Construction Modeling and Simulation
CGN 4905 Section 18961; CGN 6905 Section 26784
Lectures: Tuesday Period 7 (1:55PM – 2:45 PM EST) ***Location:*** MAEB 0234
Labs: Thursday Period 7-8 (1:55PM – 3:50PM EST) ***Location***: Weil 408E
Zoom (when needed; seek instructor permission in advance): https://ufl.zoom.us/j/4369404526
Academic Term: Fall 2022

Instructor:
Eric Jing Du
eric.du@essie.ufl.edu
(352) 294-6619
Office Hours: R: 12:30PM-1:30PM, Zoom: https://ufl.zoom.us/j/4369404526

Course Description
3 credit hours

Course Pre-Requisites / Co-Requisites
Instructor permission

Course Objectives
Exploration of data-rich, object-oriented, and parametric representation technologies of civil engineering facilities, from which views and information can be extracted and analyzed for construction project acquisition, planning, and controls. Topics include Building Information Modeling (BIM) for engineering design, model-driven cost estimating, construction operations simulation, scanning and photogrammetry technologies, and advanced topics in construction modeling and simulation. Students will:

1. Understand the use of Building Information Modeling (BIM) in construction management
2. Learn how to create a Building Information Model (BIM for design)
3. Learn how to detect clashes between building components using BIM (constructability review)
4. Learn how to create 4D Construction Visualization Models (BIM simulation)
5. Learn how to use BIM to estimate project cost (5D)
6. Learn other emerging visualization technologies (**Graduate students only**)
7. Learn how to formulate BIM-related research (**Graduate students only**)

Required Textbooks and Software
No required textbooks. The following software packages are required to be installed:

- Autodesk Revit 2022 or 2023
- Autodesk Navisworks Manage 2022 or 2023 (note: Not Navisworks 360)
- Autodesk Recap Pro
- Optional: Lumion 12.5 (https://lumion.com/) This program requires high-end graphic cards to be installed in your computer. It is optional.

All Autodesk software packages are free to UF students. Please go to http://www.autodesk.com. Register and login with your UF email, and then go to "Manage Products and Downloads".

Materials and Supply Fees
No materials and supply fees. However, computers (desktop or laptop) that can support Autodesk software packages (listed in "Required Textbooks and Software") are required for homework and team projects. Specifications recommended by Autodesk can be found at https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/sfdcarticles/sfdcarticles/System-requirements-for-Autodesk-Revit-2020-products.html.
***Apple Users:** Please note Apple operation systems (e.g., MacOS) are NOT compatible with Autodesk products. If you own Apple computers (e.g., MacBook, iMac), please use Boot Camp to install Windows OS as the secondary operation system. Make sure to allocate enough disk space to the secondary Windows OS (>200 GB) as most Autodesk software packages take up a lot of space.
***UF Apps: if you are having troubles installing the required software packages on your personal computer, an alternative is UF Apps.** https://info.apps.ufl.edu/. UF Apps allows you to use your web browser or "virtual machine" to open remote software packages installed on UF IT servers. It provides access to software applications

from any computing device--laptops, tablets, desktops, and smartphones--from any location, at any time. We will go over UF Apps together in day 1 of the class (8/25/2022).

Recommended Materials (Optional)

- *BIM and Construction Management: Proven Tools, Methods, and Workflows*
  - Brad Hardin
  - 2015 2nd edition
  - ISBN: 978-1-118-94276-5
- *BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers*
  - Rafael Sacks, Chuck Eastman, Ghang Lee, and Paul Teicholz
  - 2018 3rd edition
  - ISBN: 978-1119287537

Course Schedule

Dates	Topics	Presenters	Assignment Due
Week 1 (8/25)	Introduction and Course Overview	Dr. Eric Jing Du	
Week 2 (8/30)	BIM Overview	Dr. Eric Jing Du	
Week 2 (9/1)	Lab: Revit tutorial 1 - Architecture	LAB	
Week 3 (9/6)	BIM Overview - cont'd	Dr. Eric Jing Du	
Week 3 (9/8)	Lab: Revit tutorial 2 - Architecture - cont'd	LAB	
Week 4 (9/13)	A brief history of BIM	Dr. Eric Jing Du	
Week 4 (9/15)	Lab: Revit tutorial 3 - Structure	LAB	
Week 5 (9/20)	**Class exercise – Bidding game**	**Class exercise**	
Week 5 (9/22)	Lab: Revit tutorial 4 - MEP	LAB	
Week 6 (9/27)	BIM and Pre-construction	Dr. Eric Jing Du	
Week 6 (9/29)	Lab: Navisworks tutorial 1 - Clash Detection	LAB	
Week 7 (10/4)	4D BIM - BIM for Scheduling	Dr. Eric Jing Du	
Week 7 (10/6)	**Dream House/BIM Model Presentations**	**Students**	**Dream House Models Due**
Week 8 (10/11)	4D BIM - BIM for Scheduling - cont'd	Guest	
Week 8 (10/13)	Lab: Navisworks tutorial 2 - 4D Simulation	LAB	
Week 9 (10/18)	**Clash Detection Presentations**	**Students**	**Clash Detection Files Due**
Week 9 (10/20)	Lab: Let's Fly a Drone!	LAB	
Week 10 (10/25)	Scanning: LiDAR	Dr. Eric Jing Du	
Week 10 (10/27)	Lab: Assemble tutorial 1	LAB	
Week 11 (11/1)	Scanning: Photogrammetry	Dr. Eric Jing Du	
Week 11 (11/3)	Lab: Scanning - LiDAR & Photogrammetry	LAB	
Week 12 (11/8)	**4D BIM and Scanning Presentations**	**Students**	**4D BIM models Due/ Photogrammetry/Scanning Files Due**
Week 12 (11/10)	Lab: Assemble tutorial 2	LAB	
Week 13 (11/15)	VR/AR and future tech	Dr. Eric Jing Du	
Week 13 (11/17)	Lab: Du lab visits	LAB	
Week 14 (11/22)	**Teams to keep working on final projects (NO CLASS)**		
Week 15 (11/29)	5D BIM - BIM for Estimating	Guest	**5D BIM Due**
Week 15 (12/2)	**FINAL PRESENTATIONS**	**Students**	
Week 16 (12/6)	**FINAL PRESENTATIONS – cont'd**	**Students**	**All Presentations/Reports Due**

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is expected. Students are responsible for any information communicated during class. Project presentation attendance is mandatory. Missed presentations can only be made up when it is an excused absence. Excused absences must be consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation. Student must contact the instructor as soon as the student knows that he/she will have an excused absence to arrange for makeup.

Evaluation of Grades – Undergraduate students

ID	Assignment	Total Points	Percentage of Final Grade
	Individual project		
A	My Dream House project	100	30%
B	Pop quizzes	100	10%
	Team projects		
C	Constructability and Clash Detection	100	10%
D	Construction Estimating	100	10%
E	4D Construction Model	100	10%
F	Photogrammetry Project	100	10%
G	Final Presentation	100	20%
H	Peer Evaluation (team members)	1.0	Multiplier
Final Grade=A*30%+B*10%+H*(C+D+E+F)*10%+H*G*20%			

Evaluation of Grades – Graduate students

ID	Assignment	Total Points	Percentage of Final Grade
	Individual project		
A	My Dream House project	100	30%
B	Pop quizzes	100	10%
C	Final BIM review paper	100	10%
	Team projects		
D	Constructability and Clash Detection	100	10%
E	Construction Estimating	100	10%
F	4D Construction Model	100	10%
G	Photogrammetry Project	100	10%
H	Final Presentation (must include visualization project)	100	10%
I	Peer Evaluation (team members)	1.0	Multiplier
Final Grade=A*30%+B*10%+C*10%+I*(D+E+F+G)*10%+I*H*10%			

My Dream House Project (undergraduate and graduate students)

1. Create the Revit model of your dream house (no drawings will be provided) (using Revit).
2. Submit the ".rvt" file containing your model using Google Drive.
3. Put as many building components as you can. (Ex. foundation, walls, columns, doors, windows, MEP, and so on)
4. No accurate dimension is required.
5. Prepare a walkthrough using Revit or other tools such as Modelo (http://modelo.io), or Lumion.
6. Prepare a video to "sell" your dream house.
7. **Give a 5-min presentation to the class on October 6.**
8. The model will be evaluated by the class (50%) and instructor (50%) based on *completeness* 30% (if architecture, structure and MEP systems are modeled and presented), *design* 40% (how good the design is) and *presentation* 30% (how well the model is presented).
9. Bonus point: a demo with Virtual Reality or Augmented Reality.

Constructability and Clash Detection (undergraduate and graduate students)

1. A model will be provided - Review the provided model.
2. Find any clashes between building components (using Navisworks).
3. Produce a discrepancy report presenting 10 most critical clashes and solutions.
4. A proper description, necessary snapshots, and some suggestions are expected for each clash.
5. Submit the ".doc" file containing the discrepancy report.
6. Submit the ".nwd" file containing the federated model.
7. **Give a 10-min presentation to the class on October 18 (must navigate to the clashes).**
8. The ability to detect clashes and explain them will be evaluated by the *classmates* (20%) and the *instructor* (80%).
9. Bonus point: Using BIM Cloud tools (e.g., 360 or Modelo) to coordinate with other team members and present the process.

4D Construction Model (undergraduate and graduate students)

1. Develop the list of the activities (line items) and their durations.
2. Combine the 3D model and line item information (in Navisworks or Synchro).
3. Submit the ".nwd" or ".syn" file containing a 4D Construction Model.
4. **Give a 5-min presentation to the class on November 8 (total presentation time is 10 mins for both 4D and Photogrammetry/Scanning).**
5. The ability to develop a 4D Construction Model will be evaluated by the *classmates* (20%) and the *instructor* (80%).

Photogrammetry or scanning project (undergraduate and graduate students)

1. Build a 3D model of any UF structure (interior or exterior) using Photogrammetry or LiDAR.
2. Submit the model (file or address) using Google Drive
3. **Give a 5-min presentation to the class on November 8 (total presentation time is 10 mins for both 4D and Photogrammetry/Scanning).**
4. Present to the class; it will be evaluated by the *classmates* (20%) and the *instructor* (80%).

Construction Estimating using BIM (undergraduate and graduate students)

1. Extract the Bill of Material (BOM) from the Revit model (using Assemble).
2. Produce an Excel spreadsheet presenting the assumed construction cost (using Assemble).
3. Submit the ".rvt" file and ".xls" file containing the BOM and construction cost.
4. The ability to accurately produce the BOM and construction cost will be evaluated by the instructor, including: (1) completeness of building objects captured in Assemble (50%); (2) accuracy of unit costs (20%); (3) correct use of Assemble filters and output formats (30%).
5. **No presentations needed; the instructor will check each team's project page on November 29.**

Final Project – BIM Presentation (undergraduate and graduate students)

1. Each team forms a BIM consulting company.
2. Prepare a whole lifecycle solution for construction management using BIM (must include main techs learned in this class).
3. Develop a visual-based presentation material for your plan to manage the project.
4. Submit ".ppt" file.
5. **Give a 30-min presentation to the class on Dec 2 and Dec 6.**
6. Graduate students must include emerging visualization technologies in their presentation.
7. The final project will be evaluated by the *classmates* (20%) and the *instructor* (80%).

Final Project – BIM Review Paper (Graduate students only)

1. Write a research paper on BIM related topics. Examples include but not limited to: Overall challenges and opportunities of BIM; BIM applications in AEC industry; Data issues in BIM; BIM for facility management; BIM and mixed reality; BIM and AI etc.
2. Please use technical writing (e.g., Introduction, problem statement, objectives, literature review, summary and discussion, conclusions and future agenda)

3. >3,000 words.
4. **Report due on December 6.**

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by

a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: https://distance.ufl.edu/state-authorization-status/#student-complaint*.