Abstract

Rana A Bahaa

Hygroscapes: Innovative Shape Shifting Façades

This chapter focuses on the testing and design of shape shifting façade prototypes that are programmed to passively sense stimuli and respond in a controlled setting based on the hygroscopic properties of wood. Wood is introduced in this context as a low-tech smart material with a naturally soft responsive mechanism that offers a substitute for mechanical actuators. First, a set of physical experiments were conducted to deduce the design parameters that affect wood morphology, behavior and response time upon changes in humidity levels and moisture content, including dimensional ratio, grain orientation, material thickness, type of wood, and lamination. We then report on the process and outcome of a workshop held at the American University in Cairo, with the main challenge of regulating the morphology and hygroscopic behavior of wood to work as an actuator with specifically desired motion for adaptive building façade prototypes. Based on the observations and analysis of concepts and mechanisms, we discuss shape shifting grammars as a framework for devising adaptive façade prototypes from a generative design perspective, where specific combinations of motion parameters are used to induce semantic rules and customized commands for the overall behavior of shape shifting mechanisms.