ARCH 2431 BUILDING TECHNOLOGY III
1 lecture hours and 6 lab/studio hours, 4 credits

Course Description: Course focus is on steel construction. This course studies the development of building systems as they occur during the design development phase of architecture. The focus will be on steel construction. Using case study research methods, students analyze factors, such as building assemblies and systems, codes and government regulations, human ergonomics, and sustainability, which affect building construction and use. Their solutions to these issues are integrated into their final building design solutions. Students create a series of reports and a set of construction drawings using both analog methods (hand sketching and drawing) and digital tools including traditional CAD software and Building Information Modeling techniques.

Course context: This is the third in the required sequence of four building technology courses.

Prerequisites: ARCH 2331: Building Technology II with a grade of C or higher. Math 1275.

Required Texts:
Allen, Edward and Joseph Iano. *Fundamentals of Building Construction: Materials and Methods*. John Wiley and Sons, 2014.
Ching, Francis. *Building Construction Illustrated*. John Wiley and Sons, 2014.

Recommended Text:
American Institute of Architects and Keith E. Hedges. *Architectural Graphic Standards: Student Edition, 12th Ed*. John Wiley and Sons, 2017.
Lance Kirby, Eddy Krygiel, and Marcus Kim. *Mastering Autodesk Revit 2018*. John Wiley and Sons, 2017.
Edward Allen and Joseph Iano. *The Architect's Studio Companion: Rules of Thumb for Preliminary Design*, *6th Ed*. John Wiley and Sons, 2017.

Attendance Policy: No more than 10% absences are permitted during the semester. For the purposes of record, two late arrivals are considered as one absence. Exceeding this limit will expose the student to failing at the discretion of the instructor due to lack of class participation and mastery of class material.

Academic Integrity: Students and all others who work with information, ideas, texts, images, music, inventions and other intellectual property owe their audience and sources accuracy and honesty in using, crediting and citation of sources. As a community of intellectual and professional workers, the college recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and is punishable by penalties, including failing grades, suspension and expulsion.

Suggested Text: Texts will be assigned according to the subject covered that day.

Course Structure: Lectures and lab work. Assignments include a series of reports, class presentations, class notes, and a set of construction drawings. Digital tools learned in prior building technology courses are reinforced.

Grading:	40%	Case Study & Comprehensive Drawing Set (cumulative grade of multiple presentations)
	15%	Student Notes & Field Trip Assignments (#1-7)
	10%	Studio Lab Assignments (# 1-9)
	15%	Drawing Studies & Research Assignments (#1-3)
	20%	(5) 3D Digital Models of Building Assemblies

General Education Learning Outcomes / Assessment Methods	
Learning Outcomes	**Assessment Methods**
Upon successful completion of this course the student shall be able to:	To evaluate the students' achievement of the learning objectives, the professor will do the following:
1. **Knowledge** Develop **knowledge** from a range of disciplinary perspectives, and develop the ability to deepen and continue learning. Depth of Knowledge Engage in an in--depth, focused, and sustained program of study. Pursue disciplined, Inquiry--based learning in the major.	1. **Review** students' research projects, notes, assignments, and final drawing sets and **assess** for a development of knowledge about materials and assemblies.
2. **Skills** Acquire and use the **tools** needed for communication, inquiry, analysis, and productive work Inquiry/ Analysis Derive meaning from experience, as well as gather information from observation. Understand and employ both quantitative and qualitative analysis to describe and solve problems, both independently and cooperatively. Employ scientific reasoning and logical thinking. Use creativity to solve problems.	2. **Assess** for how the student interprets the results of their research investigations and energy analyses into the development of their projects and as demonstrated by their final drawing sets.
3. **Integration** Work productively across disciplines. Integrate Learning Resolve difficult issues creatively by employing multiple systems and tools. Make meaningful and multiple connections among the liberal arts and between the liberal arts and the areas of study leading to a major or profession.	**3.** **Review** students' research projects, assignments, and final projects and **assess** for how the student interprets and applies their investigations into the development of their projects and as demonstrated by their final drawing sets.
4. **Values, Ethics and Relationships** Understand and apply values, ethics, and diverse perspectives in personal, professional, civic, and cultural/global domains. Professional/ Personal Development Demonstrate Intellectual honesty and personal responsibility. Discern consequences of decisions and actions Demonstrate intellectual agility and the ability to manage change. Work with teams, including those of diverse composition. Build consensus. Respect and use creativity.	4. **Review** students' ability to execute work through a collaborative process by working in teams for a semester long project and **assess** for an ability to consider and respect the viewpoints of others, evaluate options, and build consensus.

National Architectural Accrediting Board (NAAB) Students Performance Criteria (SPC)/ Assessment Methods	
Learning Outcomes	**Assessment Methods**
Upon successful completion of this course the student shall be able to: (Realm. Number) title [depth]	To evaluate the students' achievement of the learning objectives, the professor will do the following:
1. (B.3) Codes and Regulations [reinforced] ABILITY to design sites, facilities and systems consistent with the principles of life-safety standards, accessibility standards, and other codes and regulations.	1. **Review** students' final projects and notes and **assess** for a basic understanding of life-safety standards, accessibility standards, and local codes and regulations, and the **ability** to apply them to an architectural project.
2. **(B.4) Technical Documentation** [reinforced] ABILITY to make technically clear drawings, prepare outline specifications, and construct models illustrating and identifying the assembly of materials, systems, and components appropriate for a building design.	2. **Review** students' final drawings sets, outline specifications, and digital models, and **assess** for an understanding how materials, systems, and components are assembled into a building design, and the **ability** to produce a set of technically clear drawings that demonstrates how these elements are integrated into an architectural project.
3. (B.5) Structural Systems [reinforced] ABILITY to demonstrate the basic principles of structural systems and their ability to withstand gravity, seismic, and lateral forces, as well as the selection and application of the appropriate structural system.	3. **Review** students' final projects and notes and **assess** for the ability to demonstrate the basic principles of concrete structural systems and the **ability** to integrate a system into the development of an architectural project.
4. (B.7) Building Envelope Systems and Assemblies [reinforced] UNDERSTANDING of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources.	4. **Review** students' final projects and cladding research assignment and **assess** for an understanding of the basic principles involved in the appropriate selection and application of a building envelope system relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources.
5. **(B.8) Building Materials and Assembly** [reinforced] UNDERSTANDING of the basic principles utilized in the appropriate selection of interior and exterior construction materials, finishes, products, components and assemblies based on their inherent performance including environmental impact and reuse.	5. **Review** students' final drawings sets, outline specifications, notes, and research assignments, and **assess** for an **understanding** of the basic principles utilized in the appropriate selection of interior and exterior construction materials, finishes, products, components and assemblies based on their inherent performance including environmental impact and reuse.
6. (B.10) Financial Considerations [reinforced] UNDERSTANDING of the fundamentals of building costs, which must include project financing methods and feasibility, construction cost estimating, construction scheduling, operational costs, and life-cycle costs.	**6.** **Review** students' notes and **assess** for an **understanding** of construction cost estimating.

Course Specific Learning Outcomes / Assessment Methods	
Learning Outcomes	**Assessment Methods**
Upon successful completion of this course the student shall be able to:	To evaluate the students' achievement of the learning objectives, the professor will do the following:
1. **Understand** the process and requirements of developing a design from a schematic concept into design development drawings. (Knowledge)	1. **Review** students' process through individual desk critiques and frequent pin-ups and **assess** their final drawing sets.
2. **Generate** clear and concise talking points to guide oral presentations of research assignments. (Gen Ed)	2. **Review** students' presentations and **assess** for an ability to generate clear and concise talking points.
3. **Understand** the advantages and limitations of BIM (building information modeling) as a tool for design development and project delivery. (Skill)	3. **Review** students' process and final digital models and drawings sets and **assess** for an ability to use BIM as a tool for design development and project delivery.
4. **Sketch** and **draft** details in orthographic and 3-D views in analogue and digital media. (Skill)	4. **Review** students' process and detail drawings in final drawing sets and **assess** for the ability to produce both 3D and 2D detail drawings.
5. **Apply** knowledge of professional construction drawing standards for page composition, title blocks, annotation, and schedules. (Skill)	**5. Review** students' final drawing sets and **assess** for the appropriate use of standard architectural drawing conventions.
6. **Develop** a professional quality coordinated, edited, and organized set of design development documents for a given building design using BIM. (Skill)	**6. Review** students' final drawing sets and **assess** for the appropriate the content, coordination, and organization for a design development set of drawings.

- **Reading and quizzes:**
  Reading assignments will be given each week with short spot quizzes scheduled during the first 10 minutes of each class. Quizzes will start and end promptly and cannot be made up is missed.
- **Class and submittals list:**
  A complete submittals list will be provided for the semester long case study project.
- **Assignments:**
  Detailed assignments sheets and grading policy will be provided.

Weekly Course Outline:

WEEK 1	**Day 01.**	**Course Introduction**
	Activity 1	Learn to Read Drawings: In class observation discussion, review of isometric building sections showing the assembly of buildings. What do you see?
	Activity 2	Case Study Project: Introduction to semester long project, deadlines and responsibilities.
	Activity 3	Introduction to Revit: Introduction to the Revit user interface, Building Information Modeling, project files and families. Review the scavenger hunt project file.
	Assignment 1.1	Case Study Boards: Identify three potential case study subjects, format each on an 11 x 17 sheet landscape format and pinup at start of next class
	Assignment 2.1	Scavenger Hunt: Goal is to understand and describe assembly. Find three stories. Layout three sheets. Work in multiple coordinated views showing plan, elevations, section and isometric.

	Day 02	**Scavenger Hunt & Case Study Pinup**
	Activity 1	Case Study Board Pinup: Review and discuss case study projects. Select projects and setup teams. Review first research assignment.
	Activity 2	Scavenger Hunt: Continue to review Revit. What makes a good story? Discuss inquiry methods – how is the building assembled? How to layout a sheet. Adding annotation and dimensions. Naming sheets. Red mark session.
	Assignment 1.2	Case Study Research Presentation: Teams to visit case study buildings before next class. Presentation of photographs and research presentation showing additional information about building. Presentation in PowerPoint.
	Assignment 2.2	Scavenger Hunt: Final presentation for scavenger hunt due next class.
WEEK 2	**Day 03**	**Scavenger Hunt & Case Study Review**
	Activity 1	Scavenger Hunt Final Pinup: Final Pinup. In class student / professor grading.
	Activity 2	Case Study Review: Team PowerPoint presentations.
	Activity 3	Introduction to 3D Revit Families: Creating parametric 3d Revit families and assembling these in a project file. In class creation of a steel column and a steel beam and assemble in position as start of connections assignment.
	Assignment 3.1	Steel Connections: Based on Building Construction Illustrated: 3rd Edition: 7.24 Goal is to recreate the page including all steel pieces, assemble in place, add annotation and dimensions and present on titleblocks. Focus of each detail study is to include multiple coordinated views (plan, elevations and section) First sheet with overall composition due for next class. ½" or ¾" scale.
	Day 04	**Steel Connections: Overall Studies**
	Activity 1	A steel building from the ground up: Lecture/discussion on construction of steel frame buildings (foundations, columns and beams, floor systems, roof systems, exterior wall systems. Review photos of construction.
	Activity 2	Continue 3D Revit Families: Build 3D families. Assemble project files. Create callout views at 1 ½" and 3" = 1'-0". Layout detail studies on titleblocks.
	Assignment 3.2	Steel Connections: Develop first sheets. 1 full composition.
WEEK 3	**Day 05**	**Steel Connections: Detail Studies**
	Activity 1	Connections Pinup #1: In class pinup, review and discussion.
	Activity 2	Steel Connections: Lecture/discussion – a closer look at steel assembly.
	Activity 3	Continue 3D Revit Families: Build 3D families. Assemble project files. Create callout views at 1 ½" and 3" = 1'-0". Layout detail studies on titleblocks.
	Assignment 3.3	Steel Connections: Develop first sheets. 1 full composition.
	Day 06	**Steel Connections: Detail Studies**
	Activity 1	Connections Pinup #1: In class pinup, review and discussion.
	Activity 2	Steel Connections: Lecture/discussion – a closer look at steel assembly.
	Activity 3	Continue 3D Revit Families: Build 3D families. Assemble project files. Create callout views at 1 ½" and 3" = 1'-0". Layout detail studies on titleblocks.
	Assignment 3.4	Steel Connections: Develop 4 sheets. 1 full composition and 3 detail sheets.

WEEK 4	**Day 07**	**Steel Connections: Detail Studies**
	Activity 1	Connections Pinup #2: In class pinup, review and discussion. In class grading.
	Activity 2	Steel Connections: Lecture/discussion – a closer look at steel assembly.
	Activity 3	Continue 3D Revit Families: Build 3D families. Assemble project files. Create callout views at 1 ½" and 3" = 1'-0". Layout detail studies on titleblocks.
	Assignment 3.5	Steel Connections: Final study due in two classes.
	Assignment 1.3	Case Study Development: All students must be prepared to begin drawing their case study buildings during next class. Teams/individuals must know plan dimensions, location of structure, and floor to floors spacing.
	Day 08	**Case Study Development- Structural layout**
	Activity 1	Start Case Study Project File: Create individual case study project files. Create grids and levels, select titleblock size and layout sheets.
	Activity 2	Discussion of case studies: Map out case study goals & focus, set deadlines, define research, assign team responsibilities. Review required drawings list and presentation requirements and schedule of graded deadlines.
	Assignment 4.1	Field Trip: Meet at Home Depot – next class.
WEEK 5	**Day 09**	**Field Trip #1**
	Activity 1	Observe and learn
	Assignment 4.2	Visual Vocabulary: Select three items from the field trip tour and research their use and purpose. What are they for? How are they assembled? What other pieces do they work with? Combine your photographs with your research to create a visual vocabulary / specification.
	Day 10	**Field Trip #1 Presentations & Intro to Steel Façade Systems**
	Activity 1	Visual Vocabulary Presentations
	Activity 2	Façade Modeling Assignment: Steel Facades Systems: Lecture discussion of façade systems. Begin to develop 3D families to model precast concrete facades and develop 3D families to study connections to a steel frame building.
	Assignment 5.1	Metal Panel & Rain Screen Façade Systems: Working with a façade develop a steel panel layout. Develop 3D families for precast panels and steel connections needed to connect / support panel to a steel frame structure. Layout sheets. Begin research.
WEEK 6	**Day 11**	**Metal Panel & Rain Screen Façade Systems**
	Activity 1	Metal Panel Façade Systems: Review of metal panel façade construction methods. Students must be prepared to discuss their research on steel panel systems and identify manufacturers. Continue to layout façade panels and develop wall sections – layout on sheets. Review of detail items and development of custom Revit families.
	Assignment 5.2	Metal Panel & Rain Screen Façade Systems: Continue to develop 3D families. Identify all necessary detail views in plan (inside/outside corners, typical panel joint, and windows) and section. Layout Sheets.
	Day 12	**Metal Panel Façade Systems**
	Activity 1	Façade Modeling Assignment: Continue to develop steel panel systems.
	Assignment 5.3	Metal Panel Façade Systems: Complete Steel Panel Studies. Presentations and drawings are due in two weeks along with window system studies.

WEEK 7	**Day 13**	**Window Systems**
	Activity 1	Window Systems: Lecture/ discussion of windows systems and window details
	Activity 2	Family Development: Working with existing window families. Developing your own 3D window families. Layout on detail sheets. Window schedules.
	Assignment 6.1	Window Systems: Complete layout of window studies on titleblocks. Begin to add annotation and dimensions. Conduct research into window manufacturers and locate details.
	Day 14	**Window Systems**
	Activity 1	Window Systems: Continue to develop window details. Develop layouts to include 3D isometrics, section and plan details. Add annotation and dimensions.
	Assignment 6.2	Window Systems: Final presentation of window system studies are due in two classes along with steel panel systems.
	Assignment 1.4	Mid-Semester Case Study Review next session
WEEK 08	**Day 15**	**Mid-Semester Presentations & Pinup**
	Activity 1	Pinup and Review of Team Case Studies and Individual Drawings.
	Day 16	**Field Trip #2**
	Activity 1	Observe and learn: Walking tour of buildings under construction
	Assignment 7.1	Document three assemblies through photographs, sketches and annotations to describe the assembly of some building components observed during the field trip. Documentation should be supplemented by research – site all sources.
WEEK 9	**Day 17**	**Field Trip #2 Presentation – Metal Panel and Window Study Pinup**
	Activity 1:	Field Trip Observation Presentations
	Activity 2:	Metal Panel & Window Study Pinup Presentation
	Assignment 8.1	Read about Curtain Wall: Building Construction Illustrated: 3rd Edition: 8.30-8.33
	Day 18	**Glazed Curtain Wall Systems**
	Activity 1	Glazed Curtain Wall Systems: Lecture/ discussion including Stick System, Unit System, Unit and Mullion System, Column Cover and Spandrel Systems
	Activity 2	Glazed Curtain Wall Systems: Using curtain wall tools in Revit. Developing your own 3D window families. Creating walls, adding grids, mullions and panels.
	Activity 3	Family Development: Use both existing curtain wall tools and your own 3D window families to create details. Layout on detail sheets. Window schedules.
	Assignment 8.2	Glazed Curtain Walls: Based on Building Construction Illustrated: 3rd Edition: 8.31 Goal is to recreate the page showing glazed curtain wall systems including Stick System, Unit System, Unit and Mullion System, Column Cover and Spandrel Systems. Each detail study is to include multiple coordinated views (plan, elevations and section) First sheet with overall composition due for next class. ½" or ¾" scale. Final drawings will include annotation and dimensions. Complete thorough research of one of the systems, locate manufacturers' details.
WEEK 10	**Day 19**	**Glazed Curtain Wall Systems**
	Activity 1	Glazed Curtain Wall Systems: Continue to develop details. Develop layouts to include 3D isometrics, section and plan details. Add annotation and dimensions.
	Assignment 8.3	Glazed Curtain Walls: Focus on one of the sub-types and develop detailed drawings at 1 ½". Coordinated Isometrics, plans, elevations and sections.

	Day 20	**Glazed Curtain Wall Systems**
	Activity 1	Glazed Curtain Wall Systems: Pinup and discussion. Continue development of drawings. Review of research.
	Assignment 8.4	Glazed Curtain Walls: Continue development. Add detail items, annotation and dimensions.
WEEK 11	**Day 21.**	**Glazed Curtain Wall Systems Pinup & Review**
	Activity 1:	Glazed Curtain Wall Systems: Final Pinup and discussion.
	Assignment 9.1	Reading on stairs and codes for egress and occupancy
	Day 22	**Stair Systems**
	Activity 1	Stair Studies: Using case study subject develop both monumental and fire stairs.
	Assignment 9.2	Integrate stairs into case study drawings. Develop Stair Detail Sheets
WEEK 12	**Day 23**	**Stair Systems**
	Activity 1	Stair Studies & Egress: Pinup Review. Continue development.
	Assignment 9.3	Stair Studies: Due for final review next class
	Day 24	**Stair Systems Pinup and Review**
	Activity 1	Stair Studies: Pinup and grading
	Assignment 10.1	Reading on roof systems
WEEK 13	**Day 25**	**Foundation & Roof Systems**
	Activity 1	Foundation & Roof Systems: Lecture/ discussion.
	Activity 2	Develop roof plan for case study project. Integrate roof details into wall sections.
	Assignment 10.2	Develop Roof Drawings: Pinup for discussion next class
	Day 26 Foundation & Roof Systems	
	Activity 1	Foundation & Roof Systems: Continue to develop foundation and roof systems
WEEK 14	**Day 27**	**Working Session for Case Study Presentations**
	Activity 1	Continued development case study drawing set including floor plans and reflected ceiling plans, et al.
	Day 28	**Working Session for Case Study Presentations**
	Activity 1	Continued development case study drawing set including floor plans and reflected ceiling plans, et al.
WEEK 15	**Day 29.**	**Final Presentations & Pinup**
	Activity 1	Team / Individual PowerPoint Case Study Presentations
	Assignment 1.5	Final Drawing Sets Due for Class 30
	Day 30.	**Final Presentations & Pinup**
	Activity 1	Team / Individual Pinup

Course Structure:

Course format will include a combination of any of the following activities:

- **Field Trips / High Impact Learning Practices:**
  Field trips will look to visit existing buildings, similar to the typologies being studied, and the site of projects led by either the instructor or on-site experts in the field or the subject.

- **Lectures:**
  Lectures will be given by a qualified instructor and if warranted invited guest lecturers or experts in the field or subject.

- **Activities:**
  Students will participate in activities that provide them with the opportunity to apply what is learned in a given subject.
- **Research Activities:**
  Students will be given directed research assignments and be required to integrate their investigations into their projects.

- **Presentations:**
  Students will participate in written, oral and graphic presentations of the course subjects both to their peers and to outside guest critics.