

## Historic daubed corner-timbered constructions in Czech Republic

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**ABSTRACT:** The objective of this paper is to present, due to regional fragmentation of research, a little-known type of construction, combining properties of wood and earth, whose qualities and long-term popularity across all layers of society predispose it to become a lesson for contemporary sustainable architecture. In historic Czech lands, a corner-timbered construction with massive protective earthen coating, dating back to the end of the first millennium, was predominantly presented in the medieval period and survived till the 20th century. Thanks to the systematic analytic surveys, much progress has been made in recent years in its understanding. Besides the better identification of the vernacular oldest buildings (especially houses with “smoky” living (all-purpose) room and wooden “vaults”), a valuable contribution of latest surveys is the approach to the study of this type of construction as an integral part of Czech built heritage.

### 1 INTRODUCTION

The historical Czech lands (Bohemia, Moravia and Silesia) have known two general methods of building in wood not only used in vernacular architecture: with framed walls (*hrázdění*) and with walls of horizontal timbers connected by a corner notching (*roubení*). A corner-timbered construction, dating back to the end of the first millennium, was predominantly presented in medieval period and survived till 20th century. The focus here is on its conjunction with massive earthen coatings, that combines the advantages of both materials, as well as on the principles of the historic use of this type of mixed construction.

The knowledge presented of these historic constructions is based on the literary and archival sources and field data gathered since the 80 s by inventories and historic structures analyses of selected buildings.

### 2 BUILDING TECHNIQUES

#### 2.1 Corner timbering

##### 2.1.1 Timber walls

Widely distributed in Eastern and Central Europe, log wall construction of timbers laid horizontally and connected by corner notching, *roubení* in Czech or *Blockbau* to use the German term, it is one of the principal methods of building in wood, using its mass and dead weight, but not its tensile properties.

As it consumes much more wood than timber-framing, it is linked with heavily forested regions. In Czech lands, though older examples are known, its massive use appears naturally in the period of the so-called great (outer) colonization (13th - 14th century).

Species of trees, that have long straight trunks, providing large log components, especially fir from the original natural forests, were preferred as ideal for this type of construction.

The timbers might be left round or “faced” to create smooth walls. Whatever the timber walls are made with debarked logs or timber baulks (hewn—shaped by axe or split lengthwise), each timber is notched at the ends, crossing at the angles. Among several types of locking joints the most common are those with the heads of beams being notched in dovetail form. Evolution of techniques led to more complex corner assemblies, called simply “lock” (*zámek* in Czech).

For the horizontal joints between timber layers a filling made from compliant substance, such as moss, earth, fibers or rope, is needed.

##### 2.1.2 Log ceilings and false vaults

The more archaic way of upper enclosure of the corner-timbered construction is that of log ceilings or false vaults, which are both part of medieval structures across all social layers.

The timber ceilings are made of massive logs, placed over supporting beams. In the oldest identified structures it was only one central hewn beam, which in case of existing and representative rooms



Figure 1. Vraclav, distr. Ústí nad Orlicí, farmhouse No. 49: datation 1651 on the central beam of the “light” living (all purpose) room. (Credits: Jiří Škabrada).



Figure 3. Vračovice, distr. Ústí nad Orlicí, farmhouse No. 2: secondary interior earthen coating of the former smoky room dated 1538 supported by wooden nails. (Credits: Jiří Škabrada).



Figure 2. Čistá u Litomyšle, distr. Svitavy, farmhouse No. 12: with an “incomplete” false vault of the living (all purpose) room. (Credits: Václav Mencl).

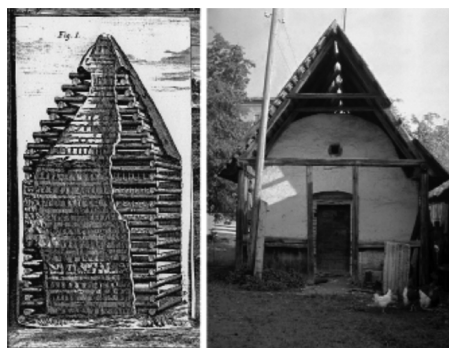


Figure 4. Left: Illustration of the construction of dwellings in Pontus according to the Vitruvius description by Claude Perrault (Vitruvius 1684). Right: Daubed corner-timbered 19th century granary from Lenartov (Slovakia). (Credits: Zuzana Syrová).

was also the main decorated element of the construction, and may bear dating (e.g. Živoňošť No. 22 from 1617 (Škabrada 1977, Mencl 1980), Vraclav No. 49 from 1651 (Ebel et al. 2002)).

In case of false corbelled vaults the timber walls, as the horizontal logs gradually become shorter, incline to the centre as a barrel, barrel pointed or cloister vault (Fig. 4). The vault may be “incomplete” with upper part formed by log ceiling (e.g. Sezemice No. 2 (Edel 1990, 1992), Vitějovice No. 15 (Vajdiš 1992), Čistá No. 12 (Mencl 1980), Trstěnice No. 111 from 1772 (Ebel et al. 2002)).

## 2.2 Daubed earth

An analysis of the earthen materials used in historic constructions shows (Kříž & Vorel 1998) daub shared much in common with solid traditional earth walling techniques of cob, stacked or coffered bread-shaped pieces – *války*, as it is known from Moravian regions. The primary difference was that daub as non-structural construction needs support. The amount of fibres in the mixture is generally more important as it may also have helped to reduce the weight of the material.

Loess was preferred as a universal building material for all traditional earthen constructions

including daub. Earth for the construction was extracted usually in quarries called *hliník*. However the dauber might use the earth immediately surrounding the building.

Daubed earth was applied on a supporting substructure of wattle, wooden fillings of timber-framing or timber walls of corner timbering.

The earthen coating of corner timbering, traditionally called “fur-coat” (*kožich*), can achieve significant thickness up to 15–20 cm. In case of corner-timbered walls with log ceilings and vaults, which form in fact structurally homogeneous cells, the entire shape of these wooden “boxes” (the walls from both sides and the upper side of the ceiling) is covered with protective earthen coating. Good adherence of the earthen layer to the timber wall is achieved by means of wooden nails (*ježkování* – “hedgehog”) and by axe cuts in the wood.

The surface of daubed earth was rendered with lime mortar, or traditionally with earth mixed with finely chopped straw, whitened with lime or later colored in blue or yellow.

### 3 DAUBED CORNER-TIMBERING HISTORY

#### 3.1 Period before the end of the 18th century

##### 3.1.1 Written and iconographic sources

Construction with logs with false cloister vault and earthen coating was described already by Roman architect Vitruvius Pollio in his architectural treatise *De architectura*, as a primitive way of construction of dwellings in Pontus (former Roman Empire province Dacia).

With regard to Czech lands, references in written texts are extremely rare. Use of earth was so common, that medieval written texts, in this regard, are almost silent. However, the abundance of names for daubers and other workers of mud coatings like *lepař*, *hlinák*, *hlinomaz*, undoubtedly demonstrate the use of daubed earth.

Iconographic references, among which the most known are probably scenes from the illuminated manuscripts of the Velislav biblia picta of 1325–1349 and the bible of king Wenceslaus IV of 1390–1400, show corner-timbered or plastered façades of living rooms and sleeping chambers with upper vaulted parts with visible ends of the logs, which correspond to the preserved examples described below.

##### 3.1.2 Archeological references

Corner-timbered constructions before the period of the so-called “inner” medieval colonization are known only through few archeological findings. One of the most important was probably the three-cell corner-timbered house excavated by I. Borkovský at Przemyslid fort *Levý Hradec* and dated to the second half of the 9th century (Mencl 1980).

Construction of corner-timbered rooms with “exterior” earthen coating inserted between stone walls, which served as warm bedrooms, are attested by imprints of logs in the earthen coat in medieval castles like *Kašperk* in Bohemian Forest (Škabrada 2003).

Archeologists often discovered pieces of burnt earthen coatings with imprints of logs that could belong to the vertical or horizontal log constructions. Many examples from the defunct villages could be cited for the “pioneer” period of the inner medieval colonization (Nekuda 2002).

##### 3.1.3 Living (all purpose) room

The use of the daubed corner timbering is since the medieval period closely linked to the construction of living (all purpose) rooms and to the chamber-granaries.

Daubed corner-timbered rooms are attested and preserved in manor, town and rural houses, mainly as a part of three-cell spatial arrangement of dwelling that is in most cases horizontal, but can also be vertical.



Figure 5. Čistá u Litomyšle, distr. Svitavy, farmhouse No. 171 with „smoky” room dated 1583; the restitution of the „smoky” room and the current state with the „light” room; 1 - entrance hall, 2 - living (all purpose) room, 3 - kitchen / chamber, 4 - chamber—granary, 5 - descent to the cellar, 6/7 - stables?. (Credits: Jiří Syrový).

Their older evolutionary phase is the living (all purpose) “smoky” room (*dymná jizba*, in German *Rauchstube*). The room itself was a confined place that served for preparing the meals, for living and sleeping purposes. An open hearth and bake oven stood in a corner by the entrance of the room. The smoke occupied the upper part of room and escaped through the upper smoke windows or smoke openings. Sufficient room height (generally about 3,5 m) was needed, so that man could move below the smoke. Their horizontal size is naturally limited by the length of the available tree trunks (usually 6 × 6 m). The space could be increased by vault, that was also used advantageously for letting warm smoke rise and escape through openings in end walls. Horizontally laid timber massive baulks, were carpented only partially on the exterior side, from where they were, as well as the top of the log ceiling or false vault, covered with earthen coating.

Smoky rooms were gradually abandoned in favour of clean space of the so-called “light” rooms (*světnice*). This was allowed by the adoption of stove and the related transfer of the open hearth

in the adjacent entrance hall, or separated of the so-called “black” kitchen (*černá kuchyně*).

The transitional phase is represented by “semi-smoky” room (*polodymná jizba*) with wattle daubed hood hung over the open hearth.

The adjective “smoky” (*dymná*) or “semi-smoky” (*polodymná*) are recent. Medieval texts or designations preserved on dialects only know the simple word *jizba*.

The “light” rooms even newly constructed conserved for some period a great height of smoky rooms and their characteristic triangular composition of windows (*Havlíčkův Brod* No. 2015). Their interior stripped of smoke could also be covered with earthen coating.

This important change of heating system did not take place at once, according to the social status of the owner of the house. The turning point, regarding rural houses, is the period around the Thirty Years’ War. The farmhouse No. 171 in the village *Čistá* near *Litomyšl* was constructed according to the dendrochronological datation shortly after 1583 with “smoky” room, while the small house for the retired farmer No. 97, on the other side of the valley in the same village was constructed in 1617 with a “light” room (*Syrová & Škabrada 1989, Ebel et al. 2002*).

The oldest known daubed corner-timbered rural existing (all purpose) rooms date from the 15th century (*Škabrada 2003, 2004, Anderle et al. 2000, Ouroda et al. 2010*).

Many remarkable structures, mainly three “smoky” rooms and several “light” rooms from the 16th-17th centuries, were identified through the inventory and survey of selected buildings of the *Litomyšl* and *Vysoké Mýto* region (*Ebel et al. 2002*).

Daubed corner-timbered rooms can also be found in the regions of the old settlement, where at the latest since the late Middle Ages, enough of wood for construction could not be found. In the houses of the Southeastern and Central Moravia from 16th-18th centuries with characteristic porch called *žudr* the daubed corner-timbered existing (all purpose) rooms are incorporated in houses constructed entirely using massive earthen or stone constructions (e.g. *Pouzdrány* No. 49 from 1596).

Main features, which enable to recognize whether the room was constructed and served as “smoky” room, are:

- room height sufficient to ensure that man can stand below the surface of smoke;
- presence of smoke holes or windows;
- soot-blackened surface of the timber and joints in the interior;
- external earthen coating (internal coatings do not make sense before the transition to the “light” room);



Figure 6. *Čistá* u *Litomyšle*, distr. *Svitavy*, farmhouse No. 171: detail of the smoke window of the living (all purpose) room. (Credits: Jiří Škabrada).

- orientation of the bake oven (may be confirmed by local archeological survey in the hearth corner).

The chronological list below contains a selection of the most important examples of the daubed corner-timbered (all-purpose) living room from the whole Czech republic.

Smoky rooms:

- Saky, distr. Kladno, No. 2–1495
- Vračovice, distr. Ústí nad Orlicí, No. 2–1538
- Cerekvice, distr. Svítavy, No. 11–1550
- Lučice, distr. Klatovy, No. 2–1556
- Čistá, distr. Svítavy, No. 171–1583

Light rooms:

- Kutná Hora, distr. Kutná Hora, No. 25–1438
- Kutná Hora, distr. Kutná Hora, No. 42–1438
- Kutná Hora, distr. Kutná Hora, No. 34–1441
- Kutná Hora, distr. Kutná Hora, No. 20–1491
- Vitějovice, distr. Prachatic, No. 4–1492
- Rtyně, distr. Trutnov, No. 53–1548
- Praha–Podskalí, distr. Praha, No. 412–1597
- Čistá, distr. Svítavy, No. 97–1617
- Vraclav, distr. Ústí nad Orlicí, No. 49–1651
- Havlíčkův Brod, distr. H. Brod, No. 2015–165?
- Trstěnice, distr. Svítavy, No. 61–1664
- Benátky, distr. Svítavy, No. 28–1669
- Čistá u Litomyšle, distr. Svítavy, No. 186–1672
- Sádek u Poličky, distr. Svítavy, No. 48–1681
- Knínice, distr. Blansko, No. 112–1692
- Čistá u Litomyšle, distr. Svítavy, No. 33–1702

Rooms with unidentified type of heating:

- Mirkovice, distr. Český Krumlov, No. 1–1430
- Sedlešovice, distr. Znojmo, No. 20–1528
- Pouzdrány, distr. Břeclav, No. 49–1596

### 3.1.4 Chamber-granary

The chamber-granary served for the storage of grain, food and all valuable objects of the farm. It might be constructed as one of the parts of the



three-cell house, or as a separate building (Fig. 4). In both cases it usually has three storeys—a cellar and a lower and upper chamber that can have the false log vault covered with protective earthen coating. Due to its importance as “safe” of the farm, this part of house was often built in the rural houses since late Middle Ages already in stone in Bohemia, and in cob or rammed earth in South-eastern and Central Moravia.

### 3.2 Period after the end of the 18th century

#### 3.2.1 Interventions of the modern state

Since the second half of the 18th century wood in wall constructions in generally is slowly replaced by earth (especially adobe and rammed earth), brick and stone. It is not only because of the lack of timber, but the modern state intervenes through the reforms, the first building codes, regulations against fire and repeated interdictions of wooden constructions.

At their beginning is the fire patent for Moravian margraviat and for Bohemian kingdom from 1751, followed by patent for extinction of fires (1755), fire order of the emperor Josef II for Bohemian kingdom (1785), fire order for countryside, towns and villages in Moravia and Silesia (1787), decree of general obligation to submit the plans of building construction (1788), general prohibition of wooden constructions (1816), decree authorizing peasants to produce bricks (1819), and orders of the construction for kingdom of Bohemia and margraviat of Moravia (1833, 1835). These, slowly and with difficulty, enforced regulations set out technical details of use of *clay* for fire protection purposes and conditions under which it is possible to use the wood in constructions (among others also the thickness of earthen coatings of wooden walls and ceilings) (Ebel 2001, 2007). Also the treatises on construction, builder handbooks and even teaching materials for secondary schools, published in Prague (Jöndl 1840a, b, Jöndl et al. 1865) and in Brno (Gabriely 1861) describe the technique of daubed earth as the most advantageous fire protection of wooden constructions.

Application of the daub on the wooden construction is required and promoted by the state and it becomes important to hide the wood from the inquisitive eyes of the authorities.

#### 3.2.2 Preserved building stock

The earthen coatings of this period are in general much thinner compared to earlier periods. However, in some regions as the surroundings of *Litomyšl* and *Vysoké Mýto* (e.g. *Tisová* No. 48 from 1764, *Trstěnice* No. 111 from 1772, *Sedliště* No. 33 from 1802, *Benátky* No. 32 from 1838 (Ebel et al. 2002)) in Bohemia and *Luhačovičské Zálesí* (e.g. *Želechovice nad Dřevnicí* No. 81) or *Haná* in Moravia (Kšír 1956, Pokorný 2012) tradition of



Figure 7. Tisová, distr. Ústí nad Orlicí, farmhouse No. 48 with “light” living (all purpose) room dated 1764. (Credits: Jiří Škabrada).

solid daubed timber-cornered living (all purpose) rooms survives, although the rest of the house is already built of solid stone or brick masonry.

In southern Bohemia and northern Moravia a large number of separate chamber-granaries from this period are preserved. In Slovakia it is even possible to find separate chamber-granaries built with daubed corner-timbering even in the first decades of the 20th century.

## 4 LONG TERM POPULARITY AND PROPERTIES OF THE CONSTRUCTION

It is remarkable that this method of construction remained one of the most successful from its boom in the period of the medieval inner colonization down to its gradual demise during recent centuries. One of the main reasons was its fire resistance proven by such events as the intentionally fire set of the farmhouse No. 2 in *Vračovice* in the twenties of the 20th century, which was a part of an insurance fraud. Although the house burned a few days, its corner—timbered “smoky” room from 1537 survived the fire thanks to its massive earthen protective coating.

The thermal comfort of daubed corner—timbered living (all purpose) rooms was and, in case of survived structures, still can be appreciated. Long-term temperature monitoring of unoccupied daubed corner-timbered living rooms shows that the temperature in their interiors rarely falls below freezing point (Kříž & Vorel 1998). The situation had to be better when they were heated in winter and vice-versa during the period of greatest summer heat, when the interior keeps also a comfortable temperature.

The construction successfully combines thermotechnical advantages of wood and earth. We must not forget that it did not exist in laboratory conditions as a tested sample of wooden log with earthen coating. The house functioned as a whole. According to the orientation of the house to the

sun, the roof overhang allowed to heat up the mass of earthen coating of the room in winter and provided the necessary shade in the summer. For this reason, many old houses (Mirkovice No. 1, Benátky No. 28, Trstěnice No. 61, Draženov No. 8) turned their back to the public space and preferred orientation towards the cardinal points.

## 5 CONCLUSIONS

From the contemporary perspective, the daubed corner-timbered constructions, with their long term success, proved their sustainability.

The reason for their survival was not just a natural conservatism of local population or application of building codes and regulations. If historic building codes and regulations were strictly followed, no corner-timbered could be built without earthen coating since the end of the 18th century. But the historic use of daubed corner-timbering is mainly associated with two basic types of structures, in which it really could prove its fire resistance and thermotechnical properties: living (all purpose) room and chamber-granary. The knowledge of these preferences can also help us in historic structures analysis to correctly identify the former use of the rooms. Although, from the viewpoint of earthen architecture, the technique of the daubed earth is the same in case of any wooden supporting substructure, the corner-timbering is specific, because the wood in it works by its mass. Both materials—earth and wood—acted together and the earthen coating may be as old as its wooden support. From this perspective, unfortunately, frequent practice of removal of all earthen elements from the wooden constructions seems extremely inappropriate.

As a final consideration it should be noted, that this construction is little known beyond Central Europe and that the majority of its literary references are written in Czech, therefore this paper has also the objective of contributing to its knowledge and diffusion.

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