HydroSKIN: Climate-resilient Membrane Façade Prototyping

Christina Eisenbarth[1*], Walter Haase[1], Lucio Blandini[1,2] and Werner Sobek[2]

[1] Institute for Lightweight Structures and Conceptual Design (ILEK)
University of Stuttgart
Pfaffenwaldring 7, 70569 Stuttgart, Germany
e-mail: christina.eisenbarth@ilek.uni-stuttgart.de, web page: www.ilek.uni-stuttgart.de

[2] Werner Sobek AG
Albstraße 14, 70597 Stuttgart
e-mail: mail@wernersobek.com, web page: www.wernersobek.com

ABSTRACT

Figure 1 HydroSKIN façade prototypes at D1244 experimental high-rise building in Stuttgart © Christina Eisenbarth

Extreme heat and heavy rainfall events affect urban architecture with considerable personal injuries and material damage on buildings and infrastructure. While social developments lead to increasing urban densification, surface sealing, and the construction of high-rise buildings, the effects of climate change urgently require the creation of more infiltration and buffer surfaces. Building envelopes cover a considerable part of the urban exterior surfaces, and therefore have a significant leverage effect on the climate resilience and sustainability of buildings and cities.

HydroSKIN represents a revolutionary façade element for rainwater retention and evaporative cooling. The lightweight textile skin collects the wind-driven rainwater hitting the building façade. Use of the harvested rainwater inside the building e.g., for toilet flushing and plant irrigation aims to a reduction of fresh water and energy consumption. In heat periods water is released by HydroSKIN to cool the interior and exterior environment by evaporation. The aim is a drastic reduction of urban inundation and heat risks by relieving the sewage infrastructure and providing natural microclimate regulation with a minimal amount of embedded mass, energy, and CO2 emissions. Due to its lightweight system design, the façade add-on element is suitable for both new and existing building façades.

Preliminary laboratory investigations indicated an absorption of almost the entire amount of wind-driven rain droplets by the textile material. Empirical evaluations of the cooling effect in an evaporation test stand showed a temperature reduction at the textile surface of about 10 K, accompanied by an associated cool downdraft. This paper focuses on the subsequent realization and evaluation of HydroSKIN performance and efficiency at the D1244 experimental high-rise building in Stuttgart under real weather conditions. Benefits result from the implementation of HydroSKIN facades at high-rise buildings since driving rain yields hitting the facade and evaporation rates of water exponentially increase with the building height.

REFERENCES

[1] Eisenbarth C, Haase W, Blandini L, Sobek W. Potentials of hydroactive lightweight façades for urban climate resilience. Civil Engineering Design. 2022

[2] Eisenbarth C, Haase W, Blandini L and Sobek W. 2022. ‘Climate-Adaptive Façades: An Integral Approach for Urban Rainwater and Temperature Management. Proceedings of the 5th International Conference on Structures and Architecture (ICSA2022), Aalborg

[3] Eisenbarth C, Haase W, Blandini L and Sobek W. 2022. ‘HydroSKIN: Lightweight Façade Element for Urban Rainwater Harvesting and Evaporative Cooling’. Proceedings of the Façade Tectonics 2022 World Congress, Los Angeles

[4] Rentz A, Oei M, Eisenbarth C, Haase W, Böhm M, Blandini L and Sawodny O. 2022. ‘A Hydroactive Facade for Rainwater Harvesting and Evaporative Cooling: Dynamic Modeling and Simplification for Application in Optimization-based Long-term Building Operation Strategy’. Proceedings of the Conference on Control Technology and Applications (CCTA 2022), Trieste

[5] Borschewski, D.; Albrecht, S.; Bischoff, M.; Blandini, L.; Bosch, M.; Dazer, M.; Efinger, D.; Eisenbarth, C.; Haase, W.; Kreimeyer, M.; Leistner, P.; Nitzlader, M.; Roth, D.; Sawodny, O.; van den Adel, F.; Voigt, M.; Weber, S. (2022) Ökobilanzierung adaptiver Hüllen und Strukturen (engl.: ‘Life cycle assessment of adaptive envelopes and structures’). Bautechnik.