

“Wired Skins,” Research and Development and Hands-On Design-Fabrication Workshop Fall 2017

COLUMBIA GRADUATE SCHOOL OF ARCHITECTURE, PLANNING, AND PRESERVATION

Instructors: Todd Dalland, FAIA, tdalland@pvilion.com
Robert Lerner, AIA, rlerner@pvilion.com
Colin Touhey, EE, ctouhey@pvilion.com

Course Format: Presentations and Studio Project, Field Visits to Pvilion Design/Fabrication Workshop in DUMBO Brooklyn, Field Visits to local fabrication shops.

BACKGROUND

Building envelopes have evolved in recent years to provide more active and passive environmental controls. Reducing the mass of buildings has been a goal to make buildings more efficient structurally while meeting structural and environmental needs. Wired skins are performance membranes and surfaces that can generate power, and respond to environmental conditions such as solar orientation, wind, rain, snow or other factors.

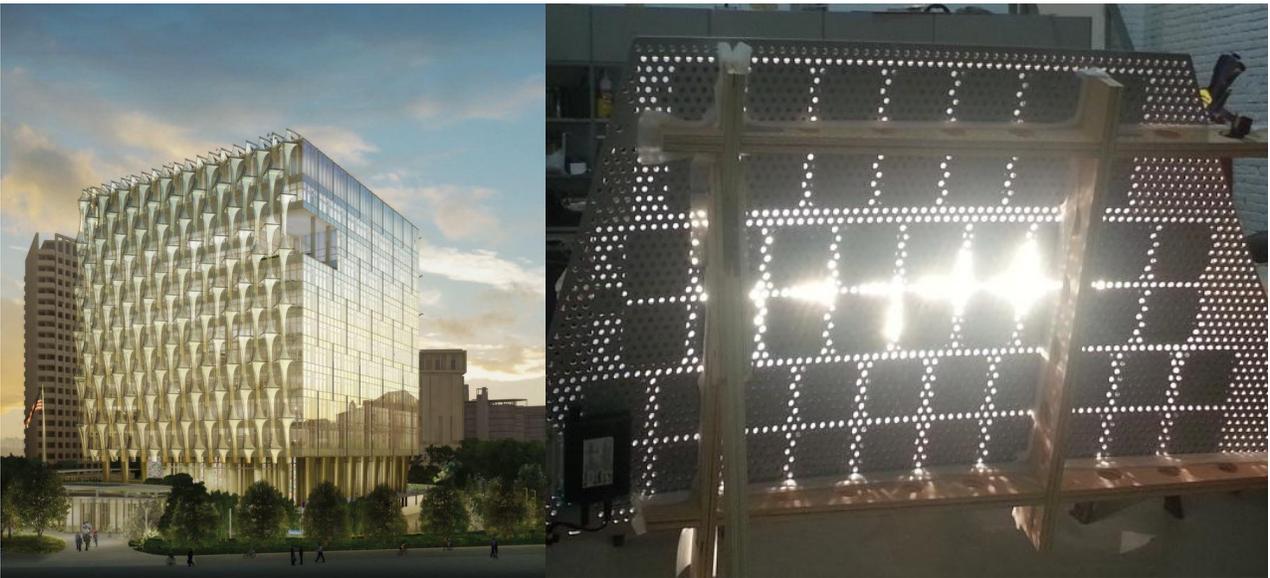
“WIRED SKINS” looks at the building skin as an active surface, collecting energy, moving to respond to dynamic loads or solar orientations. The course will explore how new materials such as flexible photovoltaics, and industrial textiles can be employed to make building skins that are active, dynamic functionally and visually. We will take a hands-on approach to research and development, learning about materials and methods through fabrication and testing. We will investigate the use of self-powering mechanical devices, such as linkages and actuators, coupled with sensors and controls which can be used to create more efficient and habitable buildings. While architects enjoy pushing the limits of technology, architectural fabricators are often key members of the design team, determining what is realistic technically, within project budgets and time frames. The course will focus upon developing the discipline of design from the fabricator’s point of view, by testing ideas in fabrication work-shop environment. Case studies will be presented by the instructors to demonstrate the role fabricators play in the design process with reference to current projects such as the new US Embassy in London, the new Artists for Humanity building in Boston, recent projects at Google’s Headquarters, and other projects.



COURSE REQUIREMENTS

Students are required to attend all classes and field trips, and participate in hands-on fabrication workshops. There will be three main assignments :

- 1) **Case study presentation:** Each student will prepare a 10-15 minute presentation showing an example of a fabricator's significant contribution to the realization of a complex design challenge. The Case Study, Class Participation and Attendance will account for 20% of the Course Grade
- 2) **Independent research:** Each student will prepare a short paper on novel materials or methods of construction and implications for architectural applications. 20% of Course Grade
- 3) **Design, Fabricate, Build Project:** This will be a group project involving design, fabrication and construction of an architectural product, project subcomponent, or subscale pavilion. 60% of Course Grade



The new US Embassy in London, designed by Kieren-Timberlake. Fabrication design, engineering, testing, manufacturing and installation by Pvilion.



Capital Cascades Bridge, Tallahassee, FL. designed by Figg Bridge Group. Photovoltaic membrane design, engineering, testing and fabrication, by Pvilion.

SYLLABUS

Wk 1 Presentation: Course introduction, Instructor Introduction and Background, presentation on the work of Pvilion Inc. including firm history dating back to 1977, as tensile structure design engineering firm FTL Design Engineering, FTL Happold, FTL Solar, Pvilion. Wired Skins, introduction, current work and focus of the firm as designer/fabricator/builders. Introduce studio project topics, research and development topics. Open discussion about the state of the art of wired skins, membranes, fabrication, and research interests of presenters and students.

Wk 2 Interface between digital design and hands-on fabrication. 3-d modeling, hands on model making, introduction to digital fabrication technologies, 3-d printing, cad cam milling, CNC, new technologies in materials and methods of fabricating, shape memory materials, active control technologies, smart materials.

Wk 3 Research and Development as part of the designer/fabricators practice: Presentation of the research and development projects of instructors, including work for NASA, US Army, US Airforce, numerous commercial clients, NYSEDA, and many others. This R&D presentation will include case studies in: high and low pressure air beams, the advanced inflatable airlock for NASA, flexible photovoltaics, the US Embassy in London – Photovoltaic Screens. Week 3 will introduce numerous research and development topics which may be pursued by student teams as part of the course project. Assignment: Case Study in which a fabricator solved a key design problem on an architectural project.

Wk 4 Hands-on Design Workshop: Wired Skins Model-making and prototyping techniques. Students will learn how tensioned membranes are designed and modeled with hands-on physical model making techniques.

Wk 5 Instructors will introduce project ideas to students. The project will be team based and will include a research and development component, and design/fabricate component. Case study student presentations.

Wk 6 Students visit Pvilion studio/workshop in DUMBO for presentation of Pvilion's fabrication shop. Discussion of student projects.

Wk 7 Field trip to Fabrication Shop: Pvilion will organize a field trip to a fabrication shop in the tri-state area to observe cad-cam manufacturing processes such as: waterjet cutting, plasma cutting, laser cutting, milling, etc.

Wk 8 Conceptual design review of student projects: drawings, models, research and development, proposed tests.

Wk 9 Design development review of student projects: drawings, models, test fixtures.

Wk 10 Design review of student projects: progress review, interim pin up with guest critics.

Wk 11 Design review of student projects: drawings, models, fabrication,

Wk 12 Fabrication at Pvilion Workshop

Wk 13 Final Project Review

Guest Critics:	Cristobal Correa	Buro Happold
	David Bott	Heintges & Associates
	Peter Yeadon	Yeadon Space Agency
	James Carpenter	James Carpenter Design Associates
	Peter McCleary	Professor Emeritus, University of Pennsylvania