Title or Proposal: Conformationally Adaptive Novel Solar Shading Prototype for Testing, Display, and Proof of Concept

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Abstract:
Innovative technologies which enable more efficient use of energy in the built environment contribute to the effectiveness of green building design, and to sustainable building practices. The objective of this proposal is to create a prototype for a patent pending, novel solar shading device which relies on the properties of certain sustainable composite materials to change shape while under strain, and return to their original shape when at rest. The behavior of this device will be modeled and tested using advanced computer modeling and digital fabrication techniques, built full scale, and then put on display in a gallery format show.

Proposal:
Solar shading is an essential component to passive energy design for buildings. Sun angles and building orientation have been basic architectural considerations dating as far back as ancient Egypt, and are commonly seen in such vernacular building formations as shotgun and dog-trot houses, or wrap-around porches. Traditionally, solar design has come in the form of static shading devices applied to building openings, or in building forms which accommodate such strategies in their basic shape and orientation. New technologies, however, have created adaptive solar shading which responds to lighting conditions, time of day, and the presence of building occupants. Active shading devices currently do exist and take the form of motorized metal fins and roll-down shades. These technologies rely on mechanical solutions to architectural problems. The use of adaptive material-based solutions, however, remains relatively unexplored.

This proposal centers on the use of carbon fiber, fiberglass, wood, and other composite materials to create prototype solar shades which actually change shape in response to ambient conditions and user needs. The use of modern composites in active sun shading could create solar shades which are able to stretch (Figs G1, G2, G3), bend, and twist (Figs G4, G5, G6) to adapt to lighting needs, passive energy strategies, and for the enrichment of architectural space. Such sunshades would contribute to the creation of a materially rich architectural environment, while still accommodating building performance and occupant needs.

The proposed construct will take advantage of a novel and patent pending system which can be deformed not only to occlude or permit the passage of light, but also to produce optimal angles for the insolation of the surface of the device.
itself. This will permit efficient use of active solar technologies such as photovoltaics applied to the surface of the device in future experiments. Optimal angles and opacities can also be created to shade buildings and building openings to allow diffuse light while blocking direct light, or to allow visibility through the screen from selective angles. For instance, in an architectural application, when fully closed, the device can be made sufficiently strong to resist the damaging effects of hurricanes and major wind storms, to block sunlight, or to provide privacy. When fully open, the device can allow the passage of natural light and breezes, and to provide views to the outdoors, allow for the integration of active solar technologies, as well as hurricane protection for coastal buildings.

Once finished, the solar shading prototype will be tested for shading efficiency, and adaptability, as well as material stress optimization. The device and supporting work will then be shown in a local gallery both as a means to showcase the work itself, but also to highlight the cutting edge technology which is currently being integrated with the curriculum at the School of Architecture and Community Design, and within the CoTA as a whole.