Spitzer The Bernard & Anne Spitzer School of Architecture

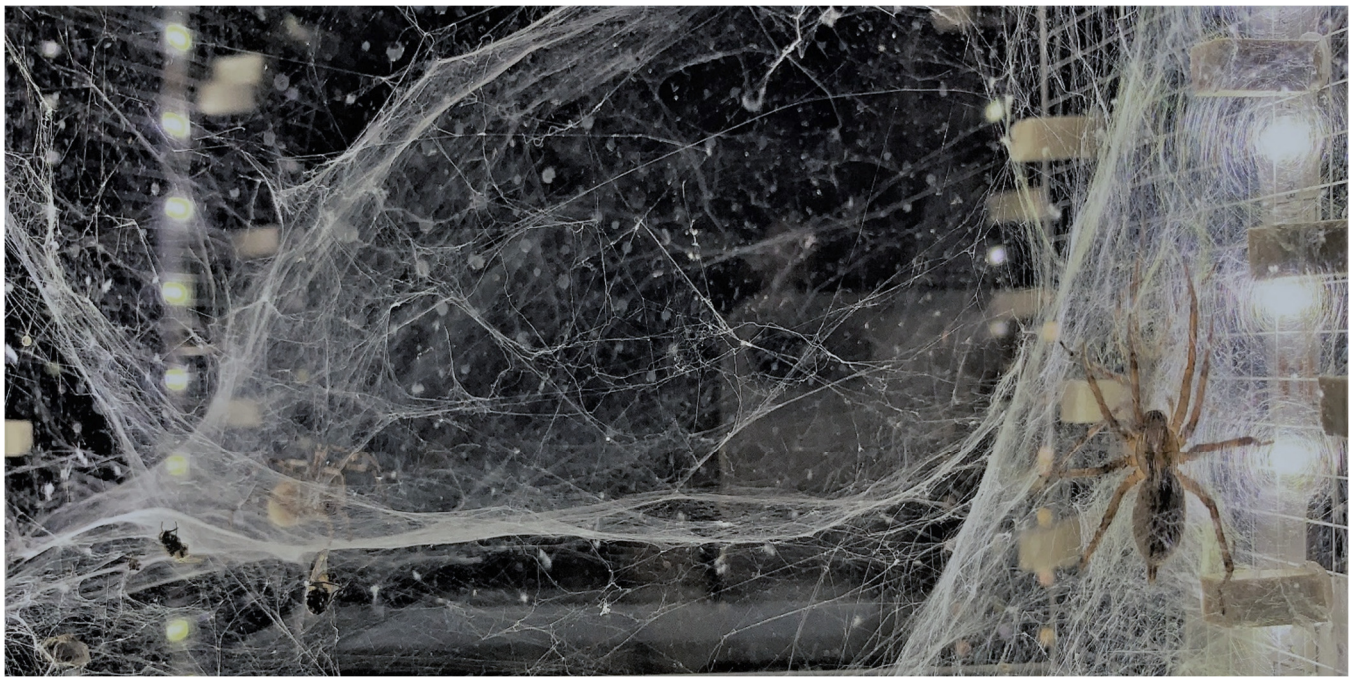
Type of Course:	**Graduate Studio + Research Workshop/Design Seminar**
M.Arch 2nd yr:	ARCH 73100 Architecture Studio III (6 cr) + ARCH 73501 Research Workshop (3 cr)
M.Arch 3rd yr:	ARCH 85100 Advanced Studio (6 cr) + ARCH 85200 Research Workshop (3 cr)
MS Arch:	ARCH 91102/93103 Advanced Studio (6 cr) + ARCH 91202 Design Seminar (3 cr)
Class Meetings:	**Workshop M 9:30-12:20; Studio M/TH 2:00-5:20pm**
Office Hours:	**Aydogan, Thu. 10am-12pm; Katz, Mon. 1pm-2pm**
Instructor:	**Professor Ahu Aydogan / Neil Katz**
Location:	**207**
Semester/Year	**Fall 2024**

GENERAL DESCRIPTION

STUDIO: This advanced studio explores an architectural project through extended design research and in-depth building design propositions. Engaging with a variety of contemporary architectural design topics, students analyze and synthesize human, socio-cultural, contextual, technical, and regulatory forces. Project work includes quantitative investigation of environmental impacts and articulation of mitigation strategies. Independent research methodologies are supported, and student work is expected to achieve the quality of a well-developed architectural design thesis and design proposition.

RESEARCH WORKSHOP: This required seminar course focuses on special topics of study that support and broaden the design studio curriculum. Students co-enroll in this course with their architectural design studio.

Weaving the Double Skin IV



Aydogan Advanced Studio, 2019

Studio Overview:

This studio's goal is to build a shading system for the JTI Headquarters in Genova, Switzerland, using "live" spider's webs as organic elements. To integrate energy-efficient building systems, students will incorporate multidisciplinary knowledge from ecology, science, engineering, and the arts. The studio has a strong emphasis on experimental design, combining cross-disciplinary thinking with environmental analysis to produce modular solutions that improve the building's thermal and visual performance while reducing energy consumption. The project emphasizes nature's role in design, promoting ecological sensitivity and the use of natural materials to improve building performance while reducing environmental impact.

Specific Description:

To create advanced building systems for sustainable settings, it is necessary to apply interdisciplinary knowledge across many scales. We need to broaden our design thinking to include a broad range of disciplines and scales. We believe that the integration of scientific, natural, organic, and artistic values enhances architectural design. Innovative design solutions no longer rely on traditional drawings and patterns. They are holistic approaches that focus on the design process and methodology by analyzing, evaluating, comparing, and proposing alternative solutions to architectural problems.

Science, engineering, and artwork that conceptualizes ecology all impart knowledge that shapes our thinking during the architectural design process. The objective is to creatively apply the design expertise acquired during this semester to our present and future projects. The process of shifting from traditional methodologies to research-based technologies in the fields of science and art can be difficult, but it is not impossible. In order to implement this change, it is necessary to use a multi-scale design thinking approach. We like to challenge the way we observe, the way we think, and the way we solve problems from a cross-disciplinary point of view.

Buildings frequently use artificial shading elements, favoring them over organic alternatives. Using organic materials benefits the environment by reducing the carbon footprint, as they require less energy-intensive methods for extraction, production, and transportation. These materials are biodegradable, help to minimize waste, and lessen the negative effects on landfills. In addition, they improve indoor air quality by preventing the release of toxic compounds commonly found in manufactured materials. **This studio's primary goal is to redirect attention towards the development of a shading system that uses organic components.** Students will guide **"live spiders"** to weave webs that respond to environmental variables, ultimately improving energy efficiency in buildings. The inherent potential of spider webs, frequently overlooked, resides in their multi-layered and transparent composition, providing distinct benefits for both shade and thermal control. This one-of-a-kind technique involves creating a self-contained ecosystem within buildings, including nature.

Research-based technology solutions and their practical application in building integrated applications are the studio's primary focus. Your task within this studio will be to design a shading system that seamlessly integrates into the double-skin façade of the JTI Headquarters, a design by SOM located in Genova, Switzerland. **The design development process will analyze quantitative and qualitative factors such as solar radiation, shading, natural ventilation, lighting, and illumination solutions in the given case study.**

In this studio, students will work in teams (groups of two).

Spider Webs:

"Spiders, we now understand, have given us a model of which the present is a simulacrum, though not just the technocratic, seemingly intangible future-present of life online but also the real-world urgency of environmental relationships and their fragility." (David Toop, Filament Drums: The Endless Instrument, in Cosmic Jive: The spider Sessions, 2014)

Tomas Saraceno, an artist working with large-scale, interactive installations and floating sculptures, made us aware of three-dimensional form geometry of spider webs. His studies have opened our eyes in the direction of comparative studies in mathematics, engineering, arachnology, art and architecture. In this studio, from an architecture point of view, spiders will be used to create webs to form organic shading elements in the double skin façade to save energy by shading the facade. This project is not biomimicry, designing artificial webs by observing spiders, it is making spiders work in the direction of the simulation analysis of the environmental parameters. During the development of the design, quantitative and qualitative solar radiation, shading and natural ventilation, lighting, illumination strategies will be examined through the given case study.

Hybrid Webs: Tomas Saracena

Specific Learning Objectives:

Studio portion:

The learning objectives of this studio course focus on equipping students with the ability to apply architectural research methods to test and evaluate innovative design approaches, while developing processes that shape the built environment. Students will learn to integrate multiple factors, such as user and regulatory requirements, across various scales, ensuring that their designs are both practical and adaptable. Additionally, the course will require them to consider the environmental impacts of their design decisions, integrate multidisciplinary expertise, and develop innovative strategies that surpass conventional techniques. The course also emphasizes the importance of engaging in experimental and simulation-based design processes to refine architectural solutions and foster ecological awareness.

Workshop portion:

The workshops will give students technical information on facade systems, focusing on double-skin facades, including trade-offs and factors involved in a decision to incorporate this type of facade in a building (including performance, climate, cost, etc.); and skills to perform various types of analysis (energy, daylighting), from an understanding of these analyses to knowledge of the tools used. Complementing the expertise of the instructors, we will include guest lecturers and a site visit to a facade fabricator showroom. In addition to learning the analysis software (primarily Climate Studio for Grasshopper) we will also explore techniques to digitally model the spiderwebs so that they can be used in documenting their designs and with the analysis tools.

Research:

In this studio we will seek to navigate between multiple scales and across disciplines to find alternative solutions for the building skin. Material selection, performance, movement, scalability, ease of assembly, and maintenance are the important parameters to start the design with. This design research project's primary goal is to reduce the building's energy consumption by creating shading to minimize solar radiation. When designing this shading, it's crucial to maintain a delicate equilibrium, ensuring the building's occupants' view remains unobstructed. We will explore both quantitative and qualitative analyses during the design process. There will be two types of occupants: office workers and spiders. We will discuss and answer the needs of both users.

Before we start the design process, we will do research on facade issues in "efficient" buildings. We will look at double-skin facades, operable facades, window-wall ratios, glass technologies (such as coatings, frit, R/U values, and electrochromic glass), facade orientation strategies, and building-integrated photovoltaics (BIPV). Overall, the aim of this studio is to design modular vertical solutions and provide several fundamental advantages to the building (energy, thermal benefits, visual quality, etc.). This project will utilize modular systems to shade the building, creating parametric solutions using a double-skin façade. During the development of the design, quantitative and qualitative solar radiation, shading and natural ventilation, lighting, and illumination strategies will be examined through the given case study.

Program and Building:

This studio's program is to design organic shading elements in the double-skin façade. This shading element's design is critical in this studio because it will impact the building's thermal performance. The design process will achieve the optimal solution to the performance problem after several experimental and simulation-based trials.

The case study building for this studio project is JTI Headquarters, a design by SOM located in Geneva, Switzerland. The building is the competition-winning design considered one of the most sustainable in Europe. Given that the project is situated in Switzerland, the energy and building codes (energy efficiency standards, insulation requirements, and materials), together with climate data (temperature and humidity, solar radiation and wind patterns, precipitation, and snow loads), will be thoroughly examined during the studio's design phase.

"The innovative Closed Cavity Facade system (developed for the JTI Headquarters in Geneva, Switzerland) was developed as a unique unitized curtain wall system responding to the requirements of European Energy Directives and the Swiss Minergie sustainability rating. The CCF offers a new approach to the double skin facade system and builds upon SOM's history of developing innovative curtain wall systems and building envelope technologies for decades.

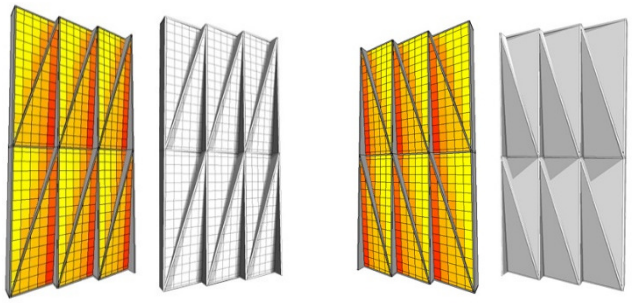
Both European regulations and the Minergie Standard (among the most demanding in Europe) aim to reduce energy demand significantly by introducing criteria for facades of all new buildings.

Working within those requirements, SOM sought to develop a façade system that maintained the visual qualities of an all-glass façade design (panoramic views, abundant daylighting, sky exposure for occupants and refined aesthetics) while responding to the demands of seasonally changing external climatic conditions. The CCF system prioritizes occupant comfort and has developed integral ways to reduce the whole building's energy demand and carbon emissions.

It consists of triple glazing on the inner layer and single glazing on the outer, forming a cavity with a fabric roller blind in between. Rather than ventilating the double skin, the panels are sealed and equipped with a pressurized supply of filtered and dehumidified air in order to avoid condensation and heat build-up inside the cavity. The roller blind assists to achieve the very low G-value as required for Minergie certification.

Together with low-emissivity insulating coatings, it achieves the low U-value ensuring comfort for workspaces located near the glazing. The selection of low-iron glass improves colour rendering and achieves neutral tones of reflection."

All text and image credit to Architizer's Website:
https://architizer.com/projects/closed-cavity-facade/



East façade

Reduction in total incident solar radiation:14 %

West façade

Reduction in total incident solar radiation: 13 %

JTI Headquarters I Genova, Switzerland (Architect: Skidmore, Owings & Merrill (SOM)

Research activities in the studio will investigate the following topics during different phases of design:

Week 1: Introduction
Week 2 - 4: Precedents, Literature Review and Building Analysis
Week 5 - 7: Environmental Analysis and Schematic Design
Week 8 - 11: Design and Experimental Process
Week 12 - 15: Design Development and Performance Analysis

WEEKLY SCHEDULE, M 9:30am-12:20pm, M/TH 2:00-5:20pm

Note: schedule below is subject to revision through the duration of the semester.

W1		Research Workshop (morning)	Studio (afternoons)
Th	08.29		**Convocation @ 2:00pm, Aaron Davis Hall** **Grad Studio Lottery @ 3:00pm, rm. 107 (Spitzer)** Followed by first studio meeting

W2			***Precedents, Literature Review and Building Analysis***
Mon	09.02	College Closed (Labor Day), no classes	
Th	09.05		**Hour SSA/JEDI Climate Survey (in studio) 2-3pm** ***Sketches "Biophilia"***
W3			
Mon	09.09	Workshop: Introduction; facade considerations for "efficient" buildings; iterative modeling, analysis, optimization	Studio
Th	09.12		Studio **Sciame Lecture: Lawrence Vale**
W4			
Mon	09.16	Workshop: a. Lecture by Louis N. Sorkin (AMNH) b. Spiderwebs: exploring their geometry, and strategies for modeling (in Grasshopper)	Studio
Th	09.19		***Studio Presentation:*** ***Precedents, Literature Review and Building Analysis*** **Rudin Lecture: Alan Hantman**
W5			***Environmental Analysis and Schematic Design***
Mon	09.23	Workshop: Environmental analysis overview: discussion of the various types of analysis, and the tools used to perform them	Studio _BISAM façade showroom site visit
Th	09.26		Studio **Sciame Lecture: Maria Carrizosa**
W6			
Mon	09.30	Workshop: Using Climate Studio (part 1)	Studio
Th	10.03		No Classes
W7			
Mon	10.07	Workshop Using Climate Studio (part 2)	Studio
Th	10.10		***Studio Presentation:*** Schematic design and thermal and daylight analysis **Sciame Lecture: Jon Michael Schwarting & Frances Campani**
W8			***Design Evaluation and Experimental Process***
Mon	10.14	College Closed (Columbus/Indigenous Peoples' Day), no classes	
Tu	10.15	Workshop (classes for a Monday schedule): Daylighting analysis	Studio
Th	10.17		Studio **Sciame Lecture: Anna Pashynska & Tania Pashynska**
W9			
Mon	10.21	Workshop: Modeling in Grasshopper (part 1)	Studio

Th	10.24		Studio
W10			
Mon	10.28	Workshop: Additional environmental strategies for facades, both static and dynamic	Studio
Th	10.31		**Mid-semester assessments**
W11			
Mon	11.04	Workshop Modeling in Grasshopper (part 2), focusing on modeling the spiderwebs	Studio
Th	11.07		***Studio- Midterm Review***
W12			***Design Development and Performance Analysis***
Mon	11.11	Workshop: Comparative analysis (with and without interventions – how effective are the spiderwebs?	**Grad Sharing Session** Studio
Th	11.14		Studio
W13			
Mon	11.18	Workshop: Guest review, focusing on analysis	Studio
Th	11.21		Studio
W14			
Mon	11.25	Workshop Panel discussion / presentation	Studio
Th	11.28		College Closed (Thanksgiving), no classes
W15			
Mon	12.02	Workshop Wrapping up; presenting the analysis	Studio
Th	12.05		Studio

FINAL REVIEWS, Dec 9-13

Mon 9 Dec	Tues 10 Dec	Wed 11 Dec	Th 12 Dec	Fri 13 Dec
Foundation	**Foundation**	**Grad Studios**	**Grad Studios**	**Grad Studios**
Kirsimagi King	Kim	Salcedo Aydogan	Kuehl Ebo	Haferd Zhang

Mon/Tu 12.16 + 17 Clean-up Days (all materials, projects, and any other items must be removed from studio)
Tu 12.17 End of Semester Assessment (faculty only)

FINALS

Tu 12.17 Student Portfolios due for: SSA/CCNY Archive, etc. as directed by instructor
Fr 12.27 Final Grade Submission Deadline

GRADING/ATTENDANCE POLICIES AND STUDIO CULTURE

Learning Outcomes:

- To apply architecture research methods for testing and evaluating innovative approaches to design. (NAAB PC.5)

- To devise and develop a process for shaping the built environment through design. (NAAB PC.2)
- To successfully identify and integrate multiple factors into a design process, working in at least two scales. (NAAB PC.2)
- To demonstrate the ability to understand and synthesize user requirements, regulatory requirements, site conditions, and accessible design into a design project. (NAAB SC.5)
- To demonstrate the ability to consider the measurable environmental impacts of design decisions. (NAAB SC.5)
- To integrate multidisciplinary expertise and develop innovative design thinking by creating a comprehensive design strategy that surpasses conventional techniques.
- To engage in experimental and simulation-based design processes to develop and refine architecture solutions and cultivate ecological awareness.

Course Expectations:

- That students will develop a high level of independent thought and rigor and a willingness to go beyond both basic project requirements and their own perceived limits and abilities.
- That students will successfully complete all project requirements. No make-up or postponed project submissions will be accepted except in the case of medical emergencies or other extraordinary circumstances. Excused absences and project delays must be officially cleared by professor in advance to be considered valid.

Community Agreement:

- As noted on the schedule, the professor will make time for an *Hour SSA* session for a supportive open discussion among students.
- Studio members will work *together* to create a community agreement for interacting together over the semester. Definition: "A consensus on what every person in our group needs from each other and commits to each other in order to feel safe, supported, open, productive and trusting… so that we can do our best work." https://www.nationalequityproject.org/tools/developing-community-agreements
- *Hour SSA* will be repeated at the middle of the semester.

Methods of Assessment:

- **Studio performance & work habits:** Ability to respond to studio discourse & feedback in a consistent & clear manner throughout the semester as demonstrated in the evolution and development of design work.
- **Clarity of representation & mastery of media:** Ability to utilize both digital and manual drawing and model-making techniques to precisely and creatively represent architectural ideas.
- **Pre-design:** Ability to develop a comprehensive design strategy for an architectural project focused on integrating organic shading elements, such as spider webs, into building façades. This includes assessing environmental and site-specific conditions, analyzing user needs, and reviewing relevant building codes, sustainability standards, and their implications for the project. The strategy will also involve setting criteria for site selection and design assessment, particularly emphasizing the innovative use of natural materials and processes to enhance building performance and sustainability.
- **Research:** Understand and apply both theoretical and practical research methodologies to explore and innovate within the design process, particularly in developing sustainable and nature-integrated architectural solutions.
- **Integrated evaluations and decision-making design process:** Ability to demonstrate the skills associated with making integrated decisions across multiple systems and variables in the completion of a design project. This demonstration includes problem identification, setting evaluative criteria, analyzing solutions, and predicting the effectiveness of implementation.
- **Attendance**: Consistent level of preparation and on-time presence for each studio class and scheduled evening lectures.
- **Portfolio**: Completion of final portfolio or collection of studio work as directed by instructor and/or coordinator and attendance at all scheduled portfolio related events.

Grading Assessment:

- **Final Grade**: The final grade is determined based on the cumulative assessment of all assignments, projects, and participation, according to the weighted criteria outlined at the beginning of the course.
- **Attendance**: Consistent level of preparation and on-time presence for each studio class and scheduled evening lectures.

- **Portfolio**: Completion of final portfolio or collection of studio work as directed by instructor and attendance at all scheduled portfolio related events.

Studio:

Project Development in Response to Semester Schedule	55%
Project Presentations	30%
Participation & Attendance	10%
Documentation - completion & submission	5%

Research Workshop/Design Seminar:

Research documentation on Facade Systems	15%
Rhino/Grasshopper - modeling (facade, spiderwebs)	25%
Rhino/Grasshopper - analysis (solar energy, daylighting)	25%
Attendance & Participation	10%
Application & Documentation	25%

A (+/-) Work meets all requirements and exceeds them. Presentations are virtually flawless, complete, and finely detailed. Work exhibits professional, "museum quality" level of craft. Student has developed an individual design process that shows a high level of independent thought and rigor. Work shows evidence of intense ambition and effort to go beyond expectations, and beyond the student's own perceived limits of their abilities.

B (+/-) Work meets all requirements. Presentations are complete and finely detailed. Work exhibits professional level of craft. Student has developed an individual design process that shows a high level of independent thought and rigor.

C (+) Work meets minimum requirements. Deadlines are missed. While presentations may be somewhat complete, student has struggled to develop an individual design process and/or is lacking in craft or design resolution.

F Work is below minimum requirements. Student does not develop adequate design process, and/or does not finish work.

INC Grades of "incomplete" are not given under any circumstances unless there is evidence of a medical or personal emergency. In such cases, instructor and student develop a contract to complete work by a specified date, as per CCNY policy. Classes and/or work missed due to illness must be explained with a physician's note.

Notes:
C is the lowest passing grade for M. Arch I and M.S. Arch students. No C- or D grades may be given to graduate students.
Working in teams does not guarantee the same grade for each team member; grades are based on a range of criteria for each individual student.

For more information on grading guidelines and other CCNY policies and procedures, consult the current CCNY academic bulletins: https://www.ccny.cuny.edu/registrar/bulletins

Office Hours:
Each studio/unit faculty member schedules regular office hours over the semester, as posted at the top of the syllabus. If a student needs to speak in private with a studio/unit critic, they should ask or email in advance to request a specific meeting time. Students may seek office hour appointments to discuss any matters of concern including personal, private matters and general inquiries about course related work, grading, assessment and

content.

Probation & Dismissal: for program specific information related to grades, academic standing, probation and dismissal, please see your program academic advisor:
Graduate: Hannah Borgeson hborgeson@ccny.cuny.edu

Studio Culture:
Working collaboratively and respectfully on studio assignments, with and alongside others, is an expectation in studio. Studio culture is an important part of an architectural education, and it extends to expectations for Faculty and the School's Administration as well. Please see the Spitzer School of Architecture Learning, Teaching, and School Culture Guidelines, which can be accessed on the SSA website here: https://ssa.ccny.cuny.edu/about/policies/.

Absence & Lateness:
Arriving more than ten minutes late to class will constitute an absence. Two unexcused absences will result in a whole letter grade deduction from a final grade; more than four will result in a failing grade. It is expected that all students will participate in all scheduled working, midterm and final reviews and contribute constructively to the discussions.

Absences due to Religious Observances:
Students who will miss any class sessions, exams, presentations, trips, or the like due to a religious observance should notify the instructor at the beginning of the semester so that appropriate adjustments for observance needs can be implemented. This could include an opportunity to make up any examination, study, or work requirement that is missed because of an absence due to a religious observance on any particular day or days.

Readings & Journals:
Students are expected to keep a journal or sketchbook throughout the duration of studio to document their thought process & take notes of any texts, books, terms or references that are mentioned by either the studio critic or fellow classmates and to selectively follow up on these and any other assigned readings before the next class.

Academic Integrity:
As a student you are expected to conduct yourself in a manner that reflects the ethical ideas of the profession of architecture. Any act of academic dishonesty not only raises questions about an individual's fitness to practice architecture, but also demeans the academic environment in which it occurred. Giving or receiving aid in examinations, and plagiarism are a violation of an assumed trust between the school and the student.

Plagiarism, i.e. the presentation as one's own work of words, drawings, ideas and opinions of someone else, is as serious an instance of academic dishonesty in this context as cheating on examinations. The submission of any piece of work (written, drawn, built, or photocopied) is assumed by the school to guarantee that the thoughts and expressions in it are literally the student's own, executed by the student. All assignments must be the student's original work. Any copying, even short excerpts, from another book, article, or Internet source, published or unpublished, without proper attribution will result in automatic failure of the entire course.

The CCNY Academic Integrity Policy: https://www.ccny.cuny.edu/about/integrity

For citations, the Chicago Manual of Style is recommended:
http://www.chicagomanualofstyle.org/tools_citationguide.html

AccessAbility Center (Student Disability Services):
The AccessAbility center (AAC) facilitates equal access and coordinates reasonable accommodations, academic adjustments, and support services for City College students with disabilities while preserving the integrity of academic standards. Students who have self-identified with AAC to receive accommodations should inform the instructor at the beginning of the semester. (North Academic Center 1/218; 212-650-5913 or 212-650-6910 for TTY/TTD). For further information, go to http://www.ccny.cuny.edu/accessability/ or email disabilityservices@ccny.cuny.edu

Health And Wellness Support:
City College's Office of Health and Wellness Services offers free and confidential counseling. Contact: Health and

Wellness Services, Marshak Science Building, room J-15: counseling@ccny.cuny.edu.

Gender Based Violence Resources
City College has resources to support you if you have experienced sexual violence, intimate partner/domestic violence, gender-based discrimination, harassment or stalking. For confidential support, you can contact the Student Psychological Counselor: Confidential Advocate at (212) 650-8905 or the Gender Resources Program at (212) 650-8222. If you would like to report sexual misconduct, you can contact the Chief Diversity Officer and Title IX Coordinator, Diana Cuozzo, at 212-650- 7330 or dcuozzo@ccny.cuny.edu. If there is an emergency on campus, you can call Public Safety at 212-650-777 and off campus call 911. Https://www.ccny.cuny.edu/affirmativeaction

Library:
The school's library is a shared resource that is necessary supplement to all research and design work. Please direct questions to the library staff or the Architecture Librarian Nilda Sanchez-Rodriguez: nsanchez@ccny.cuny.edu

NAAB (National Architectural Accrediting Board)
The National Architectural Accrediting Board (NAAB) is the sole agency authorized to accredit US professional degree programs in architecture. Since most state registration boards in the United States require any applicant for licensure to have graduated from a NAAB-accredited program, obtaining such a degree is an essential aspect of preparing for the professional practice of architecture. While graduation from a NAAB-accredited program does not assure registration, the accrediting process is intended to verify that each accredited program substantially meets those standards that, as a whole, comprise an appropriate education for an architect.

More specifically, the NAAB requires an accredited program to produce graduates who: are competent in a range of intellectual, spatial, technical, and interpersonal skills; understand the historical, socio-cultural, and environmental context of architecture; are able to solve architectural design problems, including the integration of technical systems and health and safety requirements; and comprehend architects' roles and responsibilities in society.

Students should consult the NAAB website www.naab.org for additional information regarding student performance criteria and all other conditions for accreditation.

NAAB CRITERIA ADDRESSED (2020 Conditions for Accreditation)

PC.2 Design—how the program instills in students the role of the design process in shaping the built environment and conveys the methods by which design processes integrate multiple factors, in different settings and scales of development, from buildings to cities.

PC.5 Research & Innovation—How the program prepares students to engage and participate in architectural research to test and evaluate innovations in the field.

SC.5 Design Synthesis—how the program ensures that students develop the ability to make design decisions within architectural projects while demonstrating synthesis of user requirements, regulatory requirements, site conditions, and accessible design, and consideration of the measurable environmental impacts of their design decisions.

CONTACT INFORMATION:

Ahu Aydogan, PhD
aaydogan@ccny.cuny.edu

Neil Katz, FAIA
nkatz@ccny.cuny.edu