Historical structures - inspiration from concepts through details to forms

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Summary

Consideration of restoration aspects of historical (medieval) timber structures taking into account historical carpentry with its intrinsic capacity to pass over centuries technology information together with the structural quality, sustainability and appearance creates the first part of the paper. The second part is focused on one elegant spa colonnade structure composed of steel, timber and masonry which features several innovative solutions.

Keywords: historic structure; carpentry tool traces; medieval cranes; metal-timber hall; restoration.

1. Introduction

Working in the field of architectural heritage, an engineer can every day absorb inspiration and learn lessons from historic materials and structures. Historic materials and structures contain a wise essence of experience and knowledge handed down by our ancestors – craftsmen, architects and engineers. However, the intrinsic technology and the engineering value of heritage structures in many cases do not immediately strike the eye, and have been waiting to be revealed.

2. Understanding structures

A historic structure, like any other structure, is defined and understood as an orderly organized mass aimed at withstanding the effects of external forces and the surrounding environment. There is no doubt that structures have aesthetic qualities. They form an integral part of the whole work, and are one of the most valuable heritage characteristics of a cultural monument. However, an aesthetic evaluation of structures is often made difficult by a "false skin" imitating traditionally understood structures, for example timber vaults or cladding envelopes. The most intrinsic value of historical structures lies in their functional characteristics. Here it should be emphasized that, according to the definition, all structures bear loads or are subjected to environmental actions. Even items that are clearly objects of art with a specially designed supporting structure nevertheless share in the resistance against external forces. Further, the forged hinge of a door leaf is not only a masterpiece by a local village smith: its shape significantly improves the stress distribution between the nails and the timber frame. Simply inserted stiffeners in the door frame not only artistically form the frame but also make the corners of the frame rigid without any iron nails or bolts, and prevent lateral deformations. These features represent design without engineers – the long evolution of craft skills and the deep understanding that craftsmen have for structural performance.

3. Historic carpentry message

A technological survey starts on the surface of historic structures. Various kinds of technological traces can be found, especially on timber and stone elements. Wood, in particular, has a high capacity to conserve fine traces over centuries. Few people are aware that axe woodworking is one of the oldest human manual skills. The most important traces come from squaring and jointing carpentry operations. Iconography and experimental craft research into medieval carpentry technology investigating traces and the use of traditional tools has helped to reconstruct the technology used for squaring logs into beams and for preparing carpentry joints [1]. From the distinctive traces left by woodworking tools, we can read the traditional technological process. The splinter mark (“bladeprint”) is a straight or curved split on the surface of the hewn wood. It is oriented according to the position of the carpenter in relation to the log. The splinter mark is left by the cutting edge of the blade of the axe after reaching the bottom of the cut-out area. Marks that may be called licks (or scratches) of the surface by a cutting edge are left on the surface of the cut by imperceptible irregularities in the cutting edge of the instrument. The spatial relation between the bladeprint, the lick, and their orientation on the surface conserves information on the timber manufacturing process, which can be analysed (Fig.1).

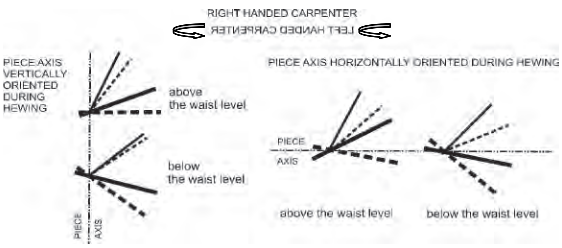

Fig. 1: A tool for analysis of carpentry traces

4. Composite metal-wood frame

The overall exterior appearance of the metal promenade colonnade in Marienbad is perceived as a cast iron structure, because the main steel frames are covered with cladding like other buildings from the end of the nineteenth century, e.g. [2]. In the colonnade, all columns, purlins and parapets on the facade side of the promenade span are faced with cast iron cladding components but the inner faces of the braces and trusses in the interior are provided with a sheet zinc decorative cladding richly moulded and looking like a cast iron cladding at a cursory glance. The building is provided with a timber coffered ceiling, Fig. 2, which is the only stiffening structure in the roof plane. Steel domes are located in the widened parts. Their lunettes are not filled with masonry, but are erected as light-weight plastered corrugated steel walls. This is another "false" structure imitating masonry traditions. The principal steel structure is assembled from transverse frames consisting of a cranked column, the lantern arch with a tie-rod and a cantilever beam constrained in oversize masonry or in a steel plate column. The cross section of the cantilever and the upper part of the cranked column is considerably complex. The profiles are very subtle, and the building, slightly curved in its layout, forms a very elegant interior space in which the exposed and hidden structural elements play an important aesthetic role. Of course, the full beauty and the building richness of the structural design of such objects is revealed only when we have an opportunity to "dissect" it. In the case of monuments, such an occasion occurs only when the structure needs restoration or repair, and this is another engineering challenge.

Fig. 2: Timber coffered ceiling roof structure helps to achieve extremely low steel consumption.

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5. References

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