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'Analysis of the rectification of deformed walls of barracks located on the grounds of the former Auschwitz II Birkenau concentration camp'

Summary of doctoral dissertation

The doctoral thesis focuses on the rectification of severely deformed brick walls in historic barracks situated in Auschwitz II-Birkenau, a former German concentration and extermination camp. These deformations result from second-order effects induced by heavily loaded walls. The eccentricity of the load originates from the horizontal force exerted on the brick wall by the wooden roof strut and the eccentric positioning of the truss columns on the pilasters. Such second-order deformations have resulted in the detachment of the external transverse walls from the longitudinal walls, thereby altering the static configuration of the walls. Consequently, horizontal displacements of up to 156 mm have been observed in walls that are 120 mm thick, accompanied by openings in the bed joints. This dissertation was conducted as part of the 'Implementation Doctorate' project, during which a method for rectifying the walls was developed, computationally analyzed, verified in situ, and ultimately implemented in four historic barracks at Auschwitz II-Birkenau. Until the dissertation's completion, the gable walls of the barracks were temporarily supported to prevent potential collapse.

The developed rectification method involves the gradual application of small displacements to the wall in a direction perpendicular to it, counteracting the wall's deformation while maintaining a constant form of deformation. These displacements are achieved using screw jacks installed between the rectified wall and the retaining structure, which is located both externally and internally within the barracks. During the rectification process, wall displacements arise from alterations in the width of the bed joints, which do not transmit normal tensile stresses. Consequently, the rectified wall exhibits significant non-linear characteristics due to the relationship between the bending moment acting on the bed joint and the angle of rotation within the bed joint. These relationships were established through numerical modeling and laboratory tests conducted on a wall section obtained from the Auschwitz-Birkenau Museum for non-destructive testing. Furthermore, laboratory tests were utilized to determine the elastic and inelastic parameters of the screw jacks employed to apply the kinematic load to the walls.

A discrete model of the rectified system served as the basis for analyzing the para calculation results of the finite element method (FEM) model of the rectified wall and for evaluating the in situ wall tests. The number of degrees of freedom in this discrete model corresponded to the number of jacks positioned between the rectified wall and the retaining structure. For this discrete model, the stiffness matrix of the rectified system, the susceptibility matrix of the rectified wall, and the shape matrix of wall displacements were computed. The values of the elements in these matrices were derived from unit kinematic loads applied by individual jacks. Comparing the values of the discrete model matrix elements obtained from calculations with those from in situ tests enables model calibration, evaluation of the rectification process, and safe control of the kinematic load during rectification. Notably, as the rectification progressed, it was observed that the wall's stiffness increased and its displacement shapes changed. The developed rectification method is currently being implemented for additional walls of the barracks.

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