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Warsaw, 15 June 2026

ABSTRACT OF THE DISSERTATION

„Early-Age Thermal–Shrinkage Cracking in Massive Reinforced Concrete Elements Constructed Entirely in the Ground"

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The subject of this doctoral dissertation is the problem of early-age thermal–shrinkage cracking in massive reinforced concrete elements constructed in the ground. In response to cracking observed in cylindrical technological shafts encountered in practice—cracking that cannot be explained solely as a result of external loads—an attempt was made to demonstrate the thesis that thermal–shrinkage effects constitute the primary factor responsible for their occurrence. As these effects are independent of structural geometry, the thesis was extended to all types of deep foundations constructed in situ.

The dissertation presents in detail selected cases of cracking, together with a line of reasoning leading to the conclusion that external loads do not explain the formation of the observed cracks. In subsequent chapters of the theoretical part, the factors influencing thermal–shrinkage cracking are discussed, along with the fundamentals of the mathematical description of thermal and mechanical processes in concrete, including the additional assumptions adopted.

In the experimental part of the dissertation, the scope of the author's own research is presented in detail. The measurement methods employed and four test sites are described, including their locations, geotechnical conditions, dimensions of the primary and secondary sections examined, and the parameters of the sensors used. The subsequent section presents the author's own thermal and mechanical models developed to reproduce the actual temperature and strain values measured at the test sites.

The measurement results were compared with the predictions obtained using the original thermal and mechanical models developed in this study. In this way, the consistency of the actual values with the results of the numerical calculations was demonstrated. Subsequently, an analysis was carried out for six variants of the leading parameters having the greatest influence on temperature, strain, and stress values in cast-in-situ concrete elements. On this basis, the thesis advanced in the dissertation was confirmed, namely that thermal effects alone may, under

a specific combination of governing factors, lead to cracking of these elements. The line of reasoning presented in the dissertation was ultimately concluded with the development of a procedure for analysing the risk of cracking in massive reinforced concrete elements cast in the ground. This procedure was implemented in a real infrastructure project.

Keywords: deep foundations, thermal–shrinkage cracking, diaphragm walls, restraint of deformation, restrained strains

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