

Integrating Climate Adaptation and Heritage Values in Urban Areas: A climate-legibility assessment of blue-green interventions in Aachen

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Keywords: Climate Adaptation; Heat Stress; ENVI-met; Urban Heritage; Blue-Green Strategies

Abstract Historic city centres are increasingly exposed to intensifying heat stress, yet most climate adaptation assessments overlook heritage layers that make these places unique (ICOMOS, 2011). Responding to the European Commission's call for smarter adaptation (European Commission, n.d.), this research develops an integrated quantitative-qualitative framework that couples ENVI-met simulations with an assessment of urban heritage values. The framework introduces the Narrative Clarity Index (NCI), a qualitative evaluation that supports context-sensitive design strategies in historically complex environments.

The city of Aachen, with thermal springs used since Roman and Carolingian times and chosen by Charlemagne as the political centre of the Frankish Empire, provides a historically layered context well-suited to testing the framework.

To this day, Aachen preserves historical street orientations, along with medieval street layouts, public spaces, and a network of piped brooks. Together with post-war redevelopments that significantly increased surface sealing (Curdes, 1999) these spatial layers contribute to intensifying urban heat stress.

To operationalise the framework, case studies of blue-green scenarios in the inner-city will be used: The "Altstadtquartier Büchel", a redevelopment replacing a demolished car park and nearby plots close to the UNESCO world heritage cathedral; and the "Kaiserplatz" corridor, which follows underground piped brooks. Studies of context-based blue-green strategies will complement the framework.

ENVI-met simulations will be used to assess how built form and materials influence urban heat and human thermal comfort for baseline and for the blue-green scenarios. Physiological Equivalent Temperature (PET) is the primary indicator; a strategy is considered successful if it achieves a PET reduction of 4° to 6° Kelvin, depending on and in relation to baseline values.

The NCI evaluates heritage compatibility through a rubric distilled from ICOMOS criteria (ICOMOS, 1964, 1987, 2011), focusing on three indicators: (i) legibility – the preservation and clarity of spatial patterns, forms, materials, and visual corridors; (ii) authenticity – compatibility of new uses with tangible fabric and spirit of place; and (iii) engagement – communication of historical narratives, accessibility, and community acceptance. The NCI applies a matrix (Classes A–D) for qualitative comparison among blue-green scenarios.

Each intervention must meet both benchmarks: a successful PET reduction and attainment of Class B or higher in the NCI based on all indicators. If not achieved, iterative refinements are conducted. This structured process reveals case-specific trade-offs and provides insights for climate-adaptive design in complex heritage contexts. Further developments and adaptations of the framework will be presented at the conference and detailed in the full paper.