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Clay Building Standards and Shared Authorship

MERLE YILMAZ

This article presents a brief overview of the development and current status of standards and regulations for clay construction in Germany, also in comparison with other countries. Clay building is generally considered as non-engineered, and construction standards have been developed in only a few countries in the last thirty years. More precisely, there are forty different standards in twenty different countries as of 2018.

In Germany, an estimated 200,000 buildings use clay and earth technologies. Of these, only a very small number relate to large-scale housing development. This phenomenon is due both to the difficulty of developing a clay building market and to a rigid (and to some extent obtuse) bureaucratic apparatus. At the beginning of the century, the German sociologist Max Weber saw bureaucracy as an impersonal positive entity, characterized by an organizational structure governed by standardized procedures and a meticulous division of labor and responsibilities.[1] In this article, I indirectly elaborate on this concept of impersonality, as the experimental buildings show that it is precisely through the clash with bureaucracy that the architect's authorship is ultimately destroyed. The examples I show demonstrate that architectural experimentation increasingly requires a collaborative effort, and therefore, is a form of shared authorship made up of several specialists.

The first contemporary clay building standard in Europe was the *Lehmbauordnung* (German Earth Building Code) of 1944. This code combined the entire body of technical knowledge to temporarily mitigate the damage caused by the Second World War, and to eventually provide shelter for the homeless population. During this period, the local availability of clay was crucial, and the German Earth Building Code specifically had to organize and regulate the use of this material in construction.

However, due to post-war reorganization problems, the code only became effective as a *Deutschen Instituts für Normung* (German Institute for Standardization [DIN]) standard seven years later in 1951, with the DIN 18951. Over the next five years, other DIN codes were developed of which only the first one came into force, but the use of clay declined and only a few years after the end of the war it disappeared again. The 1951 DIN code of was then simply withdrawn and never replaced.[2]

1. See Toren 1976.
2. See Schroeder 2018: 115.

Germany had to wait until the 1980s for the revival of clay in construction, when awareness of the ecological crisis brought a natural, non-toxic, and easily recyclable material to the fore as an alternative to conventional building materials.[3] In times of threatening environmental catastrophes and policies aimed at saving energy and resources, clay promises to be one of the possible alternatives and versatile materials. Indeed, the 1980s was also a decade that saw the appearance of many scientific publications and handbooks on earthen architecture, highlighting the experimental characteristics and multiplicity through which this material developed overtime in Germany and abroad.[4]

An important milestone occurring several years later was the establishment of the *Lehmbauregeln* (Earthen Building Regulations) in 1998. Founded six years earlier, in 1992, the *Dachverband Lehmbau e.V.* (German Association for Building with Earth) established this set of rules on behalf of the *Deutsches Institut für Bautechnik* (German Institute for Construction Engineering [DIBt]). Subsequently, the first official set of DIN standards for clay construction was published in 2013. Since then, these standards have been revised and a new extended version of them is published every five years.[5] Today, the *Dachverband Lehm e.V.* represents the federal trade association for clay and earth construction under whose power all regulations are drawn up. The board members bring together representatives of the *Prüf-, Überwachungs- und Zertifizierungstelle Lehmbau* (Testing, Surveillance, and Certification Body for Earthen Building), which is involved in testing, monitoring, and certifying materials according to building regulations, together with the *Bundesanstalt für Materialforschung und -prüfung* (Federal Institute for Materials Research and Testing). The main task of the *Dachverband Lehm e.V.* is to provide a platform for the exchange of information and ideas among manufacturers, retailers, architects, builders, stakeholders, and scholars working on the topic of clay. In addition, the *Dachverband Lehmbau e.V.* maintains a variety of training opportunities for various disciplines and carries out interlaboratory tests [Fig. 01, 02] where the validity of the standardized tests is checked and any recommendations are communicated to the DIN Earth Construction Standards Committee.[6]

The normative model that emerges with the definition of these DIN standards brings Germany in line with other international realities. The thirty-three standards listed in Table 01 show the state of the art in nineteen countries as of 2012. In terms of scope, the table addresses three different aspects, namely: soil classification, earth construction materials, and earth construction systems. However, a uniform document or internationally accepted terminology is still lacking and a comparison between countries is complicated to undertake, just as an attempt to achieve a worldwide standard still seems far off.[7]

In the meantime, new specialists and pioneers of building with earth and clay have also emerged in Germany, such as ZRS architects, Anna Heringer, and Martin Rauch among others.

The first public building made of clay after a period of 150 years in Germany is a chapel in Berlin consisting of a monumental rammed-earth structure flanked by a translucent façade of wooden slats. This clay building, called the *Chapel of Reconciliation*,

3. Ibid.
4. See Güntzel 1986.
5. See Schroeder / Röhlen / Ziegert 2020: 2.
6. See Blaschek / Ziegert 2021.
7. See Schroeder 2012.



Fig. 01. Figure of eight shaped formwork for the making of test specimens for the test of cohesiveness according to the Dachverband Lehm e.V.'s Earthen Building Regulations. Photo by Christof Ziegert. Courtesy of ZRS Architekten Ingenieure.



Fig. 02. Preparation of the test of cohesiveness. Photo by Christof Ziegert. Courtesy of ZRS Architekten Ingenieure.

inaugurated in 2000, is the result of a joint effort by Berlin architects Rudolf Reitermann, Peter Sassenroth, and Martin Rauch's company *Lehm Ton Erde Gmbh* (which won the German Sustainability Award for architecture in 2020 for the largest office building with a rammed earth façade and integrated geothermal wall heating in Europe, the *Alnatura Arbeitswelt* building in Darmstadt). The material, technical, manufacturing, and legal issues requested for the approval of the project, required an integrative collaboration and exceptional teamwork of architects, structural engineers, materials scientists, and construction companies.[8]

If we cross the border to the west of Germany, we can see that France also has a long tradition of building with earth and clay. However, clay in France is classified as a non-traditional construction method and "a standard for earth blocks is currently being developed based on the corresponding German standard."[9] Rammed earth is not listed among the French building standards and buildings that employ this technology need a case-by-case assessment and are called "experimental buildings" or *Appréciation Technique d'Expérimentation (ATEx type b)*. In the domain of public buildings, an example of experimental building is *L'Orangerie*, a recently opened co-working space in Lyon designed by Clément Vergély Architectes in collaboration with Nicolas Meunier. The construction of this public building required several tests of the load-bearing capacity of the rammed earth walls and countless discussions with the structural engineer over a period of two years.[10] In the end, non-load-bearing steel supports had to be installed in addition to the load-bearing rammed earth walls. As noted above for the case of Germany, clay constructions in France involve difficult approval steps and require different skills. Successful projects are usually the result of teamwork.

An example of this kind of collaborative effort is the Cusset Substation in Villeurbanne, designed by Tectoniques Architectes. This building was successfully constructed after complex calculations for which a wide range of skills were required.[11] The clay walls were built by specialized craftsmen in collaboration with the CRAterre association, which carried out research on materials, and the engineering firm BETerre, which followed the construction phase. This building provides an interesting example of collaboration between architects, experienced builders, and researchers aimed at assessing the load-bearing capacity of the building in relation to the structural properties of clay.

If we move about 7,000 kilometers south-east, we find similar issues at stake in India. In 2018, Karnataka's first rammed-earth government building, the HN Science Center, was built by the architect Ajith Andagere.[12] The approval of this project was met with strong resistance by government officials. High costs and inexperience in the field of experimental clay construction were the main concerns. However, Andagere eventually managed to convince the authorities of his idea of a sustainable building. In the end, rammed earth was used for the load-bearing walls, clay for the partition walls and other natural materials for the remaining building components [Fig. 03].

Compared to other countries, the Indian regulatory framework allows for a wide range of experimentation. For example, the Buddi School, built in Jakkur (Bangalore)

8. See Braun 2007.
9. Schroeder / Röhlen / Ziegert 2020: 1.
10. See Jeske 2020.
11. See Gauzin-Müller 2020.
12. See Andangere 2021.

Table 01. An overview of the types of earth building standards and normative documents. Source: Schroeder, Horst. 2012. “Modern earth building codes, standards and normative development.” In: Matthew R. Hall / Rick Lindsay / Meror Krayenhoff. *Modern Earth Buildings*. Oxford: Woodhead Publishing. 79-81.

NO.	COUNTRY	DOCUMENT	SCOPE OF DOCUMENT					REF.
		Name	Type	Soil	Building material	Construction system	Geogr. level	
	01	02	03	04	05	06	07	08
01	Africa	ARS 671-683 (1996)	S		EB	EBM	R	[16]
02	Australia	CSIRO Bulletin 5, 4th ed. (1995)	ND		EB, CSEB, EMM	RE, EBM	N	[22]
03	Australia	EBAA (2004)	ND	E	E EB, EMM	EBM, RE	N	[23]
04	Brazil	NBR 8491-2, 10832-6, 12023-5, 13554-5 (1984-96)	S		CSEB		N	[44]
05	Brazil	NBR 13553 (1996)	S			CSRE	N	[44]
06	Columbia	NTC 5324 (2004)	S		CSEB		N	[45]
07	France	AFNOR XP.P13-901 (2001)	S		EB		N	[27]
08	Germany	Lehmbau Regeln (2009)	S	E	C, LC, EB, EM, CP	RE, C, EBM, EP, EI, WL	N	[8]
09	Germany	RL 0803 (2004)	ND		EP		N	[11]
10	Germany	TM 01 (2008)	ND		EP		N	[9]
11	Germany	TM02(2011)	D[d]		EB		N	[10]
12	Germany	TM 03 (2011)	D[d]		EMM		N	[32]
13	Germany	TM04(2011)	D[d]		EP		N	[40]
14	Germany	TM05(2011)	ND	E			N	[36]
15	India	IS: 2110 (1998)	S	E, ES		RE	N	[19]
16	India	IS: 13827 (1998)	S		EB	EBM, REa	N	[20]
17	India	IS 1725 (2011)	D[d]		CSEB		N	[37]
18	India	KS02-1070 (1999)	S		CSEB		N	[47]
19	Kyrgyzstan	PCH-2-87 (1988)	S	E, ES		REa	N	[25]

S Standards issued by national standards bodies (NSBs) or specialised organisations that have passed a predefined procedure of approval and are recognised by a state building authority.
BC Building codes issued by NSBs with one or more chapters on building with earth.
ND Normative document issued by specialised organizations that have passed a predefined procedure of approval but are not recognised by a state building authority.
L Local
N National
R Regional
C Cob
CP C lay panel
E, ES Earth, earth stabilized with cement
EB Earth block; Adobe; compressed earth block, CEB; compressed stabilized earth block, CSEB; poured earth blocks, PEB
EBM Earth block masonry
EM Earth mortar; earth plaster, EP; earth masonry mortar, EMM; earth spray mortar, ESM
El Earth infill; wattle and daub, WD; poured earth infill, PEI
LC light clay
RE Rammed earth; cement stabilized rammed earth, CSRE
WL Wall lining



Fig. 03. Making of rammed earth wall in plywood formwork for the HN Science Center by Andagere Architects.

and designed by Bangalore-based architects Chitra Vishwanath and Monalika Nanda, proves that a 1,500 square meter rammed earth building is possible within the standards and without complex approvals. The walls of the school are made of compressed stabilized earth bricks (CSEB), a construction technique present in current Indian standards.

To conclude, we can state that the approval of an experimental building usually requires a case-by-case assessment that can hardly be reduced to the normative abstraction (or generalization) of bureaucracy. However, as the realization of public buildings with clay clearly underlines, experimental architecture is possible and at every scale and dimension, but mainly as a result of collective authorship and collaborative teamwork of specialists from different domains of science and craftsmanship.

The aim of creating a set of standards for clay construction should guarantee quality through standardized calculation and execution, but in order to become such a standardized material, clay is forced to move slightly towards the domain of industrial construction with the inevitable effect of reducing and weakening the widespread experimentation of local, spontaneous builders.[13] In Germany, also as a result of the development of DIN standards, the construction industry is slowly realizing that it cannot do without earth and clay constructions.[14] Pioneer projects by collaborative teams of architects, engineers, and craftsmen promise to be a good driving force for its development.

13. See Rauch / Sauer 2017: 124–125.
14. See Blaschek / Ziegert 2021.

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