Abstract

In this thesis a theoretical framework is developed for the transfer of daylight simulation from its application to modern buildings to lost building states in the context of historical research. It is exemplified in the form of an interdisciplinary workflow by means of a reconstruction of the interior of the 6th century Hagia Sophia. In its course, the physical, geometric, astronomical, atmospheric, and perceptual-psychological models of the method are contextualised for the historical sciences. Starting with the formation of hypotheses regarding the illumination of the Justinianic building, this progresses via the evaluation of findings by building research, archaeological study and the study of sources for the geometric reconstruction to the modelling of the building geometry. The model is complemented by the measurement, reconstruction, and modelling of the unaltered optical properties of the materials marble, glass mosaic and window glass. Then, the simulation is carried out over the course of the day at Christmas, Easter, and St John's Day in the years 562 and 564, respectively, under clear, intermediate and overcast skies, calculating the contributions of windows and reflective surfaces in nave, apsis, aisles and galleries to the lighting. Subsequently, the evaluation is divided into a numerical analysis of the illumination of the surfaces and the perceptual-psychological and reception-analytical investigation of the impression of brightness and colour. Finally, the results are interpreted in an interdisciplinary discourse showing significant differences compared to the lighting of today's building and revealing a complex and dynamic interplay of direct and diffuse lighting with the effectful glow of the materials under changing solar direction and weather conditions. While the nave and side aisles are mostly evenly lit, with the altar area almost always brightly emphasised, the orientation of the building towards the rising sun on Christmas morning results in a particularly impressive lighting. The conclusion points to the potential of the method for future research in the intertwined investigation of historical production methods, material properties and environmental conditions with cognitive and socio-cultural processes.