

Engineering Faculty Document 64-20  
February 25, 2020  
Page 1 of 1

To: The Engineering Faculty  
From: Division of Construction Engineering and Management  
Re: Professional Master of Science in Construction Engineering & Management

The Faculty of the Division of Construction Engineering and Management has approved a Professional MS in Construction Engineering and Management degree program, now submitted to the Engineering Faculty with a recommendation for approval.

- 1) MSCNE – Master of Science in Construction Engineering & Management
- 2) Non-thesis
- 3) 30-credit hours
- 4) The program will provide professionals with construction industry experience additional knowledge in several specialty areas of construction engineering. A primary feature of the program will include in-depth study of a complex problem in construction engineering.

**Reason:** The construction industry has become increasingly complex with high demands for practitioners to address areas of equipment automation, schedule and cost control, unique financial and legal arrangements, automation, virtualization, visualization, continuous project management, safety, and temporary structures. This program is envisioned to address these and other areas in a unique and desirable manner.



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Makarand Hastak, Professor and Head  
Division of Construction Engineering & Mgmt.



# Construction Engineering and Management

Title of Concentration: Professional MSCNE

## Statement of the Mission

The mission of the Professional Master's Concentration in Construction Engineering and Management (CEM) is to provide advanced technical education combined with leadership in key areas of interest in the construction sectors of regional, national, and international importance. The need for this concentration comes from discussions with people working in construction engineering and what they feel are the unmet needs.

The target audience will be:

- Current Purdue BS students wishing to undertake graduate studies, improve their skills, and increase their employability in key industry sectors.
- Domestic and international students at other institutions who, upon graduating, wish to receive a Professional Master's concentration from Purdue to gain a professional degree from a top US Engineering College to improve their skills and increase their employability in key industry sectors.
- Practicing professional engineers wishing to return for additional technical depth and leadership, to improve their career path.
- Students interested in only pursuing a master's degree with no interest in continuing on in a PhD program.

As construction is a service industry, the multidisciplinary aspect in research, education, training, and pedagogical development becomes even more important to prepare students to address the needs of clients/facility owners from diverse sectors. However, in its present form the graduate specialization in construction engineering is restricted to students entering the program through Civil Engineering, which limits the domain of complex problems and development to Civil Engineering topics. This proposal for a new CEM Professional Master's degree consists of seven specialty areas: Heavy Highway, Industrial, Commercial, Energy, Equipment/Automation, Information Engineering, and Facilities Engineering, that are specific to the construction industry and its integration with multiple engineering fields; it represents unique learning opportunities for professionals.

## Research Focus

The Professional Master's concentration will not have a thesis/research component and will not have direct articulation to a PhD program. If a student decides during the course of their studies to pursue a PhD they can apply to the appropriate program.

## Core and technical courses

There are 30 course hours in the plan of study, typically 10 3-credit hour courses or equivalent. Consistent with CEM's undergraduate program of required internships, the professional-focused degree encourages the student to bring a complex problem from their employer and work with

Purdue’s experts to identify an effective process or solution, in addition to advanced coursework. (Those students that do not have a complex problem from their employer may be able to utilize a complex problem from a corporate supporter). This will be recorded as CEM 59800 – Independent Study (Complex project/problem) – 6 credits

The CEM Professional Master’s degree consists of seven specialty areas: Heavy Highway, Industrial, Commercial, Energy, Equipment/Automation, Information Engineering, and Facilities Engineering, that are specific to the modern construction industry and its integration with multiple engineering fields; it represents unique learning opportunities for professionals. The figure below presents a matrix of functional and specialty areas for courses with individual courses listed below.

Functional Areas	Specialty						
	Heavy Highway	Industrial	Commercial	Energy	Equipment/Automation	Information Engineering	Facilities Engineering
Basic Engineering	1, 4, 5, 6	7, 15	16, 17	7, 11, 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, 14	3, 8, 9, 10, 14	3, 8, 9, 10, 14	3, 8, 9, 10, 14
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	6, 9, 13	9, 13	9, 13	9, 13	9, 13	9, 13	9, 13
Temporary Structures	29	29	29	29	29	29	29
1	Remote Monitoring & Inspection			15	Sustainable Construction Materials		
2	Robotics in Construction			16	Site Pollutant Reduction/Control		
3	Construction Visualization & Simulation			17	State & Federal Regulations		
4	Tunneling			18	Construction Dispute Resolution		
5	Waterway Engineering			19	Construction Delivery Methods - Benefits/Risks/Contracts/Forms		
6	Highways & Railways			20	Statistical Methods in Construction		
7	Process Plant Construction			21	Operations & Productivity		
8	Work flow planning and reliability			22	Measuring the Unmeasurable		
9	Time Buffers & Task Duration			23	Infrastructure Systems		
10	Cost/Benefits of Planning Details			24	Infrastructure Management - IT Systems		
11	<i>Leading Lean EPC</i>			25	Infrastructure Decay Mechanisms		
12	<i>Lean Implementation</i>			26	Infrastructure Assessment Techniques & Tools		
13	BIM Tools & Applications			27	<i>Infrastructure Planning</i>		
14	BIM in Project Controls			28	<i>Construction Analytics</i>		
				29	<i>Temporary Structures</i>		

The seven specialty areas will allow professionals with construction as well as non-construction engineering backgrounds the opportunity to increase knowledge and awareness of the complexities associated with construction including: constructability, scheduling, 4D/5D modeling, and automation. Likewise, advanced construction engineering instruction is applicable to other engineering areas including: manufacturing, chemical processing, power plants, and other areas where a complex process integrates physical or virtual objects over time.

Courses outside CEM that may be considered in the program include:

- MGMT 54600 – Decision Support and Expert Systems
- MGMT 57100 – Data Mining
- MGMT 60000 – Accounting for Managers
- MGMT 65000 – Strategic Management I
- MGMT 6600 – Operations Management
- IE 53000 – Quality Control
- IE 54500 – Engineering Economic Analysis

## IE 57700 – Human Factors in Engineering

### Participating faculty:

Faculty Coordinator for the Professional Master's concentration:

Participating Faculty: Makarand Hastak (Professor in CE/CEM and Head of CEM), Phillip Dunston (Professor in CE/CEM), Hubo Cai (Assoc. Professor in CE/CEM), Dulcy Abraham (Professor in CE), Theodore Weidner (Assoc. Professor of Engineering Practice in CEM),

### Expected number of students

Initially we would expect 6 students both residential and on-line. Over time, we would expect this to increase to 32 students.

### Learning Outcomes

The graduate pursuing this professional concentration will be able to:

- Demonstrate increased technical depth within construction engineering.
- Make sound engineering decisions
- Communicate, negotiate, and lead within local, regional, national, and international engineering enterprises.
- Demonstrate awareness of broader implications (economics, technical, ethical, and business aspects) of construction engineering.

CEM is uniquely positioned to offer a professional master's degree that affords an opportunity for individuals from multiple backgrounds and experiences to leverage their undergraduate education and professional experiences with a diverse faculty and subject areas that are all dependent on the ability to integrate and optimize activities in a 4D or 5D environment. In such an environment, graduate students can tackle complex projects using both traditional non-traditional methods for construction engineering.