A Decision-Making Framework for Dynamic Control of Electroactive Patterning on Next Generation Architectural Glazing

by

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ABSTRACT

There is a growing trend toward glass buildings and transparency in architecture. This creates a problem of controlling for glare, privacy, and solar heat gain while maintaining the unrestrained views and feel of de-materiality translucency provides. The complex relationship of transparency, light, and heat is compounded by climatic influences such as diurnal swing and seasonal change, as well as programmatic needs and human variability of individual and collective preferences. Currently available solutions like dynamic glazing, integrated devices, and double skin façades are capable of addressing these issues separately but not necessarily holistically. Dynamic glazings have blanket on or off conditions and lack precision and variability. Integrated devices such as electronic blinds and prisms create conditions of limited transparency and are not ideal for mitigating heat gain. Double skin façades are imperfect because of high initial costs, high embodied energy, as well as for limiting views and lacking variability.

It is hypothesized that if an adaptive glazing unit incorporates emerging electroactive polymer billboard display technology, then transparency and privacy is simultaneously achievable while accounting for daylighting issues such as glare, solar heat gain, and light quality. By using display technology to this end, media evolves as an architectural form with the capacity for strong positive and negative effects. These effects vie for authority with the goals of “ecologically prescient” architecture.

As such, research and development of next generation façade systems that include the capacity for display communication must be particularly cognizant of social and personal considerations, as well as the wider context of life cycle energy accounting for advertised products. System quality emerges through the relationships between functional demands and design characteristics. This thesis proposes a hybrid quantitative and artistic decision-making framework that can ensure that the performative and social criteria of the bioclimatic media wall are transparently discursive in a participatory process across a range of actors. This framework can ultimately be encoded in patterning algorithms and sensory functioning.

A series of experiments was performed including physical and parametric modeling, climate analysis, and cultural comparisons to inform the development of the decision-making framework. This framework will be a tool for understanding the

complexity of conflicting priorities among a wide field of functional requirements and users that can aid in the design development of a culturally-loaded condition that occurs when mechanical comfort systems for a building are placed prominently on the façade. “Bioclimaticism” begins to play out aesthetically. The explicit visual display technology creates a semantic level to architectural environmentalism in the urban condition as well as the building interior. The possibility of influencing the thoughts and behaviors of individuals vis-à-vis the value system of sustainable design is suggested. Advertising, however, can operate from the same display platform as a conflicting purpose obtrusively foisted into the public realm.

Because the overall thermal environment of the building is greatly influenced by a wide range of holistically integrated variables including morphology, interior design, and mechanical systems, the focus of this study is on building a useful decision-making framework for evaluating the transfer of electroactive polymer technology to the design of dynamic glazed building envelopes. The relationship of these glazed units to the larger energy framework remains speculative and requiring of further investigation.