

## Construction Engineering and Management Online MS Proposal

Beginning with two major tracks in the Construction Engineering and Management Online MS (to be enlarged to seven tracks as illustrated on the last page). The tracks are based on industry needs and the strengths of faculty in CEM. The condition of US infrastructure is frequently cited as poor. Whether talking about roads and bridges, water treatment, energy generation, or buildings in general, there is widely accepted recognition that a great deal of work is required to ensure the built environment retains value to support the productivity of industry and businesses in the US.

The construction industry is under growing pressure from several sources to increase output and deliver projects that meet the needs of society. The growing pressure means practicing engineers find it difficult to find time to develop new expertise that will help them to tackle problems about speed, efficiency, effectiveness, or cost. New expertise is available through additional education about new, best practices, or technology applications. When these education programs are available, they are predominately available only through residential or on-site delivery that requires students to leave the project. When project managers must leave the worksite to obtain new knowledge it frequently results in a loss of productivity and defeats the goal of obtaining greater understanding or new knowledge that is only available in a residential education program.

The goal of an online construction engineering program, focused on post-baccalaureate students, is to provide access to educational resources without the need to leave the normal workplace. While coursework may be taken individually, students can also obtain an advanced degree through a combination of construction-focused courses and other supplemental engineering, technology, and scientific courses that are all available asynchronously. Asynchronous delivery means students can obtain the additional knowledge at any time and avoid leaving projects that may have critical needs. Online delivery can also address immediate needs when a construction manager encounters a difficult problem that requires new knowledge or better understanding.

The areas of greatest need that will be addressed by a new Online Construction Engineering and Management MS program are heavy construction (tunnels, pipelines, roads, and bridges) and facilities engineering (operation and life-cycle preservation). The education areas are further described below. As the program develops, five additional specialty areas will be offered and are shown in the attached matrix.

A total of ten courses (30 credit hours) are required to complete the entire program and receive a MS degree. Courses may be taken individually for students not interested in the degree program. **In addition, an Interdisciplinary Engineering MS CEM Concentration may be obtained by taking a minimum three courses (9 credit hours) from the available offerings.**

## **Heavy Construction** (specialty area)

**Development of Underground Space** - Underground space is an essential part of the human living environment. This course will cover major elements involved in the development of underground space with the primary focus on construction. (primary instructor – Iseley/secondary instructor – Abraham) CEM 58600

**Pipeline Condition Assessment and Integrity Management** - The core of pipeline risk-based asset management is the financial management of assets. Accurate pipeline condition assessment is essential to optimizing the portfolio and is an essential support for achieving asset management. In this course, the pipeline includes infrastructures that transport portable water, wastewater, crude oil, refined petroleum products, and natural gas. (Iseley/Abraham) CEM 58800

**Underground Infrastructure Asset Management** – Most of the U.S. water and wastewater conveyance infrastructure was installed during the first half of the 20<sup>th</sup> century and is coming to an end of its useful life. This course applies the principles and practices of Asset Management (AM) which involves every aspect of the organization to develop and implement best business practices. (Iseley/Abraham) CEM 58700

**Temporary Structures (1)** - This class will provide construction professionals the skills to understand construction loads and their combinations, wind loads and their impacts, timber construction, bracing and guying, vertical forming systems, and shoring analysis for vertical construction. (McCullouch/Cai) CEM 58500

## **Facilities Engineering** (specialty area)

**Infrastructure Planning\*†** – This course provides the student with an in depth understanding of the issues related to infrastructure planning, engineering, and economics. The focus will be on the prioritization, stewardship, management, and decision-making roles within the engineering division of a large public works agency. Various infrastructure planning concepts will be reviewed and discussed. (Hastak/Weidner) CEM 53200

**Infrastructure Analytics** – This course investigates the data sources and numerical tools required to assess the status of constructed facilities and to make informed decisions from the data. Issues of sustainability, regulations, and other factors are discussed and examined. (Weidner/Hastak) CEM 53300

**Facility Engineering & Management** – The course will focus on the total life-cycle cost of a capital construction project beginning with planning, business rationale, economic analysis, and programmatic specifications. This course provides the student with an understanding of the issues related to facilities management for owner organizations. The owner's perspective on annual operating costs will be examined including calculation of daily, weekly, monthly, and annual operating costs. The implications of stewardship and customer service are reviewed and analyzed including the implications on total life-cycle costs. (Weidner/Hastak) CEM 53100

**Implementation of ISO 41001** – This course provides the student with an understanding of ISO 41001 and related standards applied to facilities management. Students are coached through the requirements of a management system, writing the document in manageable pieces. (Weidner/Hastak) CEM 59700

## Construction Fundamentals (functional area)

**Construction Accounting** – The course addresses financial accounting for construction, cost management, improving estimating for construction, applying accounting procedures for project control, and addressing costing changes and claims. (Adrian/Weidner) CEM 59700

**Construction Productivity** – The construction industry is one of the largest industries; it is vital to the economics and growth of a nation. In this course you will learn the importance of increases in productivity to the profitability of the construction firm as well as the value of the project to the project owner. The course entails an all-encompassing approach to the measurement and improvement of job site productivity. (Adrian/Hastak) CEM 59700

**Construction Business Management** – Comprehensive risk-based management of construction projects is essential to support society's quality of life, public health, economic development and living standard. This course will focus on personnel, operational, and logistical management tools that lead to success in construction. (Bowen/Iseley) CEM 59700

**Construction Health & Safety** – This comprehensive course covers fundamentals to safety and health applied to civil infrastructure, capital projects industry, and building construction. Topics include safety concepts and theories, planning, design, techniques and tools, management, rules and guidelines (e.g., OSHA standards and related safety practices), best practices in the workplace, and inspection strategies. This course also explains how to estimate the costs associated with work accidents and discusses job hazard analysis and risk assessment. (Hasanzadeh/Abraham) CEM 59700

**Construction Equipment Systems** – Assuming study of productivity, hourly owning and operating costs, and general categories of heavy construction equipment, this course emphasizes equipment-intensive, multi-stage (linked) construction operations. Integration of material production, transport, and placement is the chief focus. Analysis by computer simulation is also introduced. (Dunston/Adrian) CEM 59700

## Supplemental Courses

- Computer Applications in Construction\*† CE 52200
- BIM for Construction\*† (1) CE 59700
- Computer Applications of Artificial Intelligence and eConstruction\*† (1) CE 59700
- Fundamentals of Building Information Modeling\*† (1) CE 59700
- Economic Decisions in Engineering† IE 56400
- Safety Engineering† IE 55800
- Linear Algebra with Applications† MA 51100
- Advanced Mathematics† MA 52700
- Statistical Methods† STAT 51100
- Applied Regression Analysis† STAT 51200
- Practical Systems Thinking† SYS 53000

See attached matrix of knowledge areas and planned degree tracks

Functional Areas	Specialty						
	Heavy Construction	Industrial	Commercial	Energy	Equipment/ Automation	Information Engineering	Facilities Engineering
Basic Engineering	1, 4, 5, 6	7, 15	16, 17	7, 12, 16, 15, 17	2, 3, 8, 9, 10, 20, 21, 22, 24	1, 13, 14, 20, 22, 24, 28	23, 24, 25, 26, 27,28
Equipment	1, 2	1, 2	1, 2	1, 2	1, 2	1, 2	1, 2
Project Controls & Finance	3, 8, 9, 21	3, 8, 9, 14, 17, 21	3, 8, 9, 10, 14	3, 8, 9, 10, 11, 14	3, 8, 9, 10, 14	3, 8, 9, 10, 14	3, 8, 9, 10, 14, 21, 31, 32, 33, 34
Legal Aspects	18, 19	18, 19	18, 19	18, 19	18, 19	18, 19	18, 19
Virtual Construction	3	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3
Project Management & Safety	6, 9, 13, 36	9, 13	9, 13	9, 13, 35, 26	9, 13	9, 13	4, 9, 13, 35, 36
Temporary Structures	29	29	29	29	29	29	29

1	Remote Monitoring & Inspection	18	Construction Dispute Resolution
2	Robotics in Construction	19	Construction Delivery
3	Construction Visualization & Simulation	20	Statistical Methods in Construction
4	<i>Development of Underground Spoce</i>	21	<i>Construction Productivity</i>
5	Waterway Engineering	22	Measuring the Unmeasurable
6	Highways & Railways	23	Infrastructure Systems
7	Process Plant Construction	24	Infrastructure Management - IT Systems
8	Work flow planning and reliability	25	Infrastructure Decay Mechanisms
9	Time Buffers & Task Duration	26	Infrastructure Assessment Techniques & Tools
10	Cost/Benefits of Planning Details	27	<i>Infrastructure Planning</i>
11	<i>Construction Accounting</i>	28	<i>Infrastructure Analytics</i>
12	<i>Heavy Construction Innovation</i>	29	<i>Temporary Structures</i>
13	BIM Tools & Applications	30	<i>Construction Leadership</i>
14	BIM in Project Controls	31	<i>Construction Cost Analysis and Control</i>
15	Sustainable Construction Materials	32	<i>Construction Management</i>
16	Site Pollutant Reduction/Control	33	<i>Pipeline Condition Assessment &amp; Integrity Management</i>
17	State & Federal Regulations	34	<i>Underground Infrastructure Asset Management</i>
36	<i>Implementation of ISO 41001</i>	35	<i>Facility Engineering &amp; Management</i>
37	<i>Construction Equipment AR/VR</i>	38	<i>Construction Health &amp; Safety</i>