TEN YEARS AFTER THE RECONSTRUCTION OF PLEČNIK´S FOOTBRIDGE AT PRAGUE CASTLE

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SUMMARY

An example of a successful reconstruction of the small but important and culturally significant structures Plecnik's footbridge located on the premises of Prague Castle is discussed in this paper. The building was severely disrupted for 10 years after a previous reconstruction. This damage and degradation was caused mainly as a result of faults incorrectly designed new waterproofing and water freezing in the new drainage pipe bridge. Technically properly designed and in 2006, well made reparations, resulting problems removed and for 10 years after completion fulfils its function perfectly and reliably protects valuable object.

Keywords: *Waterproofing, bridge, reconstruction design, structural survey.*

1. INTRODUCTION

Plečnik's footbridge is a small bridge structure located on the north side of the castle area. Footbridge is connecting the Na baště garden with Paccassi gate and as a peripheral communication also the north forefront of the Prague Castle with Hradčanské square.

The project design was prepared in connection with refurbishment of the Fourth Courtyard and Na baště garden. First ideas about the form and function of mentioned furniture emerged when Plečnik was first planning the conceptual work for the Prague Castle. New idea emerged in the beginning of 1930s (first sketches are from 1921) extending the original concept – which basically respected traditional functions of the garden and courtyard – with a peripheral road from Hradčanské square through the Na baště garden connected to a new bridge structure or footbridge. Final project was presented by Josip Plečnik to Artistic Committee on 25th October 1927.

In December 1929 a company was selected to construct the footbridge. Based on sketchy information we can assume that the Plečnik's footbridge was finished by 1932 or in the beginning of 1933 (March). The Prague Castle archives contain sketches and photographs from 1932 - 1933.

Pillars and individual vaulted arches were masoned from solid extruded bricks on lime-cement mortar. They carry the reinforced bridge deck and massive double-sided hand-railing made from Mrákotín quarry granite with decorative elements (balusters) made from precast stone.

The main lengthwise part of the Plečnik's footbridge is formed by line of massive brick-built vaulted arches, increasing in height from the Powder Bridge to Fourth Courtyard in proportion to the descent of the parallel ramp on the side of the Deer Moat slope. Part of the footbridge is also the transverse part built above the former electrical substation under the room viewed from the, leading to right walkway next to main gate entry.

Between Plečnik's footbridge and Spanish Hall there is an area of a north courtyard connected under the last arch of the footbridge with the road descending on the slope of Deer Moat from the Powder Bridge forefront. Rising granite staircase is connected to the more distant end of the footbridge leading to Na baště garden (sometimes called Italian) which is further connected to the Fourth Courtyard.

The bridge deck wearing layer between hand-railing is formed by pebble pavement. The bridge deck is tub-like shaped on the surface with drainers in the linear axis. Six more remote drainers are leading in gargoyles facing the Deer Moat side. Other two drainers of the main part are leading directly to the sewerage. Originally there was no drainage system on the transverse part so the water was spilling on the main footbridge part.

Fig. 1. *This is a Plečnik's footbridge viewed from the Paccassi gate, front of the Spanish Hall at Prague Castle.*

Fig. 2. *There are brick arches structure of the Plečnik's footbridge - the original state in 2004.*

2. REPAIR AND RECONSTRUCTION

2.1. Previous repairs

Minor reconstructions of the footbridge were probably carried out during 1957 – 1958, when the adjacent restaurant pavilion was built close to the former citadel based on the design of the architect Moravec.

During 1995 - 1996 was carried out the radical reconstruction by Ing. arch. Hlaváček design. During this reconstruction was removed the original pebble pavement laid into concrete during the First Czechoslovak Republic period and were carefully finished the base plates above the brick-built bearing walls. After thorough water jetting the concrete slab was reinforced with KARI mesh applied with silicate water-insulation crystallic-type paint (Xypex).

Another layer was 80 mm of concrete with cobblestone pavement 32/63 laid in the cement bed in the thickness of about 20-25 mm. Brick-built bearing parts of the footbridge were plastered with the maintenance plasters Bayosan. Joints in granite hand-railing elements were sealed with silicon cement and precast stone balusters received repair.

Fig. 3. *A closer look at the the state of lower construction - icicle on a significant crack in 2004.*

However during the following period the bridge deck tightness was damaged again which led to ingress of water on the bottom face of arches, soaking and plaster degradation. Dismal condition of the structure deteriorated mostly by the leakage and frost action led the bridge caretaker to decision about new repair. Principal problems were leakage of rain water, humidity capillary action and salting. Klokner Institute of CTU in Prague was delegated to perform the structural and technical survey aiming to find causes of degradation as well as the subsequent reconstruction design in order to solve the adverse situation.

Repair works procedure was divided in two stages. The first stage concentrated on elimination of deterioration sources, i.e. water insulation and drainage of the structure, the second one on repair of damaged brickwork of the substructure and damaged plasters, i.e. renovation of the original appearance.

Fig. 4. *Water from melting snow and ice on deck in 2004.*

Fig. 5. *A detail frozen gullies in 2004.*

Fig. 6. *The soaking wet structures - North Side with gargoyles in 2004.*

Specialists from the Klokner Institute of CTU in Prague found out during the diagnostics that gargoyles freeze during the winter season and the mesh and water from melting snow are accumulating in this area of the footbridge. The issue of insufficient drainage of the water is further accented also by the deck surface shape where each drainer has its separate watershed. Such a watershed would unavoidably fill with the water and melting slush in case of an impassable drainer. A possible solution emerged to connect all drainers by linear neck gutter thus allowing drainage by any open drainer. However this proposal was unacceptable by the heritage protection authority so heating of outlets leading to gargoyles was designed in order to prevent their future freezing. Two gargoyles were also added as new on the lateral line of the footbridge which had no own drainage previously.

2.2. Reconstruction 2006

First stage of the repair was carried out during the building season 2006 and was represented by removal of pebble pavement, execution of heated inlets to gargoyles, repairs and levelling of the base, execution of screed asphalt modified water insulation BAKOR, execution of new modified spread concrete footing and replica of the original cobble pavement. This stage included also finishing works, drainage and repaving of the north courtyard including renovating of the ceiling in the former electrical substation under the room by Paccassi gate - a suspended ceiling lateral with the footbridge line.

During following years was applied a layer of so called lost lime plaster (absorbent) on the substructure brickwork absorbing most of the harmful salts. This layer was knocked down after next few years and the structure was subsequently applied with a new plaster.

Fig. 7. *The drying brickwork after removing the old plaster.*

Fig. 8. *The state after the destruction and demolition of the existing bridge deck drainage, original design end of the drain pipe on a right side.*

Fig. 9. *The situation after the installation of new drains pipes with electrical heating, the installation of power cables on the right side.*

Fig. 10. *The night work with concrete and new reinforced concrete deck slab modified silica fume.*

Fig. 11. *The working on the first layer of hot asphalt waterproofing membrane Bakor 770, a rubber sheet around the connection of drain pipe on the right side.*

Fig. 12. *The pipe end in gargoyles before covering in 2006, a gargoyle to normal operations in February 2016 on the right side.*

Fig. 13. *To refit original gullies in 2006.*

Fig. 14. *The working on a new pebble pavement in November 2006.*

Fig. 15. *The hot asphalt modified grout joints by Bakor 513 in November 2006.*

Fig. 16. *The condition decisive details after ten years of operation in February 2016.*

Fig. 17. *This is a Plečnik's footbridge viewed to the Paccassi gate, front of the Spanish Hall at Prague Castle in February 2016.*

2.3. Conclusions

Functionality of the drainage system, its heating and very high quality double water insulation of the bridge deck had been tested during several frost waves in the winter 2007. Reliability of the new solution was confirmed, the system is fully protecting the footbridge structure against adverse impacts of rainwater which is led from the structure even during winter operation under action of the frost and layers of snow with ice melting on the bridge deck. We are pleased to state that the repair carried out in 2006 is unlike previous attempts reliable and fully functional even after ten years of operation of the reconstructed Plecnik's footbridge and is in compliance with all demands of the national heritage authority related to this unique works.

ACKNOWLEDGEMENTS

This study is an outcome of the research project DG16P02M050 “Optimisation of Observations and Assessment of Heritage Structures”, supported by the Ministry of Culture of the Czech Republic.

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