SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program: Civil Engineering	Department: Department of Civil, Computer, and Electrical Engineering
Degree or Certificate Level: Bachelor of Science	College/School: School of Science and Engineering
Date (Month/Year): June/2023	Primary Assessment Contact: Dr. Jalil Kianfar, PE

In what year was the data upon which this report is based collected? 2020/2021, 2021/2022

In what year was the program's assessment plan most recently reviewed/updated? 2019/2020

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle?

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

8) An ability to design a system, component, or process in more than one civil engineering context.

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please identify the course(s) in which these artifacts were collected. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CVNG 3040	Assignment on Water Quality for Human Consumption
CVNG 3120	Evaluation and Assessment of Corridor traffic Improvement Project
CVNG 3160	Reinforced Concrete Frame Project
CVNG 4500	Capstone Preliminary Design Alternatives Project Report

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

CVNG 3020	Analysis Challenge #2 focused on Estimating Loads and Determining Load Paths
CVNG 3160	Reinforced Concrete Frame Project
CVNG 4500	Capstone Preliminary Design Alternatives
CVNG 4510	Capstone Final Design

8) An ability to design a system, component, or process in more than one civil engineering context.

CVNG 3110	Combined Homework on Pavement Design and Long-range Transportation Planning
CVNG 3130	Exam Questions Focused on Culvert Design

CVNG 3150	Exam Questions Focused on Design of Steel Beams and Columns
CVNG 4510	Capstone Final Design

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and include them in/with this report.

The Faculty Review process includes a self-assessment at the course level followed by an independent review of specific outcomes by two faculty members who did not contribute to that respective outcome. Each independent reviewer was asked to answer the following questions:

1) What are the critical program strengths identified in this outcome?
2) What are the critical program weaknesses identified in this outcome?
3) Are there suggested plans of action to improve the results of this outcome? If so, are they adequate?
4) To what extent is the outcome met by the assessment measures on a scale of 1-5?
   (1 = Not at all, 2 = Slightly, 3 = Moderately, 4 = Mostly, 5 = Completely)

Following the independent review of the outcomes, the faculty meet for an assessment retreat as a group to develop a collective plan of action to address any weaknesses.

Note: All rubrics are included at the end of this report.

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Outcome 2 was assessed using four different assignments/projects in four different courses. Three courses cover three specific sub-disciplines, while the fourth is the culminating capstone experience. Those four courses are CVNG 3040—Sustainability and Environmental Engineering, CVNG 3120—Transportation Engineering Lab, CVNG 3160—Intro to Structural Design Lab, and CVNG 4500—Capstone Design I.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Outcome 5 was assessed using four different assignments in four different courses. Two courses cover one sub-discipline, while the third and fourth are the culminating capstone experiences. Those four courses are CVNG 3020—Structural Analysis Lab, CVNG 3160—Intro to Structural Design Lab, CVNG 4500—Capstone Design I, and CVNG 4510—Capstone Design II.

8) An ability to design a system, component, or process in more than one civil engineering context.

Outcome 8 was assessed using five different assignments/exams in three different courses that cover three respective sub-disciplines within civil engineering that focus on design along with the capstone design experience. Those four courses are CVNG 3110—Transportation Engineering, CVNG 3130—Hydraulic Engineering, CVNG 3150—Intro to Structural Design, and CVNG 4510—Capstone Design II.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Only two of the four assessment measures successfully met the benchmark of 80% for rubric score in the 2020-2021 academic year; however, all four assessment measures met the benchmark of 80% for raw score. Two of the three assessment metrics met the benchmark of 80% for rubric score in the 2021-2022 academic year, and all three met the benchmark of 80% for raw score. Assessment data for CVNG 3040 were not collected in the 2021-2022 academic year; however, assessment data were collected in the 2022-2023 academic year for this course and will be analyzed in the next assessment cycle. In terms of continuous improvements, the CVNG 3160 reinforced concrete frame project met the benchmark of 80% for the rubric score in 2021-2022 as the result of improvements made to the course. On the other hand, changes made to CVNG 3120 corridor traffic improvement project were not sufficient to meet the 80% for rubric score, and additional instructions about the project will be provided to the students in the following year. In comparison to the previous review cycles (2019-2020), the civil engineering program made progress toward improving students learning regarding Outcome 2.

Outcome 2 Assessment Results Summary for 2020-2021, 2021-2022 (Current)

	Course	CVNG 3040		CVNG 3120		CVNG 3160		CVNG 4500	
Year	Assess. Measure	Assignment on Water Quality for Human Consumption		Project on Evaluation and Assessment of Corridor Traffic Improvement		Reinforced Concrete Frame Project		Capstone Preliminary Design Alternatives Project Report	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
2020 - 2021	Average	48.67	2.87	81.36	1.63	68.07	1.71	93.5	2.25
	SD	3.58	0.35	9.24	0.50	3.66	0.82	3.12	0.38
	High	50	3	90	2	74	3	97	3
	Median	50	3	85	2	67	1.5	93.5	2
	Low	40	2	70	1	65	1	90	2
	Total Pts	50		100		80		100	
	≥ 70%	15		11		14		20	
	< 70%	0		0		0		0	
	% ≥ 70%	100		100		100		100	
	Target		2		2		2		2
	≥ 2		15		7		7		20
	< 2		0		4		7		0
	% ≥ 2		100		63.63		50		100
	Status	**Met**	**Met**	**Met**	**Not Met**	**Met**	**Not Met**	**Met**	**Met**
2021 - 2022	Average			89.19	1.76	26.71	3	89.43	2.18
	SD			3.74	0.44	1.65	0	3.03	0.25
	High			95	2	29	3	92	2.5
	Median			88	2	27	3	90	2
	Low			85	1	25	3	85	2
	Total Pts			100		30		100	
	≥ 70%			21		21		14	
	< 70%			0		0		0	
	% ≥ 70%			100		100		100	
	Target				2		2		2
	≥ 2				16		21		14
	< 2				5		0		0
	% ≥ 2				76.19		100		100
	Status	**Not**	**Reported**	**Met**	**Not Met**	**Met**	**Met**	**Met**	**Met**

Outcome 2 Assessment Results Summary for 2019-2020 (Previous)

	Course	CVNG 3040		CVNG 3120		CVNG 3160		CVNG 4500	
Year	Assess. Measure	Assignment on Water Quality for Human Consumption		Project on Evaluation and Assessment of Corridor Traffic Improvement		Reinforced Concrete Frame Project		Capstone Preliminary Design Alternatives Project Report	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
2019 - 2020	Average	6.45	2	88.16	1.79	74.94	2.17	94.19	2.286
	SD	2.24	0.67	5.326	0.42	5.59	0.38	2.60	0.46
	High	9.5	3	95	2	85	3	98	3
	Median	6.5	2	90	2	74	2	94	2
	Low	1	1	80	1	68	2	92	2
	Total Pts	10		100		90		100	
	≥ 70%	9		19		18		21	
	< 70%	10		0		0		0	
	% ≥ 70%	47.37		100		100		100	
	Target		2		2		2		2
	≥ 2		15		15		18		21
	< 2		4		4		0		0
	% ≥ 2		78.95		78.95		100		100
	Status	**Not Met**	**Not Met**	**Met**	**Not Met**	**Met**	**Met**	**Met**	**Met**

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

All four assessment measures successfully met the raw score and rubric score benchmark in the academic year 2020-2021, and three of the assessment measures met the benchmark for raw score and rubric score in the academic year 2021-2022. The CVNG 3160 reinforced concrete frame project did not meet the benchmark values in 2021-2022, and suggestions for future improvements were provided for the course. In comparison, only one raw score benchmark was not met for the previous assessment period (2019-2020 academic year).

Outcome 5 Assessment Results Summary for 2020-2021, 2021-2022 (Current)

	Course	CVNG 3040		CVNG 3012		CVNG 3016		CVNG 4500	
Year	Assess. Measure	Analysis Challenge #2		Reinforced Concrete Frame Project		Capstone Preliminary Design Alternatives		Capstone Final Design	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
2020 - 2021	Average	4.32	2	4.29	2	4.18	2.05	3.93	2.55
	SD	0.60	0	0.60	0.55	0.76	0.39	0.73	0.69
	High	5	2	5	3	5	3	4.75	3
	Median	4.4	2	4.43	2	4.3	2	3.9	3
	Low	3	2	2.7	1	2	1	2	1
	Total Pts	3.5		3.5		3.5		3.5	
	≥ 70%	10		12		18		16	
	< 70%	1		2		2		4	
	% ≥ 70%	90.91		85.71		90		80	
	Target		2		2		2		2
	≥ 2		11		12		19		18
	< 2		0		2		1		2
	% ≥ 2		100		85.71		95		90
	Status	**Met**	**Met**	**Met**	**Met**	**Met**	**Met**	**Met**	**Met**
2021 - 2022	Average	4.15	1.89	3.61	1.62	4.33	2	4.24	2.14
	SD	0.54	0.31	0.96	0.59	0.40	0	0.53	0.66
	High	4.8	2	5	3	4.93	2	5	3
	Median	4.2	2	3.8	2	4.2	2	4.15	2
	Low	2.5	1	1.3	1	3.6	2	3.5	1
	Total Pts	3.5		3.5		3.5		3.5	
	≥ 70%	17		13		14		14	
	< 70%	2		8		0		0	
	% ≥ 70%	89.47		61.90		100		100	
	Target		2		2		2		2
	≥ 2		17		12		14		12
	< 2		2		9		0		2
	% ≥ 2		89.47		57.14		100		85.71
	Status	**Met**	**Met**	**Not Met**	**Not Met**	**Met**	**Met**	**Met**	**Met**

Outcome 5 Assessment Results Summary for 2019-2020 (Previous)

	Course	CVNG 3020		CVNG 3016		CVNG 4500		CVNG 4510	
Year	Assess. Measure	Analysis Challenge #2		Reinforced Concrete Frame Project		Capstone Preliminary Design Alternatives		Capstone Final Design	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
	Average	4.17	2.06	4.30	2	4.07	1.95	3.92	1.90
	SD	0.44	0.25	0.28	0	0.51	0.22	0.67	0.44
	High	5	3	4.93	2	4.8	2	4.6	3
	Median	4.28	2	4.365	2	4.3	2	4.2	2
	Low	3.5	2	3.8	2	3	1	2.5	1
2019	Total Pts	3.5		3.5		3.5		3.5	
-	≥ 70%	16		18		18		15	
2020	< 70%	0		0		3		6	
	% ≥ 70%	100		100		85.71		71.43	
	Target		2		2		2		2
	≥ 2		16		18		20		18
	< 2		0		0		1		3
	% ≥ 2		100		100		95.24		85.71
	Status	**Met**	**Met**	**Met**	**Met**	**Met**	**Met**	**Not Met**	**Met**

8) An ability to design a system, component, or process in more than one civil engineering context.

In the 2020-2021 academic year, the raw score and rubric score measures successfully met the 80% benchmark in three courses. The exam question focused on the design of steel beams did not meet the raw score 80% benchmark, and the combined homework on pavement design and long-range transportation planning did not meet 80% benchmark for the rubric score. However, in the following 2021-2022 academic year, the long-range transportation planning met the 80% benchmark for the rubric score.

In the 2021-2022 academic year, three assessment measures met the raw score and rubric score 80% benchmark; however, the final exam questions focused on culvert design did not meet the rubric score benchmark, and the exam question focused on the design of steel beams did not meet the raw score and rubric score 80% benchmark. Improvements will be implemented in the courses to meet the benchmark in the following assessment period.
In comparison to the previous assessment period (2019-2020 academic year), there is an overall improvement in this outcome as previously only one course met both the raw score and rubric score 80% benchmark.

Outcome 8 Assessment Results Summary for 2020-2021, 2021-2022 (Current)

	Course	CVNG 3110		CVNG 3130		CVNG 3150		CVNG 3150		CVNG 4510	
Year	Assess. Measure	Combined HW on Pavement Design & Long-range Transportation Planning		Exam Questions Focused on Culvert Design		Exam Question Focused on the Design of Steel Beams		Exam Question Focused on the Design of Columns		Capstone Final Design	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
2020 - 2021	Average	27.73	1.73	13.12	1.92	12.08	2.25	17.62	2.33	90.35	2.65
	SD	4.101	0.47	1.42	0.51	2.79	0.75	2.84	0.78	4.73	0.49
	High	30	2	14.5	3	15	3	20	3	97	3
	Median	30	2	13.5	2	11.25	2	19	2.5	91	3
	Low	20	1	10	1	7.5	1	13	1	81	2
	Total Pts	30		15		15		20		100	
	≥ 70%	9		11		6		11		20	
	< 70%	2		1		6		1		0	
	% ≥ 70%	81.82		91.67		50		91.67		100	
	Target		2		2		2		2		2
	≥ 2		8		10		10		10		20
	< 2		3		2		2		2		0
	% ≥ 2		72.73		83.33		83.33		83.33		100
	Status	Met	Not Met	Met	Met	Not Met	Met	Met	Met	Met	Met
2021 - 2022	Average	27.75	1.81	21.5	1.55	8.7	1.4	16.18	1.85	92.43	2
	SD	4.80	0.40	2.44	0.60	3.28	0.68	2.41	0.49	1.65	0
	High	30	2	25	3	15	3	20	3	94	2
	Median	30	2	22	1.5	10	1	16.5	2	93	2
	Low	15	1	15	1	2.5	1	8.5	1	90	2
	Total Pts	30		25		15		20		100	
	≥ 70%	13		19		2		16		14	
	< 70%	3		1		18		4		0	
	% ≥ 70%	81.25		95		10		80		100	
	Target		2		2		2		2		2
	≥ 2		13		10		6		16		14
	< 2		3		10		14		4		0
	% ≥ 2		81.25		50		30		80		100
	Status	Met	Met	Met	Not Met	Not Met	Not Met	Met	Met	Met	Met

Outcome 8 Assessment Results Summary for 2019-2020 (Previous)

	Course	CVNG 3110		CVNG 3130		CVNG 3150		CVNG 3150		CVNG 4510	
Year	Assess. Measure	Combined HW on Pavement Design & Long-range Transportation Planning		Exam Questions Focused on Culvert Design		Exam Question Focused on the Design of Steel Beams		Exam Question Focused on the Design of Columns		Capstone Final Design	
	Scoring	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score	Raw Score	Rubric Score
2019 - 2020	Average	23.84	1.77	11.65	1.85	12.18	2.21	14.66	1.84	88.38	2.14
	SD	5.44	0.44	4.07	0.74	3.26	0.92	2.52	0.37	5.10	0.57
	High	29	2	15	3	15	3	18	2	97	3
	Median	27	2	13	2	15	3	15.5	2	87	2
	Low	15	1	0	1	5	1	7.5	1	82	1
	Total Pts	30		15		15		20		100	
	≥ 70%	9		17		10		13		21	
	< 70%	4		3		9		6		0	
	% ≥ 70%	69.23		85		52.63		68.42		100	
	Target		2		2		2		2		2
	≥ 2		10		13		13		16		19
	< 2		3		7		6		3		2
	% ≥ 2		76.92		65		68.42		84.21		90.47
	Status	**Not Met**	**Not Met**	**Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**	**Met**	**Met**	**Met**

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Independent Faculty Review

1. Outcome 2 is measured through multiple courses and activities. The civil engineering program has demonstrated improvement in the ABET rubric scores over the past three years. Multiple aspects of the assignments were modified to provide additional instruction and direction for the tasks. For the 2020-2021 assessments, two of the four did not meet the requirement; For the 2021-2022 assessments, only one did not meet the criteria, and that assessment had improved from 63% of the students meeting the criteria to 76%, which is just below the benchmark of 80%.
2. No critical weaknesses were identified in assessing this outcome. However, in three out of seven cases, the 80% benchmark for the rubric score was not met.
3. There are plans for future improvement. However, these plans could be further improved by providing additional details. For example, for the traffic impact assessment project that did not meet the threshold in 2021-2022, the improvement recommended for implementation includes providing a predefined structure for evaluating the project's impact within the final report.
4. The average rating for this outcome was a 3.0. The outcome was **moderately** met and has room for improvement.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Independent Faculty Review

1. The assessment outcome demonstrates that the program has overall strength in preparing students to function effectively on a team. Over the two-year period, only one activity was found not to meet the benchmark.
2. There are no apparent weaknesses in this outcome. The one assessment that was not met in 2021-2022 could be an outlier and may not indicate an overall trend. Further observations are needed in subsequent years. Conflict among team members or low performance by a few individuals resulted in an overall reduced score for some specific teams. This issue might stem from the fact that in engineering programs, teamwork is not typically taught.
3. Currently there is not improvement plan. However, if additional courses did not meet this outcome in future, teamwork skills training will be incorporated in the program curricula, which is an adequate approach to improving this outcome. Recently the introduction to civil engineering course was redeveloped and freshman who completed that course are expected to be well prepared for teamwork.
4. The average rating for this outcome was a 4.0. The outcome was **mostly** met, but has some room for improvement.

8) An ability to design a system, component, or process in more than one civil engineering context.

Independent Faculty Review

1. This outcome is assessed in several courses and activities. These activities span several courses and include homework assignments, exam questions, and final projects.
2. The activities associated with this outcome typically involve multiple steps to complete a calculation. A minor mistake in the process will lead to a low score in the assessment of this outcome. The rubrics for some of the assessment activities could be modified to account for minor mistakes. A minor calculation might not necessarily mean a student has not met the outcome, and rubrics could be modified to reflect this. Also, it is not clear if the materials used in different courses belong to the same cohort of students.
3. The proposed plans for improving the results of this outcome are adequate and could be further improved by providing additional details.
4. The average rating for this outcome was a 4.0. The outcome was **mostly** met and may have some room for improvement.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

Civil Engineering Program Meeting—ABET/HLC

Meeting Minutes

Monday November 7, 2022, 10:10 am - 11:00 am, MDD 2101

Attendance:
Present: Chris Carroll, Amanda Cox, Riyadh Hindi, Jalil Kianfar, and Ronaldo Luna
Absent: None
Visitors: None

1. **Meeting topic:** The topic of this meeting was focused on the Assessment Retreat portion of the Annual ABET/HLC Student Outcomes Assessment Process. The specific purpose was to evaluate the Faculty Review of Outcome 5 and Develop a Plan of Action that addresses any weaknesses that were identified during the assessment and review processes for this cycle.

2. **Review of Student Outcomes and Rubrics:** The Faculty Review process includes a self-assessment at the course level followed by an independent review of specific outcomes by a faculty member who did not contribute to that respective outcome. For the 2022 review, Dr. Cox was the independent reviewer for Outcome 5. Each independent reviewer was asked to answer the following questions:

   1) What are the critical program strengths identified in this outcome?
   2) What are the critical program weaknesses identified in this outcome?
   3) Are there suggested plans of action to improve the results of this outcome? If so, are they adequate?
   4) To what extent is the outcome met by the assessment measures on a scale of 1-5?
      (1 = Not at all, 2 = Slightly, 3 = Moderately, 4 = Mostly, 5 = Completely)

   The following sections summarize brief discussions and activities related to Outcome 5 during the meeting.

   Drs. Kianfar and Carroll presented an overview of the assessment process. Initially, independent reviewers reported on their assessment of ABET Outcome 5. Subsequently, instructors shared their suggested improvements for the courses, where applicable, which were followed by a discussion among the entire civil engineering faculty. Finally, the faculty collectively approved the action plan for addressing Outcome 5.

   Dr. Cox: The assessment data clearly demonstrate the overall strength of our program in preparing students to function effectively in a team setting. Over the past two years, only one assessment did not meet the ABET benchmark of 80% of students meeting the expectations. However, it is important to note that this particular assessment result may be an outlier and not indicative of an overall trend. Further observations and data collection in subsequent years are necessary to draw a more definitive conclusion. To enhance the performance of students in relation to Outcome 5, it is recommended to incorporate teamwork skills training into the program curriculum. This approach proves to be effective in improving student performance. In summary, while there is room for improvement, the program essentially meets the desired outcome.

   In summary, while the program has mostly achieved this outcome, improvements can be made by prioritizing the teaching of teamwork to enhance students' ability to effectively collaborate with their teammates while fulfilling their individual tasks.

   Dr. Carroll: During the 2020-2021 academic year in the structural analysis class, students demonstrated great teamwork despite the challenges posed by social distancing measures. This was particularly noteworthy as it was the first in-person semester since the pandemic began. However, one group encountered difficulties due to all members attending class remotely. In the subsequent year, the class successfully met the benchmark for both raw

scores and rubric scores. There were minor issues within one team, primarily due to a team member's introversion and lack of confidence in their work. Nevertheless, overall, the students exhibited strong collaborative abilities throughout the course. Unfortunately, the benchmark for both the raw score and rubric score was not met in this 2021-2022 year. The class experienced significant personality conflicts, which hindered the overall performance. Additionally, there were several below-average students in the class, some of whom displayed a weak work ethic, resulting in several individuals not meeting expectations. If these issues were to recur, it would be worth considering the implementation of formal teamwork skills training in the curriculum, despite it being less commonly offered in most programs. Overall, we are currently performing well in this outcome.

Dr. Luna: Every student is expected to contribute to the 30% design task, and they are evaluated by their peers via CATME and the faculty reviewer. The benchmarks were met in both years. The 2021-2022 graduating class was pretty well distributed in abilities and skills. The teamwork was pretty balanced, and particularly in the first half of the semester, teamwork was reasonable. A similar trend was observed in the assessment of students' group work for the final design task. In the 2020-2021 academic year, added stress imposed by COVID-19 of working remotely from home likely affected the team dynamics; however, students overcame these issues and worked well as a team. The 2021-2022 course was fully in-person, and students were very amenable to group work.

Dr. Carroll: With the redesigned introduction to civil engineering class, students begin working in teams from freshman year and are introduced to teamwork, group presentation, expectations, etc. With students getting exposed to teamwork so early, I think we can see more improvements during their junior and senior years. They have had more practice on group work by the time they are seniors.

Dr. Kianfar: The consensus among the faculty is that this outcome is being met, and the benchmarks were met in 7 out of 8 assessments. However, if this trend changes, the program should implement some form of teamwork skills training in the curriculum. At the moment, we do not need to implement a plan of action. I will write a summary of our discussion and suggestions and will share it with the faculty to vote on.

Civil Engineering Program Meeting—ABET/HLC

Meeting Minutes

November 16, 2022, 10:10 am - 11:30 am, MDD 2101

Attendance:
Present: Chris Carroll, Amanda Cox, Jalil Kianfar, Ronaldo Luna, and Riyadh Hindi (virtual)
Absent: None
Visitors: None

1. **Meeting topic:** The topic of this meeting was focused on the Assessment Retreat portion of the Annual ABET/HLC Student Outcomes Assessment Process. The specific purpose was to evaluate the Faculty Review of Outcomes 2 and 8 and Develop a Plan of Action that addresses any weaknesses that were identified during the assessment and review processes for this cycle.

2. **Review of Student Outcomes and Rubrics:** The Faculty Review process includes a self-assessment at the course level followed by an independent review of specific outcomes by a faculty member who did not contribute to that respective outcome. For the 2022 review, Drs. Cox and Hindi were the independent reviewers for Outcome 5, and Dr. Hindi was the independent reviewer for Outcome 8. Each independent reviewer was asked to answer the following questions:

   1) What are the critical program strengths identified in this outcome?
   2) What are the critical program weaknesses identified in this outcome?
   3) Are there suggested plans of action to improve the results of this outcome? If so, are they adequate?
   4) To what extent is the outcome met by the assessment measures on a scale of 1-5?
      (1 = Not at all, 2 = Slightly, 3 = Moderately, 4 = Mostly, 5 = Completely)

   Discussions related to outcome 2:

   Drs. Carroll and Kianfar provided an overview of the review process. The meeting focused on Outcome 2. Dr. Kianfar provided an overview of the data collected for CVNG 3040 Sustainability and Environmental Engineering, CVNG 3120 Transportation Engineering Lab, CVNG 3160 Introduction to Structural Design Lab, and CVNG 4500 Capstone Design I. Drs. Hindi and Cox were the independent reviewers for this outcome, and each had reviewed data for 2020-2021, and 2021-2022 academic years. Independent reviewers were invited to provide their review.

   Dr. Hindi mentioned assessing an outcome in one final exam question may not be the best practice, and students might not take the final exam seriously and might not come to the final exam well-prepared. This comment was regarding the final exam question in the CVNG 3040 Sustainability and Environmental; Engineering course. Dr. Cox mentioned having a final exam allows consistency in using the same or similar questions for assessment. Dr. Cox mentioned she had noticed the trend consistent with Dr. Hindi's comment, not specifically related to this outcome but some of the assessment instruments she uses in her classes . Some students do well throughout the semester but then do not do well in the final exam. Dr. Hindi agreed and mentioned in the future, we can revisit this topic. This is not an issue at the moment, but we need to monitor and make changes in the future if necessary. Dr. Kianfar commented he has noticed that in the assessments conducted in the last week of the semester, students are not very engaged as they are focusing on wrapping up projects and are preparing for final exams.

   Dr. Cox mentioned in reviewing the outcome 2 data, if we look at the available data, there was a demonstrated improvement between 2020-2021, and 2021-2022. Dr. Carroll mentioned in the first year the outcome was not met in two out of four, but the following year one outcome improved, and was met. Dr. Hindi raised concern about the CVNG 3040 assessment data not being reported. Dr. Kianfar mentioned there was a faculty retirement and data were not reported. We will make sure not collect the data in future years with the adjunct instructor and the future faculty hire.

Dr. Luna made a comment on the final exam question on water quality for human consumption, which is missing for the 2021-2022 academic year. Dr. Kianfar mentioned that instructor is no longer with the university and did not submit the data when the semester ended. Dr. Luna suggested that perhaps students' work could be recovered. Dr. Kianfar agreed to investigate the possibility and ensured to work with the 2022-2023 adjunct instructor to collect data and make sure that there will not be additional gaps in the assessment.

Dr. Kianfar shared the suggested improvements for CVNG 3120 Corridor Traffic Impact study. The instructor plans to provide more guidance to the students on how to consider a multitude of factors, such as cost, delay, and constructability when selecting the alternatives. He also plans to check in with the student throughout the project and provide feedback to make sure students have understood the project requirements correctly.

Dr. Carrol mentioned that in 2020-2021 the was met for the raw score on the project report but not on the rubric score. One group did not account for the negative moment at the end of the beam in their calculation for their predicted capacity, and one group did not submit a predicted value, which resulted in not meeting the expectations. This has been a consistent mistake for groups, and it appears that the mistake stems from students not confirming that they are approaching the problem correctly and calculations have not been due until the final project report. Based on these observations, students were required to submit their calculations well in advance for required feedback and then have an opportunity to submit their revised calculations prior to specimen testing and grading in 2021-2022.

Modifications to the project deliverables in the 2022 offering were beneficial and resulted in both outcomes being met. Each group was required to submit preliminary calculations, which were checked to ensure the correct processes were being used to calculate the cracking load and ultimate load. The groups were given one chance to revise their calculations and submit them before testing. This proved to be very beneficial as each group was able to make corrections and correctly predict the values for their specimen. The same process will remain in place in future offerings.

Dr. Luna mentioned all the benchmarks were met in the capstone design I. For the Conceptual Design (preliminary) for the senior capstone design project, students involved public welfare and safety, and environmental issues. The 2020-2021 projects were local, and the global issues were less prominent, mainly by the heritage of cultures. The report involved producing a minimum of 3 alternatives and selecting the preferred alternative. The teams were required to include a diverse number of issues that are presented when designing civil infrastructure improvements. Considering that that outcome was met, no changes were proposed for CVNG 4510 course.

Dr. Kianfar mentioned if there are any other comments from the faculty and if the faculty have additional comments about the improvement plans.

<u>Discussions related to Outcome 8:</u>

Dr. Hindi: We are doing great on this outcome. And there are no issues or concerns regarding the activities. We might also want to track the cohorts of students in each activity to identify if there is a specific cohort that is underprepared or any other issues so we can find what the contributing factors to an outcome not being met are. It would be great if instructors provided more details about their plan of action in their instructor comments section, especially when an outcome is not met. Dr. Carroll: Could you elaborate on what you mean by more detail? Dr. Hindi: I mean, how is it that an outcome is not being met, and what do we need to do to make it work for next time? Dr Carroll: We are already looking into why an outcome was not met and working to address the issue for next time. For example, in CVNG 3150, I give a question where they have to design a beam and pick the beam from the tables and the charts. Last year [two years ago], students did okay with this assessment; this past year the class did poorly on the question despite we actually building a beam in the lab, and all the demonstrations that were provided to them. I see what they are doing wrong, so I am restructuring the class in spring to devote a whole day to that topic. And I am not sure how much more detail I can add to the comments in the continuous

assessment document. Dr. Hindi: This is exactly what I am trying to say. You are doing well. This is what we should do.

Dr. Cox: In assessing students work for culvert design, If their calculation is wrong, but they assess the results correctly, I still give them partial credit. The real issue is how I have structured the rubric; If they make two math mistakes, they do not meet the outcome. Some are making math mistakes here and there, and the errors add up. It results in them not meeting the outcome. And this is a real thing. You can't make too many math mistakes in the real engineering profession, but I don't know if this is what we are trying to assess with this outcome. Maybe covid-19 was also a contributing factor to students' math skills. Dr. Carroll: One thing I learned from structural analysis problems was to focus on actually what I was trying to assess. There was a problem on virtual work, which is tied to the application of math and science. I was focused on the whole problem, and students were not meeting the outcome. Then, I re-wrote the problem where the assessment was telling me more about their math skills and can they actually apply the math. That is something worth looking into in some of these problems. Does our rubric correspond to what we are trying to assess, or is there too much going on the problem. Dr Kianfar: Regarding CVNG 3110 class, it seems the changes I made previously are working and I will be monitoring the results to see if the issues is actually addressed.

Dr. Kianfar: It seems like we have identified the areas of improvement. I will write the summary of the plan of action and will email it to you all so we can vote on it.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Artifacts of student learning • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

Please describe the actions you are taking as a result of these findings.

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Outcome 2 also implies an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Listed below are the detailed plans of action associated with each course for continuous improvement related to Outcome 2.

CVNG 3040 – Sustainability and Environmental Engineering: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 2.

CVNG 3120 – Transportation Engineering Lab: To improve this learning outcome, the instructor will provide students with examples of considering multiple decision-making factors in producing engineering solutions (e.g., economic, environmental). The instructor also plans to check in with the students at the midpoint of the project to provide feedback and ensure the expectations of the project are clear to students.

CVNG 3160 – Intro to Structural Design Lab: The project deliverables were modified in the 2022 offering. Each group was required to submit preliminary calculations, which were checked to ensure the correct processes were being used to calculate the cracking load and ultimate load. The groups were given one chance to revise their calculations and submit them before specimen testing. This proved to be very beneficial as each group was able to make corrections and correctly predict the values for their specimen. The same process will remain in place in future offerings.

CVNG 4500 - Capstone Design I: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 2. The preliminary design alternative report for the conceptual design continues to be challenging to the students. However, students raised to the occasion and met the outcome successfully. To develop the project from scratch (that is zero) information or instruction on how to create the concept. This report involved producing a minimum of 3 alternatives and selecting the preferred alternative. The teams were required to include a diverse number of issues that are presented when designing civil infrastructure improvements.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Listed below are the detailed plans of action associated with each course for continuous improvement related to Outcome 5.

CVNG 3020 – Structural Analysis Lab: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 5.

CVNG 3160 – Intro to Structural Design Lab: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 5. Students have been able to successfully complete group projects despite

the limitations resulting from social distancing. The two students who did not meet expectations were both impacted by transportation issues and also attended all other classes virtually.

CVNG 4500 – Capstone Design I: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 5.

CVNG 4510 – Capstone Design II: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 5. It is worth to mention the added stress imposed by COVID-19 of working remotely from home likely affected the team dynamics. Even with the challenges of working remotely, the class as a whole did very well

8) An ability to design a system, component, or process in more than one civil engineering context.

Listed below are the detailed plans of action associated with each course for continuous improvement related to Outcome 8.

CVNG 3110 – Transportation Engineering: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 8. The instructor plans to move the deadline for this assignment to a week earlier in the semester to avoid last week's rush to make sure all the students submit the assignment.

CVNG 3130 – Hydraulic Engineering: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 8. However, if the outcome is not met in the 2022-2023 academic year, the rubric will be modified. A primary contributing factor was the students made multiple minor mistakes, such as math errors or using incorrect coefficients. The rubric only allows for two minor errors, which caused many of the students to receive a 1 score despite having the correct approach. Had the assessment allowed for three errors, five additional students would have met the benchmark. The problem has multiple steps and opportunities for errors. If the metric continues to not be met in future evaluations, modifying the rubric to allow for more minor mistakes is recommended.

CVNG 3150 – Introduction to Structural Design: For the exam question focused on design of beams, one additional session will be dedicated to the bean design process. Students seem to make mistakes in choosing the correct beam size. Particularly, students consistently select the wrong beam size for a fully braced condition. The additional class time on beam selection aims to address these mistakes. For the exam question focused on design of columns, the 80% benchmark for raw score and rubric score were met for this outcome. However, the course will be restructured slightly in the spring of 2023 to spend more time on the effect of slenderness ratios and will likely include the use of Mola Structural Models in addition to the use of the experiential learning modules in the structures lab to illustrate the concept. This goal is to prevent minor mistakes by the students on this topic.

CVNG 4510 – Capstone Design II: There is no continuous improvement planned for the 2022-2023 academic year in this course with respect to Outcome 8.

If no changes are being made, please explain why.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

One particular change made in CVNG 3160 for Outcome 2:

The Plan of Action from the 2019/2020 academic year stated, "The constraints associated with the reinforced concrete frame project align with a specified need and consider the public safety and welfare (on a small-scale) and the economics (by limiting the weight, the cost would be directly limited). Students were able to complete the design for ultimate load, but they struggled with combining different analysis and design methods. In particular, they still struggle to understand why the maximum moment in the beam of the frame is not PL/4. Future offerings of this project will include a brief review of virtual work and the force method coupled with more guidance on how it applies in this specific context. The instructor also recognized an opportunity to incorporate the use of more modern engineering tools during the design process."

B. How has this change/have these changes been assessed?

The changes were assessed in the 2021-2022 academic year through normal assessment activities:

The project deliverables were modified in the spring 2022 offering. Each group was required to submit preliminary calculations, which were checked to ensure the correct processes were being used to calculate the cracking load and ultimate load. The groups were given one chance to revise their calculations and submit them before specimen testing. This proved to be very beneficial as each group was able to make corrections and correctly predict the values for their specimen. The same process will remain in place in future offerings.

C. What were the findings of the assessment?

In the 2020-2021 academic year, 100% of students scored at least a 70% on the design problem but only 50% scored at least a 2 (satisfactory) on the corresponding rubric. In the 2021-2022 academic year, 100% of students scored at least 70% on the design problem and scored at least a 2 (satisfactory) on the corresponding rubric.

D. How do you plan to (continue to) use this information moving forward?

Future assessment data will provide continued information regarding these changes and will allow for further enhancements.

IMPORTANT: Please submit any assessment tools and/or revised/updated assessment plans along with this report.

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors1

Course: CVNG 3040 – Sustainability and Environmental Engineering
Performance Measure: Assignment on Water Quality for Human Consumption

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Water hardness fractions were calculated incorrectly or with significant math errors. **OR** Dosages of soda ash and lime calculated incorrectly or with significant math errors.	Water hardness fractions were calculated with only very minor math or unit errors. **AND** Dosages of soda ash and lime were calculated with only very minor math or unit errors.	Water hardness fractions were calculated correctly or with only very minor math or unit errors. **AND** Dosages of soda ash and lime were calculated correctly or with only very minor math or unit errors.

Course: CVNG 3120 – Transportation Engineering Lab
Performance Measure: Evaluation and assessment of corridor traffic improvement lab

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Students were able to propose, model, and evaluate three corridor traffic improvement alternatives **AND** Students selected the preferred alternative only based on improvements in the traffic performance measures.	Students were able to propose, model, and evaluate three corridor traffic improvement alternatives **AND** Students selected the preferred alternative based on • Improvements in the traffic performance measures • Costs and right-of-way constraints • Environmental impacts	Students were able to propose, model, and evaluate three corridor traffic improvement alternatives **AND** Students selected the preferred alternative based on • Improvements in the traffic performance measures • Costs and right-of-way constraints • Environmental impacts **AND** Students select the preferred alternative by taking into account: • Social factors (impact on access to transit) • Sustainability factors (such as accommodating cyclists or including storm water bioretention in the corridor)

Course: CVNG 3160 – Intro to Structural Design Lab
Performance Measure: Reinforced Concrete Frame Project

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The virtual work/force method calculations have significant errors (e.g. integration is blatantly incorrect) or steps in the process are missing completely. **OR** The ultimate flexural strength calculations have significant errors (e.g. Mn is wrong) or the nominal strength is calculated correctly but the ultimate flexural strength is determined by setting the nominal flexural strength equal to PL/4 rather than account for negative moment capacity at the ends. **OR** The shear calculations are missing or have significant errors.	The virtual work/force method calculations are mostly correct with only minor mistakes (e.g. unit errors, dimensional errors, wrong moment of inertia) but the cracking load is determined by setting cracking moment equal PL/4 rather than using the virtual work/force method calculations. **OR** The ultimate load is predicted incorrectly because of minor errors (e.g. unit errors) in the flexural strength calculations or shear calculations or the wrong failure mechanism is selected.	The virtual work/force method calculations are correct with only minimal mistakes (e.g. unit errors) and the process to calculate the cracking load is correct using the results from the virtual work/force method calculations. **AND** The ultimate load is predicted correctly accounting for flexure in the beam (including negative moment at the ends) and shear in the beam with only minimal mistakes (e.g. unit errors).

Course: CVNG 4500 – Capstone Design I
Performance Measure: Capstone Preliminary Design Alternatives Project Report

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The report exhibits that the engineering design produced a solution that did not consider aspects of public safety and welfare. The design did not consider social, cultural, environmental, global, and economic factors.	The report exhibits that the engineering design produced a solution that meets public safety and welfare. The design considered social, cultural, environmental, global, or economic factors. Only some of the aspects of the design included these considerations.	The report exhibits that the engineering design produced a solution that meets public safety and welfare. The design considered social, cultural, environmental, global, and economic factors. Most of the aspects of the design included these considerations.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Course: CVNG 3020 – Structural Analysis Lab
Performance Measure: Analysis Challenge #2 focused on estimating loads and determining load paths

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Peer evaluation comments note that the team member: 1) did not do their portion of the work, 2) did not complete their tasks on time, 3) was disrespectful of other teammates, or 4) disrupted progress on the task. **OR** The CATME results listed the following "Exceptional Conditions" Manipulator (Manip) Low Performer (Low) Cliques (Cliq) Conflict (Conf)	Peer evaluation comments note that the team member: 1) did their portion of the work, 2) was easy to work with, 3) encouraged other teammates, 4) completed their tasks on time, and 5) was respectful of other teammates.	Peer evaluation comments note that the team member: 1) lead the team forward, 2) proactively helps other team members complete their tasks, 3) motivates and encourages other team members, 4) completed their tasks at a level of excellence, or 5) went above and beyond. **AND** The CATME results listed the following "Exceptional Conditions" High Performer (High)

Course: CVNG 3160 – Intro to Structural Design Lab
Performance Measure: Reinforced Concrete Frame Project

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Peer evaluation comments note that the team member: 1) did not do their portion of the work, 2) did not complete their tasks on time, 3) was disrespectful of other teammates, or 4) disrupted progress on the task. **OR** The CATME results listed the following "Exceptional Conditions" Manipulator (Manip) Low Performer (Low) Cliques (Cliq) Conflict (Conf)	Peer evaluation comments note that the team member: 1) did their portion of the work, 2) was easy to work with, 3) encouraged other teammates, 4) completed their tasks on time, and 5) was respectful of other teammates.	Peer evaluation comments note that the team member: 1) lead the team forward, 2) proactively helps other team members complete their tasks, 3) motivates and encourages other team members, 4) completed their tasks at a level of excellence, or 5) went above and beyond. **AND** The CATME results listed the following "Exceptional Conditions" High Performer (High)

Course: CVNG 4500 – Capstone Design I
Performance Measure: Capstone Preliminary Design Alternatives Project

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Peer evaluation comments note that the team member: 1) did not do their portion of the work, 2) did not complete their tasks on time, 3) was disrespectful of other teammates, or 4) disrupted progress on the task. **OR** The CATME results listed the following "Exceptional Conditions" Manipulator (Manip) Low Performer (Low) Cliques (Cliq) Conflict (Conf)	Peer evaluation comments note that the team member: 1) did their portion of the work, 2) was easy to work with, 3) encouraged other teammates, 4) completed their tasks on time, and 5) was respectful of other teammates.	Peer evaluation comments note that the team member: 1) lead the team forward, 2) proactively helps other team members complete their tasks, 3) motivates and encourages other team members, 4) completed their tasks at a level of excellence, or 5) went above and beyond. **AND** The CATME results listed the following "Exceptional Conditions" High Performer (High)

Course: CVNG 4510 – Capstone Design II
Performance Measure: Capstone Final Design

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Peer evaluation comments note that the team member: 1) did not do their portion of the work, 2) did not complete their tasks on time, 3) was disrespectful of other teammates, or 4) disrupted progress on the task. **OR** The CATME results listed the following "Exceptional Conditions" Manipulator (Manip) Low Performer (Low) Cliques (Cliq) Conflict (Conf)	Peer evaluation comments note that the team member: 1) did their portion of the work, 2) was easy to work with, 3) encouraged other teammates, 4) completed their tasks on time, and 5) was respectful of other teammates.	Peer evaluation comments note that the team member: 1) lead the team forward, 2) proactively helps other team members complete their tasks, 3) motivates and encourages other team members, 4) completed their tasks at a level of excellence, or 5) went above and beyond. **AND** The CATME results listed the following "Exceptional Conditions" High Performer (High)

8) An ability to design a system, component, or process in more than one civil engineering context.

Course: CVNG 3110 – Transportation Engineering
Performance Measure: Combined homework assignment on pavement design and long-range transportation planning

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Student was not able to identify the process of roadway infrastructure design (i.e., long-range demand modeling informs pavement design) **OR** Student was not able to determine user equilibrium volumes (transportation planning) **OR** Student was not able to determine for equivalent single axle loads (pavement design)	Student recognized the process of infrastructure design **AND** Student was able to determine user equilibrium volumes on each path (transportation planning) **AND** Student determined the equivalent single axle loads (pavement design) on each road	Student recognized the process of infrastructure design **AND** Student was able to determine user equilibrium volumes on each path (transportation planning) **AND** Student determined the equivalent single axle loads (pavement design) on each road **AND** Student discussed the trade-offs between travel time and pavement design

Course: CVNG 3130 – Hydraulic Engineering
Performance Measure: Exam question focused on culvert design

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Missing complete assessments for both inlet or outlet control hydraulic conditions. **OR** Analysis procedures include more than three general errors such as math errors, incorrectly assigning values for calculation variables, or misinterpreting final calculated results.	Applies correct calculation procedures for evaluating hydraulic conditions for both inlet and outlet control. **AND** With no more than two of the following conditions: 1. No more than one error associated with math calculations (e.g., missing exponent or error during calculator input). 2. No more than one error in assigning variable values (e.g., selecting incorrect inlet coefficient based on approach conditions). 3. Results are interpreted incorrectly when determining if the design is acceptable based on maximum allowable upstream water surface elevation.	Applies correct calculation procedures for evaluating hydraulic conditions for both inlet and outlet control. **AND** Calculations for evaluating upstream water surface elevation are correct with no errors. AND Results are interpreted correctly to determine if the design is acceptable based on maximum allowable upstream water surface elevation.

Course: CVNG 3150 – Introduction to Structural Design
Performance Measure: Exam question focused on design of steel beams

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Calculated the design moment correctly or incorrectly because of a minor error (e.g. used the wrong load combination, reduced M_u with a strength reduction factor, made a math error), but did not select the correct beam size for the beam with full lateral support. **OR** Calculated the design moment correctly or incorrectly because of a minor error (e.g. used the wrong load combination, reduced M_u with a strength reduction factor, made a math error), and selected the correct beam size for the beam with full lateral support, but selected an inadequate beam size for the beam with an unbraced length of 15 ft. **OR** Calculated the design moment (M_u) incorrectly because of a major error (e.g. did not factor the loads, used the wrong equation for maximum moment).	Calculated the design moment correctly and selected the correct beam size for the beam with full lateral support, but selected an overly conservative beam size for the beam with an unbraced length of 15 ft. **OR** Calculated the design moment (M_u) incorrectly because of a minor error (e.g. used the wrong load combination, reduced M_u with a strength reduction factor, made a math error), but selected the correct beam size for **BOTH** of the given unbraced lengths (L_b = 0 and L_b = 15 ft) based on the incorrectly calculated design moment.	Calculated the design moment correctly. **AND** Selected the correct beam size for **BOTH** of the given unbraced lengths (L_b = 0 and L_b = 15 ft)

Course: CVNG 3150 – Introduction to Structural Design
Performance Measure: Exam question focused on design of columns

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Calculated the slenderness ratios correctly for the x-axis and the y-axis, but calculated the design strength of the column incorrectly (e.g. used the wrong axis, used the wrong equation, left off the strength reduction factor, used the wrong effective length in Table 4-1a). **OR** Calculate the slenderness ratio(s) incorrectly (e.g. wrong K value or units error), and calculated the design strength of the column incorrectly (e.g. used the wrong axis, used the wrong equation, left off the strength reduction factor, used the wrong effective length in Table 4-1a).	Calculated the slenderness ratio(s) incorrectly (e.g. wrong K value or units error), but calculated the design strength of the column correctly based on the controlling ratio or correctly used Table 4-1a to determine the design strength based on effective lengths.	Calculated the slenderness ratios correctly for the x-axis and the y-axis. **AND** Calculated the design strength of the column correctly based on the controlling slenderness ratio or used Table 4-1a to determine the design strength.

Course: CVNG 4510 – Capstone Design II
Performance Measure: Capstone Final Design

1 – Does not meet expectations	**2 – Meets expectations**	**3 – Exceeds expectations**
The design project as seen on the report, plans, and specifications do not show a combination of different disciplines in civil engineering. Some components that are essential are missing and they are not combined into an engineered built system.	The design project as seen on the report, plans, and specifications shows an adequate combination of different disciplines in civil engineering. The components from different disciplinary areas are present but lack in being effectively combined into an engineered built system.	The design project as seen on the report, plans, and specifications shows excellent combination of different disciplines in civil engineering. The components from different disciplinary areas are clearly assembled into one engineered built system.