COLUMBIA UNIVERSITY ARCH A4112
Graduate School of Architecture Planning and Preservation Spring 2017

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SYLLABUS

OVERVIEW

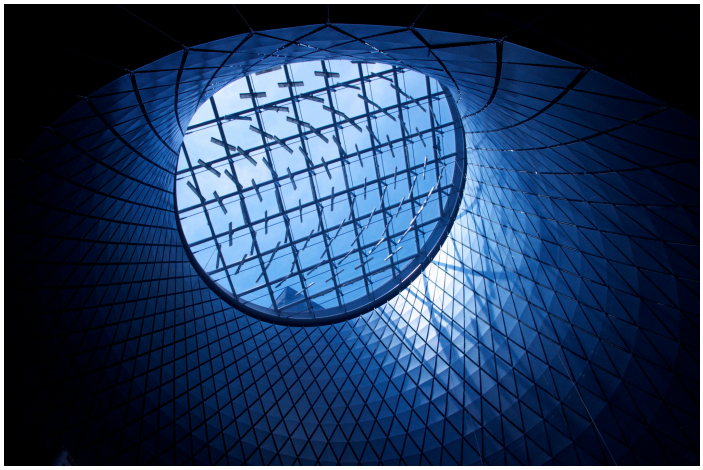

Figure 1. Sky Reflector-Net, an example of architecture that necessitated a deep understanding of structural behavior.

Some of the most prolific architectural works of the post-renaissance era have resulted from great architects and engineers working closely at every stage of the design process. These fruitful relationships demonstrate that the division of responsibilities once held solely by the *majester operis* into a wide array of technical disciplines – often led by the modern architect – has not hindered the viability of delivering a holistic end product. In fact, it has offered an opportunity to preserve harmony between innumerable aspects of design, planning and construction, while emboldening us with the capacity to embrace rapidly emerging technologies that promise to enhance our design process and built environment.

Rarely is a contemporary architect burdened with the need to perform onerous structural analysis or establish construction-document-level structural designs (though architects with such a capacity continue to do such work in niche areas of the industry). But a strong architect is still one who designs with an understanding of structural stability, robustness and quality; and seeks to push materials and assemblies to their limit. A successful architect executes this with mindfulness toward the client's design needs, budget and schedule.

This class will provide students with an understanding of what "structural design" means, and how it is carried out. Students will gain familiarity with basic elemental forms, structural assemblies and systems, and new and emerging materials. Through project-based and hands-on work, we will work together to gain an intuitive understanding of structure, empowering students to integrate into architectural concepts a level of structural coherence and technical inspiration that allows load resisting systems to both perform and intensify the spatial experience.

The design of structure requires intimate knowledge of the principles and precedents of the assembly, as well as unique construction considerations and the analytical techniques used to validate its performance. An analysis of these aspects will confirm that these assemblies exist not only because of their compelling form, but likewise as a result of the ability of early designers to prove that they can be built using conventional construction techniques at reasonable cost, and perform adequately throughout their useful lifetimes despite their unique and unusual configuration.

Students will gain a holistic understanding of these essential characteristics through group-based research and design projects. Groups will select an existing assembly, which they will explore through four class modules: principles and precedents, analysis, construction, and innovation. Each group will prepare and deliver a presentation for the class at the end of each module.

Lectures will be given for a portion of each class and will focus on notable case studies related to the current module. Students are expected to walk away from this class with a fundamental understanding of structural stability, a taxonomic approach to selecting structural solutions, and familiarity with some of the most historically significant successes and failures within this realm. As a consequence of the class format, students will also gain familiarity with the works of great engineers throughout history.

CLASS OBJECTIVE

In this class we will focus on the contemporary building environment, with modern materials, analytical methods and construction techniques at our disposal. We will seek out and study examples of building systems from the 20th and 21st Century where the building form and aesthetic involves, and in many cases is driven by the chosen structural form.

Throughout the four modules, we will critically assess structural forms ranging from fundamental to novel. We will seek to determine the drivers for the selected form, and explore how these forms reflect our collective definition of *structural efficiency*. Through individual and group work, we will establish the behavior of structural forms analytically through first principles and computational analysis.

BREAKDOWN OF MODULES

I. **Principles and Precedents.** Student groups will survey existing structural assemblies and will be assigned one for extensive study throughout the semester. Each group will prepare a presentation introducing that assembly, highlighting in detail its fundamental physical principles and notable precedents in history.

II. **Analysis.** Each group will prepare and carry out a procedure for analyzing and validating the assembly using an existing case study as the analytical context. Students will prepare a presentation on their strategy, the techniques and technologies used, and the results of their analysis.

III. **Construction.** Each group will explore the art of constructing their assembly in the field, noting common virtues and challenges faced. Students will prepare a presentation on these characteristics, noting also issues related to environmental sustainability and physical longevity of the structure over its lifetime.

IV. **Innovation.** Student groups will use the final module to prepare a conceptual design for a system that implements their chosen assembly, which acknowledges the considerations explored throughout the class. Extra credit is awarded to designs that successfully iterate on prior implementation.

GRADING

Students will receive grades based on the quality of their presentations and supplemental deliverables as assigned at the beginning of each module. Presentation and deliverables for each module will carry a 25% weight toward the final grade in the class. An additional 25% will be comprised of class participation and attendance.

SCHEDULE

Students are advised that this schedule will change, and attendance at class is critical to awareness of shifts in deadlines and milestones.

Class	Date	Module	Activity
1	1/20	Introduction	Lecture 1 – Introduction
2	1/27	Principles & Precedents	Lecture 2 – Design, Limit States and Loads
3	2/3		Lecture 3 – Forces, Stresses, Stress/Strain, Basic Materials
4	2/10		Basic Intuition Workshop
5	2/17		Lecture 4 – Systems, Assemblies and Basic Elemental Forms
6	2/24	Analysis	Introduction to GSA
7	3/3		Student Presentations
8	3/10		Student Presentations
9	3/17	Construction	No Class
10	3/24		Lecture 6 - Analysis
11	3/31		Lecture 7 - Construction
12	4/7	Innovation	Lecture 8 – Construction
13	4/14		Lecture 9 – Innovation

14	4/21		Student Presentations
15	4/28		Student Presentations

RESOURCES

TEXT

WEBSITES
Structurae: http://www.structurae.com

Textbooks – Purchasing is optional, most readings will be made available via course website.

Developments in Structural Form | Rowland Mainstone (Columbia Univ. Library) $100.00
Structure & Architecture | Angus J. Macdonald (Columbia Univ. Library) $29.95
Structural Design for Architecture | Angus J. Macdonald (Columbia Univ. Library) $48.95
Structure as Architecture | Andrew Charleson (Columbia Univ. Library) $60.95