Program-Level Assessment Plan

Program: Civil Engineering	Degree Level (e.g., UG or GR certificate, UG major, master's program, doctoral program): UG major
Department: School of Engineering	College/School: Parks College of Engineering, Aviation & Technology
Date (Month/Year): January 2021	Primary Assessment Contact: Dr. Chris Carroll

Note: Each cell in the table below will expand as needed to accommodate your responses.

#	Student Learning Outcomes What do the program faculty expect all students to know or be able to do as a result of completing this program? Note: These should be measurable and manageable in number (typically 4-6 are sufficient).	Curriculum Mapping In which courses will faculty intentionally work to foster some level of student development toward achievement of the outcome? Please clarify the level at which student development is expected in each course (e.g., introduced (I), developed (D), reinforced (R), achieved (A), etc.).	Assessment Methods	
			Artifacts of Student Learning (What) 1. What artifacts of student learning will be used to determine if students have achieved this outcome? 2. In which courses will these artifacts be collected?	Evaluation Process (How) 1. What process will be used to evaluate the artifacts, and by whom? 2. What tools(s) (e.g., a rubric) will be used in the process? Note: Please include any rubrics as part of the submitted plan documents.
1	An ability to identify, formulate, and solve complex civil engineering problems by applying principles of engineering, science, and mathematics in more than one context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).	CVNG 3010 Structural Analysis () CVNG 3040 Sustainability and Env. Eng. () CVNG 3110 Transportation Engineering () CVNG 3130 Hydraulic Engineering ()	CVNG 3010 – Exam question on the Force Method and Virtual Work CVNG 3040 – Graded assignment on stoichiometry CVNG 3110 – Graded assignment on geometric roadway design CVNG 3130 – Final exam question on backwater modeling	The assessment of student outcomes incorporates a six-step cyclic process as described on page 4: 1) Outcomes Assessment, 2) Assessment Results, 3) Faculty Review, 4) Assessment Retreat, 5) Plan of Action, and 6) Implement Plan of Action.
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.	CVNG 3040 Sustainability and Env. Eng. () CVNG 3120 Transportation Engineering Lab () CVNG 3160 Intro to Structural Eng. Lab () CVNG 4500 Capstone Design I (A)	CVNG 3040 – Assignment on water quality for human consumption CVNG 3120 – Evaluation and assessment of traffic improvement lab CVNG 3160 – Reinforced concrete frame project CVNG 4500 – Capstone preliminary design alternatives project report	Same as above

3	An ability to communicate effectively with a range of audiences.	CVNG 3020 Structural Analysis (R) CVNG 3140 Hydraulic Engineering (R) CVNG 4500 Capstone Design I (A) CVNG 4510 Capstone Design II (A)	CVNG 3020 – Final Project Oral Presentation and Report CVNG 3140 – Water Resources and Entrepreneurship Presentation CVNG 4500 – Capstone Preliminary Design Alternatives Project Presentation and Report CVNG 4510 – Capstone Final Design Project Presentation and Report	Same as above
4	An ability to recognize ethical and professional responsibilities in civil engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	PHIL 3400 Engineering Ethics (I) CVNG 3040 Sustainability and Env. Eng. (I) CVNG 3120 Transportation Engineering Lab (R) CVNG 3140 Hydraulic Engineering Lab (R)	PHIL 3400 – Final overall grade CVNG 3040 – Term Paper on Climate Change CVNG 3120 – Project on Transportation News CVNG 3140 – Social justice presentation including economic, environmental, and societal contexts	Same as above
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 Structural Analysis Lab (D) CVNG 3160 Intro to Structural Design Lab (R) CVNG 4500 Capstone Design I (A) CVNG 4510 Capstone Design II (A)	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	Same as above
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions in more than one civil engineering context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).	CVNG 3030 Civil Engineering Materials (D) CVNG 3041 Sustainability and Env. Eng. (D) CVNG 3100 Geotechnical Engineering Lab (R) CVNG 3140 Hydraulic Engineering Lab (R)	CVNG 3030 – Fiber-reinforced Concrete Bowling Ball Project CVNG 3041 – Total carbonate and non-carbonate hardness of tap water laboratory CVNG 3100 – Hydraulic conductivity of soils laboratory CVNG 3140 – Pump characteristics curves laboratory	Same as above

7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	CVNG 4500 Capstone Design I (D) CVNG 4510 Capstone Design II (R)	CVNG 4500 – Assignment on Design Criteria CVNG 4510 – Assignment on pursuit of external resources not typically taught in classes	Same as above
8	An ability to design a system, component, or process in more than one civil engineering context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).	CVNG 3110 Transportation Engineering (I/D) CVNG 3130 Hydraulic Engineering (I/D) CVNG 3150 Intro to Structural Design (I/D) CVNG 4510 Capstone Design I (A)	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	Same as above
9	An ability to explain basic concepts in management, business, public policy, and leadership.	CVNG 3040 Sustainability and Env. Eng. (I) CVNG 3070 Project Management (I/D) CVNG 3100 Geotechnical Engineering Lab (D)	CVNG 3040 – Term paper on climate change CVNG 3070 – Graded assignment on project management CVNG 3070 – Exam question on project management CVNG 3100 – Consolidation lab with project management focus	Same as above

Use of Assessment Data

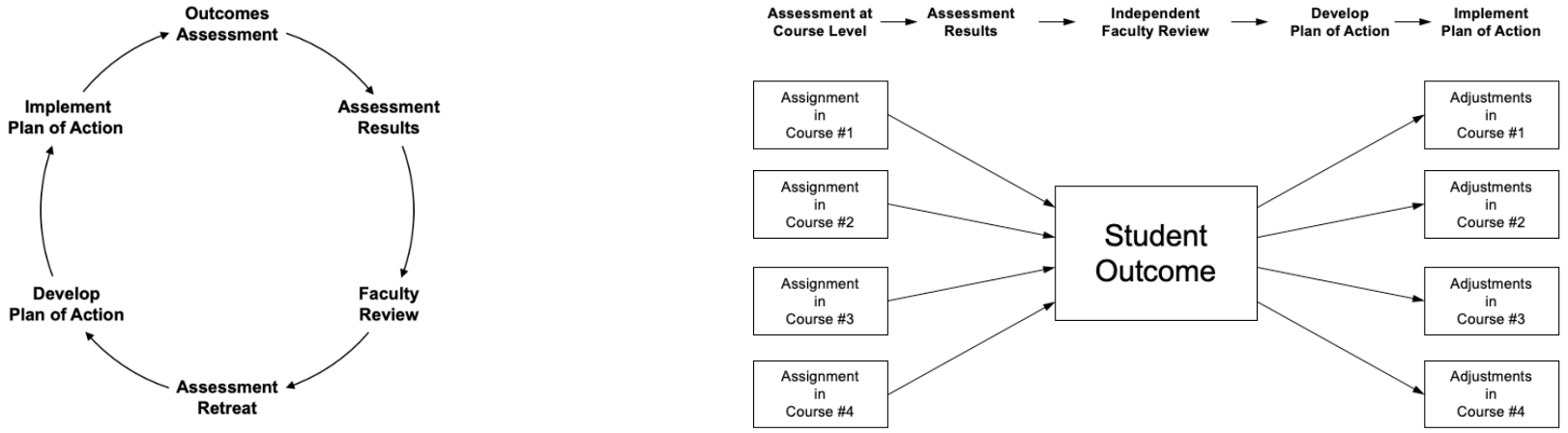
1. How and when will analyzed data be used by program faculty to make changes in pedagogy, curriculum design, and/or assessment practices?

Faculty review of the student outcomes will occur on an annual basis and uses data from student work and specific assessment rubrics. During this annual cycle, the Civil Engineering Faculty will assess student work from their respective courses in the context of each student outcome, perform independent reviews of outcomes not associated with their courses and recommend potential changes to the curriculum, develop a collective plan of action to address any concerns, and implement that plan of action in the following academic year. Data for each student outcome is collected each academic year. However, the independent faculty review and plan of action development focuses on three student outcomes per year. This process will continue on a three-year cycle ensuring that each student outcome is reviewed in-full twice during a six-year period to accommodate all accreditation needs. The six-step process is described below:

- *Outcomes Assessment* includes reviews of various assignments used as assessment measures for each of the nine student outcomes. The review is first conducted by the instructor of each respective course that contained the assignments based on student performance and faculty developed rubrics. Occurs every year for each student outcome and the data will be compiled in three-year sets.
- *Assessment Results* include an overall summary organized by student outcome including statistics and faculty comments associated with each specific assignment. Occurs every year for each student outcome and the data will be compiled in three-year sets.
- The *Faculty Review* is an independent review of each outcome by two faculty members within the program that did not contribute any data to that outcome. Both faculty members provide a response based on their independent reviews. The data from three select outcomes are reviewed each year, which will generally include three-year data sets for each outcome.
- The *Assessment Retreat* is a meeting with all Civil Engineering Faculty to develop collective responses for continuous improvement related to each of the nine student outcomes. The deliverable from the Assessment Retreat is the Plan of Action. Occurs every year for three select outcomes on a three-year cycle.
- The *Plan of Action* is a comprehensive plan for the upcoming academic year to continuously improve the program. An annual plan of action will only cover the three select outcomes for that given year.
- *Implement Plan of Action* will occur beginning in the fall of a subsequent academic year.

2. How and when will the program faculty evaluate the impact of assessment-informed changes made in previous years?

The continuous improvement approach will maintain a review cycle involving a long-term feedback loop occurring every three years, while other assessment, such as outcome achievement, will be evaluated on a one-year cycle. Thus, data for changes made to the curriculum will include three-year data sets each review cycle moving forward. Fig. 1(a) shows the general review cycle for student outcomes and Fig. 1(b) shows a linear representation from the assessment at the course level, through the independent faculty review of a student outcome as a whole, concluding with the plan of action implementation.



(a) (b)

Fig. 1—(a) General annual review cycle for student outcomes and (b) linear representation of assessment to plan of action implementation.

Additional Questions

1. On what schedule/cycle will program faculty assess each of the program's student learning outcomes? (Please note: It is not recommended to try to assess every outcome every year.)

As previously noted, the data is collected and assessed at the course level each year, but the outcomes as a whole will be reviewed in three sets every three years as listed below:

2020-2021: Outcomes 1, 4, 7
2021-2022: Outcomes 2, 5, 8
2022-2023: Outcomes 3, 6, 9
2023-2024: Outcomes 1, 4, 7
2024-2025: Outcomes 2, 5, 8
2025-2026: Outcomes 3, 6, 9

2. Describe how, and the extent to which, program faculty contributed to the development of this plan.

The Civil Engineering Program faculty met on November 6, 2019 to finalize the assessment approach. Listed below are excerpts taken from the meeting minutes.

- The Civil Engineering Program faculty reviewed the *Civil Engineering Revised Assessment Plan*, which included assessment of three outcomes every three years. Dr. Lebeau (Parks Assessment Coordinator) suggested for the program to collect data every year and assess as appropriate every two-three years.

- **Assessment Rubrics:** Dr. Carroll has spoken with other program coordinators and the Director regarding the process and most recently met with Dr. Lebeau (Parks Assessment Coordinator). Electrical and Computer Engineering currently use assessment rubrics with three levels: 1 – Does not meet expectations, 2 – Meets expectations, and 3 – Exceeds expectations. Dr. Lebeau agreed that three levels within a rubric would be sufficient for the any newly developed Civil Engineering rubrics. Dr. Carroll proposed that Civil Engineering develop rubrics similar to Electrical and Computer Engineering to better align with the School of Engineering's anticipated direction for assessment.

  Dr. Carroll presented a draft rubric used to assess an exam problem in CVNG 3010 focused on virtual work. This particular assignment will be used to assess Outcome 1. The rubric followed the same format as those used by Electrical and Computer Engineering. The draft rubric received positive feedback among the civil program faculty.

- **CATME Team Evaluation Tool:** The School of Engineering purchased CATME access for the School to use for Teamwork assessment. The civil engineering program is currently using CATME in CVNG 3020 and CVNG 4500 to evaluate teamwork on various projects for assessment and will also use CATME in CVNG 3160 and CVNG 4510 in the spring semester for additional assessment. CATME is available for any faculty member to use within the School of Engineering. Faculty members who wish to use CATME should sign up for an instructor account at: https://www.catme.org/login/request.

Dr. Carroll presented a sample of the CATME results from CVNG 3020 along with a draft rubric for teamwork loosely based on the AAC&U teamwork value rubric. The CATME results include scores in five different categories for each individual student along with peer comments.

- **Discussion of Outcome Binders:** Two representative binders for Outcome 1 and Outcome 5 were presented to the Civil Engineering Program faculty. All student work used for assessment along with the actual assessment will be placed in each respective binder. The binder for each outcome will include a tab for each course from which the assessment was taken along with divisions for each academic year that materials were recorded and assessed. The outcome binders will be housed in the Civil Engineering Adjunct Office.

- **Rubric Development:** The Civil Engineering Program faculty agreed to develop the rubrics for the assignments selected for assessment in their respective courses. The rubric development tasks are listed in Table 1. Dr. Luna volunteered to develop the General Written Communication rubric and Dr. Carroll volunteered to develop the Oral Communication rubric, both of which will be developed based on the corresponding AAC&U value rubrics. While those rubrics will be developed in their general form, they may need further modifications to align with a specific assignments in a specific course. Each capstone design advisor will complete the written communication rubric for their respective group and all faculty attending the Capstone presentations will complete the oral communication rubric for every group.

Table 1—Rubric Development Tasks

Adams	Carroll	Cox	Kianfar	Luna
Stoichiometry Assignment (1)	Virtual work exam question (1)	Backwater modeling final exam question (1)	Exam question on simple frames or machines (1)	Assignment on project management (9)
Water quality assignment (2)	Force method exam question (1)	Culvert design exam question (8)	Geometric roadway design assignment (1)	Project management exam question (9)
Term paper (4)	General Oral Communication (3)	Social justice presentation (4)	Pavement design & long-range trans. planning (8)	Hydraulic conductivity of soils lab (6)
Term paper (9)	General Teamwork (5)	Pump characteristics curves lab (6)	Eval. and assessment of corridor traffic imp. (2)	Consolidation lab with proj. mang. focus (9)
Total carbonate and non-carbonate lab (6)	Fiber-reinforced concrete project (6)		Transportation news project (4)	Capstone prelim. design alt. project report (2)
	Steel beam design exam question (8)			General Written Communication (3)
	Steel column design exam question (8)			Design criteria assignment (7)
	Reinforced concrete frame project (2)			Pursuit of external resources assignment (7)
				Capstone final design (8)

Note: number in parentheses corresponds to ABET outcome

IMPORTANT: Please remember to submit any rubrics or other assessment tools along with this plan.

Outcome1: An ability to identify, formulate, and solve complex civil engineering problems by applying principles of engineering, science, and mathematics in more than one context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).

Course: CVNG 3010 – Structural Analysis
Performance Measure: Exam question on the method of virtual work

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The virtual load is applied at the wrong location or the moment equations are incorrect due to a major error or multiple minor errors (e.g. omitted the distributed load, sums the moments about the wrong point) **OR** The integration calculation is grossly incorrect (e.g. integration method is wrong, limits are wrong)	The virtual load is applied at the correct location. The moment equations for the real and virtual loads are mostly correct with no more than two minor errors (e.g. wrong sign, wrong moment arm). **AND** The integration calculation is correct with no more than one minor math error (e.g. wrong sign, forgot to divide by the added exponent)	The virtual load is applied at the correct location. The moment equations are correct, and symmetry is used to solve the problem. **AND** The integration calculation is correct with no math errors.

Course: CVNG 3010 – Structural Analysis
Performance Measure: Exam question on the force method

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The virtual load calculations are incorrect on "Structure 1" (e.g. the virtual load is applied at the wrong location, the moment equations or integration are incorrect due to a major error or multiple minor errors). **OR** The virtual load calculations are incorrect on "Structure 2" (e.g. the virtual load is applied at the wrong location, the moment equations or integration are incorrect due to a major error or multiple minor errors).	The virtual work calculations are mostly correct on "Structure 1." Specifically, the moment equations for the real and virtual loads and the integration calculation are mostly correct with only minor errors (e.g. wrong sign, wrong moment arm, forgot to divide by the added exponent). **AND** The virtual work calculations are mostly correct on "Structure 2." Specifically, the moment equations for the real and virtual loads and the integration calculation are mostly correct with only minor errors (e.g. wrong sign, wrong moment arm, forgot to divide by the added exponent).	The virtual work calculations are almost entirely correct for both structures with no more than a total of two minor errors (e.g. wrong sign). **AND** The reactions are calculated correctly based on the results from the virtual work calculations used to solve for the redundant reaction.

Course: CVNG 3040 – Sustainability and Environmental Engineering
Performance Measure: Final exam question on water treatment plant claifier design

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Dimensions of clarifier was calculated incorrectly or with significant math errors. **OR** Calculation of critical settling velocity was calculated incorrectly or with significant math errors.	Dimensions of clarifier calculated using correct procedure with only very minor math or unit errors. **AND** Calculation of critical settling velocity was correct with only very minor math or unit errors.	Dimensions of clarifier calculated correctly. **AND** Calculation of critical settling velocity was correct with no or very minor math errors.

Course: CVNG 3110 – Transportation Engineering
Performance Measure: Graded assignment on geometric roadway design

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Students was not able to identify or formulate the trigonometric and geometric relationship between elements of a horizontal curve (radius of curve, length of curve, and central angle of the curve) **OR** Student recognized the trigonometric and geometric relationships between elements of a horizontal curve, but was not able to solve for all of the design elements	Students was able to identify and formulate the trigonometric and geometric relationship between elements of a horizontal (radius of curve, length of curve, and central angle of the curve) **AND** Student was able to solve for all of the design elements	Students was able to identify and formulate the trigonometric and geometric relationship between elements of a horizontal (radius of curve, length of curve, and central angle of the curve) **AND** Student was able to solve for all of the design elements **AND** Student developed the geometric design equations.

Course: CVNG 3130 – Hydraulic Engineering
Performance Measure: Final exam question on backwater modeling

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The water surface profile classification is incorrect (e.g., M1, M2, M3, S1, S2, or S3). **OR** The elevation change along the water surface profile is applied in the wrong direction (upstream for subcritical flow and downstream for supercritical flow).	The water surface profile classification is correct, and the elevation change along the water surface profile is applied in the correct direction. **AND** Calculations for the direct step method are correct with no more than two minor math errors (e.g., missing exponent or error during calculator input).	The water surface profile classification is correct, and the elevation change along the water surface profile is applied in the correct direction. **AND** Calculations for the direct step method are correct with no math errors.

Outcome 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.

Course: CVNG 3040 – Sustainability and Environmental Engineering
Performance Measure: Final Exam Question 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 on the basis of 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 on the basis of • 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 on the basis of • 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 cyclist 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.

Outcome 3: An ability to communicate effectively with a range of audiences.

Course: CVNG 3020 – Structural Analysis Lab
Performance Measure: Final Project Oral Presentation (Oral Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The presentation is not well organized (e.g. material out of order) and the supporting materials insufficiently supports the topic. **OR** The language choices are unclear and minimally support the topic. The delivery technique detracts from the understandability of the presentation and the speaker(s) appears uncomfortable.	The presentation is organized and the supporting materials make appropriate reference to information that supports the topic. The language is appropriate for the audience and supports the topic. The delivery techniques make the presentation interesting and the speaker(s) appears comfortable.	The presentation is very well organized and the supporting materials make reference to information that significantly supports the topic. AND The language is compelling and enhances the effectiveness of the presentation. The delivery techniques make the presentation interesting and the speaker(s) appears polished and confident.

Course: CVNG 3020 – Structural Analysis Lab
Performance Measure: Final Project Report (Written Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The report is not well organized (e.g. sections out of order) and the necessary detail to describe the work completed is lacking. **OR** The authors demonstrate minimal attention to context and purpose. The language sometimes impedes the meaning because of errors in usage.	The report is organized and mostly includes the necessary detail to describe the work completed. The background theory is adequate, but relevant source information may be lacking. The authors demonstrate awareness of context and purpose. The language is clear and the writing contains few grammatical errors.	The report is very well organized and includes the necessary detail to describe the work completed. The background theory is adequate, complete with relevant source information. **AND** The authors demonstrate a thorough understanding of context and purpose. The language is clear and the writing is virtually error-free.

Course: CVNG 3140 – Hydraulic Engineering Lab
Performance Measure: Water Resources and Entrepreneurship Presentation (Oral Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The presentation is not well organized (e.g. material out of order) and the supporting materials insufficiently supports the topic. **OR** The language choices are unclear and minimally support the topic. The delivery technique detracts from the understandability of the presentation and the speaker(s) appears uncomfortable.	The presentation is organized and the supporting materials make appropriate reference to information that supports the topic. The language is appropriate for the audience and supports the topic. The delivery techniques make the presentation interesting and the speaker(s) appears comfortable.	The presentation is very well organized and the supporting materials make reference to information that significantly supports the topic. AND The language is compelling and enhances the effectiveness of the presentation. The delivery techniques make the presentation interesting and the speaker(s) appears polished and confident.

Course: CVNG 4500 – Capstone Design I
Performance Measure: Capstone Final Design Alternatives Project Presentation (Oral Communication)

1 – Does not meet expectations	**2 – Meets expectations**	**3 – Exceeds expectations**
The presentation is not well organized (e.g. material out of order) and the supporting materials insufficiently supports the topic. **OR** The language choices are unclear and minimally support the topic. The delivery technique detracts from the understandability of the presentation and the speaker(s) appears uncomfortable.	The presentation is organized and the supporting materials make appropriate reference to information that supports the topic. The language is appropriate for the audience and supports the topic. The delivery techniques make the presentation interesting and the speaker(s) appears comfortable.	The presentation is very well organized and the supporting materials make reference to information that significantly supports the topic. **AND** The language is compelling and enhances the effectiveness of the presentation. The delivery techniques make the presentation interesting and the speaker(s) appears polished and confident.

Course: CVNG 4500 – Capstone Design I
Performance Measure: Capstone Preliminary Design Alternatives Project Report (Written Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The report is not well organized (e.g. sections out of order) and the necessary detail to describe the work completed is lacking. **OR** The authors demonstrate minimal attention to context and purpose. The language sometimes impedes the meaning because of errors in usage.	The report is organized and mostly includes the necessary detail to describe the work completed. The background theory is adequate, but relevant source information may be lacking. The authors demonstrate awareness of context and purpose. The language is clear and the writing contains few grammatical errors.	The report is very well organized and includes the necessary detail to describe the work completed. The background theory is adequate, complete with relevant source information. **AND** The authors demonstrate a thorough understanding of context and purpose. The language is clear and the writing is virtually error-free.

Course: CVNG 4510 – Capstone Design II
Performance Measure: Capstone Final Design Project Presentation (Oral Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The presentation is not well organized (e.g. material out of order) and the supporting materials insufficiently supports the topic. **OR** The language choices are unclear and minimally support the topic. The delivery technique detracts from the understandability of the presentation and the speaker(s) appears uncomfortable.	The presentation is organized and the supporting materials make appropriate reference to information that supports the topic. The language is appropriate for the audience and supports the topic. The delivery techniques make the presentation interesting and the speaker(s) appears comfortable.	The presentation is very well organized and the supporting materials make reference to information that significantly supports the topic. **AND** The language is compelling and enhances the effectiveness of the presentation. The delivery techniques make the presentation interesting and the speaker(s) appears polished and confident.

Course: CVNG 4510 – Capstone Design II
Performance Measure: Capstone Final Design Project Report (Written Communication)

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The report is not well organized (e.g. sections out of order) and the necessary detail to describe the work completed is lacking. **OR** The authors demonstrate minimal attention to context and purpose. The language sometimes impedes the meaning because of errors in usage.	The report is organized and mostly includes the necessary detail to describe the work completed. The background theory is adequate, but relevant source information may be lacking. The authors demonstrate awareness of context and purpose. The language is clear and the writing contains few grammatical errors.	The report is very well organized and includes the necessary detail to describe the work completed. The background theory is adequate, complete with relevant source information. **AND** The authors demonstrate a thorough understanding of context and purpose. The language is clear and the writing is virtually error-free.

Outcome 4: An ability to recognize ethical and professional responsibilities in civil engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Course: CVNG 3040 – Sustainability and Environmental Engineering
Performance Measure: Final Exam Question on Climate Change

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Mechanisms of global water due to greenhouse gases were diagramed and explained inaccurately. **OR** Method of determining 400,000 years of carbon dioxide and temperatures on Earth were incorrect.	Mechanisms of global water due to greenhouse gases were diagramed and explained mostly completely and accurately. **AND** Method of determining 400,000 years of carbon dioxide and temperatures on Earth were mostly correct.	Mechanisms of global water due to greenhouse gases were diagramed and explained completely and accurately. **AND** Method of determining 400,000 years of carbon dioxide and temperatures on Earth were correct.

Course: CVNG 3120 – Transportation Engineering Lab
Performance Measure: Presentation on transportation news

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The presentation only discusses one aspect of a transportation project (e.g. only focuses on technology) **AND** The presentation does not take into account the impact of a project on users, and non-users	The prestation discusses at least two aspects of a project impact in economic, environmental, and societal contexts, **AND** The presentation takes into account the impact of project on users,	The presentation provides examples of project impact in economic, environmental, and societal contexts, **AND** Provides examples from a developing nations, adds a global perspective to the issue **AND** The presentation discusses the impact of project on users, and non-users.

Course: CVNG 3140 – Hydraulic Engineering Lab
Performance Measure: Social justice presentation including economic, environmental, and societal contexts

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Lacks detail of the social justice issue from a local perspective related to their assigned viewpoint (i.e., activate levee to protect citizens of Cairo or not activate levee to protect farmland). **OR** Lacks historical context and relevant policies. **OR** Does not recognize the impact of inequity from the assigned viewpoint.	Details the social justice issue from a local perspective related to their assigned viewpoint (i.e., activate levee to protect citizens of Cairo or not activate levee to protect farmland). **AND** Provides some historical context and relevant policies. **AND** Identifies the impact of inequity from the assigned viewpoint.	Details the social justice issue from a local perspective related to their assigned viewpoint (i.e., activate levee to protect citizens of Cairo or not activate levee to protect farmland). **AND** Provides appropriate historical context and relevant policies. **AND** Identifies the impact of inequity from the assigned viewpoint. **AND** Highlights the balance between economic, environment and societal needs

Outcome 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)

Outcome 6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions in more than one civil engineering context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).

Course: CVNG 3030 – Civil Engineering Materials
Performance Measure: Fiber-reinforced Concrete Project

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The report lacks the minimum number of concrete mixtures needed for a comparison or only provides the results of the initial trial mixtures without discussion of concrete compressive strength and unit weight limitations. **OR** Fails to discuss the performance of the selected mix design with regard to durability and toughness.	The report illustrates an attempt to evaluate at least two different concrete mixtures to satisfy the needs of the fiber-reinforced concrete project. The report includes the comparison and discussion of concrete compressive strength and unit weight differences at a minimum. **AND** The report also discusses the performance of the selected mixture design with regard to durability and toughness.	The report includes a thorough evaluation of more than two concrete mixtures to satisfy the needs of the Fiber-reinforced concrete project. The results include a comparison of concrete compressive strengths and weight differences along with discussion of workability observations during trials. **AND** The report includes a thorough discussion of the performance of the selected mix design with regard to durability and toughness, including the calculation of toughness.

Course: CVNG 3041 – Sustainability and Environmental Engineering
Performance Measure: Total Carbonate and Non-carbonate Hardness of Tap Water Laboratory

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Hardness fractions were not measured mostly properly using two techniques, OR Method was not properly delineated. OR Report was not well written.	Hardness fractions were measured mostly properly using two techniques. Method was mostly properly delineated. Report had appropriate formatting, was reasonably well written and concise, and conclusions were well thought out.	Hardness fractions were measured properly using two techniques. Method was properly delineated. Report had proper formatting, was well written and concise, and conclusions were accurate.

Course: CVNG 3100 – Geotechnical Engineering Lab
Performance Measure: Compaction Test of Soils Laboratory

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The student group conducted a compaction laboratory experiment, but did not relate the results to engineering specifications. They interpreted and analyzed the data, but limited the work to presentation of results only. They did not make engineering recommendations for construction.	The student group conducted a compaction laboratory experiment to meet engineering specifications for a soil specimen. They interpreted and analyzed the data, but limited the work to presentation of results only. They did not make engineering recommendations for construction.	The student group conducted a compaction laboratory experiment to meet engineering specifications for a soil specimen. They interpreted and analyzed the data, and extended the results to make engineering recommendations for construction.

Course: CVNG 3140 – Hydraulic Engineering Lab
Performance Measure: Pump characteristics curves laboratory

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The student group conducted a pump characteristic curves laboratory experiment; but through the data analysis and reporting process, they did not generate accurate pump characteristic curves. **OR** The student group did not provide correct interpretation of the lab results and theory for more than one of the directed discussion questions.	The student group conducted a pump characteristic curves laboratory experiment and through the data analysis and reporting process, they generated accurate pump characteristic curves with only minor flaws. **AND** The student group did not provide correct interpretation of the lab results and theory for one of the directed discussion questions.	The student group conducted a pump characteristic curves laboratory experiment and through the data analysis and reporting process, they generated accurate pump characteristic curves. **AND** The student group provided correct interpretation of the lab results and theory for all directed discussion questions.

Outcome 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course: CVNG 4500 – Capstone Design I
Performance Measure: Assignment on Design Criteria

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Students assembled the design criteria list, which include: constraints, assumptions, laws and codes. Only a few of the items were considered and was not adequate. Their senior design capstone project did not adhere to the design criteria and it was not consistent in the design of the engineered built system.	Students assembled the design criteria list, which include: constraints, assumptions, laws and codes. Some of the items were not considered. Their senior design capstone project only sometimes adhered to the design criteria and it was not consistent in the effective design of the engineered built system.	Students assembled the design criteria list, which include: constraints, assumptions, laws and codes. Their senior design capstone project continued to include adherence to the design criteria and used it effectively for the design of the engineered built system.

Course: CVNG 4500 – Capstone Design I
Performance Measure: Assignment on Pursuit of External Resources not Typically Taught in Classes

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Students did not assemble a list of the resources that they were to pursue for senior design capstone class. However, they did not contact professionals in practice, city/county personnel. They limited their resources to items provided in their previous courses.	Students assembled a list of the resources that they were to pursue for senior design capstone class. However, they did not contact professionals in practice, city/county personnel. They only secured faculty advisors, and specialty resources (software and papers) available from external sources.	Students assembled a list of the resources that they were to pursue for senior design capstone class. They contacted professionals in practice, city/county personnel, faculty advisors, and specialty resources (software and papers) available from external sources

Outcome 8: An ability to design a system, component, or process in more than one civil engineering context (e.g. construction, environmental, geotechnical, structural, transportation, water resources).

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 modelling 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 not 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 not 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 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.

Outcome 9: An ability to explain basic concepts in management, business, public policy, and leadership.

Course: CVNG 3040 – Sustainability and Environmental Engineering
Performance Measure: Homework Problem on Climate Change

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
Did not sufficiently list or describe three means that society may use to sequestration carbon dioxide to inhibit climate change. **AND** Did not sufficiently describe the major negative impact or impacts for each carbon sequestration method.	Listed and somewhat described three means that society may use to sequestration carbon dioxide to inhibit climate change. Properly described the major negative impact or impacts for each carbon sequestration method.	Properly described three means that society may use to sequestration carbon dioxide to inhibit climate change. Properly described the major negative impact or impacts for each carbon sequestration method.

Course: CVNG 3070 – Engineering Project Management
Performance Measure: Graded assignment on project management (scope and resources)

1 – Does not meet expectations	**2 – Meets expectations**	**3 – Exceeds expectations**
The assignment on scope of work and resources focused on management of a project. A basic understanding of the reading was not apparent by the answers to the questions presented. Few of them were not framed correctly and were confusing. **OR** The interpretation of the essay reading was incorrect, and several statements were incoherent.	The assignment on scope of work and resources focused on management of a project. An understanding of the reading was apparent by the answers to the questions presented. Most of them were correct within a coherent framework. **OR** The interpretation of the essay reading was correct, and several statements were coherent.	The assignment on scope of work and resources focused on management of a project. An understanding of the reading was apparent by the answers to the questions presented. All of them were correct within a comprehensive and coherent answers. In some cases it exceeded the requirements of the assignment. **OR** The interpretation of the essay reading was correct, and all the statements were coherent.

Course: CVNG 3070 – Engineering Project Management
Performance Measure: Exam question on project management

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
When asked the play the role of a project manager on construction project, the student was able to explain "Safety". However, it struggles differentiating form different roles (Owner, Engineer, or Contractor).	When asked the play the role of a project manager on construction project, the student was able to explain "Safety" from only one point of view of the Owner, Engineer, and Contractor.	When asked play the role of a project manager on construction project, the student was able to clearly explain "Safety" from the point of view of the Owner, Engineer, and Contractor. Examples and case studies were described or referenced.

Course: CVNG 3100 – Geotechnical Engineering Lab
Performance Measure: Exam question on project management

1 – Does not meet expectations	2 – Meets expectations	3 – Exceeds expectations
The student group conducted a compaction laboratory experiment, but did not relate the results to engineering specifications. They interpreted and analyzed the data, but limited the work to presentation of results only. They did not make engineering recommendations for construction.	The student group conducted a compaction laboratory experiment to meet engineering specifications for a soil specimen. They interpreted and analyzed the data, but limited the work to presentation of results only. They did not make engineering recommendations for construction.	The student group conducted a compaction laboratory experiment to meet engineering specifications for a soil specimen. They interpreted and analyzed the data, and extended the results to make engineering recommendations for construction.