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# **CZECH REPUBLIC**



**Faculty of Architecture  
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## **Report about the Protection and the Conservation Conditions of Wooden Monuments in the Czech Republic**

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The research of wooden churches has been conducted within the EU Culture 2000 project entitled "Rescuing hidden European wooden religious heritage: an international methodology for implementing a database for restoration projects" (Project CLT2005/A1/CH/IT-242) in the winter and spring of 2005/2006.

### **MONUMENT PROTECTION IN THE CZECH REPUBLIC**

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The monument protection in its institutional form has existed in Czech lands since 1850 when a Central Board for Research and Preservation of Historic Buildings was established at Vienna, the centre of the then Austria. However, it was only after 108 years in 1958 that a law on monument protection came into force. The previous attempts were rejected as interfering with the owners' rights or because of the turbulent war events. The current law dates back to 1987 and is based on the State Monument Protection Act.

Under this law, the Czech monument protection is organized at two levels. The first level is formed by specialized bodies located in the centres of regions with headquarters in Prague. The executive bodies, methodologically controlled by the specialized bodies, are based in district towns and authorized villages (the relevant building authorities and departments). The entire structure is then supervised by the Ministry of Culture of the Czech Republic.

Monument protection is financed from the budget of the Ministry of Culture, however, the funding received is usually not sufficient. As a result, a large number of historic monuments are dilapidated being isolated from the life of society. This is one of the reasons why there are more and more institutions, unincorporated associations, and private monument owners whose activities are funded from the community programmes offered by the European Union (such as Culture 2000).

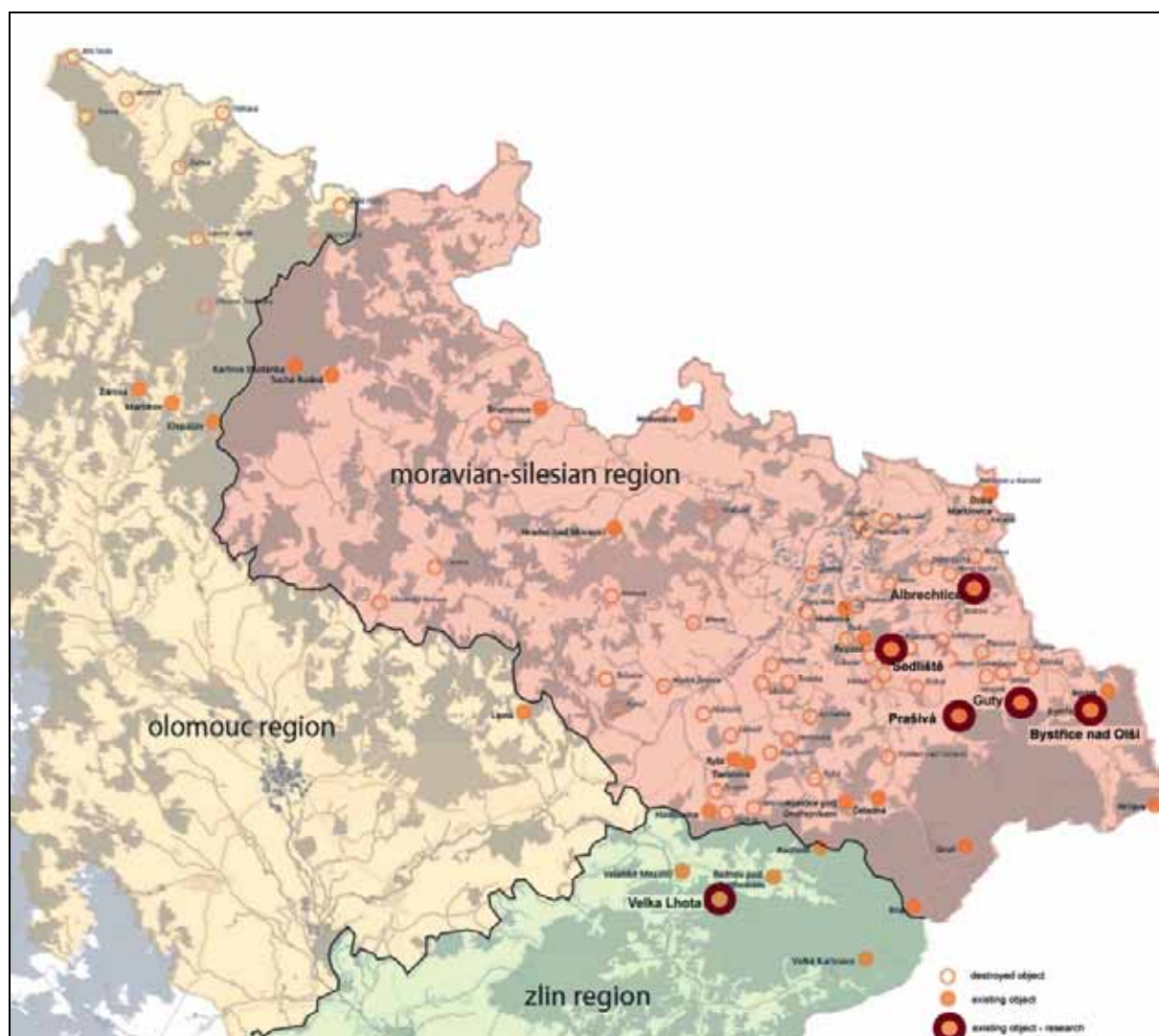
All the culture monuments are on a State List of Immovable Cultural Monuments. At present, this list contains about 40,000 items. These include 196 buildings marked as national cultural monuments, 40 cities with a historic centre classified as an urban monument reserve. Twelve items have been put on list of UNESCO cultural heritage.

In 2002 the Czech Republic adhered to European Archaeological Convention and to the European Architectural Convention. Having made this step, the Czech monument protection is now part of European and worldwide context.

### **WOODEN RELIGIOUS BUILDINGS IN THE CZECH REPUBLIC – MORAVIA AND SILESIA**

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Wooden religious buildings are seen as the peak of the art of rural building. They have mainly been preserved in the Eastern European countries in Poland, Slovakia, Czech Republic, and Ukraine. In the Czech Republic, most of them can be found in the northeast of Moravia and in Silesia. Out of the 366 probably existing Moravian-Silesian churches and chapels, 31 wooden churches have been preserved. Their number, however, is slowly decreasing as evidenced by the situation around Těšín where, according to the archives, out of the 74 wooden churches, only 10 have been preserved: in Albrechtice u Českého Těšína, Bystřice nad Olší, Dolní Marklovice, Guty, in Hřava, in Nýdek, at Prašivá, at Repiště, and at Sedliště.



1. Map of the existing and destroyed churches in Moravia and Silesia (Z.Jacková, J.Mlččka)

Apart from the above-mentioned churches also churches in the Beskydy mountains, and in the area in Moravia-Silesia around this mountain range at Gruň, in Kunčice pod Ondřejníkom, at Bílá. In the Kravaře area, wooden churches can be found in Tramovice u Štramberku and at Rybí. In Walachia, churches have been preserved at Valašské Meziříčí, at Velká Lhota, at Velké Karlovice and at Radhošť. Apart from this area, small churches have been preserved at Lipná u Polštátu, at Hněvošice in the Opava region and, among the wooden churches and chapels in the Jeseníky mountains, once so numerous, only churches at Žárov and Maršík in the area around Šumperk have remained.

Until the 17<sup>th</sup> century, an overwhelming majority of churches were built of wood, the commonest building material in the Moravian-Silesian region to date. Wood species available in the immediate vicinity of the construction were mostly used for the structures built, that is, fir, spruce, and oak. If the structure's serviceable lifetime expired or it accidentally burnt down, a new church was built within a short period. There could be up to three older churches on the same place. Only a few structural members remain from them as they were reused in a new structure. There are many differences between the load-bearing structures of each church. Local builders often bring new inventions such as mixed frame and wall supporting system or new type of roof truss.

The oldest wooden churches began to be built in Moravia and Silesia in the 13<sup>th</sup> century. By their nature they can be seen as being among West-Slavonic type churches that can be found mostly in the Czech lands, Poland, and in the Orava and Spiš areas of Slovakia. In spite of intense German influence in the region, their unique style endures because of very strong and old tradition of wooden construction. The distinguishing sign of the Moravian and Silesian churches is the dependence of their ground plan as well as of their overall church space conception on the style, mostly gothic religious architecture. Wooden churches have mostly one nave with a polygonal chancel entered from the front of the church. The construction of the church started mostly with stone bedding of heavy boulders that provides good ventilation to prevent absorption of ground and underground water. The first row of main building timber walls is made of huge oak logs as an additional

water protection and stiffening frame. The nave is neither very large nor high and it usually doesn't exceed dimensions of ordinary log cabin. Builders rather emphasized precision and decorativeness of their work. The ceilings of wooden churches are mostly flat. Rarely a wooden vault was used. The presbytery of the Guty church is an example of one. The saddle roofs are rather high and shingled. The roof often continues to the ground level to protect foundations and walls against bad climatic conditions. The gallery under overhanging roof proved to be useful shelter for gathering people in rainy days. Therefore it was usually built even if the roof ended with the walls. The church truss structure is based on the originally German close-couple system, completed by struts and tie beams. The structure components of massive beams are joined and often reinforced with wooden pins. The following may serve as examples of 15<sup>th</sup> century churches: St. Martin church in Karviná (originally a wooden church first mentioned in 1447, since 1795 with brick walls), All Saints' church in Rožnov (brick walls erected from 1748 to 1752), Virgin Mary's and St. Catherine's church in Zubří (dating back to 1453, brick walls since 1788), St. Mark's church in Heřmanice (first mentioned in 1447, pulled down in 1868), All Saints' church in Kanská u Třince (parish church in 1447, brick walls erected in 1795), Virgin Mary's Ascension church (first mentioned in 1447, brick walls erected in 1788).

The early 16<sup>th</sup> century wooden churches are built with triangularly finished presbytery and towers begin to be erected. The space under its belfry can accommodate more people than the nave itself. These are based on a structure in long beams with slightly sloping walls bearing the floor of a prism-shaped belfry with a pyramidal roof. Later the towers acquire polygonal ground plans. The helmets are shingled with two-stage onion-shaped roof on top with a lantern. At first, the towers were built as structures on their own in the vicinity of churches, being attached to churches later on above their main entrances. These were at first in the form of a low shed roof, becoming a structural part of the church later on. In the 16<sup>th</sup> and 17<sup>th</sup> centuries, a gallery is added around the nave with a simple column structure and a shingled shed roof. These type of churches have been preserved in Hodslavice, Ostrava–Hrabová, in Sedliště, Guty, and in Dolní Marklovice.

As the artistic styles were changing during the centuries, so did the decoration of churches. While the renaissance style had barely any effect on their appearance, the baroque influenced both the interior and the outward look. The shape of the triumphal arch between the nave and the presbytery changes, the simple flat form is replaced by an arch. Windows become mostly larger, their shape is changing and many are glassed with pellucis as well as stained glass, mostly in the form of small panes.

Wooden churches are mostly catholic. This was due not only to the fact that so was the population, but also to the counter-reformation period during which all but catholic denominations were banned with their churches being forcibly given to the catholic church. It was only after the Soprony Assembly's Articles in 1681 and the Tolerance Edict issued by Kaiser Joseph II in 1781 that a regulated number churches were allowed for non-catholic denominations. Such churches had to be built without towers, without fortifying components, brick walls couldn't be used and they could not be situated at major roads and in important places. The largest number of these after-Soprony-articles and after-tolerance-edict wooden churches has been preserved in Slovakia. There is only one such church in the Czech Republic - in Velká Lhota near Valašské Meziříčí.

The 18<sup>th</sup> and 19<sup>th</sup> century churches had mostly brick walls. A wooden church at that time was seen by the people as opposed to brick-walled one rather as a makeshift building. Therefore not only damaged or burned down churches are bricked, but also buildings in good technical condition. Small wooden bell-towers are replaced by brick-wall ones almost in all the villages, gradually beginning to serve for religious service and being transformed into chapels. Exceptions are the mountain areas of Jeseníky and Beskydy with abundance of wood where the tradition of timbered architecture was still live. However, the overall trend had caused a considerable reduction in the number of wooden churches in our territory. The defunct buildings included churches in Čechovice, Hnojník u Oder, Studénka, Třanovice, Heřmanice, Vrbice, Sádek u Horního Benešova, Tošovice u Oder, Kopřivnice, and Životice u Nového Jičína.

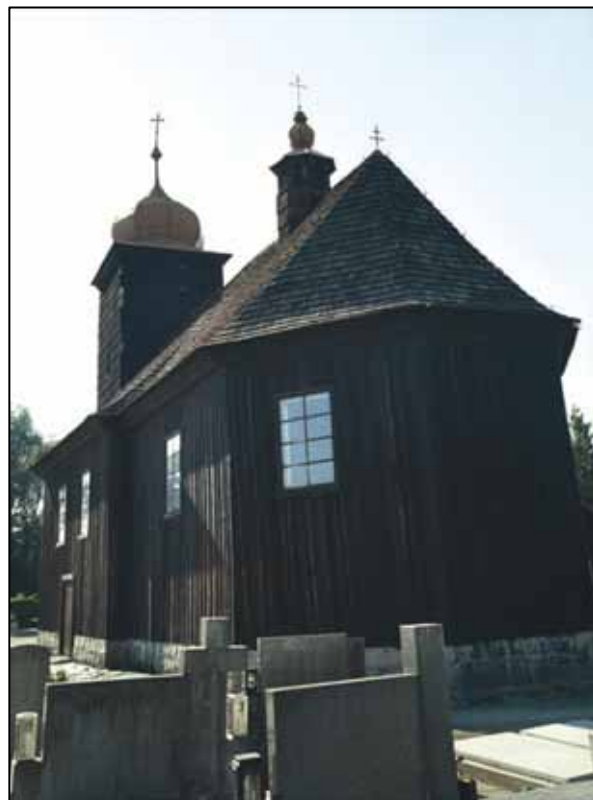
In 20<sup>th</sup> century, a large number of churches still become defunct. Photographic and graphic documentation of the defunct churches has not been collected being scattered in museums and archives of monument protection institutes or private collections of old photographs and picture postcards. Only a few fragments of the past heritage have been preserved that are worth our care and attention. Some of wooden churches are used for relatively short periods and most of the year they are closed. Suitable conditions for fast wood degradation are developed by interaction of factors as insufficient ventilation and heating in occasionally used structures. One of them is the church in Albrechtice, which is in a rather poor technical condition. By enlisting the church in our project we would like to stress that it is important to increase people's awareness of the wooden churches both in this country and worldwide to uncover the "hidden" heritage and beauty of the times past as well as binging about their reuse and revival so that they can continue to tell their stories.

This is also the main objective of the Culture 2000 project as part of which we listed 10 candidate-wooden-churches in the North East Moravia in cooperation with the National Monument Protection Institute in Ostrava. The database form designed by the project leader has been filled in for 6 of these churches. The following churches have been selected:

**1. St. Peter and Paul's church in Albrechtice, Silesia, Moravian-Silesian Region  
Ostrava - Opava Episcopate, Deanery of Karviná, Parish of Albrechtice**

Cult: Roman Catholic church  
Period: late Baroque, 18<sup>th</sup> Century  
Building Category: Rectory church  
Protection: Cultural monument

The St. Peter and Paul's church is situated in the cadastral area of Albrechtice u Českého Těšína next to a local cemetery near the river Stonávka. The building lot is on the border of the village on a plane ground with access in its southern part from a local road. To the East is a basic school with a playground. The church is one-nave wooden church with stone foundations. Slightly set-off three sided bema, the nave has almost a square ground plan. The tower is four-sided, slightly conical, 18 m high, set off in front of the western front of the nave where the entry is situated. It is covered by a cupola from galvanised sheet with a metal cross 1.8 m high. The nave is protected by a saddle shingled roof with a spirelet on the ridge. The bema and the nave are panelled. In the interior, the bema and the nave are separated by a triumphal arch with a carved date of 1766 and initials of W.P. The ceiling of the church is formed by wooden casing left in its natural colour. The nave is 17 m long and 8,5 m wide. The pavement is from Gondul sandstone. There are 8 windows in the walls each with 8 panes.



2.

**2. The Exaltation of the Cross church in Bystřice nad Olší, district of Frýdek-Místek, Moravian-Silesian Region, Ostrava - Opava Episcopate, Frýdek Deanery, Vendryně Parish**

Cult: Roman Catholic church  
Period: Romantic period, 17<sup>th</sup> Century  
Building Category: Subsidiary church  
Protection: Cultural monument

The church is situated in the place of a wooden 16<sup>th</sup> century church, in the middle of the developed area of a village on a slope along a road. It is delimited by the fencing of the old church. A cemetery is situated around an isolated church. Old evangelical church 1587, from 1654 it belonged to the Catholics, who disassembled it and built a new (catholic) church 1897 (in a romantic style designed by Albín Prokop). The church is one-nave building with rectangular, 20 x 18 m ground plan a 10 m high tower above the entrance and a polygonal chancel (flat-hexagonal-shaped) on the other side of the nave. The vestry with a staircase plus entry to the pulpit and toilet (used now as a teaching room for small children) have been added to the left-hand part of the nave. The staircase in the tower leads to a loft (with an organ) from where a ladder continues up to the tower. The foundations are made of stone. The upper structure is wooden. The roof is shingled and the ceiling is formed by wooden beams. The truss is traditional wooden, the floor is planked. The window frames are carved, and the door has a carved frame. The walls of the nave are made from smooth beams with motives of vine in some joints. In the back of the nave is a wooden loft supported by two high pillars. The parapet is carved with simple ornaments related to elements of rural art. To the left of the church is a three-winged renaissance altar, with the middle part depicting Virgin Mary bewailing Christ, the left-hand side representing Virgin Mary and the right-hand side St. John. The middle wing bears a signature and the date P.R.1588. The entrance door of the church is decorated by ironwork and woodcarving. The fixtures include a renaissance picture, two statues of Virgin Mary, Jesus Christ and a 19<sup>th</sup> century altar.

3.



**3. Corpus Christi church in Guty, Moravian- Silesian Region  
Ostrava - Opava Episcopate, Střítež Parish**

Cult: Roman Catholic church  
Period: Renaissance, 16<sup>th</sup> Century  
Building Category: Subsidiary church  
Protection: Cultural monument

The church is situated near Guty, village in a valley in the middle of fields. There are full-grown foliaceous trees around the church and a stream runs nearby. The cemetery is part of the church. The church is an one-nave church on a near-square ground plan, with the choir above the entrance to the nave. The choir is decorated with rural paintings, wooden log house altar at the head of the church, the vestry to the left of the altar. The pyramidal tower with an onion-shaped belfry protects the space in front of the main nave from bad weather. The interior of the church is very decorative the choir has rich painted ornaments dating back to 1634 when it was being extended. The walls covered with rural paintings on canvas (at present the paintings are in good condition). The design of post heads carrying the choir is of similar rural type, have heart-shaped ending of the planks sheathing the belfry head.

4.

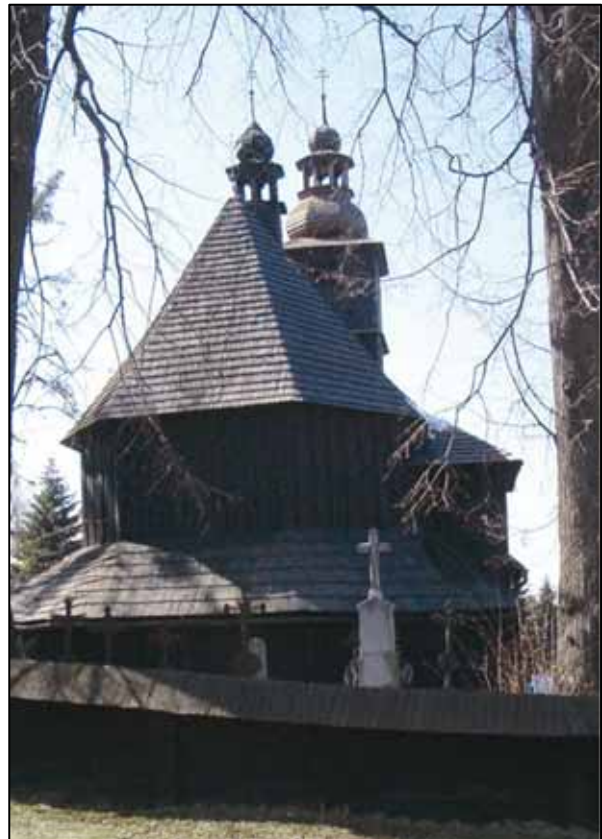


**4. All Saints' Church in Sedlišť, Silesia, Region of Walachia  
Ostrava - Opava Episcopate, Frýdek Místek Deanery**

Cult: Roman Catholic church  
Period: Modern period, 1<sup>st</sup> half of 17<sup>th</sup> Century  
Building Category: Parish church  
Protection: Cultural monument

The church is situated in the middle of a village with a road encircling it. The territory on which it stands is not a protected area. In the vicinity is land with active mines underneath. The village is situated in an area protected because of the occurrence of deposits. The geologic sub-base is formed by sandstone, slate, loess loam, gravel, and sand. The church is 22 m long and 10 m wide. It has one nave with the dimensions 9 m by 5,8 m. The nave includes a choir, presbytery 5,6 by 4 m. to the right (south). A vestry is added on one side of 1,8 m by 3,6 m with a gallery above it . A separate square tower above the entry was added with a cupola belfry facing east, a covered gallery called "sobota" is around the church to protect the church foundation from bad weather. An old cemetery lies around the church. The entire complex is contained within a wooden fence with a wooden crest and two gates situated opposite each other. In front of this area near the western gate stand statues of Virgin Mary of Frýdek and Jan of Nepomuk hewn from stone standing on prismatic posts. On the left of the entry is a large wooden cross. On the other side of the entry is then a small cross with a thorn crown installed here in 1994 bearing an inscription reading "The village to the victims of communism".

5.



## 5. Wooden Tolerance church in Velká Lhota, Central Moravia, Walachia Evangelical Church of the Czech Brethren, East Moravian Seniorate

Cult: Evangelical Church

Period: late Baroque, 18<sup>th</sup> Century

Building Category: Protestant church

Protection: Cultural monument

The church is situated at the access road to the village on the south western slope in the hilly landscape. The entry to the church is from the south east and it is longitudinally oriented along the south-west-south-east axis. The nave of the church is 16,1 m by 10,4 m and the entry is situated in the middle of the longer side. The pulpit is opposite the entry, to the right entry to the vestry size 3,62 by 3,15. The altar is placed in the centre of the area. The gallery is situated along the entry side and both shorter sides, steps to the gallery on both sides of the entry. Light comes in through 6 small windows in the upper part of the walls, two windows in each longer side, on each shorter one, six panes to a window. On the entry side and to the right from the entry, the church is extended by a covered gangway open to the roof about 2 m wide.

Pews facing the communion table are situated in the centre part of the church. They are not identical and they were made by the church-goers themselves. There were at least two pews for each family, one upstairs for the men and another downstairs for the women and children. The pulpit is covered with a colourful decor in Hungarian national colours. The original colours have been preserved. The pulpit was probably designed by parson Josef Gerža Jr. The columns and railing of the gallery are wooden, carved, white coloured. The wall paintings in the middle of the ceiling are black on white, with an inscription surrounded by an ornament: Mine house, house of prayers, gelf. Mat XXI13., 1783. The wall paintings at the entry to the pulpit and above the door leading to a store room are black oval with gilded inscriptions:

- to the left of the pulpit: I want you to know, brothers, that the gospel I preached is not something that man made up. I did not receive it from any man, nor was I taught it; rather, I received it by revelation from Jesus Christ. Galatians 1,11 – 12

- to the right of the pulpit: Who among you fears the LORD and obeys the word of his servant?. Isaiah 50,10, O my people, hear my teaching; listen to the words of my mouth. Psalm 78,1

In the 1990's the outdated harmonium was replaced by an organ made by Jiří Vaculín from Vsetín placed above the entry to the gallery.<sup>1</sup>

6.



## Conservation and protection methods applied to historical timber structures of religious buildings

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### 1. PLACE

The wooden churches under investigation are situated in Silesia (formerly an independent region now belonging to the Czech Republic as its north-easternmost part) in a piedmont woody landscape.

### 2. AGE

The age of the churches, all of them under monument protection, is measured in centuries. The latest church erected in 1897 was built in the place of a 16<sup>th</sup> century wooden church destroyed by a flood. Other churches have

Bibliography: Polášek, J.; Wooden Churches and Chapels of Moravia and Silesia [*in Czech*]; AGAVE; Český Těšín; 2001

Londzin, J.: Koscioly drewniane na Śląsku Cieszyńskim, nakładem i drukiem „dziedzictwa blog. Jana Sarkandra”, Cieszyn, 1932

Information: The National Monument Protection Institute in Ostrava, information received during the Culture 2000 project

Note: The descriptions and pictures of the churches are taken from the inventory forms under investigation.

existed for 220 to 700 years and have been repaired, extended, and reconstructed several times. The exact age of each church could be determined, for example, by a dendrochronological analysis provided, of course, that no beams from an earlier church have been used for the construction.

### **3. INFLUENCES**

The condition of each church has been the direct result of the influences on it over the years of its existence. Negative influences always bring about defects that have to be repaired. Therefore, correct evaluation of such influences is very important for any successful reconstruction or repair.

#### **3.1 Internal influences**

##### **3.1.1 Material**

Stone and wood were the prevailing traditional building materials in the foothills. They were also used to build churches – stone for the foundation, socles, floor tiles, and flagstones in the vicinity of the church, wood for the entire upper part of the construction, the roofing and the interior. The local craftsmen had been used to working with such materials for centuries and therefore were good at selecting quality material. Very often, fir wood was used for construction, but nowadays one can also find a number of other wood types in churches used for additions, reconstruction, and repairs.

##### **3.1.2 Design of load-bearing structure**

No theory of load-bearing structure design existed at the time the churches in question were built; it was mostly customs and tradition that were the decisive element later incorporated in fire and building rules – the predecessors of building standards. The design of a small church was made by a reputable local builder, who, because lacking exact knowledge of a number of things, was rather guided by his instinct. For this reason, one can find a number of deficiencies in old buildings from today's point of view. They include insufficient depth of foundation, in the first place, sometimes the foundation was non-existent. Also the section sizes of the wooden profiles of bearing structures were inadequate as was sometimes even the structural arrangement. Sometimes also the choice of the building site was wrong as in cases of places regularly, if not very often, flooded even.

##### **3.1.3 Quality of work**

Construction work on churches was of good quality corresponding to the then state of the art using expertise passed from generation to generation. Reliable and able craftsmen were chosen for the construction.

#### **3.2 External influences**

##### **3.2.1 Environmental influences**

These include influences of the climate, the aggressiveness of the environment and the manner of utilization of a building. The climate – mostly the temperature and water – represents a wide range of influences that result in a number of defects mostly caused by water leaking into the building and its wooden structures. Humidity and temperature gradient bring about degradation of wood by wood decaying fungi. These fungal attacks lead to the decreasing of wood volumetric weight what is the most important character for wood degradation. The timber strength is decreasing according to the rate of fungi degradation. UV light effect when elements are exposed to sunshine can lead onto the surface degradation of wood elements (e.g. shingles) if the elements have not applied surface protection. Heavy snowfall, so often in higher altitudes, may also cause a great deal of problems, with snow remaining longer on wooden roofs thus having a negative effect on the shingles. The aggressiveness of the environment, which is a modern problem, plays no significant role in historic wooden churches, as they are mostly situated in rural areas. This can also be said of the way in which a building is used because it is extraordinarily sparing in religious buildings. The only critical point tends to be the choir loft with an organ for which the roofing may be insufficient and next towers with bells where defects may appear sooner because of the bell vibrations.

##### **3.2.2 Change in the foundation**

Changes in the foundation usually bring about construction instability which is dangerous mainly in wide-span and high buildings, to which churches belong (the nave and the tower). This also includes changes in the underground water level with the related changes in the soil humidity, which, in fine-grain soils, may cause decrease in their bearing capacity, next freezing of the footing bottom, vibrations distributed in the soil and undermining. Of the preceding influences, some were removed in the past such as additional underpinning (with concrete) of the foundation, landscaping to bring water outside the building, the provision of spouts and eaves to bring rainwater outside the building and the surrounding soil as soon as possible.

The changes in the underground water level cause problems in one of the churches under investigation, which was built near a stream that inundates at certain intervals. Due to insufficient foundation, the church tower began to lean, which is mainly visible from the inside.

The churches are situated in a quiet, not undermined area and are, therefore, exposed neither to vibrations caused by heavy traffic nor to the effects of undermining.

### **3.2.3 Inappropriate or insufficient human intervention**

This includes insufficient maintenance, improper use of the building, inadequate construction changes in the bearing structure, and changes in the immediate vicinity of the building. The most significant of these influences is insufficient maintenance, which is for two reasons in churches. It is the negligence of minor repairs either because the defects have not been recognized in time or because the repair in question is not seen as urgent. Each neglected defect tends to grow as time goes by, and it is usually at this stage that the second reason comes in, that is, lack of funding. By the time the necessary funding is raised, the repair needed significantly grows in size.

There is usually no such thing as improper use in churches, but a number of inadequate to barbarous repairs and reconstructions do occur. A repair or reconstruction of the neatly worked out original construction with a number of decorative elements even in inaccessible parts (lofts) usually adds profiles that, although providing additional security for the construction, degrade it aesthetically. Such poor quality of repairs was really found in some churches even in public parts. The reason here was not a poorly designed repair or reconstruction but its implementation. In this respect, we at present found ourselves in a situation rather reversed to the one at the time of the construction. Then, there were skilled craftsmen and no theoretical knowledge, while now, even if the theory and state-of-the-art computing methods are available, the building company hired usually destroys the effort expended.

Changes in the immediate vicinity such as road constructions and pipe tunnels have not touched the churches in question, but often cause extensive defects.

### **3.2.4 Time influence**

If treated and maintained properly, wood is a material with a long service life, which is evidenced by wooden churches. The aging of wood first causes the joints to come loose with the behaviour of the loosened truss plates being different from that of the original rigid ones, which brings about construction deformation. Subsequently, this leads to degradation of the wooden material. The fatigue shows locally mostly through the effect of bell vibrations.

## **4. DEFECTS**

The defects found in the churches under investigation can be divided into two basic groups:

- deformation
- construction instability
- wood degradation (decrease in strength, loss of material, cracks)
- others such as inadequately performed repairs, ...

### **4.1 Deformation**

Excessive deflection of ceilings above the nave suspended on the roof truss is frequent. This is caused by the truss joints coming loose and the wooden material of the ceiling being degraded. Some deformations are caused by the lower horizontal beam rotting away due to ground humidity, with the subsequent buckling of the above-ground elements.

In a number of cases, this is caused by an insufficient size of the bearing structure or individual structural elements.

### **4.2 Structural instability**

The usual cause of instable structure almost in all of the churches under investigation is insufficiently deep or missing foundation. This shortcoming had already shown earlier and had been put right. To what extent this was done properly could be determined by observing the structure over a long period and by making probes in the foundation.

In some churches, individual walls are buckling, in one church the entire tower, in some churches no defects have been observed.

The trusses of the saddle roofs may serve as an example of how important the correct functioning of joints is. As the joints come to be loose, the pieces are released from the coupling losing their strength. With the exception of the latest churches, the trusses had been repaired and the structural elements replaced several times as can be observed when inspecting the truss.

### 4.3 Wood degradation

During the inspection of wooden elements in the churches in Silesian region was not detected significant wood degradation leading to the construction collapsing. Between the most frequent causes of wood damage we can mention these biological ones:

- Infestation by wood attack insects,
- Attack by wood decay fungi when suitable moisture condition,
- Wood corrosion.

#### Wood damage by insects

Mostly these types of degradation effect considerable degradation of wooden elements by larval phase. A number of beetles and weevils preferentially attack rotted wood (see picture below).

The variations between insects are in the lengths of each stage in their life cycle, also in the type of wood attacked and the type and extent of wood degradation caused. Correct identification of type of insect is essential for right and useful treatment.

There exist huge differences during the larval stage between favourable temperatures and moistures conditions at single types of insects.

Despite the moisture condition of wood with minimum moisture content about 20,0 % for rising of wood fungi the moisture limit for insects evolution stays lower. Just for this particular is not possibility for wood protection only by the constructive treatments. In the historical monuments of Silesian region to the main wood-inhabiting beetles belong longhorn beetles (*Cerambycidae*) and deathwatches (*Anobiidae*).

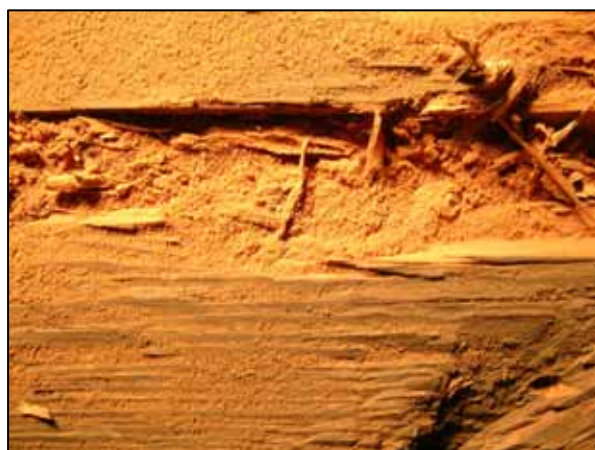


**7.** Surface damage by wood attack insects, 50 mm depth, Church Prašivá



**8.** Typical oval emergence hole from the longhorn beetle (*Hylotrupes bajulus*), Church Prašivá

**9.** Wood damage on surface by insects, existing the bore dust, Church Prašivá



**10.** Wood damage on surface by insects, existing the bore dust, tunnels, Church Prašivá





**11.** Damage of decking of ceiling by insects, Church Prašivá



**12.** Presence of using the un-barked elements in the roof construction, Church Prašivá

Wood damage by wood decaying fungi

The main criteria of decaying fungi are loss of wood material and simultaneously decrease in its strength. When there is suitable moisture condition (above 20 % of wood moisture contents) wood attack can rise and grow. They break down the wood cells by production of series of intra- and extracellular enzymes from mycelium. They realize their own metabolic activity into the wood materials by this way. Wood decaying fungi (almost *Basidiomycetes*) can cause till the 95 % loss of material. The surface of such damaged wood is almost soft and attacked wood can accept much more quantity of water. Their destructive effects can be readily distinguished with the naked eye, but for the treatment assessment must be the type of fungi identified. Wood decaying fungi are divided into the wood-rotting fungi (white or brown rot fungi) and soft-rotting fungi.



**13.** Water leaking over the wooden wall frame, Church Albrechtice



**14.** Water leaking into the ceiling construction, presence of wood insects' circular emergence holes from *Anobiidae*, Church Sedliště



**15.** Wood degradation by brown rot fungi, Church Albrechtice



**16.** Detail of wood degradation by brown rot fungi, Church Albrechtice

#### Wood damage by corrosion

Timber at some historical buildings should be damaged by degradation of the fibrous wood structure, which gives rising the macroscopic appearance of a "hairy" on wood surface. This wood corrosion is as rule combined with biological attack and brings about degradation of mechanical properties. Responsible for this wood corrosion are the recent type of coatings protection by substances based on ammonium phosphate and sulfate.

#### **4.4 Others**

Other defects do not occur so often, only occasionally. An interesting problem is the defect of a structure caused by a man who destroys values while being convinced of the positive effect of his activity. Such interventions are rare in bearing structures, but frequent in the interior such as replacing historic pews with new ones only worth the material used and the work put in.

### **5. GENERAL CONCLUSIONS**

Despite all the defects and shortcomings detected, the service life of wooden churches is surprisingly long considering the negative effects they have been subjected to over centuries. These are mostly cultural monuments that carry the regional cultural values. From this point of view, all the churches under investigation should receive much more attention from experts to extend their service life.

This attention should consist of the following measures:

- detailed research
- determination of defects and their causes
- removal of causes (if possible) and thus the defects
- further expert maintenance on a continual basis

Unfortunately, the above measures cannot be guaranteed by the owners. Therefore it would be good to at least approach this ideal situation in the subsequent projects.

#### **5.1 Restoration model of historical structures**

The restoration model should contain the general conclusions of the survey, analysis and evaluation of historical monuments.

Important items for the analysis, determination and evaluation of restoration methods include especially:

##### Results of the structural survey:

- spatial configuration of the load-carrying system
- type and dimensions of load-carrying members (real effective cross-sections)
- type of joints and connections (connections of historical timber structures are made especially by means of carpentry joints secured by wooden dowels)
- location and extent of wood damage by biological or non-biological factors
- location and extent of connection damage
- determination of load-actions (values of permanent and variable actions)

##### Determination of calculation models:

- for the original conditions of the structure
- for the real conditions of the structure

##### Material properties of the wood:

- original and real timber quality
- material characteristics of wood from particular technical survey (laboratory examination of the wood sample; or in situ materials evaluation by preferring non-destructive additional methods if possible to mechanical ones)
- identification of wood attack types due to biological and non-biological factors (including the wood corrosion due to poor protection technology) by laboratory testing methods
- risk of decay or damage in future

#### **5.2 Analysis and evaluation of historical structures**

The analysis and evaluation of the restoration methods includes:

- to evaluate the necessity of temporary stabilization
- to decide on local, partial or global restoration
- to choose an appropriate method of the rehabilitation
- to substitute damaged members and joints

The most important requirement contains the conservation of historical monuments:

- their original configuration

- differentiation of their building stages
- conservation of original members, parts and joints
- compulsory maintenance

The substitution of damaged members can be carried out using:

- original wood from another part of the structure (if possible)
- new wood of the same kind and shape (stiffening by additional members has a negative influence because it changes the original state of the structure); in this cases prefer heartwood to sapwood, which is much more susceptible to biodeterioration, connection between new and original timber part should be strengthened by fibreglasses reinforcement and injected by polymer resin
- an injection method based on a special kind of adhesive (only special kind of adhesive should be used for the injection method; appropriate are adhesives based on epoxy or polyurethane resins)
- an appropriate method of wood protection (mostly preventative chemical liquid preservatives according to the wood conditioning and appropriate secondary preservation by non-transparent coatings)

The structural issues of historical churches are quite similar to the problems in other historical monuments, especially castles and historical houses:

- calculation models should respect the spatial arrangement of the load-carrying structure
- all established facts and factors should be contained
- at present, the method of limit states is applied for the calculation and verification of historical structures (the structure should satisfied the conditions of ultimate and serviceability limit states)
- as a rule, the load-carrying capacity of joints and connectors is a decisive factor (especially the capacity of carpentry joints due to high intensity of normal stresses acting perpendicular or at an angle to wooden grains in contact areas and shear stresses acting parallel to grain in shear areas)
- spatial stability of the structure must be secured in all states of the structure.

### **6. SUBSIDIARY CHURCH OF ST. ANTHONY OF PADUA AT PRAŠIVÁ, MORAVIAN-SILESIA REGION, OSTRAVA - OPAVA EPISCOPATE, FRÝDEK MÍSTEK DEANERY**

Cult: Roman Catholic Church

Period: Modern period, 17<sup>th</sup> Century

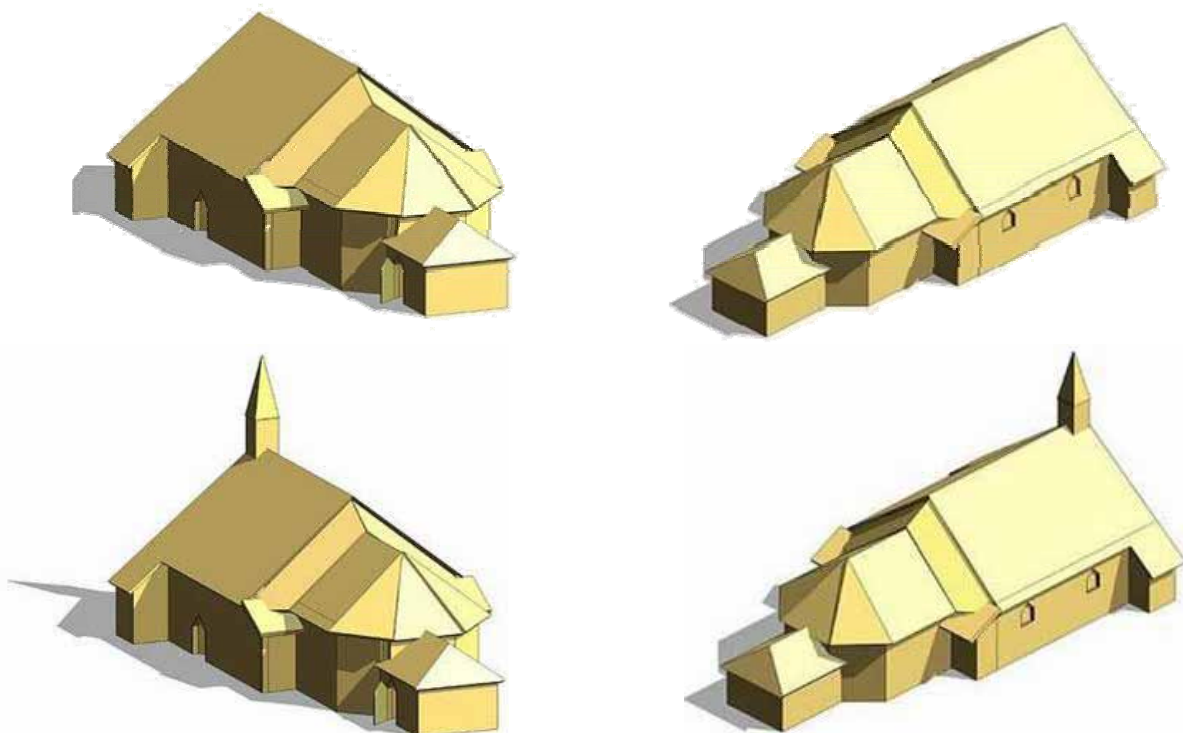
Building Category: Subsidiary church

Protection: Cultural monument

#### **6.1 History**

This wooden church is situated in Moravian-Silesian region, Czech Republic. The first mass was served in 1640. The ceiling and roof members were cut according dendrochronological report in 1641 – 1642, first written description of finished church without tower was completed in 1642.

The sacristy and choir were built in 1779, the pulpit was built in 1794, the polygonal tower in 1860 and the new rectangular tower was built in 1907.





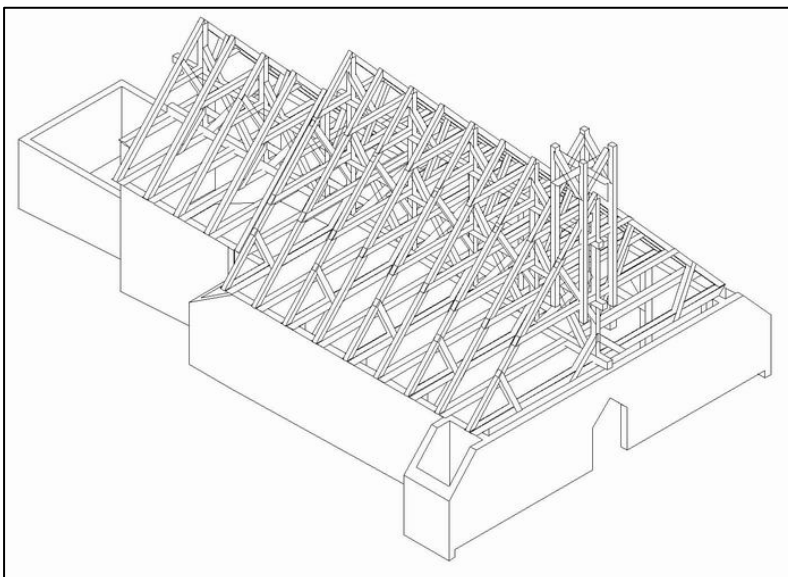
**17.** The present church is shown in the figure.  
It has a single-nave gothic structure with polygonal presbytery and rectangular sacristy and a late gothic roof structure.

## 6.2 Architectural Typology

The church is situated top of Malá Prašivá mountain near hiker hostel and hiking path in Beskydy Nature reserve. The church is one-nave building with a rectangular ground plan. The bema is three-sided, later a vestry was added to the bema. The church has the pentagonal windows with shutters and double-pitched roof, no horizontal division. A simple turret is above the entrance with corner pyramids, set in the three-to-four tier shingled roof and the ceilings are flat. In the church nave two wooden doors have been preserved with classicism-style ironwork whose box locks and bolt covers are decorated by a motive of prolonged lozenge so liked by the classicism builders. Thanks to the shutters protecting the windows, the window panes have been preserved from the end of the 19<sup>th</sup> or beginning of the 20<sup>th</sup> century fixed on suspensions with ball ends. The panes in the upper parts of the windows are decorated by rustic led glazing.

## 6.3 Nowadays

The present church is shown in the figure above. It has a single-nave gothic structure with polygonal presbytery and rectangular sacristy and a late gothic roof structure.



**18.** The model of the primary load-carrying roof structure with the part of the tower is indicated below.

Rescuing the Hidden European Wooden Churches Heritage



19. Socle of free-laid stones, recently sealed with cement grout.



20. Timber walls of hewn timber or round logs covered with shingles.



21, 22. Typical dovetail corner joints were used for the connection of wall joists.



23. Joist ceiling is supported by walls and columns with struts. Beams are also members of roof structure. Several beams are doubled.



**24.** Rafters are connected to joist and one or two collar beams. They are supported by columns in principal trusses. Members are overlapped with notched connections with wooden dowels. The detail of mortise and tenon column connection is shown in the figure.

**25.** A typical detail of overlapped bracing members

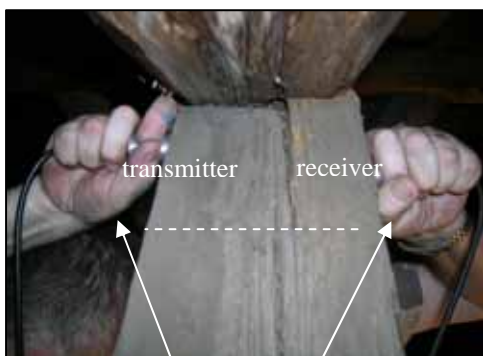
**26.** A detail of scarf joint of wall beams.

#### 6.4 Non-destructive evaluation of wooden elements

The main goal was to find out the possibility of using the ultrasound as the quantitative methods for evaluation of wood degradation. Wood degradation attends to the loss of material, before all by the wood decay fungi attack. To find out the correlation between the material losses and the velocity of ultrasound waves is the main criteria during the interpretation of results. For the measuring are set the influence agents which can caused the results changing, as existing knots, cracks, moisture contents, temperature and the anisotropy of wood.

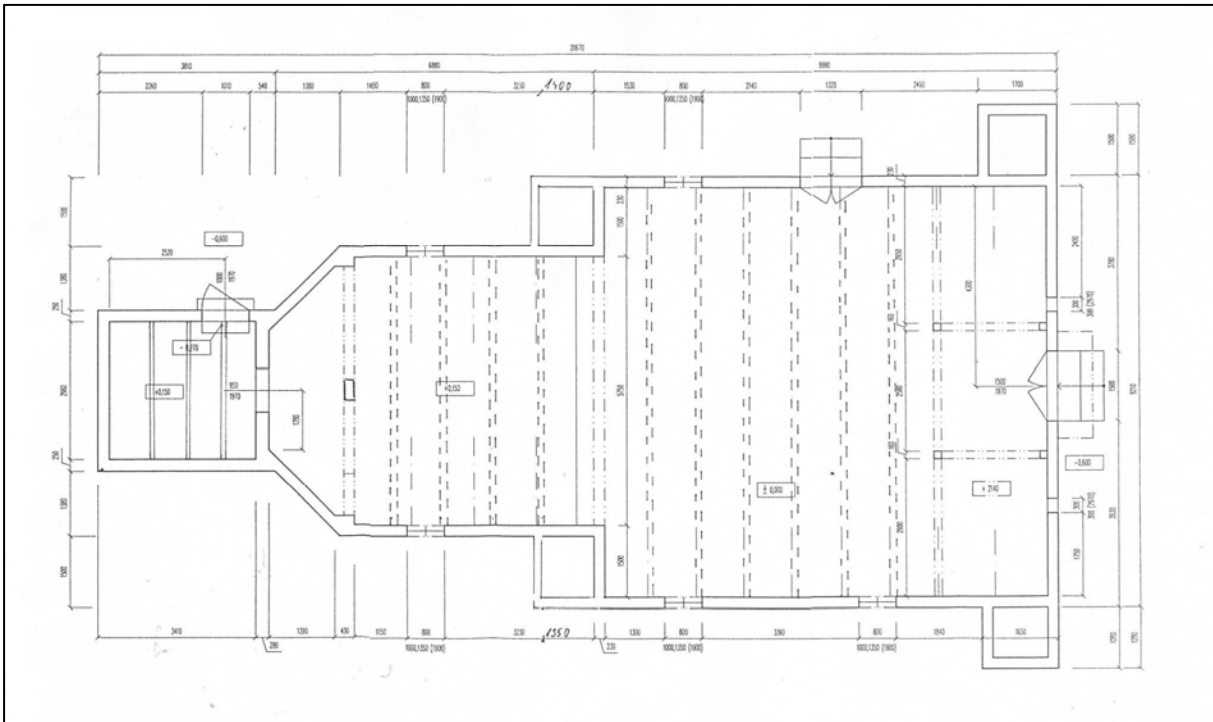
The principle of this method is based on the comparison of the ultrasound velocity which is much faster in solid wood than in wood with inner defects. Experiment was measured by the TICO ultrasonic instrument from the Proceq SA Testing Instruments with using the testing probes at frequency 82 kHz.

The schema of each measuring is shown in the photographs below. By the comparison of received values of velocity on the each elements should be detected inner damage of wooden materials, certainly measuring should be done and interpreted by qualified person.

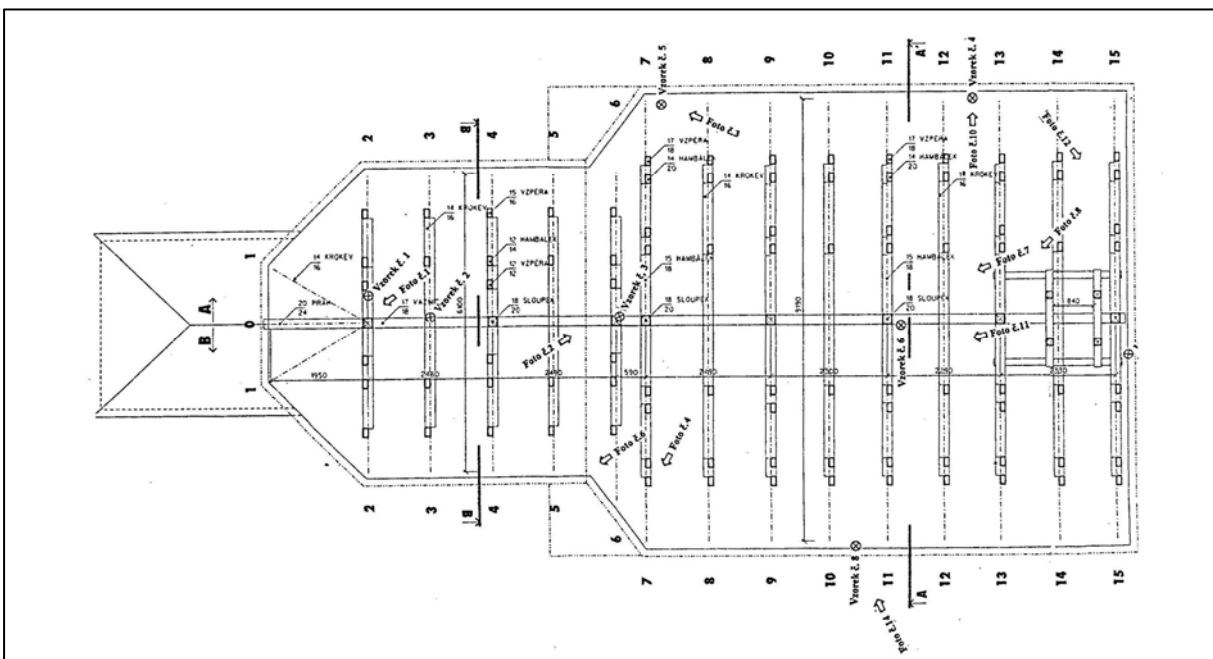


27, 28, 29.

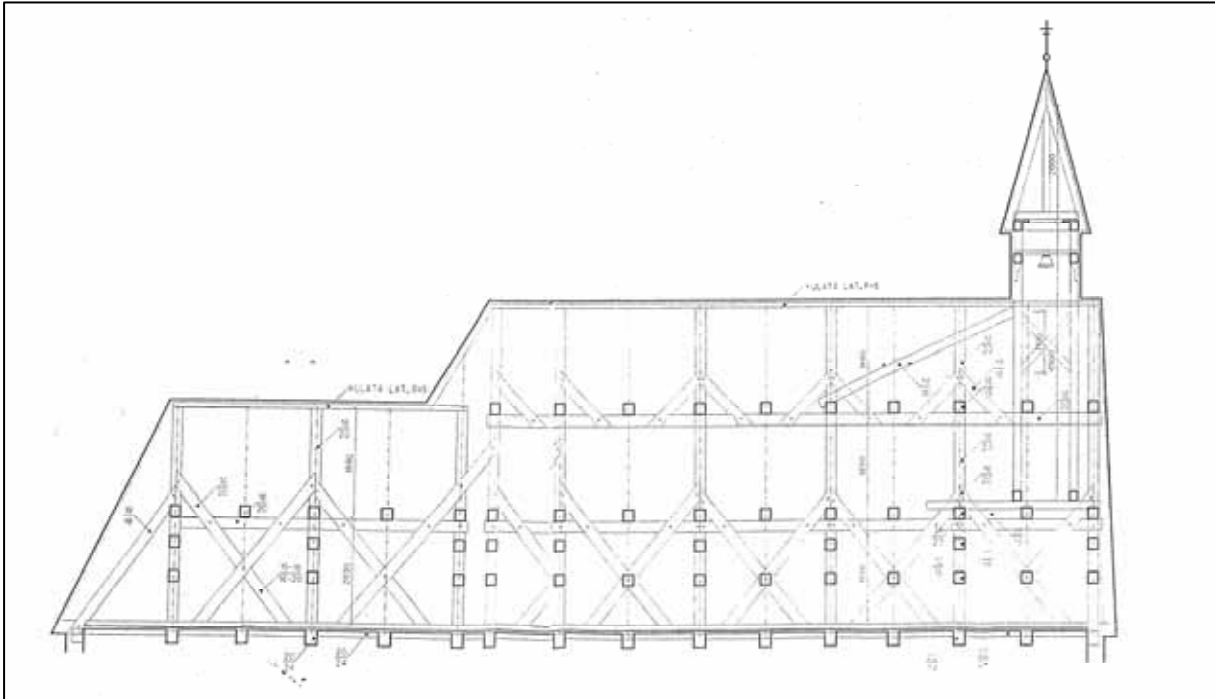
## The Church of Prašivá: Drawings



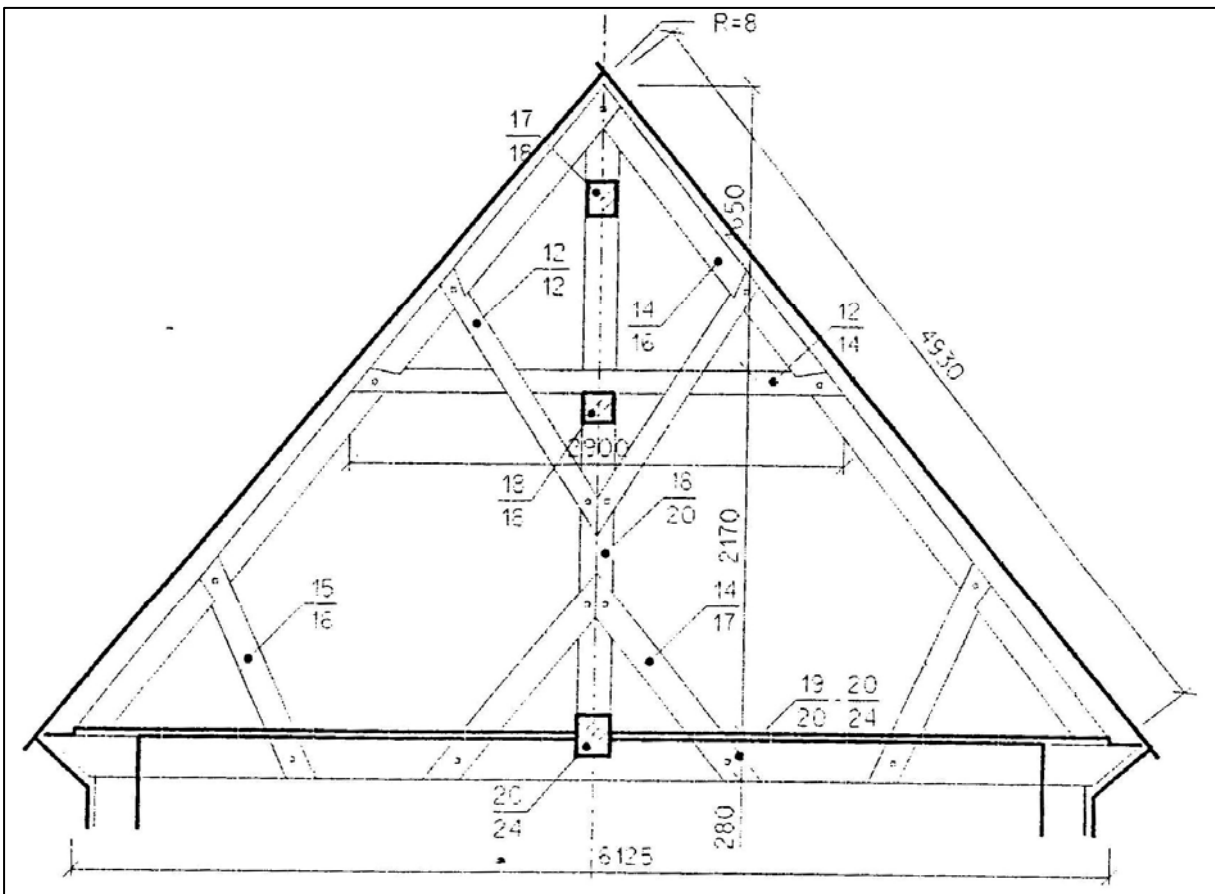
1. Ground-floor



2. Plan of the attic



3.4. Roof sections of the Prašivá church



Reference: Rosová, R.; Augustinková, L., Constructional and historical research of the State Monument Protection Institute in Ostrava, 2002

## CZECH REPUBLIC

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1966 Brno University of Technology, Faculty of Architecture, graduated in 1966 receiving a degree of ing. arch. [Master of Science]

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1997 Professorship received at the Faculty of Brno University of Technology

###### *Work experience*

1966 Agency for Industrial Buildings

1968 Teacher at the Faculty of Architecture of Brno University of Technology

1977 Scientific degree received of Candidate of Technical Sciences – specializing in industrial architecture, industrial zones

1994 – 2000 Pro-Vice-Chancellor for international relations at Brno University of Technology

1996 A certificate of merit for research and study of industrial architecture awarded by the Italian Ministry of Culture and Environment.

2002 The French minister of education, by his decree issued on 2<sup>nd</sup> March 2002, conferred upon Mrs Helena Zemánková an order of Chevalier dans l'Ordre des Palmes Académiques for the service rendered to the French culture.

###### *Professional specialization*

Protection and reconstruction of monuments

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###### *Recent publications*

ZEMÁNKOVÁ, H.: Create in created, New functional exploitation of abandoned buildings; VUT v Brně; Brno, 2003

ZEMÁNKOVÁ, H. a kol.: Zlin 1900 – 1950; ; Model of Industrial City; Catalogue to the "Ville de Zlin" exhibition held at Ecomusée du Creusot-Montceau as part of the "Bohemia Magica, Czech Days in France" event (May – December 2002), Zlin; 2002

ZEMÁNKOVÁ, H.: Transformation of Functions Proceedings of Papers and Conclusions from the Conference organized by Slovak Architects Society; Proceedings of a conference held in Bratislava on 21st October 2004. The proceedings have been published as a supplement to the journal "Project, review of Slovak architecture"; year XLVI; SAS; Bratislava 2004

ZEMÁNKOVÁ, H.: Contemporary Phenomenon / Change of Functions; Proceedings of an International Colloquium on "Change of Functions" held in Bratislava on 30<sup>th</sup> – 31<sup>st</sup> May 2005; SAS; Bratislava, 2005

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Member of Section for the protection of industrial monuments, Czech Republic

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author of 2 and co-author of 4 grant projects,

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Metal and timber structures and bridges

### Recent publications in the field of timber structures

STRAKA, B.: *Conclusions from Analysis and Construction of Timber Roof Structures*, In: *Proceedings of the 5<sup>th</sup> World Conference on Timber Engineering*, edited by J. Natterer and J.-L. Sandoz, Lausanne-Montreux, Switzerland, 1998, vol. 1, pp. 48-54, ISBN 2-88074-380-X.

STRAKA, B.: *Conclusions from Theoretical Analysis, Construction and Behaviour of Timber Spatial Structures*, In: *Proceedings of the 6<sup>th</sup> World Conference on Timber Engineering*, Whistler, BC, Canada, 2000, 6 pp.

STRAKA, B. and NOVOTNÝ, M.: *Conclusions from Rehabilitation of Existing Timber Roof Structures*, In *Report of the IABSE Conference Innovative Wooden Structures and Bridges held in Lahti, ETH Honggerberg Zurich Switzerland, 2001*, Vol. 85, p. 475-478, ISBN 3-85748-1003-X.

STRAKA, B.: *Designing and Realization of Timber Roof Structures in the Czech Republic*, In *Proceedings of the Scientific Session VSU'2001 held in Sofia, Bulgaria*, Vol. 1, p. 55-59.

STRAKA, B., VANĚREK, J., HRADIL, P., VEJPUSTEK, Z.: *Project of inspection of timber churches in Beskydy mountains*, In *Proceedings of WTA, Praha, 2006*.

### Relevant research and realization of timber structures

*Timber structure of the planetarium in Brno (CR), tennis halls in Frýdlant nad Ostravicí and Bílovec (CR), footbridge in Brno (CR), winter stadium in Vrchlabí (CR).*

### Professional activities

*Member of the Committee for Standardization of Timber Structures*

*Certified forensic expert for metal and timber structures and bridges*

*Member of the Council for Building of Timber Houses*

### Jan Vaněrek

#### Education

2004 - Ph.D. – Brno University of Technology, Institute of Forensic Engineering

2000 - Dipl. Ing. – Brno University of Technology, Faculty of Civil Engineering, Institute of Building Structures

#### Work experience

2002 – present: Faculty of Civil Engineering, Brno University of Technology

#### Professional specialization

*Rehabilitation of timber structures; Examination of wooden materials and wooden composites*

*Recent main publications in the field of timber structures and materials*

VANĚREK, J. *Building preservation of timbers*. In *Rehabilitation of damp masonry II*. Praha, WTA CZ. 2006. p. 131 - 172. ISBN 80-02-01802-8.

VANĚREK, J., SCHÁNĚL, L. *Wood deterioration by wood staining fungi*. In *Proceeding Rehabilitation and reconstruction of buildings 2005*. Brno, WTA CZ. 2005. p. 39 - 43. ISBN 80-02-01768-4.

VANĚREK, J., SCHÁNĚL, L. *Some aspects of wood degradation and decaying gained in building practices*. In *Proceeding Rehabilitation and reconstruction of buildings 2004*. Praha, Czech building society. 2004. p. 22 - 25. ISBN 80-02-01683-1.

STRAKA, B.; VANĚREK, J.; VEJPUSTEK, Z.; HRADIL, P. *Rehabilitation of timber constructions of present and historical monuments – analyzing conclusions*. In *journal Materials for building*. 2004. X(7). p. 40 - 44. ISSN 1213-0311.

### Relevant research and realization of timber structures

2005 till 2007 - holder of post-doc grant project at The Grant Agency of the Czech Republic (GA CR) 103/05/P270 "Proposal of new fiber composite material with utilization of wood fiber and polymer matrix"

2005 – present: member of research team of the project VZ MSM 0021630511 „Progressive building material with utilization of secondary raw materials and their influence upon the service life of constructions"

*Quality examination of coatings on wooden windows frame by infra-red spectroscopy, Litomyšl; Quality examination of wooden shingles at hotel roof construction, Ramzová; Examination of wooden roof elements against the biological attack on the castle Budišov, region Třebíč; Quality examination of chemical preservation at wooden roof construction; Examination of wooden floorings in different objects; Examination of tie beams and roof wooden elements on municipal house in Přešov*

### Professional activities

2003 head of the section "Timber preservation and rehabilitation" in the Czech building company ČSVTS, The Scientific and Technical Society for Buildings Rehabilitation and Preservation of Monuments WTA CZ

### Petr Hradil

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*Mechanical connections of timber structures*

#### Recent publications

HRADIL P., STRAKA B. *Semi-rigid behaviour of timber connections in bending*, In *proc. of Theoretical and structural problems of steel and timber structures*, Kočovce, STU v Bratislave, Bratislava, Slovakia, 2006, ISBN 80-227-2359-2

HRADIL, P. *Contemporary structures in Helsinki and Espoo*, In *Konstrukce*, No.3/2005 Ostrava, Czech Republic, 2005, ISSN 1213-87622005

*Relevant design competitions of timber structures*  
*Alahärmä light traffic bridge, Alahärmä, Finland*