Abstract

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A Computational Approach for Soft Adaptive Building Skins using Hygromorphic and Thermobimetal Composites

Adaptive building skins are typically developed to actively regulate the influence of weather conditions on interior spatial configurations in buildings. Most of the research in adaptive skins typically involved complex actuation devices with highly mechanistic and rigid kinematic control, therefore impeding their wider adoption in low-carbon buildings. Further development exploited notions of smart materials, material elasticity, pneumatic muscles, electro-active polymers, elastomers, and actuated tensegrity structures in response to environmental stimuli. In response to multi-faceted performative, morphological and geometrical challenges, more recent research involved low-cost low-tech smart materials such as bilayer composites, thermobimetals, and hygromorphic materials, where the focus shifted to utilizing bio-inspired systems and material properties for the development of sustainable adaptive façades. This paper introduces a responsive composite material whose motion mechanism relies on stimulating one layer of the composite – wood metal – as an active layer. This hygromorphic-thermobimetal composite does not exhibit a specific active layer, but rather depends on external stimulus and utilizes embedded properties of both layers to control output motion response. This composite is demonstrated to operate effectively for adaptive façade prototypes in hot arid climates.