

**Request for Authorization to Establish a  
Doctor of Philosophy in Civil Engineering  
(Ph.D., CIP 14.0801) at  
University of North Carolina at Charlotte**

**I. Program Highlights**

---

- The mission of the proposed Ph.D. in civil engineering degree program is to provide doctoral-level education for students seeking civil engineering careers in practice, research, and teaching/academia. The program is a terminal research degree, which emphasizes the mastery of the discipline-specific civil engineering concepts relevant to the resilience of critical facilities and civil infrastructure.
- The proposed degree program will be delivered on-campus.
- The proposed Ph.D. degree program requires successful completion of at least 72 approved graduate credits beyond the baccalaureate degree. Up to 30 approved credits from graduate courses taken during the student's master's degree, which may have been taken at another university, may be transferred towards the proposed program. Concentrations will include: 1) environmental and geo-environmental, 2) structural and geotechnical, and 3) transportation engineering.
- Six full-time students are projected in the first year. Twenty-four full-time students and two part-time students are projected by the fourth year.
- No new faculty hires are needed to implement the proposed degree program. The program would facilitate increased research productivity and external funding acquisition with the present faculty workforce. However, as the program grows over the years, more tenure-track faculty would likely be hired to meet the additional research and teaching loads and to provide the needed technical expertise as the program evolves.
- No differential tuition or fees are requested.
- The resources of the campus libraries are adequate to support the proposed degree program.
- The facilities and the primary infrastructure (testing and modeling laboratories, computing resources and software, classrooms, and office space) are in place to implement the proposed Ph.D. in civil engineering program.

**II. Board Academic Program Planning Criteria (UNC Policy 400.1)**

---

1. **Existing Programs (Number, Location, Mode of Delivery).** There are two institutions in North Carolina currently offering a Ph.D. in civil engineering: Duke University and North Carolina State University. The programs are delivered on campus.
2. **Relation to Campus Distinctiveness and Mission.** The proposed Ph.D. in civil engineering degree program is consistent with UNC Charlotte's institutional mission to "leverage its location in the state's largest city to offer internationally competitive programs of research and creative activity, exemplary undergraduate, graduate, and professional programs, and a focused set of community engagement initiatives" and to "maintain a particular commitment to addressing the cultural, economic, educational, environmental, health, and social needs of the greater Charlotte region."

## APPENDIX H

The proposed Ph.D. in civil engineering degree program is closely aligned with UNC Charlotte's goals, including those of delivering, stimulating, and enhancing opportunities for learning and research.

- 3. Demand (local, regional, state).** Hanover Research prepared market analysis of the demand for a Ph.D. in civil engineering. The analysis cited data from the American Society of Civil Engineers asserting that “the United States needs to invest \$1.4 trillion in infrastructure between 2016 and 2025 and \$5.2 trillion by 2040; without such investments, the U.S. economy could lose almost \$4 trillion and 2.5 million jobs by 2025 and \$14.2 trillion and 5.8 million jobs by 2040 due to lost productivity. As a result, future federal, state, and local investments to repair and enhance ailing infrastructure may drive demand for civil engineers.” Hanover Research observed that Ph.D. programs in civil engineering are common in states similar in size to North Carolina, although the state ranks last in the number of programs relative the population. In addition, Charlotte is the 17th largest city in the U.S. and is the only one in the top 33 by population without a Ph.D. in civil engineering. The closest program is 100 miles away at the University of South Carolina in Columbia, South Carolina.
- 4. Potential for Unnecessary Duplication.** Two institutions in North Carolina offer a Ph.D. in civil engineering: Duke University and North Carolina State University. Faculty members from both institutions were consulted in developing the content. Both institutions provided statements of support for the proposed degree program. The proposed Ph.D. in civil engineering degree program is designed to complement the programs at Duke University and NC State. Students in the Ph.D. programs at Duke University and NC State focus on theoretical and computational research, computational, material science, or risk/reliability, while the proposed UNC Charlotte program is focused on field and experimental research. The proposed degree program supports the College of Engineering goal of meeting the Charlotte area's demand for engineering graduates and assisting the Energy Production and Infrastructure Center (EPIC) to create a pipeline of specially trained civil engineers with knowledge of the energy industry.
- 5. Employment Opportunities for Graduates.** According to NCWorks ([www.ncworks.gov](http://www.ncworks.gov)), the occupational profile of North Carolina indicates that the 2015 estimated median annual wage of civil engineers is \$72,920. There are over 3,000 employers that hire civil engineers in the state of North Carolina. Although no specific labor market data is available in NCWorks for graduates with a Ph.D. in civil engineering, the projected annual openings for civil engineers at all degree levels is estimated as 409. Civil engineers are regularly hired by industry. The long-term projections for civil engineers in North Carolina indicate that there would be a need for an additional 2,000+ civil engineers by 2022 ([www.ncworks.gov](http://www.ncworks.gov)). More than 50% of these openings would be due to growth in the civil engineering sector. The state's market analysis projects the highest career prospects based on wages, projected growth rate and projected job openings in NC. Civil engineering occupations were assigned 5-star ratings by the new NC Star Jobs rating program, indicating high demand and career prospects.
- 6. Faculty Quality and Number.** No new faculty hires are needed to implement the proposed degree program. The program would facilitate increased research productivity and external funding acquisition with the present faculty workforce. However, as the program grows over the years, more tenure-track faculty would likely be hired to meet the additional research and teaching loads and provide the needed technical expertise as the program evolves. The civil engineering faculty consists of 25 members with credentials from all over the country. The most recent hires, in

January 2016, feature faculty with degrees from Lehigh University, Princeton University, and Carnegie Mellon University.

## 7. Availability of Campus Resources (library, space, etc.)

**Atkins Library Services:** The UNC Charlotte College of Engineering has offered two doctoral programs (in Electrical and Mechanical Engineering) and an interdisciplinary doctoral program in Infrastructure and Environmental Systems (INES). Over the years, the UNC Charlotte Atkins library has systematically and painstakingly acquired and continues to build solid repertoires of materials to support these programs. Based on the analysis by the UNC Charlotte Engineering Librarian Jeff McAdams, the current library holdings are adequate to support student research for the proposed degree program. Students have access to relevant databases, including Compendex, Inspec, Web of Science, ASCE Digital Library, ScienceDirect, Environmental Sciences and Pollution Management, and the Materials Research Database. The library owns hundreds of thousands of e-books from Springer, Wiley, Elsevier, Cambridge and other publishers—mostly focusing on science and engineering subject matter—in addition to a growing print collection.

**Facilities:** All the primary infrastructure (testing and modeling laboratories, computing resources and software, classrooms, and office space) is in place to implement the proposed Ph.D. in civil engineering program. Facilities include:

- The High-Bay Structures Lab is used for testing full-scale or model structures and foundations.
- The Infrastructure Security and Emergency Responder Research and Training (ISERRT) Center provides basic and applied research, education, and training.
- The Physical Security Lab supports modeling efforts, field testing of structures, and testing of structures at ISERRT facilities.
- Experimental Structural Dynamics and Health Monitoring Lab
- Construction Materials Development Lab
- Structural Materials Testing Lab
- Visualization Lab
- Advanced Geomaterial Testing Lab
- Geo-centrifuge Lab
- Unsaturated Geomaterial Testing Lab
- Field and In situ Testing Lab
- Geosynthetic Materials Testing and Performance Lab
- Pavement Materials Performance Lab
- Soil and Rock Dynamics Experimentation Lab

**8. Relevant Lower-level and Cognate Programs.** No additional subject-matter fields or cognate programs are required to support the proposed Ph.D. degree program in civil engineering. UNC Charlotte will capitalize on existing doctoral programs and graduate school support to implement the proposed degree program. In four years, an evaluation will be conducted to examine the efficacy of the curriculum. Potential changes in the curriculum may be identified at that time, but no significant changes are anticipated.

**9. Impact on Access and Affordability.** Tuition and Fees for engineering programs at UNC Charlotte are the lowest in the system, while state dollars invested in the graduate program are matched

## APPENDIX H

by external investment through research. The vast majority of students in the proposed degree program in civil engineering will be funded through external contracts. Research awards for the department exceeded \$4 million during fiscal year 2015-2016, among the highest of any unit on campus. The proposed degree program would extend access to working professionals in Charlotte who wish to pursue a Ph.D. without leaving their jobs.

No differential tuition or fees are requested.

Tuition rates for full-time graduate students at the participating institutions are as follows:

### Graduate Tuition and Fees (Fall 2017-Spring 2018)

#### NC Residents

	At Home	On Campus	Off Campus
Tuition and Fees	\$7,379	\$7,379	\$7,379
Loan Fees	\$876	\$876	\$876
Books	\$1,250	\$1,250	\$1,250
Room and Board	\$2,608	\$12,432	\$10,433
Transportation	\$2,004	\$1,659	\$1,987
Miscellaneous	\$1,500	\$1,500	\$1,500
Total	\$15,617	\$25,096	\$23,425

#### Non-Residents of NC

	At Home	On Campus	Off Campus
Tuition and Fees	\$20,813	\$20,813	\$20,813
Loan Fees	\$876	\$876	\$876
Books	\$1,250	\$1,250	\$1,250
Room and Board	\$2,608	\$12,432	\$10,433
Transportation	\$2,064	\$2,499	\$2,827
Miscellaneous	\$1,500	\$1,500	\$1,500
Total	\$29,111	\$39,370	\$37,699

**10. Expected Quality.** The criteria to evaluate the proposed Ph.D. in civil engineering degree program objectives will address operational efficiency and program impact.

- Criterion 1: Demonstrated mastery of the fundamental concepts, models, advanced research skills, and their applications to complex systems in critical facilities and civil infrastructure.

- Criterion 2: Ability to recruit, retain, and graduate excellent Ph.D. students.
- Criterion 3: Level of contribution of doctoral students and their advisors to advances in engineering, science, and technology through publications, presentations, short-courses and patents.
- Criterion 4: Level of employment of graduates from the program and service of such graduates in leadership positions in academic, government, international agencies, and the private sector within and outside the State of North Carolina.

Measures (metrics) to be used to evaluate the program include enrollments, number of graduates, and student success.

**11. Feasibility of Collaborative Program.** UNC Charlotte has a history of collaboration with NC State through the interinstitutional Ph.D. program. In addition, the Department of Civil and Environmental Engineering at UNC Charlotte recently collaborated with the Department of Civil, Construction, and Environmental Engineering at NC State in an ongoing research project, “Developing a Systematic Approach to Improving Bottleneck Analysis in North Carolina.” The proposed degree program is designed to complement the existing programs in the state. Representatives from the programs at Duke University and NC State have expressed support for the proposed degree program.

**12. Other Considerations.** None.

### **III. Summary of Review Processes**

---

**Campus Review Process and Feedback.** The proposal was reviewed by the UNC Charlotte faculty, department and university curriculum committees, provost, and chancellor. Approval was obtained at all levels.

**UNC System Office Review Process and Feedback.** Throughout the review process, UNC Charlotte provided relevant information pertaining to program requirements and resources. The institution submitted appropriate documentation and research to support its statements. External reviewers evaluated the requests and did not request further information.

### **IV. Recommendation**

---

It is recommended that the Board of Governors approve UNC Charlotte’s request to establish a Doctor of Philosophy in Civil Engineering degree program (CIP 14.0801) to enroll students starting fall 2018.