

## Traces of earth – how the history of earth building in Austria can inform modern sustainable construction methods

The clay-rich regions of Austria are located in the Molasse basin of the foothills of the Alps, in the Vienna basin as well as the inner-Alpine basins of Upper and Lower Austria. Austria also has numerous deposits of fluvial soil, terrace and slope wash soil. Loess soil, which is particularly valuable for earth building, can be primarily found in Lower Austria and Styria. [1]

Especially in eastern Austria, earth building is a traditional building technique. The trained eye can still find numerous examples in many parts of Lower Austria as well as in the Burgenland region. When looking for historical earthen structures, so-called cellar lanes in wine growing regions are probably among the most promising locations. Here, wine cellars used to be dug directly into the sides of narrow roads which were cut into the loess soil slopes. The wine press houses were then constructed using the excavation material (fig. 1). Furthermore, the wine cellar “Weberkeller” in Röschitz in the Weinviertel region was also a place of artistic expression as can be seen by numerous carvings (fig. 2). During the cold winter months, people passed the time by carving images into the naturally-moist loess soil which depicted

scenes from legends and tales, as well as important figures of politics and culture. The only reason that the construction of cellar tunnels without the use of brick or natural stone masonry was structurally possible is the low amount of annual rainfall in the region. The ground here always remains firm enough to transfer the loads.

Compared to the ambitious research efforts and the daily earth building practice in neighbouring countries such as Germany, the Czech Republic, Slovakia, and Hungary, Austrian earth building research is still very modest. The Austrian history of earth building has not been comprehensively reviewed even though individual researchers dedicate their work to certain parts of the field. There is only limited written documentation on Austrian earth building, and only few examples can be found in the literature of neighbouring countries. However, historical regulations for building with earth are nonexistent in Austria. It seems that the familiar earth building techniques were passed down from generation to generation through daily building practice.

Fig. 1 Cellar lane in Schöngrabern (Lower Austria): wine cellars with press houses dug into the loess soil slope



Fig. 2 Earth carvings in the Weberkeller in Röschitz (Lower Austria)





Fig. 3 Exterior plaster layers of a Weinviertel earth block house with whitewash

Austria's traditional earth building techniques have been applied in unusually diverse ways. This can on the one hand be traced to the varied geological conditions and the resulting multifaceted application possibilities. On the other hand, the multitude of developed earth building techniques should also be examined in connection with the architectural influences of the Pannonian plain. The concentration of load-bearing earth building techniques in eastern Austria is therefore not surprising.

#### **Austria's historical load-bearing earth building techniques**

The beginnings of earth building in Austria, with walls of woven lattices and stone houses (with earth mortar), later developed into mud-plastered log homes and "G'satz" masonry ("lift masonry" – Austrian for cob building). In addition, existing examples of rammed earth building can primarily be found in Burgenland with its geologically favourable conditions for this technique. Hand-shaped "wuzel" masonry and ashlar masonry were replaced by earth brick construction (Austrian for earth block construction) which is still particularly prevalent in many parts of Lower Austria. The historical timber frame technique with earthen infill was rarely used in Austria.

The structural parts of a house often require the use of various earth building techniques as evidenced by rammed earth floors, ceilings made of earth reels and earth brick, "wuzel" and "G'satz" masonry. At the gable end, a rammed earth or cob wall was often finished with unfired earth blocks or wattle-and-daub, as was also common in Germany [2].

The white facades which were typical in the Weinviertel region as well as in Burgenland were created by applying a layer of lime mixed with linseed oil (so-called "white-washing"). When done regularly, these coats made the fronts of the walls water-resistant (fig. 3). During times when earth was considered an inferior building material, the process of regular white-washing was not only important for the maintenance of the building. By painting over the wall structure, it became impossible to visibly recognize the building material. Masonry made of earth building materials could thus also be attributed to the more prestigious fired brick masonry.

#### **Log buildings with chinked earth**

Log buildings with chinked earth are probably the oldest preserved building technique in Austria, and to this day can be found in parts of southern Burgenland, East Styria and the Waldviertel region [3]. Evidence of this building technique can be seen in





Fig. 4 "G'satz" masonry in Haugsdorf (Lower Austria)

the vineyard houses of southern Burgenland and the so-called "Kitting-Speicher" (storehouses), granaries which were constructed using the palisade technique chinked with earth. These structures were often built several hundred years ago and their origins can possibly be dated back to the late pre-Roman iron age, the La Tène culture [4].

Masonry construction increasingly replaced the timber log construction of southern Burgenland. This development was influenced by the good reputation of prestigious convents, monasteries, and estates on the one hand, and fuelled by official fire protection measures on the other. The timber log buildings were sealed with moss and sporadically covered with earth. They were then plastered with lime, or at least later painted white, in order to imitate a masonry structure [5].

#### **G'satz masonry – cob construction**

According to the literature, examples of "G'satz" masonry or cob construction are hardly preserved in Austrian earth building. Spot checks by the author, however, have revealed the existence of individual examples of this earth building technique – e.g. in Weinviertel – which in their commonness do not appear to be "hardly preserved" (fig. 4). This load-bearing earth building technique is constructed without formwork and completely eliminates the need for

wood. In times of timber shortages, this characteristic led to a renaissance in earth building in many parts of Europe.

The Austrian name G'satztes Mauerwerk (lift masonry) comes from the procedure that is used: due to drying times of 4-12 days, dependent on the local climate and the amount of added water, the walls are constructed in "lifts" [6].

#### **Rammed earth construction**

The characteristic feature of rammed earth construction is the compaction of layers, the beginnings of which could be seen in "G'satz" masonry.

This labour-intensive load-bearing earth building technique was particularly predominant in Spain, Portugal, Great Britain, and many parts of France and Germany. In Austria, however, rammed earth construction could not assert itself at the time. Here, rare examples of this historical load-bearing earth building technique can still be seen in the southern parts of Burgenland. In this region, the rammed earth technique was used for generations until the first half of the 19th century [5]. The unevenness of the traditionally produced rammed earth wall was first levelled with an earth plaster before a thin lime plaster was applied to increase weather resistance.



Fig. 5 “Wuzel” masonry built on ashlar masonry in Zellerndorf in Lower Austria

### Wuzel masonry

The so-called “wuzel” or “batzen” masonry is a technique which was more popular in Austria than all other techniques mentioned above. The technique got its name from the action of “wuzeln” which is Austrian for forming straw-clay mixtures between one’s palms into loaf shapes by rolling and pressing (so-called “batzen”). After mixing the soil with water and adding chopped straw, the loaves are immediately stacked on top of each other. In order to ensure that the bonding of the loaves takes place in a single operation, which means without the use of mortar, it is important to stack them into walls with force. As with G’satz masonry, shovels or spades are used to cut the sides of the stacks to form a plane surface after the earth loaf stacks have dried (fig. 5).

Individual examples of the “wuzel” technique can still be found from the Weinviertel region in Lower Austria to southern Burgenland.

### Ashlar masonry

The “wuzel” and “batzen” earth building techniques as well as ashlar masonry can be considered precursors of earth block masonry. The ashlar blocks were made in rectangular-shaped moulds, so-called “Triacherln” (Weinviertel). After drying, they were stacked into walls using earth mortar with straw. Such an ash-

lar block was approximately twice the size of a masonry block (fig. 5). In the 19th century the different format of these blocks resulted in the standardization of hand-made bricks and the standard sizing of fired bricks [6].

### Earth brick (earth block)

In the literature, earth blocks are called “air bricks” in Austrian German, derogatorily also “Kotstein” (faeces block). The generally accepted term, however, is “earth bricks” (“Lehmziegel”).

From the middle of the 18th century to the beginning of the 20th century, earth buildings in Austria were primarily made of earth blocks, many of which have been preserved in large parts of Lower Austria, particularly in the Weinviertel region and the northern Burgenland (fig. 6). Their construction might be linked to decrees passed by Empress Maria Theresa which did not only favour earth block construction but also provided sample plans for various earth building techniques for the inhabitants of the royal lands, particularly Hungary. From the 19th century to the regime change during communist times in the middle of the 20th century, Hungarian earth block construction established itself as the predominant building technique [7]. The specialization and knowledge about this particular earth building technique in





Fig. 6 Weinviertel Zwerchhof built of earth blocks

such close proximity could be an indication for the predominance of Austrian earth block construction and needs to be investigated scientifically. Another likely reason for the frequent application of this load-bearing earth building technique is the low expenditure of energy in the production of and building with earth blocks. During times of war in the Austrian Empire of previous centuries, it might also have been important for women, children and older generations who had remained in the country to be able to do work which required less strength, such as the production of air-dried earth blocks. Furthermore, the geological conditions and the availability of water were ideal in these regions for the development of this load-bearing earth building technique.

Generally it can be assumed, however, that the brick – fired or unfired – is deeply rooted in the Austrian consciousness, particularly in eastern Austria. The craftsmanship for producing such a shaped object most likely developed in the last centuries through routine work. This technique might have also been so popular because, after application of the appropriate plaster and paint coat, it could model the more prestigious fired brick masonry as could already be seen with the earth-chinked log buildings of the Burgenland.

#### **Austria's golden age of earth building**

The development of technical regulations for earth as a building material in Central Europe has always been linked to the rapid growth of towns in the 14th and 15th centuries when wood as the main building material started to become scarce due to high demand. Excessive logging and clearing of forests in large parts of Europe, also as a result of the continuously growing agriculture, reduced the wood re-



Fig. 7 Weinviertel earth block house on stone base

serves of the time to an extreme minimum. In Austria – at that time the Austro-Hungarian Empire – this is evidenced by decrees in support of earth as a building material dating to the 18th century. Here, in addition to the high availability of earth everywhere, it was the benefit of the unrestricted fire resistance of earth building compared to wooden construction which led to legal regulations that pushed the use of earth as a load-bearing building material.

In the Austro-Hungarian Empire of the 18th century it was the fire ordinances of Empress Maria Theresia and Josef II which by imperial decree gave earth preference over the popular building material wood, exerting considerable influence on building activities in the towns and villages of the regions. Due to a lack of fuel for the brickworks at that time, inhabitants of all regions of the Austro-Hungarian Empire were required by law to use earth building techniques in their house construction, saving fired-brick production for the construction of Austria's palaces and for the production of ammunition for armed conflicts.

This becomes apparent with the "Feuerordnung für die mährischen Dörfer, Städte, Marktflecken und Gemeinden" (Fire regulation for Moravian villages, towns, market towns and communities) of 1751 which prohibits houses to be built exclusively of wood, and demands construction up to ceiling height using stone masonry with earth mortar, or unfired brick. The obligatory ventilation of the hearth via a chimney was also subject of the decree, as was the stipulation to build the kitchen out of stone, brick, or earth block masonry. The hearth had to be constructed of stone or brick [8].



Fig. 8 Historical mixed masonry in the urban environment of Hollabrunn (Lower Austria)

The "Hofreskript Nr. 280 in Böhmen vom 21. und in Österreich vom 26. Juli 1753–Die Gebäude auf dem Lande nicht gänzlich von Holz aufzuführen" (Court rescript no. 280 in Bohemia from 21st and in Austria from 26th July 1753 – To construct the buildings in the country not entirely from wood), is another decree with an imperial order to henceforth build at least the ground floor of all new construction out of stone or "so-called Egyptian or unfired brick" to contribute to the protection and conservation of forests as well as to the prevention of house fires [9].

The repopulation of Hungary after the devastating liberation wars from Turkish rule was initiated by Empress Maria Theresia at the end of the 17th century and continued under Josef II and Emperor Leopold II. This systematic and large-scale operation of the Austrian regime included the planning of villages, towns, and roads. While the draft layouts reflected the absolutist and symmetry-emphasizing building culture of the time, they also incorporated building traditions of the respective regions into the designs [10]:

*"According to local customs, the main wall and the dividing wall are made of rammed earth. The roof is covered with fibrous or knotty reed. The ceiling is covered with fibrous reed ... Both gables are tightly built using earth bricks 6 inches high..."*

Theresian legislation of the 18th century therefore helped the earth building techniques of cob ("G'satzt" masonry), "wuzel" masonry and earth block production reach their heights in Austria because these techniques could completely forgo the use of wood (apart from the ceiling beams). That also meant that compared to other building techniques, the construction costs of such earth buildings (using the excavation material on site and built with the help of the community) could not be undercut. This was an advantage in interwar periods of the Austro-Hungarian Empire as well as the post-war period of the Second Republic. In light of the housing shortage and scarce coal resources, earth was a locally available building material which could be processed air-dried. On the other hand, however, earth is thereby also defined as a building material for the poor, according to the principle "what costs nothing is worth nothing".

During the reign of Empress Maria Theresia this led to an avoidance of the term "earth", as searches in the Imperial Degrees have shown. Already at that time, the term had a negative connotation and was replaced by euphemisms or descriptions such as "Egyptian brick".

Despite resumed earth building activities during the reconstruction work in Austria between the wars





Fig. 9 Biedermeier house with load-bearing earth block and brick walls in the center of Vienna

and in the post-war period in the first decades of the 20th century, earth as a building material seems nonexistent in Austria's building standards. It was not until the 1950's that "unfired solid or perforated blocks" were mentioned in the standard ÖNORM B 3350:1951-06-01 Massive Mauern und Wände. Güteeigenschaften (Load-Bearing Walls, Quality Requirements). However, standard ÖNORM B 3350:1951-06-01 purely deals with quality requirements which were withdrawn in 1962 and replaced by the standard ÖNORM B 3351: 1962-05: Wände, aus künstlichen Steinen gemauert (Masonry walls made of artificial stones). "Unfired solid or perforated blocks" were not included in the subsequent norm.

In 1944, in the German Reich, however, efforts to compile all regulations and earth building techniques known thus far resulted in the so-called Lehm-bauordnung (Earth Building Code) which in 1951 was also officially approved by the building authorities in West Germany as DIN 18951. It can be assumed that after the reconstruction work was completed, the possibly insignificant field of Austrian earth building referred to German standardization. However, what is probably more likely is that Austrian earth building is by tradition an anonymous architecture. At any rate, there was obviously no need for Austrian regulations for earth building and earth building materials in the 20th century.

The fact that there never seemed to have been an application standard for the use of earth building materials in Austria leads to inescapable conclusions regarding the limited use of earth as a contemporary building material.



Fig. 10 Restoration with inappropriate materials: EPS exterior insulation of a historical earth block building in Lower Austria

### Restoration work for redensification

Urban sprawl not only requires communities to spend more money on infrastructure. In rural areas it also leads to an alarming degree of desolation in village centres. As a result of the discussion about sufficiency, which is part of the sustainability debate, a demand for the courage to shrink for the purpose of redensification is increasingly heard. This then needs to be followed by effective measures to make town centres more attractive.

In many parts of eastern Austria, existing buildings in town centres (which often are in need of repair) still consist of load-bearing earthen elements dating back to the 18th and 19th centuries (fig. 7). Load-bearing earth building techniques also spread into urban areas as shown by structures in Hollabrunn in Lower Austria and in the country's capital Vienna (figs. 8 and 9). Among the local population, there is little knowledge of the existence of these earthen buildings and how to use earth as a building material. Recent years have seen the demolition of this building culture as well as restoration efforts which did not account for the specific requirements of the material. This stresses the great need for knowledge transfer and raising awareness in the field of historical earth building in order to be able to adapt these buildings with their positive indoor climate to a modern building concept (fig. 10).

Knowledge of the added benefits of material-appropriate restoration leads to regional identity-building and thus contributes to the preservation of this ecologically-valuable architectural heritage. These efforts need to be supported by research. In addition, the potential of earth buildings must be emphasized

in order to protect valuable architectural heritage from demolition and to promote healthy living with the help of earth building materials. Successful restoration projects have already shown that this can lead to a lasting strengthening of the cultural character of a region and an awareness of a modern, environmentally-friendly and health-conscious selection of materials during the construction process.

All photographs by Jasmine Alia Blaschek

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