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Properties of Czech WW2 Concrete Fortifications after 80 Years

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1 Introduction

This paper deals with the investigation of properties of Czech fortification concrete bunkers built before Second World War (WWII). The Czech defense system consisted mainly of light bunkers type No. 37. The vast numbers of these bunkers have been preserved in various conditions to nowadays. The light bunkers type No. 37 were designed to last limited lifetime of decades. According to the preserved test protocols, strength of used concrete varied from 40 to 50 MPa, measured on cube specimens with dimensions 200×200×200 mm. The non-destructive analysis of compressive strength, determined by Schmidt hammer was performed. This method was used to maintain a historical value of the structures. Three were analyzed different bunkers type No. 37 located in Western Bohemia – Pilsner region. Tested bunkers are preserved in various conditions with various quality of concrete. The measurements by Schmidt hammer took place in several locations especially in the interior part. The exterior was also investigated but only in the locations of surface which were not covered with camouflage plaster. Non-destructive testing had shown high quality of concrete older than 80 years old concrete, with compressive strength between 50 to 60 MPa.

1.1 Testing by Schmidt Hammer

The standard Schmidt hammer type N was used, according to Czech standard (CSN EN 2013). Due to the preserved external plasters the investigation took place mainly in the interior part. The schematic cross-section of bunker No. 37 with marked location of measurements is shown on Figure 1. Minimum of 50 measurements were performed on each place (places in different heights). Also the quality of roof was investigated.

2 Results and Conclusion

Totally six different locations in the interior part were investigated by Schmidt hammer. The investigation in exterior part is limited by the protective earth wall in the front part and also by the residues of masking plasters. All results of performed measurements are summarized in Table 1. The first column describes the location according to Figure 1. Following three columns list the values of tentative compressive strength of three different bunkers No. 37. The last row

in the table contains the compressive strength calculated according to destructive test performed in 1937 on cube specimens with dimension 200×200×200 mm.

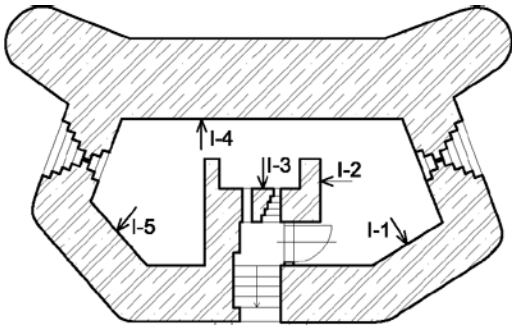

Figure 1. Schematic cross-section with marked places of performed measurements.

Table 1. Results of performed non-destructive measurements.

Designation	D-19/22/A-160	D-19/47/A-160	D-20/4/A-160
	[MPa]	[MPa]	[MPa]
Exterior	67.5	59.7	N/A
Interior (average from I-1 to I-5)	56.2	59.1	58.7
Interior (roof)	59.4	58.6	53.1
Compressive strength tested 1937	49.5	57.5	51.4

Based on performed non-destructive testing of compressive strength, determined by Schmidt´s hammer, in different location of light bunkers knows as “Model No. 37” and also according to visual evaluation we can obtain following conclusions:

- The non-destructive testing of compressive strength of concrete has its important role for determination of tentative quality of concrete structures in the case of historically valuable structures that we do not want damage. The obtained values showed high strength of over 80 years old concrete and confirmed the strength determined in 1930s.
- The quality of concrete from investigated bunkers is very different. We can find areas with excellent surface quality and also areas with exposed reinforcement and insufficiently compacted concrete with large gaps. Nevertheless, due to the robustness of long service life can be expected, if some repairs are made (especially waterproofing).

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