

# USC Viterbi

School of Engineering  
*Sonny Astani Department  
of Civil and Environmental  
Engineering*

## **CE 461 – Construction Estimating**

**Units: 4**

**Term: Spring 2024**

**Class Time: Tuesday 5:00 PM - 8:50 PM**

**Location:** DMC 157

**Instructor: Navneet Agrawal**

**Office Hours:** By appointment

**Contact Info:**

Email: [navneeta@usc.edu](mailto:navneeta@usc.edu)

Phone: 213.593.0376

Note: For focused attention, we can meet at my office at  
811 Wilshire Boulevard Ste 1500, Los Angeles 90017  
Or a Zoom meeting with prior appointment.

**Teaching Assistant:** N/A

**Office:**

**Office Hours:**

**Contact Info:**

## Course Description

This course provides the student with knowledge of the fundamental principles and practices of advanced building cost estimating using drawings, models, and industry standard databases.

Building cost estimating is a critical skillset for Construction Managers. The methods and principals used to predict cost today form the foundation of the techniques envisioned in the future. This course is for the student who is interested in learning how to use advanced techniques in building cost estimating using a “model-based workflow” and pricing from common industry commercial database sources. Upon its completion the student will have a good working knowledge of how to develop quantities for estimation using 2D drawings and 3D models, be able to search databases, find the appropriate unit price and extended it to from a system estimate. Finally, the student will learn how to combine the system estimates into a project level estimate and then how to apply General Conditions, Fees and Mark Ups to form a complete Project Estimate.

### Learning Objectives and Outcomes

#### General

- Plan Reading and project drawing layout.
- An understanding of Building Systems and Materials
- Types of Estimates and Industry Standards
- Uni-Format and Master Format systems for organizing estimates.

#### Quantity takeoff

- Use Autodesk Revit to quantify building components.
- Create Quantity based Schedules in Autodesk Revit
- Export data from Revit and manipulate it in Microsoft Excel.

#### Pricing of Construction Items

- Creation of Construction Assemblies
- Use RS Means Databases to look up Line-Item Costs
- Extend database unit costs against model-based quantities.

#### Putting together an Estimate

- Apply the concepts of Takeoff Quantities vs Pricing Quantities
- Markups of an estimate
- Including other factors (complexity, local conditions, contract type etc.)
- Building system estimate vs Line-Item Estimates vs Resource Level Estimates

### **Prerequisite(s): course(s) that must be taken prior to this course.**

CE 460 or graduate standing in engineering, architecture, business or urban planning required. Familiarity with building cost estimating, as well a good computer skill is encouraged.

**Registration Restriction:** Registration is only open to the following class level(s): Junior, Senior, Master Student, and Doctoral Student

# Course Description

## Course Notes

This course will provide the student with knowledge of the fundamental principles and practices of advanced building cost estimating using a “**model-based workflow**”. The course covers advanced quantity surveying techniques using models created in Autodesk Revit as well as building component pricing using RS Means. Building plans of a small educational building will be issued. From these documents “Estimating Models” will be created using Autodesk Revit Architecture 2022 (or newer version). Additionally, the student will learn how to interrogate the model, manipulate, and export schedules for used for estimating purposes. Models will be used to derive quantities to be used in mini systems focused estimating exercises. The unit pricing to be used in these systems estimates will be found from **RS Means Building Construction Cost Data or Building Construction Costs Data Online**. Students will learn techniques to combine quantities from a model with data from RS Means to create systems-based estimates. The class is broken down by building system with a case study of building systems being studied each week. The end of the class combines the systems-based estimates to create a single building estimate.

## Technological Proficiency and Hardware/Software Required

During this class, students will be using the following software:

- **Revit Architecture and Revit Structure** (2023 or 2024) – 3D modeling Software for understanding building elements and quantifying material.
- **Bluebeam** – vector-based pdf document reader for reviewing drawings and performing quantity takeoffs.
- **Microsoft Excel** – Beginner to Intermediate skill level for creating Estimating calculations.
- **Microsoft PowerPoint** – for making presentations.
- **RS Means Online Pricing Database** - used for creating Estimates of construction assemblies and various estimating supplemental tools.
- **LinkedIn Learning with Lynda.com** content through your USC account.

Additional required reading packages will be posted on the course Blackboard site under the section entitled Course Reading

## Required Readings and Supplementary Materials

Reading and video assignments are identified on the course agenda. Assignments will be from online sources, from reading material handed out by the instructor or self-study courses from LinkedIn Learning.com for Autodesk Revit. It is important to complete readings prior to the date listed, since they will form the basis for classroom discussions.

### Note:

The course uses Autodesk Revit as a primary tool for quantifying certain building components. The students will be required to **self-teach** themselves Autodesk Revit throughout the course completing Online Training Courses at Lynda.com.

# Course Description

## Description and Assessment of Assignments

The course grade is a cumulative grade of all the tests, homework, and oral presentation as well as a digital submittal of the course summary (the estimate). The Homework assignments will consist of the modeling of a building system in Revit, deriving quantities, summarizing them from the model, and pricing those quantities using RS Means. There will be approximately 7 homework assignments throughout the semester.

Homework assignments must be handed in to the instructor by the date listed on the assignment. Late assignments are rarely accepted, but the instructor may allow exceptions for extreme circumstances. Dates of assignment and due dates for all assignments, exams, and the Written Report are shown on the course agenda and are subject to change based on class progress.

At the completion of the Semester each of the models and cost estimates are to be summarized and presented in a single cohesive estimating and pricing package with views and schedules taken from the model and cost estimates of each system and summarized.

## Class Presentation (Oral)

Each student will be required to give two presentations (powerpoint or other methods) of 25 - 30 minute each on an Estimating topic which will be provided by the instructor during the coursework. This exercise will require the student to research the subject and discover complexities associated with it. Student can rely on the class material. The scoring will be based on the coverage and the depth of content and the effort made to explore the various facets associated with that topic. Each student will select topic and inform the instructor latest by Week 3.

## Team Exercise

As part of the requirements for the course, each student will be required to participate in a team exercise which illustrates industry set up of bidding relationships between material vendors, subcontractors, general contractors, and building owners. This exercise is set up in a game-like environment where various teams assume different roles and compete with each other by intelligently bidding their scope of work and attempting to win their bid.

## Grading Schema

Grades will be based on completeness and quality of assignments, attendance, and participation. Additional breakdown for grading for each assignment will be provided in assignment descriptions that will be handed out during the semester.

### Grading Breakdown

Assignment/Test		Max Score	Score by Category	% age
Homework #1	Revit Architecture	75	400	33%
Homework #2	Revit Structure and Schedules	75		
Homework #3	Productivities & Earthwork	50		
Homework #4	Foundation & SOG	50		
Homework #5	Decks, Column & Walls	50		
Homework #6	Interior Construction + Finishes	50		
Homework #7	General Requirement + General Conditions	50		
Classwork #1	Bidding Game	100	100	8%
Mid Term Exam		200	500	42%
Test Final		300		
Presentation #1		100	200	17%
Presentation #2		100		
<b>TOTAL SCORE</b>		<b>1200</b>	<b>1200</b>	<b>100%</b>

### Grading Scale\*

Course final grades will be determined using the following scale

A	95-100
A-	90-94
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

\*Grading schema subject to adjustment depending upon class participation and cumulative results.

### Assignment Rubrics

#### Homework Rubric:

Quantities – 40%  
 Pricing – 40%  
 Présentation – 20%

# Grading Schema

## **Additional Policies**

### ASSIGNMENT SUBMISSION:

Homework assignments must be handed in to the instructor by the date listed on the assignment. Late assignments are rarely accepted, but the instructor may allow exceptions for extreme circumstances.

As a rule, all assignments are to be submitted electronically. Any hard copies of assignments and tests submitted will not be returned automatically. Paperwork unclaimed by a student will be discarded after 4 weeks from the due date and will not be available should a grade appeal be pursued following receipt of their grade.

### CLASS PARTICIPATION:

Continuous attendance is critical for your success in this class as the class topics build on each other and attendance is part of the evaluation criteria. If you miss a class, it is your responsibility to ask at the next class what you missed or find out about topics covered. If you are late for class, it is your responsibility to make sure we check you present, if not you will not get credit for attendance.

Your participation in the class is part of the evaluation criteria. This is a highly interactive class. There is continuous interchange between the instructor, guest lecturers (if available) and students. Questions and participation in discussions are highly encouraged.

## Class Schedule (Spring 2024)

Week	Date	Class No.	Lecture Topic	Assignments	Issue Date	Due Dates	Max Score	Days for this Assignm ent	Gap from Prev. Assignm ent
Week 01	1/9/2024	A	"Introduction to Construction Estimating"	HW #01 Revit Architecture	1/9/2024	2/6/2024		28	28
		B	"Budgeting" + Estimating Basics						
Week 02	1/16/2024	A	Organization of an Estimate & The RS Means Database	HW #02 Revit Structure and Schedule functio	1/16/2024	2/13/2024		28	7
		B	"Introduction to Model Based Quantities"						
Week 03	1/23/2024	A	"Labor Resources and Productivity"	Reading Material					
		B	"Equipment Resources and Productivity"						
Week 04	1/30/2024	A	Field Visit (date to be adjusted at later)						
		B							
Week 05	2/6/2024	A	A Substructure : Earthwork & Shoring	4 Student Presentation					
		B	Mehtods of Estimating : Earthwork & Shoring	HW #03 Productivity and Earthwork	2/6/2024	2/20/2024		14	7
Week 06	2/13/2024	A	A Substructure : Foundations and Slab-on-grade	4 Student Presentation					
		B	Methods of Estimating : Foundations & Slab-on-grade	HW #04 Foundations & Slab on Grade	2/13/2024	2/20/2024		7	0
Week 07	2/20/2024	A	B10 Superstructure (Decks, Beams,Columns, and Walls)	4 Student Presentation					
		B	Methods of Estimating : Concrete Construction	HW #05 Concrete Structural Systems	2/20/2024	2/27/2024		7	7
Week 08	2/27/2024	A	B20 Exterior Enclosure + B30 Roofing & Waterproofing	4 Student Presentation					
		B	Review of HW #3, #4 & #5						
Week 09	3/5/2024	A	Mid -Term Exam (3 Hrs)		3/5/2024	3/5/2024		0	7
		B							
Break	3/12/2024	A	Spring Recess (No Class)						
		B	Spring Recess (No Class)						
Week 10	3/19/2024	A	"C10 Interior Construction + C30 Interior Finishes	4 Student Presentation					
		B	Methods of Estimating : Interior Construction + Finishes	HW #06 Interior Construction	3/19/2024	3/26/2024		7	28
Week 11	3/26/2024	A	D10 Elevators + D20 Plumbing	4 Student Presentation					
		B	Review of Mid Term Exam						
Week 12	4/2/2024	A	D30 HVAC + D50 Electrical	4 Student Presentation					
		B	Construction Contracts & Estimating	Reading Material					
Week 13	4/9/2024	A	General Conditions + General Requirements Estimate						
		B	Methods of Estimating : GRs + GCs	HW #7 GRs + GCs	4/9/2024	4/16/2024		7	21
Week 14	4/16/2024	A	"Finishing the Estimate: Mark Ups and other factors"	Reading material					
		B	Bidding Game - Part 1	Team Assignment - Part Homework	4/16/2024	4/23/2024		7	7
Week 15	4/23/2024	A	Bidding Game - Part 2	Team Assignment - Part Classwork					
		B	Review of HW #6 & HW #7 + Catch up Session						
Week 16	5/1/2024		Final Exam (3 hours)	Test	5/1/2024	5/1/2024		0	8

## Course Training

Following is the Training Outline for Autodesk Revit. It is suggested that the Revit Architecture 2023 Essential Training and Revit Structure Training is taken within the first two weeks of class. While it is suggested that the student takes the entire training course, the courses highlighted below are the key courses to understanding the “Model Based Estimating Workflow”.

“Revit 2024 Essential Training for Architecture” (Imperial)	“Revit 2022: Essential Training for Structure” (Imperial)
With Paul F. Aubin	with Eric Wing
<ul style="list-style-type: none"> <li style="text-align: center;">Introduction</li> <li>1. Core Concepts</li> <li>2. Interface Basics</li> <li>3. Starting a Project</li> <li>4. Modeling Basics</li> <li>5. Links, Imports, and Groups (Optional)</li> <li>6. Sketch Based Modeling Components</li> <li>7. Stairs (Optional)</li> <li>8. Complex Walls (Optional)</li> <li>9. Visibility and Graphic Controls (Optional)</li> <li>10. Rooms (Optional)</li> <li>11. Schedules and Tags</li> <li>12. Annotations (Optional)</li> <li>13. Detailing (Optional)</li> <li>14. The Basics of the family editor, (Optional)</li> <li>15. Sheets, Plotting and Publishing (Optional)</li> <li style="text-align: center;">Conclusion</li> </ul>	<ul style="list-style-type: none"> <li>1. Setting up the Project</li> <li>2. Grids and Columns</li> <li>3. Foundations</li> <li>4. Steel Framing</li> <li>5. Floors and Slabs</li> <li>6. Reinforcing</li> <li>7. Steel Brace Frames</li> <li>8. Stairs, Ramps and Slopes (Optional)</li> <li>9. Detailing and Annotating (Optional)</li> <li>10. Schedules and Tagging (Optional)</li> <li>11. Trusses (Optional)</li> <li>12. Project Management (Optional)</li> <li>13. The Steel Tab (Optional)</li> <li>14. Precast Concrete (Optional)</li> <li>15. Structural Loading (Optional)</li> <li style="text-align: center;">Conclusions</li> </ul>



# Statement on Academic Conduct and Support System

## Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](https://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](https://policy.usc.edu/scientific-misconduct).

## Support Systems:

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*  
[engemannshc.usc.edu/counseling](https://engemannshc.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*  
[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call*  
[engemannshc.usc.edu/rsvp](https://engemannshc.usc.edu/rsvp)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) | Title IX - (213) 740-5086*  
[equity.usc.edu](https://equity.usc.edu), [titleix.usc.edu](https://titleix.usc.edu)

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

*Bias Assessment Response and Support - (213) 740-2421*  
[studentaffairs.usc.edu/bias-assessment-response-support](https://studentaffairs.usc.edu/bias-assessment-response-support)

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

*The Office of Disability Services and Programs - (213) 740-0776*  
[dsp.usc.edu](https://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Support and Advocacy - (213) 821-4710*  
[studentaffairs.usc.edu/ssa](https://studentaffairs.usc.edu/ssa)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*  
[diversity.usc.edu](https://diversity.usc.edu)

## Statement on Academic Conduct and Support System

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*  
[dps.usc.edu](https://dps.usc.edu), [emergency.usc.edu](https://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*  
[dps.usc.edu](https://dps.usc.edu)

Non-emergency assistance or information.