Surface, Screen & Structure

ARCH A4781

Tech Elective Fall 2014
Thursday, 7-9 PM
Ware Lounge - 600 Avery

Professor: Joseph Vidich: jwv2102@columbia.edu

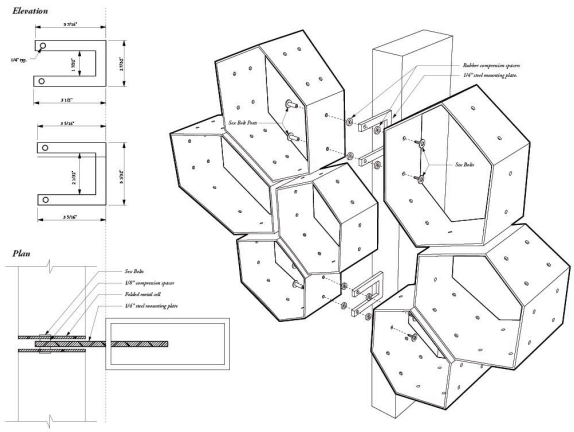
COURSE THESIS:

This course focuses on the design and digital fabrication of full-scale prototype sun screening systems. Primarily an applique, the screens will perform as ornamental expression and functional shading. Students will design thoughtful solutions that are graphic, spatial while creatively resolving light transmittance and structural requirements. At the building scale, the screening systems will be designed, iterated and optimized using Rhino. At the scale of the panels and connection details, the full-scale prototype will be designed using Solidworks, a parametric sheet metal modeling software. Prototypes will be made from 22 gauge stainless steel sheet. The screening system prototypes will be necessarily constrained by physical properties (thermal expansion, machine limitations, light transmittance requirements and assembly requirements) and students will need to design with such realities in mind. The site for the screening systems will be the 5th floor of the Adidas Sport Performance store at 610 Broadway. Students will work in teams of 3-4 and will be provided all the structural details and 3D models of the Adidas Sport store facade in order to expedite the prototype design process.

DIGITAL FABRICATION + PROTOTYPE:

The digital fabrication will be done with Maloya Laser and their 4000 watt laser cutter and with GSAPP's fabrication lab. Students will have the opportunity to learn and work directly with Maloya Laser's President, Reto Hug, and CAD/CAM fabrication experts. In addition, throughout the semester students will meet with and discuss their design strategies with licensed structural engineers, lighting designers and facade system designer and manufacturers.

The prototype, literally a 3D sketch, allows for an unparalleled opportunity to experiment, learn and modify. It emphasizes a circular rather than linear process, informing the digital design which in turn will inform future prototype iterations. Each prototype will be tested for material, tectonic and design failures, combining hands-on learning with physical optimization. The digital model, capable of numerous simulations, will be iterated with the data received from the prototypes to advance the design and further analysis of the system as a whole. Teams will be required to design and fabricate two full-scale prototypes.



COURSE STRUCTURE:

1. Utilize Rhino as generative modeling tools in order to design a screening system that is responsive to the material capabilities of metal, natural and artificial light transmittance and CNC machine techniques
2. Review design work with a structural engineer, to analyze the forces that will act globally upon your cladding system as well as locally at each joint or connection
3. Use Solidworks to create an accurate parametric model, materially and structurally, of a single connection detail.
4. Digitally fabricate two stainless steel prototypes using Maloya Laser and the CNC routers available at the GSAPP

COURSE DELIVERABLES: (per team)

1. Two full-scale digitally fabricated prototypes of your screening systems
2. A Technical Report at the end of the semester providing all the process, analysis, and technical data for your system

GUEST LECTURES:

- Reto Hug: President Maloya Laser – relationships between the designer and fabricator. Optimizing for fabrication. and analysis. Pricing structures and the reality of value engineering
- Structural engineer and curtain wall consultant – analysis and optimization of global and local systems (panels, armature and detail)
- Facade system manufacturer – Capabilities of the full-scale mock-up and built-up structural cladding details. Finishing techniques (black oxide patina, powder coating, galvanizing, anodizing, plating)

FIELD TRIPS:

- Maloya: Touring the advanced CNC machines and technologies with Reto Hug
- FACE Design + Build: Touring the structural metal working studio and design studio with Todd Fouser
- Possible site visits to see rain screen and sun screen systems in the process of installation

BIBLIOGRAPHY - OPTIONAL:

- The Function of Ornament, Farshid Moussavi and Michael Kubo, Actar, Barcelona, 2008
- The Function of From, Farshid Moussavi, Actar, Barcelona, 2009
- Digital Fabrication: Architectural and Material Techniques, Lisa Iwamoto, Princeton Architectural Press, 2009
- Atlas of Novel Tectonics, Reiser + Umemoto, Princeton Architectural Press, 2006
- Tooling, Pamphlet Architecture 27, Aranda/Lasch, Princeton Architectural Press, 2006
- Pye, David, The Nature and Art of Workmanship, Herbert Press, London, 1995
- Pye, David, The Nature and Aesthetics of Design, Herbert Press, London, 1978
- Architecture in the Digital Age: Design and Manufacturing, ed. Branko Kolarevic, Taylor & Francis, New York, 2003
- Refabricating Architecture, Stephen Kieran + James Timberlake, McGraw-Hill, 2004

SURFACE, SCREEN & STRUCTURE

Course Schedule // Fall 2014 // Thursday, 7-9 PM - Ware Lounge

wk 01 Sept 04 **Introduction to course** // Precedent examples // Past student work // Why digital fabrication
+ **Guest lecture** - Reto Hug (Maloya) // Porter House, Dialogue with SHOP, data management, tolerence and assembly
+ **Assignment 1** - Concept development + precedent research

wk 02 Sept 11 **Site and initial concept review** // facade precedents // Graphic representation + ornamentation
+ **Workshop** - Solidworks Introduction + sheet metal modeling
+ **Assignment 2** - Panel and global pattern design

wk 03 Sept 18 **Project progress reviews by group** // Review of screen systems + overall facade concept
+ **Assignment 3** - Chipboard prototype + Connection detail design development
+ **Guest lecture** - Reto Hug // systems, global design, materials, structural engineering

wk 04 Sept 25 **Project progress reviews by group** // Review of Chipboard prototype + Connection detail design development
+ **Assignment 4** - Prepare shop drawing set for preliminary fabrication
+ **Guest lecture** - Lighting engineer // sunshading systems, bulb types, artificial lighting

wk 05 Oct 02 **Work Session** // Detailing in sheet metal // Preparing unfolded sheet metal screens for laser cutting
+ **Workshop** - Tolerance and machine drawings for the laser cutter + Prepping Files for laser cutting at Maloya
+ **Assignment 5** - **.dxf** laser cut files for presentation and fabrication at Maloya Laser
+ **Guest lecture** - Structural engineer // panel to panel connections, structural details

wk 06 Oct 09 **Work Session** // Solidwork Sheet metal modeling // shop drawing reviews
+ **Workshop** - Tolerance and machine drawings for the laser cutter + Prepping Files for laser cutting at Maloya
+ **Guest lecture** - Reto Hug // preparing machine ready cut files

Oct 13 **+ Prototype 01 laser cut files MUST be sent to Maloya Laser for fabrication by 12 Noon**

wk 07 Oct 16 **Class trip to Maloya Laser** // Shop tour // CNC laser cutting and press break demonstration
+ **Workshop** - Prepping Files for laser cutting at Maloya
+ **Guest lecture** - Reto Hug // large scale manufacturing techiniques and protocols

wk 08 Oct 23 **Work Session** // Mid-term week // review progress and presentation
+ **Fabrication** - Students to schedule time in the Fabrication Lab as necessary

wk 09 Oct 30 **Mid REVIEW // Ware Lounge 7-10 PM**

wk 10 Nov 06 **Cost Analysis** // Project feasibility assesment
+ **Workshop** - How to assess costs for material, fabrication, assembly and installation
+ **Assignment 5** - Creating costing spread sheet

wk 11 Nov 13 **Work Session** // Solidworks model review + final prototype review
+ **Review** - Presentation of fully developed Solid model + analysis of final prototype for fabrication
+ **Assignment 6** - Complete Solidworks models with screen, armature and details
+ **Guest critic** - Structural engineer

wk 12 Nov 20 **Work Session** // Lighing review // Sun screen performance // Interor and exterior lighing scenarios
+ **Review** - Presentation of screening and lighting properties of the physcial prototypes
+ **Assignment 7** - **Final .dxf** laser cut files for presentation and fabrication at Maloya Laser
+ **Guest critic** - Lighting engineer

Nov 24 **+ Prototype 02 laser cut files MUST be sent to Maloya Laser for fabrication by 12 Noon**

wk 12 Nov 27 No Class - Thanksgiving Holiday

wk 14 Dec 04 **Work Session** // Final prototype and review strategy // Structural review of details
+ **Review** - Presentation of full scale details
+ **Assignment 8** - Shop drawings complete and ready for fabrication

wk 15 Dec 11 **Final REVIEW // Ware Lounge 7-10 PM**

wk 16 Dec 17 **Grades due**