

## Summary Report of Student Learning Outcomes (SLOs) for the Construction Program

The multi-year results of the direct and indirect assessment of the 17 SLOS for the construction program are shown in the table below.

SLO No.	SLO Description	Fall 2016 to Spring 2019 Averages		Fall 2020 to Spring 2023 Averages	
		Direct Assessment	Indirect Assessment	Direct Assessment	Indirect Assessment
1	Create written communications appropriate to the construction discipline.	97%	3.9	88%	4.3
2	Create oral presentations appropriate to the construction discipline.	99%	3.7	100%	4.0
3	Create a construction project safety plan.	100%	3.5	81%	4.1
4	Create construction project cost estimates.	100%	3.0	86%	3.8
5	Create construction project schedules.	100%	3.3	92%	3.4
6	Analyze professional decisions based on ethical principles.	88%	4.1	84%	4.3
7	Analyze methods, materials, and equipment used to construct projects.	94%	3.9	86%	3.9
8	Apply electronic-based technology to manage the construction process.	91%	3.1	85%	3.9
9	Apply basic surveying techniques for construction layout and control.	91%	2.7	80%	3.6
10	Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.	93%	4.2	82%	4.2
11	Understand construction accounting & cost control.	83%	3.3	83%	3.6
12	Understand construction quality assurance & control.	100%	3.5	100%	4.2
13	Understand construction project control processes.	89%	3.6	82%	4.1
14	Understand the legal implications of contract, common, and regulatory law to manage a construction project.	96%	3.8	95%	4.0
15	Understand the basic principles of sustainable construction.	100%	4.0	95%	4.1
16	Understand the basic principles of structural behavior.	88%	3.4	94%	3.8
17	Understand the basic principles of mechanical, electrical and plumbing systems.	88%	3.5	87%	4.0

The performance criteria used are as follows:

- Direct Assessment: an SLO is achieved if the assessment score is  $\geq 80\%$
- Indirect Assessment: an SLO is achieved if the assessment score is  $\geq 4.0$

In the multi-year periods from 2016 to 2019 and from 2020 to 2023, the direct measures are met for all 17 SLOs in both analysis periods. For the indirect assessment, 14 of the 17 SLOs were not met during the 2016 to 2019 analysis period, while from 2020 to 2023, this reduced to 7 SLOs that did not meet the indirect assessment score threshold. Additionally, all the indirect assessment scores improved from the 2016-2019 period to the 2020 to 2023 period.

In consultation with our faculty, advisory board members, employers and alumni, several action items were identified and subsequently implemented to improve the attainment of SLOs based on the 2019 analysis and results. They are as follows, along with feedback from our construction industry constituents:

1. Introducing improvements to the planning and delivery of the capstone senior project course sequence, including:
  - Realigning deliverables to better match project requirements and reducing their number from eleven to eight (four in each semester) by consolidating them starting with the 2020-2021 Academic Year. This allowed for a much better coordination of instruction with deliverable requirements throughout the semesters because of the extended periods between deliverables due dates.
  - Hiring industry mentors starting with the fall semester.
  - Introducing improvements on team and course assessment methodologies. A methodology for assessing the level of contribution of every team member was developed. Meetings with the senior project teams on a regular basis (normally twice per semester) were conducted to monitor course progress and make sure the students have the instruction and support they need to complete their projects.
2. Increasing the credit hours for CON 493, Senior Project Planning, from 1 hour to 2 hours, and using the extra time to include coverage of project management software and other technology related topics. When this modification was discussed with our industry partners their input was as follows:
  - Industry Partner Input*
  - Training students on the use of software and technology should happen before the senior project course.
  - Make sure students at least know MS Excel, MS Access (use for cost database and schedule tracking), MS Project, and Primavera.
  - Make sure OnScreen Takeoff (OST) and BlueBeam are covered.
  - Incorporate the use of hand-held devices.
3. Introducing improvements to the delivery of CON 326 Estimating, and CON 392 Scheduling by integrating more technology into these courses, such as: Procore, OnScreen Takeoff, BlueBeam, and MS Project, and by requiring students to complete a project in the Estimating and Scheduling courses during the semester. An industry professional was hired to assist in teaching the lab portion of the Estimating course for two semesters. The industry professional contributes to the course by sharing current knowledge and practical experience and providing a

project for students to work on and mentoring them through it. When this modification was discussed with our industry partners their input was as follows:

*Industry Partner Input*

- CON 326 and CON 392 are the most critical courses. They need to be revamped.
  - Consider requiring Estimating 1 and Estimating 2. Same for Scheduling.
  - What sectors of the industry are our graduates going to? Make sure they are prepared for them.
  - Keep bringing in people from the industry and make sure the industry instructor is available for the lab sessions.
  - Requiring students to have an internship will help.
4. Creating a new required 3-hour course CON 388 Contract Administration, by combining course content from CON 380 (Required) and CON 395 Claims and Change Orders (Elective). The course description for CON 388 Contract Administration is: Introduction to construction law, bonding, insurance, DBE requirements, risk analysis and management. Types of contracts and contract content to include specifications, general conditions, and bidding requirements. Introduction to AGC, AIA and EJCDC construction contract documents. Regulations and types of potential claims and change orders and dispute resolution. Reasons and costs of change orders and claims. Global and emerging contractual and procedural issues. Dispute resolution. Case studies.

When this modification was discussed with our industry partners their input was as follows:

*Industry Partner Input*

- Combining CON 380 and CON 395 is a good idea and having someone from the industry teaching the course would be beneficial.
  - We like what you did with the contracts class.
5. Creating a new required 3-hour course: CON 492 Construction Project Controls, to improve instruction related to project controls and risk management and construction accounting. The course description is: Use of project control processes for construction management to include risk management, cost, scheduling, and quality assurance and control. Practical application of financial and accounting fundamentals specific to the construction industry. Prerequisite: CON 392.

When this modification was discussed with our industry partners their input was - this is adequate and should address all accreditation and assessment issues.

6. Creating a 3-hour surveying course, CON 206 Surveying, that reflects the current status of the industry and introduces students to current technology. The course description for CON 206 is: Theory and applications of measurements of horizontal distances, differences in elevations, horizontal angles, vertical angles, bearings, azimuths, and areas and volumes. Simple horizontal and vertical curves, topographic surveys and mapping. Basic surveying techniques for construction layout and control. Public land surveying systems. Emerging surveying and mapping technology.

When this modification was discussed with our industry partners their input was as follows:

*Industry Partner Input*

- Make sure you do not overdo the surveying course.
- Make sure students understand the limits of technology.

- Understanding the basics of layout control is essential.
  - Incorporate surveying case studies into the course; e.g. when a survey is gone bad.
  - Make sure students understand the tolerances and limitations of the different systems.
  - Students need to understand the fundamentals of building control.
  - The proposed outline for the new surveying course is good.
7. Modifying the course content of CON 487 Design of Steel and Concrete Structures, and CON 489 Design of Wood and Masonry Structures, and replacing them with two new courses: CON 470 Design of Steel and Wood Structures, and CON 471 Concrete and Masonry Construction. The new course restructuring will better reflect the needs of the students and the industry. CON 470 will combine the coverage of the basics of steel and wood design and introduce students to the basics of structural behavior with a focus on structural issues that may be encountered during construction (formwork, temporary shoring and bracing, etc.). CON 471 will focus on the material and construction aspects of reinforced concrete and masonry elements and less on their design. CON 471 will also include a laboratory component, which students have suggested in numerous senior exit interviews. The course descriptions are as follows:
- CON 470 - Design of Steel and Wood Structures (3 hours) Overview of the basic principles of structural behavior and introduction to the analysis and design of steel and wood structural members. Formwork design and applications in other construction related problems. Prerequisite: C E 270 or IMT 324
  - CON 471 - Concrete and Masonry Construction (3 hours) Overview of materials used in concrete and masonry construction. Introduction to reinforced concrete design and basic concepts in concrete and masonry construction. Laboratory Experiments. Prerequisite: C E270 or IMT324

When this modification was discussed with our industry partners their input was as follows:

*Industry Partner Input*

- Make sure to cover more about connections.
- These are good changes. Removing the prerequisite dependency between the courses is good.
- Incorporate new structural materials such as CLT (Cross-Laminated Timber). It is being used quite a bit now.

Industry partner input was also solicited for specific SLOs. The comments received from our Advisory Board members, Employers and Alumni on ways to improve SLOs with low indirect assessment scores are as follows:

- **SLO 4. Create construction project cost estimates**
  - Keep having a professional from the industry involved in the instruction of the estimating laboratory.
  - Revamp CON326 and have the industry help in drafting the syllabus for it.
  - Covid may have played a role in the adequacy of instruction.
  - Incorporate the effects of changes in cost on the cost estimate.
  - Incorporate the effects of changes in scope on the cost estimate.
  - Incorporate the use of case studies in the course.
  - Focus on the fundamentals and basic concepts.
  - Understand the different software available.

- Encourage students to obtain internships.
  - Introduce project case studies.
  - Incorporate project-based examples.
  - Internships will help.
  - Make students complete a full cost estimating project in CON326.
  - Include coverage of how to deal with unforeseen circumstances in the course.
  - Preconstruction.
  - Incorporate concepts related to changing materials costs.
  - What and how things tie together.
  - Make sure students understand the big picture: impact of different items.
- **SLO 5. Create construction project schedules**
    - Make sure at least MS Project is covered in the scheduling course.
    - Have a professional from the industry involved in teaching the scheduling course and keep doing so for the estimating laboratory.
    - Make sure realistic activity durations are used when teaching scheduling.
    - Expose students to how things are built. If they understand how the items are built it will be easier for them to understand how to develop a schedule or a cost estimate. They need to know how many people are involved and how to gather information from subs and suppliers to create a schedule or an estimate.
    - If there is anything that BU should be known for, it is estimating.
    - Revamp CON392 and have the industry help in drafting the syllabus for it.
    - Make sure students do understand how a building is built.
    - Make sure students understand the concepts of durations.
    - Covid may have played a role in the adequacy of instruction.
    - Make sure students understand the different types of schedules.
    - Have industry involved in the scheduling class.
    - An internship will help a lot.
    - Introduce project case studies.
    - Incorporate project-based examples.
    - Internships will help.
    - Make students complete a full scheduling project in CON392.
    - Include coverage of how to deal with unforeseen circumstances in the course.
    - Tie-in to basic construction sequence.
    - Make sure students understand how to build a building first.
    - Incorporate more hands-on in the scheduling course.
    - Make sure Primavera is covered (at least P3).
    - Get the industry involved in the course.
- **SLO 7. Analyze methods, materials, and equipment used to construct projects**
    - Promote internships.
    - Make use of the construction laboratory.
    - More industry engagement in related courses.
    - Field trips and class guest speakers about equipment used to construct projects. Use technology (FaceTime, Zoom, YouTube). Homework: daily reports on equipment used (or for milestones).
    - Take a closer look at the coverage in CON270 and CON342.
    - Make sure students understand the different types of construction, including top-down.

- Types of cranes.
  - Logistics planning.
  - Residential vs. Commercial vs. Hotels
  - Value engineering.
  - Increase the number of practical examples in the associated courses.
  - Obtain scale models of equipment and introduce the use of the appropriate Performance Handbook, which should be available from the manufacturer.
- **SLO 8. Apply electronic-based technology to manage the construction process.**
    - Procore is very helpful
    - Incorporate BlueBeam in more courses. Power can facilitate the relationship with BlueBeam.
    - Incorporate more of updating digital documents in CON132.
    - Incorporate document analysis in all projects assigned in courses (i.e. through Procore).
    - Hire people from the industry to teach CON132.
    - Incorporate technology (i.e. Procore), and make sure students understand the process, including RFI's and Submittals.
- **SLO 9. Apply basic surveying techniques for construction layout and control**
    - A corrective action has already been taken to address this shortcoming and it is in the process of being implemented.
- **SLO 11. Understand construction accounting and cost control**
    - A corrective action has already been taken to address this shortcoming and it is in the process of being implemented.
- **SLO 14. Understand the legal implications of contract, common, and regulatory law to manage a construction project**
    - A corrective action has already been taken to address this shortcoming and it is in the process of being implemented.
- **SLO 16. Understand the basic principles of structural behavior**
    - A corrective action has already been taken to address this shortcoming and it is in the process of being implemented.
- **SLO 17. Understand the basic principles of mechanical, electrical and piping systems**
    - Get subcontractors involved.
    - Make sure students get a review of one-line diagrams.
    - Make sure to cover the different systems and how they work.
    - Use BIM and incorporate clash detection.
    - Focus on the basics; i.e. objective: air to be cooled – how is it distributed.
    - Combination of having industry coming to talk to the class about a project and then arranging for a field trip to see it.
    - Power is thinking about a little project for students.
    - Use BIM.
    - Use the Business/Engineering Center for show and tell – there are quite a bit of exposed items.

- Develop an electronic library of construction items (materials, equipment). Reach out to alumni for help to provide material (photos, videos)
- Make sure the objectives of the course are clear to the students and ask them if they are being reached all along.
- Build physical models in the construction laboratory.
- Reach out to the union or apprentice school and make an organized effort to collaborate with them.
- Field trips.
- Incorporate the use of BIM models.
- Build physical models in the construction laboratory.
- Incorporate the use of AR into related courses.