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Fastening, tiling, machine processing – everyday solutions for modern earthbuilding

Promoting earthbuilding for modern construction in industrialised nations entails addressing certain fundamental aspects and topics. For example, demonstrating fitness for purpose, compliance with building laws or elaborating environmentally relevant properties. With the development of DIN standards and Environmental Product Declarations (EPDs), the Dachverband Lehm e.V. Weimar has carried out internationally recognised pioneering work in this area.

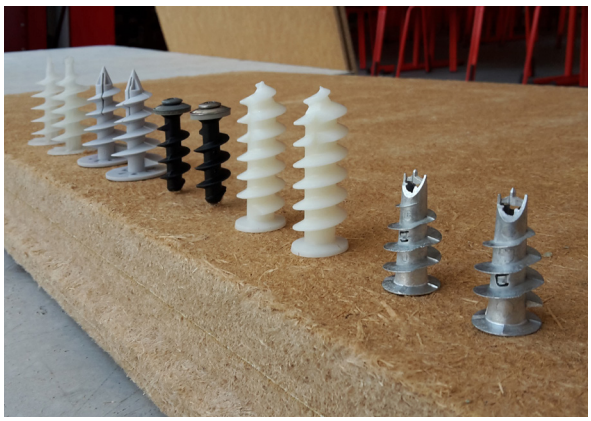
However, when using earth as a building material in everyday life, it is often the little things that determine how feasible they are for use on the construction site. CLAYTEC e.K. has been developing and selling building materials made of clay and earth since 1984. Many of these building materials solve specific problems: for example, stainless steel plaster base mesh for half-timber renovation or a clay joint filler for interior finishing work. Both products closed important gaps in application technologies when they were first introduced.

In recent years, CLAYTEC has been approached by various important German building industry market players to co-develop solutions for the application of earth building materials which had been requested by architects, contractors and end users. The following text describes the most important examples of these cooperations and their results.

Fastening in earth

The company WÜRTH produces and distributes assembly and fastening hardware as well as tools. It is the market leader in Germany and employs over 7,000 people. Around 5 years ago, the firm decided to expand their product portfolio to better support sustainable construction. This included the central task of testing, selecting and, where necessary, developing fasteners for natural building materials. The focus soon shifted to earth as a building material with an initial emphasis on solid building materials such as rammed earth and earth blocks. At the suggestion of CLAYTEC, the product range was expanded to include earth drywall building materials which are much more widespread in terms of quantity and for which there were no empirically developed fastening solutions. Fastening alternatives for wood fibre insulation boards (HFD) and wood fibre finishing boards (HFA), as comparatively less solid natural building materials, were also of particular interest.

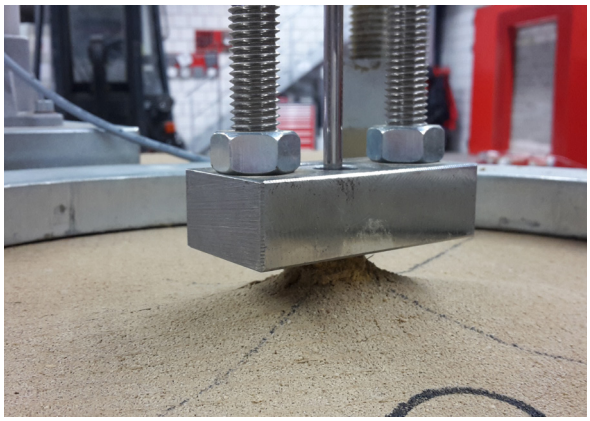
Anchoring options for wood fibre insulation boards



Earth block masonry test setup for tensile tests

Anchor channel in earth block

Supporting bracket in earth brick wall



Jute-laminated clay drywall boards during the pull-out test

Workbench with test specimens and screws

The earth block tests were carried out on masonry walls constructed of earth blocks of application class Ib approved for load-bearing construction as well as of blocks of application class II according to DIN 19845. The best results were achieved using the W-UR 8 plastic frame anchor, which ranged from 1.80 kN to an impressive 4.19 kN (which corresponds to a mass of 419 kg). Based on an average of 2.5 kN and a safety factor of 5, approximately 50 kg could be fastened to this type of load-bearing point in an earth block wall. However, this figure was not published due to a lack of data on the strength behaviour of the earth blocks under changing air humidity. The role that jute lamination plays in enhancing the pull-out resistance of clay drywall boards was surprising.

WÜRTH brochure "Befestigungen im Lehmbau" (Fastening in earth building materials) – Drilling in earth building materials

After numerous tests and selection phases, reliable information was elaborated on which fasteners are best suited for earth blocks, clay panels and wood fibre panels. Special accessories such as drills, dust extraction bells and compressed air spray for cleaning drill holes, which are crucial for fastening in earth building materials, were also selected. The results are documented and advertised in WÜRTH's brochure "Befestigungen im Lehmbau" (Fastening in earth building materials), which has been in publication since 2018.

This good example set a precedent. The anchor manufacturer TOX also developed an interest in the topic. Their "red all-purpose anchor" has made the company well-known and a leader in the field. TOX offers a comprehensive range of around 1,500 anchors and fastening systems. As with WÜRTH, the best fastening components for the respective purpose were selected. But TOX went a decisive step further: in addition to precise instructions on application and installation, the company was first in naming definitive load values for earth building materials. These range from 5-25 kg in earth drywall construction depending on the panel and fasteners. A value of 3 kg could be designated for wood fibre finishing boards. While this value may be rather low in the building industry, it is literally a "loadable" parameter and thus a novelty. The results of this joint pioneering work have been summarised in the brochure "Fester Halt in Lehm" (A strong hold in earth).

TOX brochure "Fester Halt in Lehm" (A strong hold in earth) – Load values for earth building materials

Haltewerte in Lehmbaustoffen

		Lehmbauplatte D22	Lehmbauplatte D25	Greentech 700	Pavaboard N+F/ Pavadentro	Maxi Base/Internal	Mauerwerk Ziegel + Stampflehm
Tri / Trika	6/36	-	6 kg	15 kg	-	-	-
Tri / Trika	6/51	-	10 kg	30 kg	-	-	4 kg
Tri / Trika	8/51	-	10 kg	40 kg	-	-	5 kg
Acobat	M5x65	5 kg	25 kg	-	-	-	-
Acrobat	M6/65	5 kg	25 kg	-	-	-	-
Spagat Plus	M5/M6	10 kg	25 kg	40 kg	-	-	-
Spagat Pro	M8	15 kg	25 kg	40 kg	-	-	-
Spagat	M6	15 kg	25 kg	40 kg	-	-	-
Spiral	32	-	8 kg	-	-	-	-
Spiral Plus	37	-	8 kg	30 kg	-	-	-
Thermo	50	-	-	-	3 kg	3 kg	-
Thermo Plus	55	-	-	-	3 kg	3 kg	-
Barracuda	6/30	-	-	-	-	-	3 kg
Barracuda	8/40	-	-	-	-	-	4 kg
Altbaujoker	8/90	-	-	-	-	-	7 kg
Altbaujoker	10/90	-	-	-	-	-	10 kg
Tiger	8/60	-	-	-	-	-	10 kg
Tiger	10/60	-	-	-	-	-	15 kg
Liquix	M8	-	-	-	-	-	20 kg

Hinweise zur Verarbeitung: Siehe TOX-Katalog.

Testing tile bonding on an earth plaster substrate

Verlege-Empfehlung

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Belegung von Lehmputzen
mit keramischen Fliesen

Lehmputze sind im Trend. Geschätzt werden sie wegen Ihrer ökologischen und baubiologischen Eigenschaften. Sie sind offenporig und können große Mengen Wasserdampf schnell aufnehmen und bei Trockenheit wieder in die Raumluft abgeben. Dies macht sie besonders geeignet für Küche und Bad.

Bei Verwendung eines Lehmputzes sollten nur kleine Flächen mit Keramik bekleidet werden. Dies vor dem Hintergrund, dass durch das Bekleiden mit Keramik relevante Eigenschaften des Lehmputzes verloren gehen. Es gibt natürlich Bereiche, wo die Ausführung von Fliesen notwendig ist, z. B. im Küchenspiegel oder an den Waschbecken.

In Bereichen mit hoher Nassbelastung, z. B. in Duschen, sind Lehmputze nicht geeignet. *
Das maximale Format der Fliesen beschränkt sich auf 60/60 bei saugfähigen Keramiken (z. B. Steingut) bzw. 30/30 bei nicht saugender Keramik (z. B. Feinsteinzeug). Grundsätzlich sollten saugfähige Keramiken bzw. Keramiken mit hohem Fugenanteil bevorzugt werden.

	Beschreibung	Produktabbildung
Untergrund	Claytec Lehmklebe- und Armierungsmörtel Claytec Lehm-Feinputz 06 Claytec Lehm-Unterputz Stroh	
Grundierung	Claytec Tiefengrund Sopro Grundierung GD 749	
Fliesenkleber	Sopro's No.1 Flexkleber 400 Sopro FKM® XL 444 Sopro's No.1 schnell Flexkleber 404 Sopro FKM® Silver 600	

* Hier sind feuchtebeständige Putze zu wählen, z. B. Kalkzementputz der Mörtelgruppe CS II/III nach DIN EN 998-1 oder Zementputz der Mörtelgruppe CS IV nach DIN EN 998-1.*

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Installation recommendations “Belegung von Lehmputz mit keramischen Fliesen” (Ceramic tiling on earth plasters)

Tiles on earth plaster

SOPRO Bauchemie GmbH is one of the leading manufacturers of construction chemical products in Europe. Its core competence lies in products for tiling. Their technical support had been repeatedly asked to supply information about SOPRO primers and tile adhesives suitable for use on earth plasters. The author and other presenters can confirm that questions about tile bonding are very common.

CLAYTEC provided earth base coat and earth fine-finish plasters as well as a clay adhesive and reinforcing mortar for adhesion tests.

The first question was whether a primer was necessary before the tile adhesive was applied. The surfaces were tested with and without primer (CLAYTEC deep penetrating primer based on potassium silicate and SOPRO Primer GD 749). It was found that pretreatment of the earth plaster with a primer is always advisable.

The tests resulted in adhesion values of ≥ 0.20 N/mm^2 (for comparison, earth plaster mortar as per DIN 18947, strength class II: ≥ 0.10 N/mm^2.) The value 0.20 N/mm^2 is also the minimum required adhesive strength for tiling installed as coverings on composite waterproofing membranes. The fracture pattern according to EN 12004 was always a cohesion fracture within the substrate, i.e. within the earth plaster layer. Adhesion between tile adhesive and earth plaster surface is therefore not the limiting factor.

SOPRO limits the size of the tiles to 60/60 cm for absorbent ceramics (e.g. earthenware) and 30/30 cm for non-absorbent ceramics (e.g. porcelain stoneware). For product recommendations, SOPRO chose flexible tile adhesives and quick tile adhesives that are well established on the market. The combination of CLAYTEC earth plaster mortars and SOPRO tile adhesives is shown in the installation recommendations “Belegung von Lehmputz mit keramischen Fliesen”.

↗ Video demonstration

Cutting of earth drywall board using the FESTOOL separation system

Clay putty sanding using the FESTOOL long neck sander

Cutting of earth drywall boards and sanding of clay putty

The company FESTOOL produces professional power tools for the trades. The machines have an excellent reputation on the market. The development of solutions for processing ecological building materials is part of the FESTOOL sustainability concept. The cutting of earth drywall boards at the building site is more complex than with other gypsum boards commonly used in drywall construction. This, in addition to increased dust generation, is a market barrier which can be remedied with professional equipment. Larger-scale and partly public construction projects which increasingly use earth drywall construction systems require optimised execution techniques. When testing various cutting tools, the diamond cutting system DSC-AG proved to be particularly well-suited, in addition to the widely used plunge saw. This is a carriage-guided angle grinder with a diamond cutting blade for particularly clean cuts. The mobile FESTOOL dust extractors are not only able to cleanly collect most of the dust at the point of origin, they also have a high-volume collection chamber which is well-suited to earth drywall construction.

This optimised earth drywall board process is captured in the CLAYTEC/FESTOOL video for trades and contractors. It not only shows the ideal machines, but also gives a precise description of cutting methods and useful accessories. Power drills, mixing and grinding machines round out the practical recommendations for contractors in the drywall construction trades. Special emphasis is placed on the economical production of clay putty surfaces with a very smooth surface quality (Q3), which is in increasing demand.

↗ Video demonstration

Equipment for moist earth plaster mortar BARON/WAGNER

Mixing and processing of earth plaster mortars and thin-layer clay coatings

The economical processing of earth plaster mortar with professional plastering machines is the key to distributing these products to a wider market segment. It is good to see that many, also very well-known, machine manufacturers embraced this and devised solutions early on. One example is Knauf PFT, the market leader from Iphofen, who manufactures the G4 machine, which almost every plasterer knows. Smaller manufacturers have also taken the subject very seriously.

A distinction needs to be made between two types of plastering machine systems: "continuous mixers" such as the G4 on the one hand, and "compulsory mixers with mortar pumps" on the other. The latter are of great importance for earthbuilding as they can be used to process moist earth plaster mortars that are inexpensive and also have exceptionally high environmental product data (EPD) credentials. An example of an open system is the combination of the BARON M 110 Mixer and the WAGNER PC 1030 mortar pump.

The core competence of COLLOMIX from Ingolstadt is mixing. For smaller construction sites and the preparation of clay paint plasters and other thin-layer clay coatings, which make up a large part of the application of earth building materials, hand mixers are the right choice. In spring 2020, COLLOMIX not only tested and compiled a list of the best equipment for earthbuilding, they also dedicated a six-part podcast on the topic of mixing earth materials (approx. 1½ hours of material). The series deals with the topic of earthbuilding far beyond the confines of direct processing and thus presents the topic with great enthusiasm to a young, social-media savvy audience (especially craftspeople).

Collomix Podcast

↗ Schau mal wer da mischt

Conclusion

All of the above examples contribute to improving everyday work with earth building materials on the building site. They are important milestones in the development of the practical suitability and economic efficiency of earth building systems and support their implementation. The interest shown by major market players testifies to the increasing relevance of earthbuilding on the German market today. It shows how companies across the construction sector are making significant contributions to the promotion of earthbuilding, its quantitative expansion and, in particular, its qualitative integration into the German construction industry.

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