

USC Viterbi

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

CE 461 – Construction Estimating

Units: 4

Term: Spring 2023

Class Time: Tuesday & Thursday 5:30 PM - 7:20 PM

Location: GFS 118

Instructor: Navneet Agrawal

Office: GFS 118

Office Hours: 30 Minutes Before and After Class

Contact Info:

Email: 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

Revit

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

RS Means

- Use RS Means Databases to look up Line-Item Costs
- Extend database unit costs against model-based quantities

Estimating

- Apply the concepts of Takeoff Quantities vs Pricing Quantities
- Use Uni-Format and Master Format to summarize estimates
- Create a construction assembly
- Create a building system estimate

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 2020 (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

The student must purchase a 1-year license to the RS Means Database for use in this class. Each student shall text a \$ 150.00 payment to 480.241.6631. Upon receipt of the payment, I will activate your account and you will receive an activation notice that will ask you to go into and Register to the website. This website can be used in all your classes and will be a great resource of productivity rates as well as cost information. **DO NOT SIGN UP FOR THE ONLINE EDUCATIONAL VERSION OF THE PRODUCT, IT WILL NOT WORK FOR THIS CLASS.**

License Amount \$150.00

Access to LinkedIn Learning with Lynda.com content through your USC account. (Free)

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 10 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)

Towards the end of the coursework, each student will be required to present a 12 - 15 minute presentation (powerpoint or other methods) on an Estimating topic which has already been covered 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 Thursday 04/06/2023.

Project Report

As part of the requirements for the course, each student will be required to submit a minimum 1500 word (6 to 8 page with images, charts and bibliography) written report on a piece of new construction technology. This report should be written in **Chicago Manual of style (Chicago Style)**. Each student will research currently available or upcoming construction technologies and discuss their relevance in increasing productivity and/or creating higher quality product. The research and subsequent report shall clearly state the issue the technology is trying to resolve. The paper shall concisely analyze the problem comparing the current state with the future state if the technology was deployed. The report shall include a cost to benefit analysis and discuss how construction productivity and final quality achieved is affected. The paper shall conclude with a recommendation as to a course of action. In general, the written report shall include the following:

- Executive Summary or Abstract
- Introduction
- Main Body of the Report
- Conclusion and Recommendation

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	Points	% of Grade
Tests (2)	100	10%
Homework (10)	300	30%
Class Assignments (4)	100	10%
Class Presentation	100	10%
Project Report	100	10%
Final Exam	200	20%
Class Participation	100	10%
TOTAL	1,000	100%

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 2023)

Week	Date	Class No	Lecture Topic	Assignment	Issue Date	Due Date	Max Score
Week 01	1/10/2023	1	"Introduction to Construction Estimating"	Homework #1 Revit Architecture	1/10/2023	1/24/2023	30
	1/12/2023	2	"Budgeting"				
Week 02	1/17/2023	3	"Estimating Basics"	Homework #2 Revit Structure	1/17/2023	1/31/2023	30
	1/19/2023	4	"Labor Resources and Productivity"				
Week 03	1/24/2023	5	"Introduction to Model Based Quantities"	Homework #3 Revit MEP	1/24/2023	2/7/2023	30
	1/26/2023	6	"Earthwork, Equipment Resources and Productivity"				
Week 04	1/31/2023	7	"A10 Foundations"	Homework 4 Foundations & Slab on Grade	1/31/2023	2/14/2023	30
	2/2/2023	8	"Special Foundation Systems"				
Week 05	2/7/2023	9	"A1030 Slab on Grade"	Class Assignment #1			25
	2/9/2023	10	"B10 Superstructure - Steel"	Homework #5 Steel Structural Systems	2/9/2023	2/23/2023	30
Week 06	2/14/2023	11	"The RS Means Database"				
	2/16/2023	12	Test 1 (Max 1 hr 30 min)	Test			50
Week 07	2/21/2023	13	"Concrete Formwork, Material and Resources"	Homework #6 Concrete Structural Systems	2/21/2023	3/7/2023	30
	2/23/2023	14	"B10 Superstructure Concrete"				
Week 08	2/28/2023	15	"B20 Exterior Enclosure"	Homework #7 B20 Exterior Enclosure	2/28/2023	3/14/2023	30
	3/2/2023	16	"B30 Roofing and Waterproofing"				
Week 09	3/7/2023	17	"C10 Interior Construction"	Homework #8 B30 Roofing	3/7/2023	3/21/2023	30
	3/9/2023	18	"C30 Interior Finishes"	Class Assignment #2			25
Break	3/14/2023		Spring Recess (No Class)				
	3/16/2023		Spring Recess (No Class)				
Week 10	3/21/2023	19	"D10 Elevators"	Homework #9 C10 & C20 Interior	3/21/2023	4/4/2023	30
	3/23/2023	20	"D20 Plumbing"				
Week 11	3/28/2023	21	"D30 Heating Ventilation Air Conditioning"	Homework #10 D Services (Combined)	3/28/2023	4/11/2023	30
	3/30/2023	22	"D50 Electrical"	Class Assignment #3			25
Week 12	4/4/2023	23	Test 2 (Max 1 hr 30 min)	Test			50
	4/6/2023	24	"G20 Sitework"	Finalize Estimating Presentation topic	4/6/2023	4/25/2023	
Week 13	4/11/2023	25	"General Conditions Estimate"				
	4/13/2023	26	"General Requirements Estimate"				
Week 14	4/18/2023	27	"Finishing the Estimate, Fees and Mark Ups"	Class Assignment #4			25
	4/20/2023	28	Class Review #1				
Week 15	4/25/2023	29	Estimating Presentation #1 (5-6 students)	Presentation			100
	4/27/2023	30	Estimating Presentation #2 (5-6 students)				
Week 16	5/2/2023	31	Class Review #2 and Project Report Submission	Project Report			100
	5/4/2023	32	Final Exam (1 hr 30 minutes)	Test			200
Total Score for Assignments and Tests							900
Class Participation							100
Total Maximum Score for this course							1,000

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 2023 Essential Training for Architecture” (Imperial)	“Revit 2022: Essential Training for Structure” (Imperial)	“Revit 2023: Essential Training for MEP” (Imperial)
With Paul F. Aubin	with Eric Wing	with Eric Wing
<p style="text-align: center;">Introduction</p> <ol style="list-style-type: none"> 1. Core Concepts 2. Interface Basics 3. Starting a Project 4. Modeling Basics 5. Links, Imports, and Groups (Optional) 6. Sketch Based Modeling Components 7. Stairs (Optional) 8. Complex Walls (Optional) 9. Visibility and Graphic Controls (Optional) 10. Rooms (Optional) 11. Schedules and Tags 12. Annotations (Optional) 13. Detailing (Optional) 14. The Basics of the family editor, (Optional) 15. Sheets, Plotting and Publishing (Optional) <p style="text-align: center;">Conclusion, 53s</p>	<ol style="list-style-type: none"> 1. Setting up the Project 2. Grids and Columns 3. Foundations 4. Steel Framing 5. Floors and Slabs 6. Reinforcing 7. Steel Brace Frames 8. Stairs, Ramps and Slopes (Optional) 9. Detailing and Annotating (Optional) 10. Schedules and Tagging (Optional) 11. Trusses (Optional) 12. Project Management (Optional) 13. The Steel Tab (Optional) 14. Precast Concrete (Optional) 15. Structural Loading (Optional) <p style="text-align: center;">Conclusions</p>	<ol style="list-style-type: none"> 1. Starting a Revit Project (Optional) 2. Revit Electrical 3. Revit Mechanical 4. Revit Plumbing, 5. Revit Workflow (Optional) 6. MEP Fabrication Parts (Optional) 7. System Browser (Optional) <p style="text-align: center;">Conclusion</p>

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. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
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

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

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, 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

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

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

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

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, 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

Non-emergency assistance or information.