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PROPORTIONS - DISPOSITION RELATIONSHIP ANALYSIS OF A HISTORICAL TRUSS IN A RURAL HOUSE IN VÁPENNÁ VILLAGE, CZECH REPUBLIC

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Abstract

We have analysed historical trusses based on previous building-historical researches, particularly focusing on sacral buildings, in chosen regions of Slovakia, with one of the primary goals to examine geometric concepts and proportional relationships used for their construction. The knowledge of proportional principles and relationships used in various historical sacral trusses, additionally supported by contemporary literature, was applied to a village house truss from 1774 in Vápenná, Jeseníky district of the Czech Republic.

Keywords:

Historical truss;
Geometry;
Proportion.

1. Introduction

The analysis of proportional relationships in a rural house is based on historical-structural, archival, and dendrochronological research of the object as a whole. The objective of this research is not only the analysis of truss's proportions, but also its relationship to the ground plan, whose concept is based on proportional relationships as well. The principle suggested by the contemporary literature as one of the possible means of designing the truss height has been clearly identified in case of historical trusses of sacral buildings from Slovakia, which we have previously analysed [3, 5], as well as in case of the researched secular house from Vápenná in the Czech Republic.

2. Building-historical development

House No. 98 in Vápenná, Jeseník region, Czech Republic (Fig. 1) was built in the 2nd half of the 18th century as a reflection of establishment's aims to raise the numbers of tax-paying subjects [3]. The first written note originates in 1786, when Michal Hauke sold the house to his son, Michal [1]. Dendrochronological analysis of the ceiling - after 1775 is also an evidence for the house being built in the 2nd half of the 18th century 70s. The building is a typologically common rural house with a central room and a hood kitchen, but has been richly designed to contain decorations in form of painted red frames, which have been preserved in the western attic area. Despite the ceiling parts being largely preserved above the ground floor, the truss was newly built (1974/75 according to dendrochronological dating) with an inclusion near the southern gable. The living room was partitioned in the southern section on the verge of the 19th and 20th century, which relates to the muring of the window in the southern wall. The kitchen hood in the central tract was under-arched and a stove was set up in the south-eastern room.

Fig. 1: The researched object – a rural house No. 98 in Vápenná.

3. Truss construction

The building has a gable roof finishing with masonry gables. The main south facade has an ornate Baroque gable with windows and vents. Roof truss structure consists of two separate truss structures with a transition portion, which form a space with the same ridge height. The truss structures can be divided as follows: over the hall structure, south side of the building, and the structure above the rooms in the northern part.

The truss over the southern part has a rafter – collar tie structure and consists of two collar tie levels and base struts located at the base of the rafters. Lateral stools, whose posts are placed on the threshold beams, were later incorporated into the design. Central binding rafters bearing the collar beams are tenoned to the posts. The posts are also stabilized using single-sided outer bracing structures clad together into binding beams. The posts in the marginal joints are longitudinally wind-braced by struts (three views of the truss are on the Fig. 2).

The truss over the northern part is also of a rafter - collar beam structure with two collar beam levels, positioned at the same height as in the southern part. Unlike the southern roof its central posts are located in the marginal joints, which are placed on the threshold beam. The posts are stabilized by base struts. The truss itself is longitudinally secured by inclined bracing structures passing through the anchor post into the columns and the anchor posts below the lower collar beams.

Most of the joints used are dovetail joints fixed by wooden stakes. Tenon joints are used in case of the anchor posts and rafters with binding beams.

Fig. 2: The inner view of the truss.

4. Geometric concepts and proportional relationships within the truss

After previous examinations of historical trusses of primarily sacral buildings it was found that one of the most commonly used principles for determining the essentials truss dimensions is a principle we dubbed "*n* plus one" [4]. It is a principle determining the height of a truss based on its width as follows: the width is divided into 2 *n* units and the height is then (*n* + 1) units. The same principle was applied in case of the rural truss in Vápenná, with *n* = 5 and the ratio between the width and height of the truss being 10 : 6 (= 5 : 3). A basic square ABCD dimensions are 5 x 5 units was obtained (Fig. 3a, b). The unit used for determining the truss height based on its width is also five times the measure of length corresponding to the span (contemporary measure), in this case 19.3 cm [8]. The used measure (span) was found on the top side of the ceiling beam in the form of an engraved circle (Fig. 4b). (The cut of the beam with the engraved circle was included in the depository construction details Technical University of Ostrava under inventory number 176. A, [2].)

For the design of the remaining important elements of buildings and trusses were formerly used a simple integer ratio, in the literature often named as "music" ratios [6, 7]. In the researched truss were used these ratios: the main collar tie is located at half of the height of the base square; upper collar tie is located at the height of the basic square; struts and rafters are placed on the tie beam in one tenth of the total width of the truss. The floor plan of the rural house (Fig. 4a) in relation to the truss is designed in such a way that the relationship between its length and width is 3 : 2, this relationship expressed by a span is 75 : 50. The original big front room on the South side of the house has internal dimensions in the same proportion as the entire floor plan of the house, hence the 3 : 2 (45 : 30).

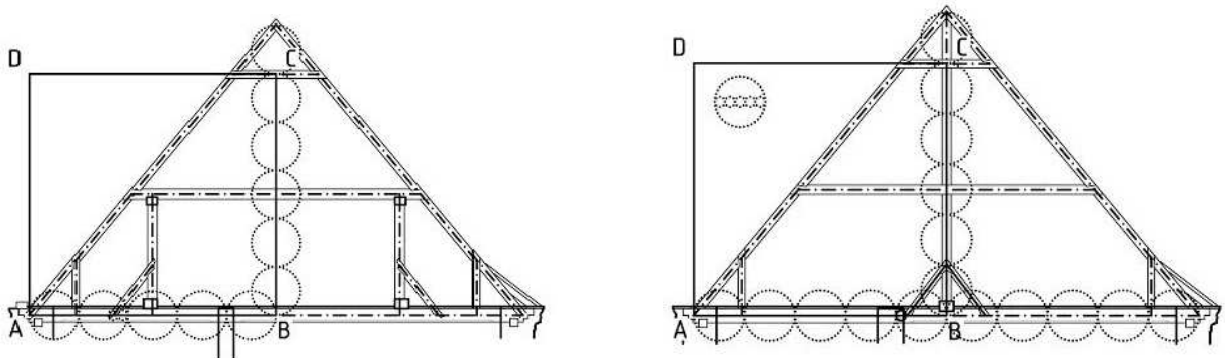

Fig .3: (a) Section of the south truss; (b) Section of the north truss.

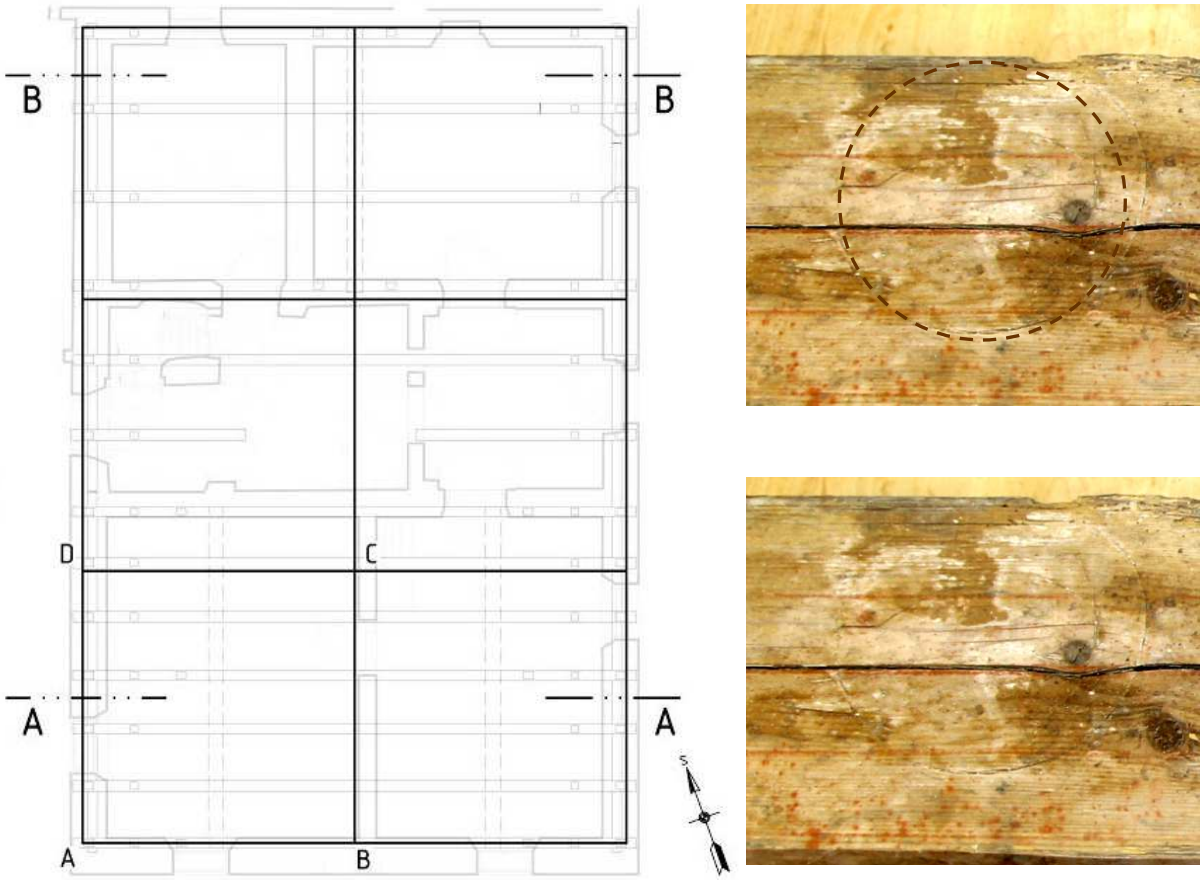

Fig. 4: (a) Floor plan; (b) Engraved circle.

5. Conclusions

There has been identified the geometrical and proportional concept of truss design on the researched object, in relation to the concept of the object floor plan, which is based on the use of contemporary system of measure. Geometric and proportional analysis of the original concept design of the truss and the object itself may be helpful in understanding the historical development of the object, used historical measures, proportions, and structures. Knowledge of ratios and geometric concepts can highlight the impacts of cultural and socio-economic links with architecture in the region. Reached knowledge about proportional and geometric concept can be a guide for the methodology of recovery in relation to heritage preservation of historical objects.

For a deeper understanding of the relationship it is necessary to carry out a greater quantity of analysed concepts to create a huge statistical file for numerical analysis.

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