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The influence of orientation and leaf area indices of a vertical green wall on historic building materials

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Built heritage is a vital component of urban environments and is rich in cultural and economic values. These buildings are abundant in city centres and have been the site of development for several centuries. They have created dense urban environments, exhibiting strong urban heat island effects. Ground-based vertical greening is a widely used green initiative in dense urban environments to mitigate the current climate stressors due to its small footprint and its ability to cover a large surface area with vegetation. The impact of this green initiative on the materials and structural integrity of built heritage is currently poorly understood and thus the focus of this research.

Several studies have already proven the efficacy of ground-based vertical greening in fostering a more stabilized condition on the underlying wall surface, characterized by reducing the amplitude of temperature and relative humidity fluctuations and the amount of solar irradiation. More stable conditions can imply a lower risk of common degradation processes, such as freeze-thaw weathering and salt crystallization, in historic building materials.

Since the extent of the vertical greening performance and the deterioration of building façades strongly depend on the orientation of the façade, part of this research aims to establish a relationship between those two variables while considering the orientation of a building façade. Monitoring case studies in the historic city centre of Antwerp during summer develops an understanding of the shading performances of vertical greening and characterises the boundary conditions, such as orientation or leaf area index (LAI), that signify the extent of efficacy. The current case studies reveal a positive correlation between the LAI and the shading potential of vertical greening and highlight the significant role of orientation in mitigating the environmental parameters on the wall surface, as the cooling processes of vegetation mainly depend on the amount of solar irradiation. More specifically, the highest leaf area index and a south or west orientation show us the most significant cooling behaviour during the day which can reduce the risk of salt crystallization the most. The shading performance of vertical greening is only one of the several mechanisms determining the impact of vertical greening on the local environment and the subjected historic materials.