

TECHNICAL COMPATIBILITY OF VERTICAL GREENING WITH HISTORIC BUILDING MATERIALS

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Climate change is receiving significant attention and concern worldwide. The global temperature is increasing due to increasing greenhouse gas emissions with drastic consequences for natural and human environments. In addition, urban heat island effect poses extra challenges to urban environments. Due to hard coverage and its infrastructure, cities experience higher temperatures and higher pollution levels in their centre relative to their surroundings. The health of residents suffers from the effects of climate change. Air pollution affects the respiratory health, changes in temperature, relative humidity or precipitation cause a wider spread of infections and increase risk of mortality.

Nature-based solutions are the sustainable methods of addressing and mitigating those climate stressors by implementing blue (water-based) and green (plant-based) infrastructure, each having their own ways of adapting. Cities are implementing them to mitigate elevated temperature and pollution levels, and improve the health and wellbeing of residents. Despite the abundance of built heritage in the core of the city, where the urban heat island effect is strongest, built heritage is often exempt from contributing to mitigation strategies. First of all, nature-based solutions, especially green initiatives, are often seen as a threat for built heritage by causing possible material deterioration, loss of heritage values or altered conservation practices. However, they actually may offer a more sustainable solution to heritage conservation. Furthermore, it is not always easy to implement such green initiatives. The rules of conservation, the dense urban fabric and the structural vulnerability can hinder an implementation of green initiatives. Nevertheless, if the cultural, historical and aesthetic values of built heritage are to be preserved, it needs to contribute to tackling the aforementioned urban challenges.

Due to the major concern about the effect of green initiatives on historic building materials, this research scopes the compatibility of vertical greening with built heritage. We will characterize the impact of vertical greening on heritage microclimates, considered in the context of known mechanism of decay, including salt crystallization, frost events, biodeterioration and pollutant deposition. Vertical greening represents vegetation growing along exterior walls. The plants are rooted on the ground and climb up the façade, either by attaching themselves on the vertical surfaces or by using metal wires to attach them. The implementation method of this nature-based solution is easy to implement and maintain, low cost, and has a minimal footprint, but the plants need some time to grow into such a vertical green façade. Living walls, with plants rooted on the façade, are excluded in this stage because of a more complex implementation on historic fabric.

The information for this research will be conducted in five different ways. First of all, in literature studies, it's understood that green initiatives can have an impact on air and surface temperature, relative humidity, solar irradiation, particulate matter and wetness, and it gives overview about what's already established in previous research. A mitigating effect of ivy as a green façade on the frost events in a natural stone wall is shown in recent research. Due to the insulation effect of ivy, the average minimum temperature may increase and can cause a reduction till 46% in frost events [1]. But research shows also a higher relative humidity under an ivy coverage [2], changing the risk of salt crystallization cycles and improving conditions for biodeterioration [3].

Monitoring case studies and performing laboratory studies will further develop the understanding of the key environmental changes, beneficial or adverse, on the material risk to heritage buildings. Our case studies will focus on existing green façades in the historical city centre of Antwerp (Belgium), comparing with bare walls of similar structures. We will closely monitor temperature, relative humidity, wetness, solar irradiation and air pollution at the outer wall. Some parameters will be measured only on the wall surface, others will be measured on the surface and in the depth of the material. Additionally, in the laboratory studies we will work with an imitation of a green façade on a small scale, where the parameters will be tested in a more controlled environment. Laboratory studies and additional computer-based simulations allow us to test future-oriented, different wall compositions or whether vertical greening can attenuate the negative effect of the implementation of insulation in heritage buildings. Gathering all that information will be completed with participatory approaches within the professional field. They could enrich our research by providing knowledge from a practical point of view. With their additional knowledge, we search for a practical approach than can be implemented with a beneficial effect for built heritage and a willing contribution of practitioners.

With this research, we want to comprehend the relation between the historic building materials and the environmental changes due to vertical greening in an urban area and we want to find a way where historic buildings could fulfil an active role in the mitigating strategies instead of undergoing a passive role. Therefore, we hope to illustrate a beneficial effect of vertical greening on historic building materials to accomplish a contribution of built heritage in mitigating the climate stressors and the urban heat island effect without compromising heritage and its associated values. With the focus on the applicability of green walls by testing different practical approaches (such as different wall compositions and different sizes of green coverage), we will address the practitioners to focus more on sustainability in heritage buildings and be open for different sustainability scenario's. This research could influence the academic world, what determine the view of the future experts on greening built heritage in the future, and the practitioners themselves by showing practical possibilities of using vertical greening with built heritage and framing their specific impact on the materials.

KEYWORDS (min. 3 keywords)

Heritage, climate change, degradation, green initiatives.

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