



Integration of Sustainability across the Civil Engineering Curriculum at the University of Nebraska



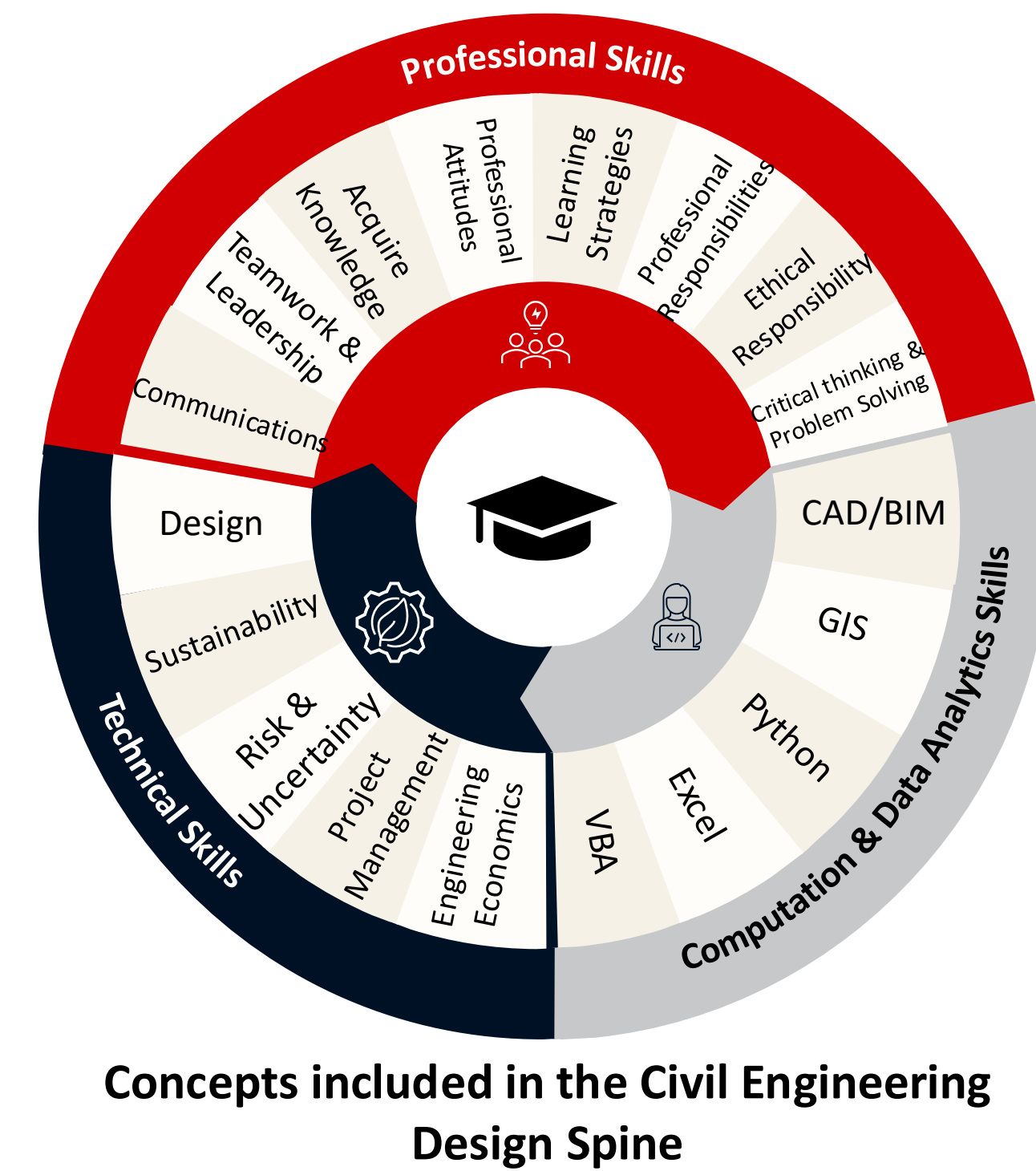
CIVIL AND ENVIRONMENTAL ENGINEERING

Curriculum at the University of Nebraska

Dr. Shannon L. Bartelt-Hunt, Dr. David Admiraal, Dr. Nirupam Aich, Dr Jiong Hu, Dr. George Hunt, Dr. Elizabeth Jones, Dr. Seunghee Kim, Dr. Wissam Kontar, Dr. Kaycie Lane, Dr. Chung Song, Dr. Jamilla Teixeira, Dr. Matthew Williamson, Dr. Christine Wittich, and Dr. Li Zhao
Department of Civil and Environmental Engineering, University of Nebraska-Lincoln

Introduction

The Department of Civil and Environmental Engineering modified their curriculum in the 2021-2022 academic year to incorporate an eight semester 'design spine' to integrate civil engineering tools, data analysis and programming, systems thinking and technical skills and professional skills across the degree program. Sustainability learning outcomes based on the Engineering for One Planet framework were incorporated into this eight-course sequence. In this grant, we further expanded the coverage of sustainability learning outcomes across the discipline specific courses taken by civil engineering students in the second and third year of the degree program. Outcomes included incorporation of sustainability within disciplinary courses including structural engineering, transportation engineering, geotechnical and materials engineering, environmental engineering and water resources engineering.



Procedure/Methods

Starting in 2022, the department's faculty began a series of *ad hoc* meetings to discuss how to incorporate professional and technical skills into the **Civil Engineering Core**, also called our Design Spine. For coverage of sustainability, the group elected to adopt the Engineering for One Planet Framework. Faculty identified specific learning objectives that were incorporated into the 10X, 20X, 30X, and 40X courses. This exercise demonstrated that sustainability coverage was needed in other courses within the curriculum, leading the faculty to apply for the EOP grant.

During the EOP grant period, instructors of **Civil Engineering Breadth** courses (*highlighted in green*) worked independently to incorporate EOP learning objectives into their courses. Feedback and assistance from our project mentor helped faculty identify specific resources to assist in their course development.

The UNL Civil Engineering Curriculum

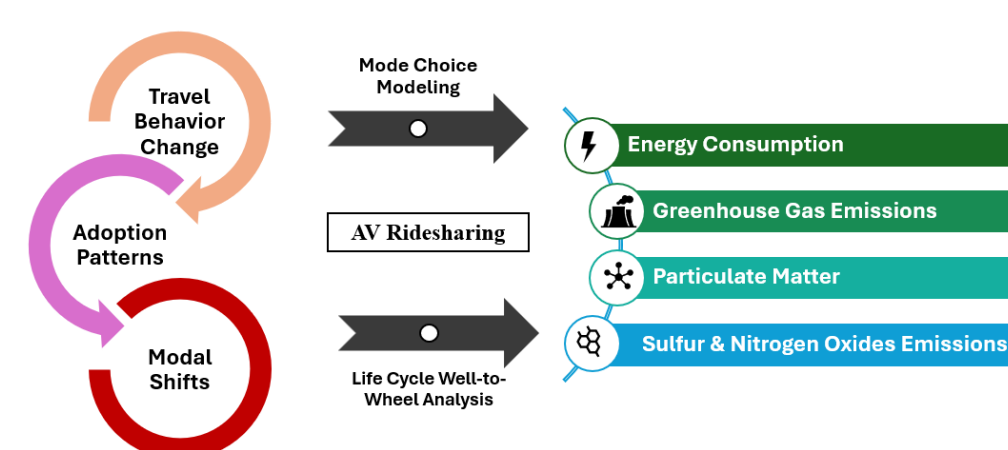
Civil Engineering Core		18 cr
CIVE 101	Introduction to Civil Engineering	3 cr
CIVE 102	Geomatics for Civil Engineering	3 cr
CIVE 201	Civil Engineering Analysis I	2 cr
CIVE 202	Civil Engineering Analysis II	2 cr
CIVE 301	Civil Engineering Synthesis I	1 cr
CIVE 302	Civil Engineering Synthesis II	1 cr
CIVE 401	Civil Engineering Design I	3 cr
CIVE 402	Civil Engineering Design II	3 cr
Civil Engineering Breadth		25 cr
CIVE 310	Fluid Mechanics	3 cr
CIVE 310L	Hydraulics Laboratory	1 cr
CIVE 321	Principles of Environmental Engineering	3 cr
CIVE 321L	Environmental Engineering Laboratory	1 cr
CIVE 331	Introduction to Geotechnical Engineering	4 cr
CIVE 341	Structural Analysis Fundamentals	3 cr
CIVE 342	Structural Design Fundamentals	1 cr
CIVE 351	Introduction to Water Resources Engineering	3 cr
CIVE 361	Principles of Transportation Engineering	3 cr
CIVE 371	Materials of Construction	3 cr
Civil Engineering Depth Electives		9 cr
General Engineering		12 cr
Technical Electives		6 cr
Science and Mathematics		35 cr
General Education		21 cr

EOP Sustainability Framework incorporated beginning in the 2022-2023 Academic Year

Focus of this project – to expand sustainability coverage using the EOP framework in the 2025-2026 Academic Year

Specific Examples from Courses

Transportation: The course incorporated structured in class discussions that engaged students with contemporary literature, analytical frameworks, and technical case studies. Guided discussions were anchored in the conceptual sequence shown in the below figure. Students learned to connect travel behavior analysis to the estimation of environmental impacts that arise from individual and system level mode choices. Through this sequence, students examined life cycle assessment principles, mode choice modeling, and the methodological basis for environmental emission calculations.



Structural Analysis: EOP concepts were primarily incorporated through the semester project "Analysis of Windbreak Structures for Use in Rural Nebraska". Windbreaks are structurally simple systems that require students to idealize load paths, model wind effects, and interpret structural behavior. However, many traditional tree-based windbreaks contribute to woody encroachment and other ecological concerns, which creates a meaningful context for students to examine structural performance alongside environmental and sustainability aspects. Integrating systems thinking within this project reinforced that structural analysis is not performed in isolation but within broader ecological and social systems where engineering decisions have meaningful impacts.

Water Resources: The EOP framework is incorporated through a semester long project evaluating the proposed Perkins County Canal, which will divert water from Colorado's South Platte River to Nebraska. Students will analyze the environmental, social and economics impact of the project. Students will increase environmental literacy by evaluating water usage, water scarcity and water rights data for the state and region.

Materials: EOP Materials Selection Learning Objectives are incorporated through a research project and symposium. Student groups propose an innovative and sustainable alternative solution for civil engineering construction, aiming to significantly reduce environmental impact while maintaining or improving performance compared to conventional materials and methods. Students must justify the selection of their proposed material based on previous works (journal papers, conference papers, some non-academic news) and/or their own laboratory test results. Students communicate findings through a professional poster presentation at the symposium, which is attended by local professionals.



Student Presentations at the Sustainable Materials Symposium

Progress/Plans for Scaling Up

- 2 courses were taught in Fall 2025
- 4 courses are scheduled for Spring 2026
- Faculty will further refine course materials and begin to incorporate sustainability in follow on technical elective courses



Evaluation/Impact

- ✓ 6 courses modified
- ✓ 12 faculty involved in EOP grant
- ✓ 614 undergraduate students with enhanced sustainability knowledge

Acknowledgements

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