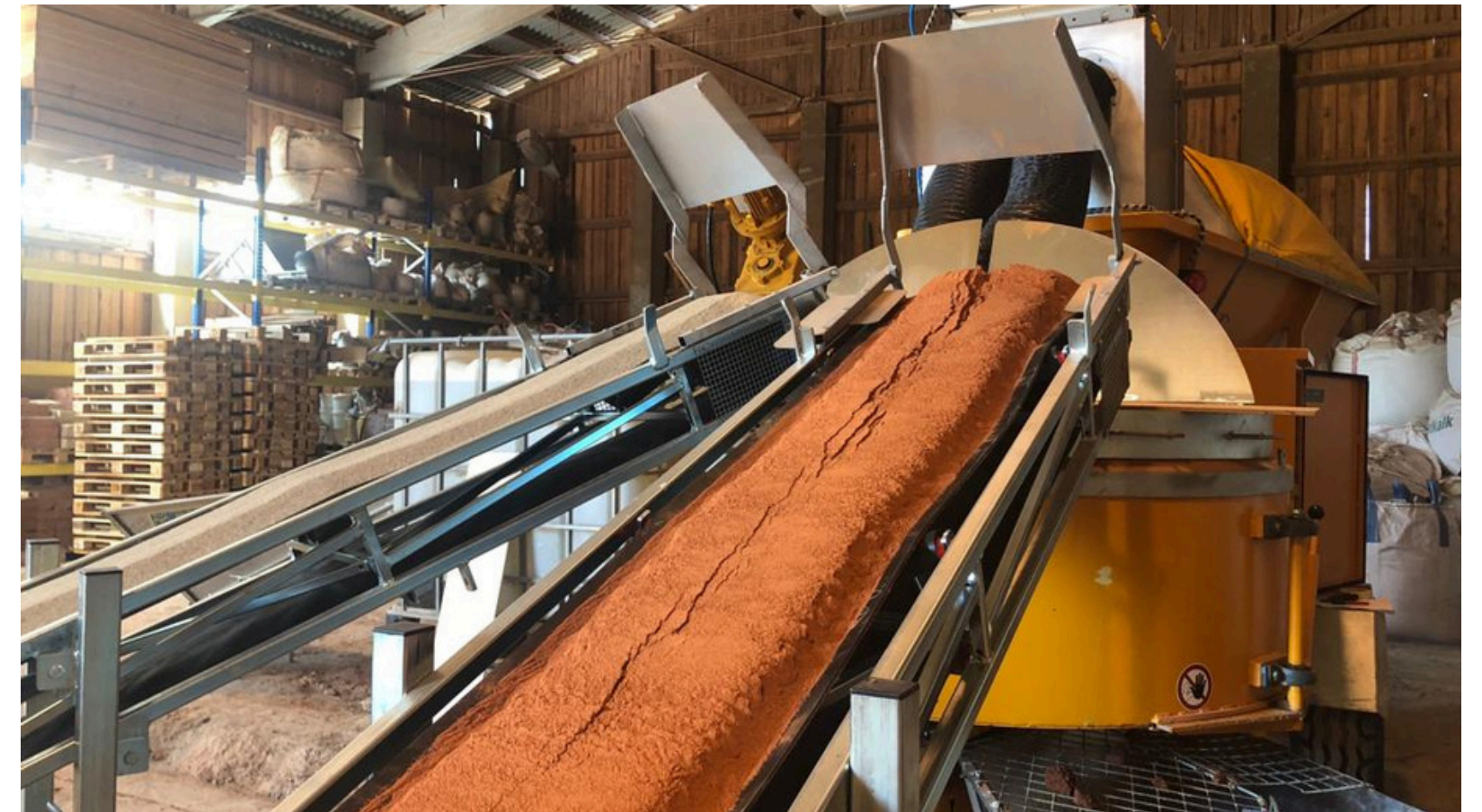
Stabilizer/deflocculant:
organic/mineral (optional)



CONCRETE

8% of all man-made CO₂ emissions
come from the cement industry
1 ton of cement = 0,6-1 ton of CO₂

The energy intensity of raw earth mass
mixtures (concrete, bricks, plasters) is
1-5% of that of cement mixtures





House Rauch, Roger Bolthäuser, Martin Rauch, Schöls, Austria



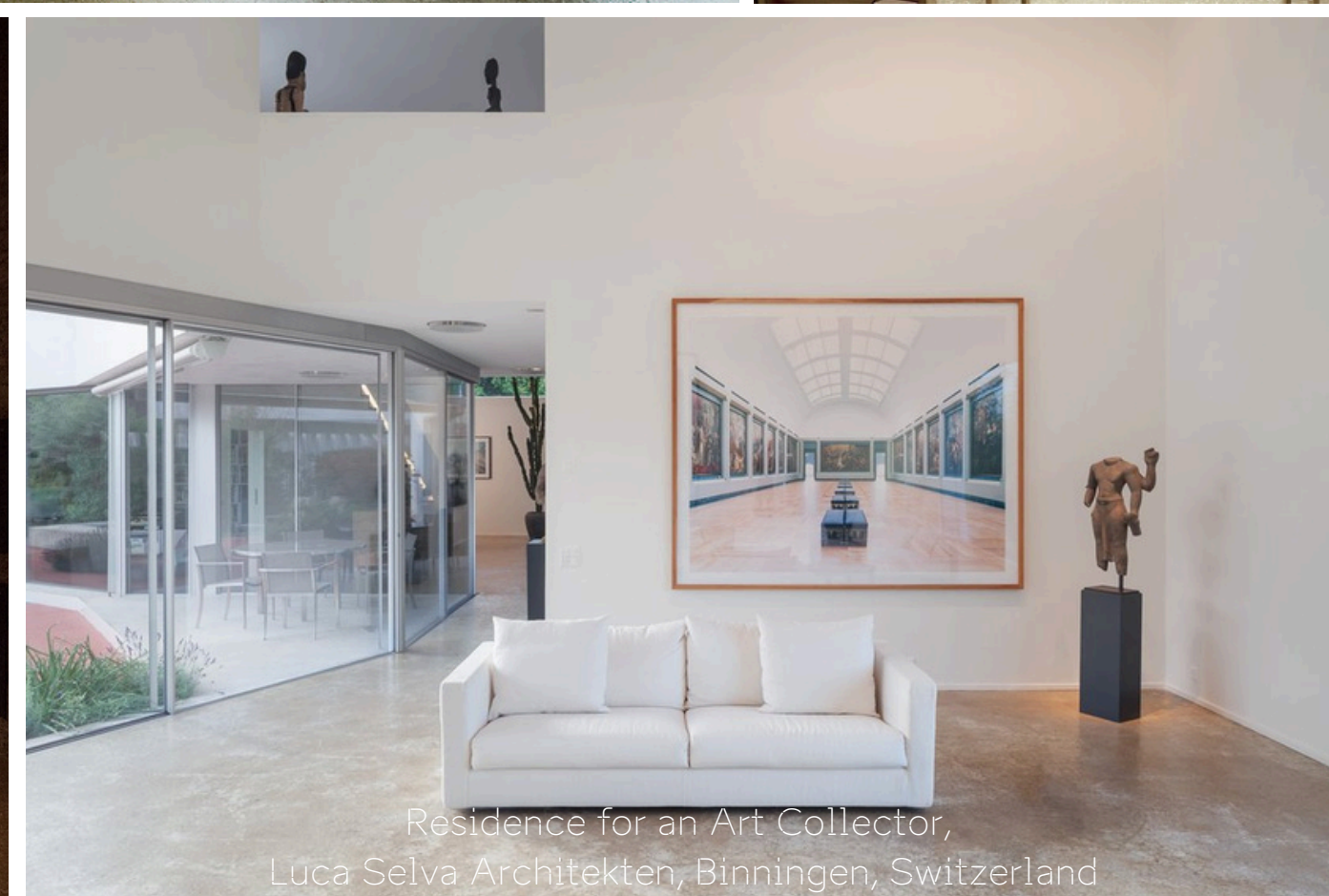
St. Martha Church, Nürnberg, Germany



Krohwin OÜ office, Tartu, Estonia



Sülchen Church Bishop's Tomb, Cukrowicz Nachbaur Architekten, Rottenburg am Neckar, Germany



Residence for an Art Collector, Luca Selva Architekten, Binningen, Switzerland



Holiday Villa, Kasper Järnefelt, Barosund, Ingå, Finland



Mil Lieux Architeure, Kindergarten, Manom, France



Agency Design & Architecture, Technical Center, Grenoble, France



Michael Frerking, residential building, Santa Fe, USA



Mil Lieux Architeure, Kindergarten, Manom, France



Michael Frerking, residential building, Santa Fe, USA

3D PRINTING



Earth/Clay



Natural fibers
(optional)



Sand/Gravel



Stabilizer/deflocculant:
organic/mineral (optional)





Mario Cucinella Architects, Massa Lombarda, Italy

TECLA - Technology & Clay



LIME(STONE)



Bearing constructions



Insulation



Finish

INSULATION

Hempcrete (hemp-lime)



Lime



Hemp shives



Possibility: mineral light aggregates



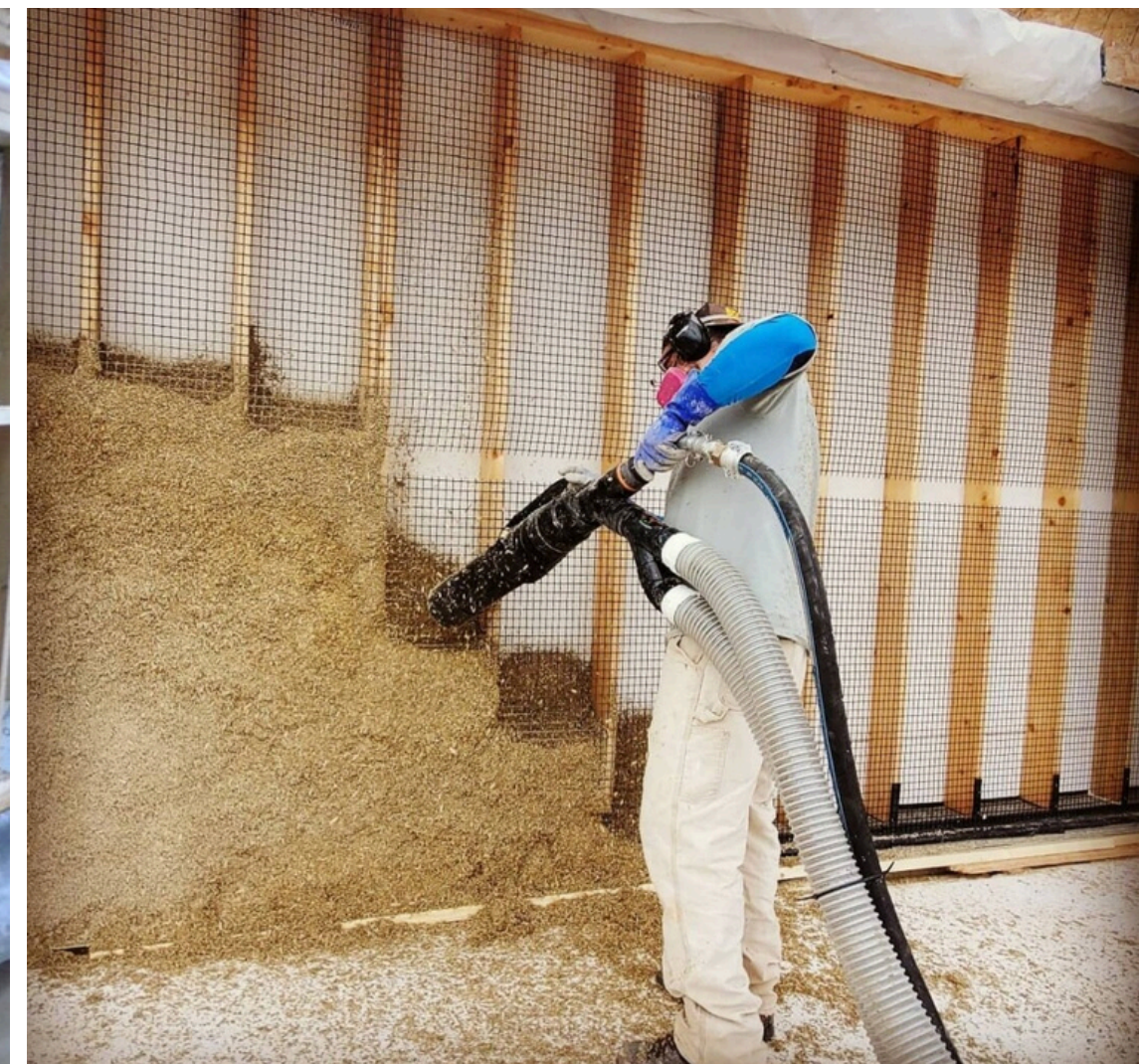
Stabilizer: hydraulic additive





The mixture is gently tamped using a formwork in layers of 10-15 cm between the trusses, previously prepared and dried blocks are laid, or the wall is sprayed.

Density: 250-600 kg/m³





Private house, Cambridgeshire, England



Accommodation building, Paris



Bakery, Bokrijk, Belgium



Regional house, Edegem, Belgium



Social House, Paris, France



EML building, Mooste, Estonia



Decorative elements by Krohwin



Hans Hubert Villa, Haapsalu, Estonia



Hans Hubert Villa, Haapsalu, Estonia



Decorative elements by Hannah Segerkrantz



Decorative elements by Krohwin

Wall panels and decorative elements, made of hempcrete and finished with clay and lime plasters

BIOBASED MATERIALS



Natural fiber



Fiber boards



Fiber insulation



Fibers in mixtures



Make Architects, Gateway building, Nottingham, England



Christian Hackel, School Montreuil, France



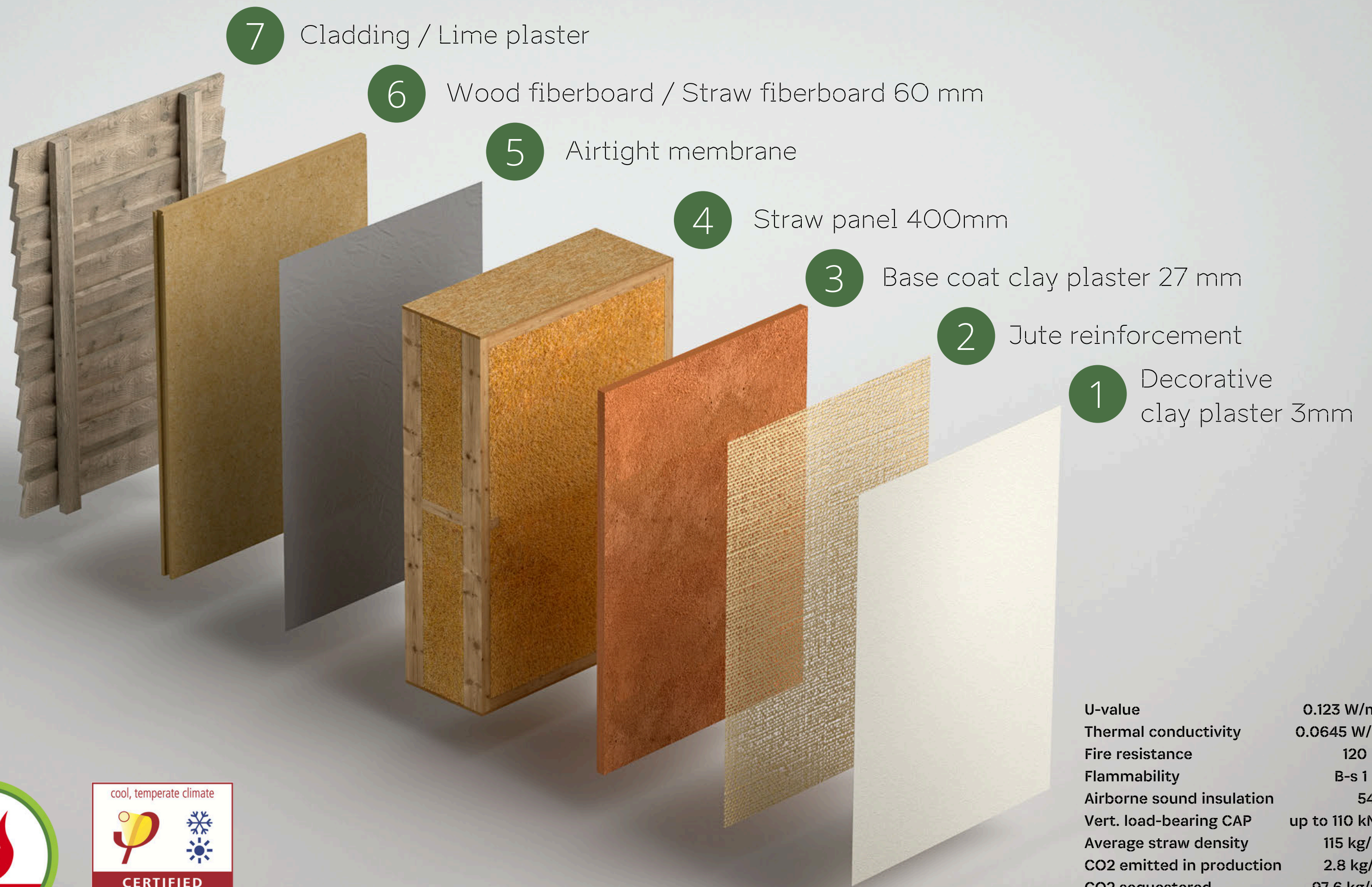
Atelier SCHMIDT GmbH, Apartment buildings, Nänikon, Switzerland



DE-SO, Center for Performing Arts, Mazan, France



Antoine Pagnaux, Jules Ferry 7-storey certified passive apartment building, Saint Dié, France



eco 
COCON
 STRAW WALL SYSTEM



U-value	0.123 W/m ² K
Thermal conductivity	0.0645 W/mK
Fire resistance	120 min
Flammability	B-s 1, d0
Airborne sound insulation	54 dB
Vert. load-bearing CAP	up to 110 kN/m
Average straw density	115 kg/m ³ *
CO ₂ emitted in production	2.8 kg/m ² *
CO ₂ sequestered	97.6 kg/m ² *
*EcoCocon panel only	



New fully automatic production facility for EcoCocon® straw panels in Slovakia.
Straw panels combined with LVL trusses.
Year of construction: 2023



Combining mass timber trusses with EcoCocon straw panels in the construction of a 10-story apartment building in Sweden. Year of construction: 2024/2025

SALIX

"solitaire schoonheid, alzijdige waker in het landschap"



Geïnspireerd op de robuuste, sculpturale vorm van de wilg (*salix alba*)



Salix, 13-story residential tower building in Netherlands.

Hybrid building will be made using EcoCocon straw panels, along with concrete and wood.



THANK YOU! GET IN TOUCH AND FOLLOW US!



**EESTI
MAA
EHITUS**

COMPETENCE CENTER
FOR ECOLOGICAL
BUILDING

JOIN OUR TRAINING AND EVENT INFO MAILING LIST

FOLLOW US IN SOCIAL MEDIA

EESTIMAAEHITUS.EE

