REPAIR OF THE ASHLAR MASONRY BATTLEMENTS OF KOST CASTLE
WITHIN THE LAPIDARIUS PROJECT

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ABSTRACT

A few years ago we acquired research project funding from the Ministry of Culture of the Czech Republic to develop a comprehensive methodology for the selection and craft processing of replacement stones for the repair of ashlar masonry in historical constructions. The main objective of the project called "Lapidarius" is to develop a model procedure for a comprehensive survey and the subsequent appropriate repairs of ashlar facing walls made of sedimentary rocks.

In 2012 we participated in a battlement wall gallery restoration at the medieval Kost Castle solidly built of squared Cretaceous sandstones in the 14th century. First a detailed survey of its initial state was completed and then the stone masonry was described from a geological, structural and historical perspective. Depending on the kind and degree of damage and weathering, the stone elements that could be restored and those that needed to be replaced were determined. To replace the blocks it was necessary to find a matching local alternative rock or a comparable one from another site. Therefore a geological survey was made to identify and document possible historic quarries from where the stone for construction and subsequent repairs of the castle walls was taken. During the repair copies of historical stonemasonry tools were used as well as stone working technologies from the period – both with an utmost respect towards authentic material.

Keywords: historic monuments conservation, medieval castle, ashlar masonry, Cretaceous sandstones, historical stonemasonry tools.

INTRODUCTION

A team of experts comprising of specialists in geology, construction history, monument conservation and restoration is preparing a comprehensive methodology for the selection and craft processing of a stone intended for the replacement and repair of the ashlar masonry in historic constructions. It should help to determine an adequate intensity of interventions, select the most suitable material for substitutions and prescribe relevant parameters of craftsman’s processing, all with an emphasis on respect for authenticity and the specifics of a particular historical monument. Implementation of this methodology will make it possible to obtain adequate historical, technological, technical and structural surveys and investigations, and subsequently propose an optimal procedure for the repair process of a particular historical structure.
A CASE STUDY: PARAPET WALL OF KOST CASTLE

Kost Castle is one of the most famous, important and best preserved medieval aristocratic residences in the Czech Republic. In the second half of the 14th century Peter von Wartenberg, a leading courtier of Charles IV the king of Bohemia and Holy Roman emperor, built here his ancestral seat here to demonstrate the dignity of his social status. Wartenberg’s personality, wealth and knowledge of progressive foreign examples resulted in the excellent quality of craftsmanship used within structures built of ashlar stone masonry. A upper part of the castle, situated on the peak of a sandstone rock, is equipped with parapet walks and battlements permitting the more active defense of the site.

The rampart consists of approximately 2.5 m thick walls, on top of which the massive merlons protect a spacious parapet walk used by defenders. The walkable area consists of large stone slabs laid in a gentle slope. Single merlons are topped by roofs of trapezoidal shape all made of big sandstone blocks (Fig. 2). A corner of the wall is protected by a small square turret. To build the walls a regular ashlar masonry technique of three leaf walls with a rubble infill was extensively used around the castle. The walls are not plastered; a mortar in joints recedes slightly into the wall. Among the unique remnants of original equipment, there are gutters to hold folding shutters which would have been used to protect the openings between merlons.

Northern and north-eastern sections of the castle wall gallery have been preserved in an almost authentic state that corresponds to the late 14th century and has undergone no major reconstruction or even restoration.
Geology of the Castle and Its Surroundings

The castle is situated on a massive rock block on a plateau divided by a mosaic system of steep locked valleys. The stream valleys are mostly steeply cut into a canyon shape. The slope margins create the morphology of “rock towns”. Most of these are parts of the sandstone plateau loosened by rock slides.

From the point of view of regional geology, the location is situated in the Bohemian Cretaceous basin. The bedrock is created by Mesozoic platform sediments of the Upper Cretaceous age (late Turonian, Coniacian), represented by Teplice sandstones of a complex strata. These sandstones contain silica cement. The stones are horizontally and sub-horizontally lying. They are tectonically broken into three main orthogonal systems where the dominant system is bedding. Besides these systems there is a minority of other oblique systems. Tertiary volcanic rocks penetrate the Cretaceous stones. Quaternary sediments create the superincumbent bed. The plains are overlaid by loess and loess loam. Diluvial sediments are located on the slopes and fluvial stream sediments cover the valley floor. Sandy or argillaceous-sandy sediments, sometimes containing the stone chips, are dominant [1].

The stones of the bedrock parts are of variable grain-size and naturally ordered sandstones with varying types and kinds of cement although thick-bedded quartzose sandstones are dominant. Cement is mostly quartz, sometimes with a portion of argillaceous or marly minerals. These properties influence such characteristics as color, separation, point of breaking and strength. The color is mainly gray-ochre [2].

Places of thick-bedded sandstones alternate with places of less durable sandstones with worst cement binding. Less durable places are selectively weathered and create imbedded benches. The places with a different content of iron or manganese usually have an ochre to yellowish or rusty to reddish color. We can observe honeycomb weathering in some parts. The exposed surface is blackish with gray infiltrations, probably due to the presence of manganese. The bedding is almost horizontal except for the positions with a herringbone structure.

Fig. 2: A section and front view of the parapet wall situated on the eastern side of the castle
As is obvious from the terrain reconnaissance, the material used is partly local from the actual castle surroundings or from the rock massif on which the castle is situated. We found several places where the sandstone material was extracted. In some areas only the extraction of a few blocks occurred. It is possible that even debris material was also used for the construction of the castle. Larger sandstone quarries are situated to the south between Kost Castle and Sobotka, close to the villages of Střehom and Vesec u Sobotky (Fig. 3 and 4). These quarries may have served as a source of material for the later additions to the castle [3].

Fig. 3 One of the abandoned quarries situated in the vicinity of Kost Castle shows distinct traces of sandstone extraction (cca 1.5 km near Vesec)
We can find the following varieties of sandstones among the building material:

- quartzose sandstones;
- sandstones with quartz cement containing calcareous, argillaceous, marly or ferruginous parts;
- sandstones with syntaxial, meniscale and pore-filling cement;
- fine-grained, medium-grained and well graded sandstones;
- badly graded sandstones;
- sandstones to conglomerates.

![Fig. 4 A situation of sandstones quarries close to the villages Střehom and Vesec u Sobotky](image)

**HERITAGE AND HISTORICAL PERSPECTIVE**

Sandstones of different granulation, colour and quality come from local natural sources. The large variation, given due to the layers of sedimentation, helps to account for the typically multifarious and vivid look of the castle and is one of its distinctive properties. Despite the partial surface degradation, which of course corresponds to the length of exposure of the blocks to the weather for almost seven centuries, the stone used is still very firm and consistent. External surfaces are deformed by corrosion to produce depressions or even deep caverns and are covered with deposits and crusts. Due to the degradation of bonding mortar the stones covering the top of the merlons were loosened. The upper parts are significantly degraded and one gutter is completely missing. The walls, however, are solid (Fig. 5).
In the past only routine maintenance and repair of grouting masonry was performed. The western half of the southern section of the wall was damaged in the past and actually repaired at the end of the 19th century. The fact of their being evidence of only limited repairs and alteration demonstrate the quality and durability of the original workmanship which necessitates the requirement of a maximum degree of protection and absolute caution in approaching regular maintenance and any restoration. These structures can be seen as not only as historical artifacts but as art, viewed as a kind of architectural sculpture. Any intervention to a building should be such as not to affect in any way the surviving original historical form and material.

Fig. 5 Appearance of the site before restoration

Fig. 6 Various traces on the surface of the wall: signs of transportation, tool marks, stonemason’s mark and indications of weathering and aging
METHODOLOGICAL APPROACH

The high degree of authentic preservation of the wall galleries and their significance required a highly responsible approach to recording and investigating when planning the restoration. Therefore a detailed photo documentation of the initial state was taken and also geodetic-processed photoplan of the facing surfaces to serve as a basis for all related research and designs. Those that followed were:

1) A structural history research – mapping the historical context of the construction and subsequent amendments

A state-of-the-art report including the history of site and construction, analysis of archive sources, survey of its own construction characteristics, documenting of stonemason's marks, distinguishing the newer modifications, an architectural and art historian evaluation and the determination of its specific heritage value.

2) Historic traceology research – analysis of tool marks and traces

Detailed analysis of traces of tools used in stone processing, identification of historic instruments and technological steps (Fig. 7), an ideal reconstruction of the technological process of craft production of blocks, guidelines for the preparation of new substitute stone blocks in compliance with the integrity of the original medieval structure [4].

Fig. 7 The actual replicas of period tools used in the repair

3) Geological survey of possible material sources

Description of the historical rock material used in masonry, a determination of its composition, investigating the geological characteristics of the site, a survey of historic deposits in the vicinity and identification of possible future sources of stone for alternative rock material.
4) Pre-restoration survey and proposal of remedial measures

Description of damage, deterioration and other defects of stone and mortar in joints, material analyses of historic mortars, assessment of its state as a whole and its individual components, the long-term behaviour of structures in relation to the damage, remedial design and construction intervention; identification of damaged rock material necessary to be changed; limits and conceptual principles of recovery.

Fig. 8 One of the merlons on the battlements before and after the repair

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REFERENCES

[1] Geological map of Czech Republic, scale 1:50 000, sheet 03-34 Sobotka