CONSTRUCTION ENGINEERING AND MANAGEMENT

HISTORY

There are few modern feats of engineering achievement that surpass the great pyramids of Ancient Egypt. The sheer scale of the technological and physical challenge facing the creators of these superstructures was immense. The management skills by those early engineers were equally impressive. The demands of the clients (the Pharaohs) had to be fulfilled while co-coordinating, controlling and monitoring the subcontractors (the artisans) and employees (the slaves), as well as ensuring the optimum use of material resources (Fraidoon Mazda, 1997).

Construction engineering and management (CEM) is no simpler today and both beginner and experienced engineers find it difficult to come to terms with this subject. Today's construction industry has become more complex than ever before with the emergence of new business demands and challenges. Sophisticated clients and competitors will force civil engineering firms to adapt management concepts and theories to construction, and to shift their focus from the traditional project management approach to new management focus areas.

With the beginning of the 21st century, there is a true need for long-term strategic planning to take place in civil engineering organizations to provide them with greater chances and abilities to compete in the global economy. In this era of technological innovation and emerging global economy, there is a growing need for professionals possessing a unique set of business and engineering competencies.

CEM is still a relatively new discipline in the civil engineering realm. In the USA, it started with the development of pioneering master's programs approximately 45 years ago, followed by PhD programs 5 years later (Carr, 1997). Today, CEM is an established academic and research area that builds upon a long series of publications of scholarly work and debate.

INTRODUCTION

Construction Engineering and Management concerns the planning and management of the construction process for different infrastructure projects such as high ways, bridges, airports, railroads, buildings, dams and reservoirs. Construction of such projects requires knowledge of management principles, business procedures and human behavior. Construction Engineers engage in the design of temporary structures, quality assurance and quality control, building and site layout

surveys, on site material testing, concrete mix design, cost estimation, planning and scheduling, safety engineering, materials procurement, selection of equipment and cost engineering and budget.

Construction engineers design and execute processes for building and maintaining the infrastructure of our world. The tools of the trade for today's successful construction engineer include the following: strong math, science, and computer skills; creativity; an aptitude for applying science and engineering methods to solve problems; a love of building structures; an interest in working indoors and outdoors; initiative and a strong work ethic; the ability to collaborate with diverse people; good communications skills; and a desire to learn in a constantly changing environment.

Construction engineering management, or CEM, involves the application of technical and scientific knowledge to infrastructure construction projects. While engineering focuses on design and construction management is concerned with overseeing the actual construction, CEM often represents a blend of both disciplines, bridging design and management or project execution. Construction engineering managers may have an educational background at both undergraduate and graduate levels as well as experience in construction management techniques.

Their skills may be applied widely to the architecture, engineering, and construction (AEC) industry.

Project management responsibility that remains constant is the effective orchestration, guidance, and control of the construction process from beginning to end. Project management means managing the construction project.

Construction Engineering, the proper technique of assembling materials, components, equipment and systems, and the selection and utilization of the best construction technology to do so.

Management of the construction process, establishing the most effective way to implement the construction process, including proper scheduling and the coordination and control of the flow of labor, materials, and equipment to the jobsite.

EDUCATIONAL REQUIREMENTS

Individuals looking to obtain a construction engineering degree must first ensure that the program is accredited by the Accreditation Board for Engineering and Technology (ABET). ABET accreditation is assurance that a college or university program meets the quality standards established by the profession for which it prepares its students. In the US there are currently twenty-five programs that exist in the entire country so careful college consideration is advised.

A typical construction engineering curriculum is a mixture of engineering mechanics, engineering design, construction management and general science and mathematics. This usually leads to a Bachelor of Science degree. The B.S. degree along with some design or construction experience is sufficient for most entry-level positions. Graduate schools may be an option for those who want to go further in depth of the construction and engineering subjects taught at the undergraduate level. In most cases construction engineering graduates look to either civil engineering, engineering management or business administration as a possible graduate degree.

PROGRAM DESCRIPTION

This program is a combined study of basic civil engineering and construction management courses. Graduates shall be knowledgeable on the fundamentals of structural and construction engineering like design and analysis, material testing and quality assurance, building systems, construction technologies, and surveying. Graduates shall demonstrate a deep understanding of management principles and its application that are essential in construction projects such as economics, business, accounting, law, statistics, ethics, leadership, decision making and optimization methods, process analysis and design, safety, and cost engineering.

The program's thrust is to create and maintain an educational environment that shall enable graduates to practice as successful construction engineers and managers for the advancement of society and to promote professionalism in practice. Within the five years after graduation, the graduates of Construction Engineering and Management program shall have:

i. Undertaken, singly or in teams, projects that show an ability to solve complex engineering problems

ii. Had substantial involvement in projects that take into consideration safety, health, environmental concerns and the public welfare, partly through adherence to required codes and laws.

iii. Demonstrated professional success via promotions and/or positions of increasing responsibility

iv. Demonstrated life-long learning via progress toward completion of an advanced degree, professional development/continuing education courses, or industrial training courses

v. Exhibited professional behavior and attitude in engineering practice

vi. Initiated and implemented actions toward the improvement of engineering practice

PROGRAM OUTCOMES

a. Ability to apply knowledge of mathematics, science and engineering

b. Ability to design and conduct experiments, as well as to analyze and interpret data

c. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. Ability to function on multi-disciplinary teams

e. Ability to identify, formulate and solve engineering problems

f. Understanding of professional and ethical responsibility

g. Ability to communicate effectively

h. Broad education necessary to understand the impact of engineering solutions in the global and societal context

i. Recognition of the need for, and an ability to engage in life-long learning

j. Knowledge of contemporary issues

k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

l. Knowledge and understanding of engineering and management principles, as a member and leader in a team, to manage projects in multidisciplinary environments

CAREERS IN CONSTRUCTION ENGINEERING

In career path of construction engineering and management there are two options of working it's either in office setting which they focus on the design aspect, or out in the field which they focus on the actual building phase of the project.

Degree of Construction Engineering:

- General contractors (bridges, roads, buildings, healthcare, facilities and centers)
- Owners and Developers
- Mechanical/electrical contractors
- Renewable energies
- Consulting and design firms
- Oil and gas industry
- Aviation industry
- Historical Restoration

Construction engineers are also responsible in:

- ✓ Planning and overseeing the construction operations of a project
    - Conducting site layout
    - Scheduling
    - Selecting equipment
    - Organizing the work crew
    - Managing materials
    - Safeguarding the Environment
    - Building Temporary structures
- ✓ Designing (both temporary and permanent)
- ✓ Checking and modifying plans and specifications for constructability, efficiency, and safety
- ✓ Developing cost estimates and preparing bids
- ✓ Utilizing Building Information Modelling (BIM) software for 3D models

- ✓ Managing subcontractor firms
- ✓ Working with the owner to ensure that the project meets requirements
- ✓ Solving job site problems, moving between the field and office
- ✓ Gaining additional education and training

TECHNICAL AND LEADERSHIP BACKGROUND

Construction engineering managers are often called upon to use computers and construction management software to produce and analyze designs for their projects. They are responsible for assembling teams of qualified engineers who can ensure completion of a given project. Construction engineering managers also need to possess the right knowledge for controlling estimation and planning of associated costs for a project.

WORK RESPONSIBILITIES

Construction engineering managers often work out of a central office but may make frequent visits to job sites and sometimes engage in on-location work with labor. They also tour sites regularly to inspect the work being done and to ensure that proper standards in the construction project are being maintained. The typical workweek for a construction engineering manager is 40 hours, but many works longer hours in an effort to meet deadlines or solve problems that arise within a project.

A construction engineering manager also has a host of other responsibilities. He or she is often called upon to survey the job site prior to the beginning of a project, addressing environmental issues and local laws or codes that must be followed. Before work commences, an engineering manager typically prepares a report on their findings and collaborates with others involved with the project, including governmental agencies, environmental associations, contractors, and subcontractors.

PROFESSIONAL SKILLS AND EXPERTISE

Construction engineering managers must possess a thorough understanding of laws, regulations, and building codes, especially those that have a direct impact on the project at hand. They must also be able to estimate the total cost of a given project with consideration to:

- Site inspections
- Drainage, sewage, and elevation level tests
- Equipment and materials
- Labor

Construction engineering managers are also responsible for managing the workings of various other entities involved in the project. They are responsible for providing expert supervision from beginning to end while also keeping the project running on or ahead of schedule and within budget. The job requires strong leadership and interpersonal skills and attention to detail. Like any other kind of engineer, construction engineering managers need to possess strong problem-solving, analytical, and mathematical skills.

CONSTRUCTION ENGINEERING MANAGEMENT JOBS

As with other areas of construction, the job of a construction engineering manager is in demand and experiencing growth. According to the U.S. Bureau of Labor Statistics, the construction industry is expected to see upwards of 20 percent growth over the next 8 to 10 years. That alone will expand the need for qualified managers at every level of the construction process, making it a good choice when trying to decide on a career in construction.

REFERENCES

Burger, R. (2018), *"What Is Construction Engineering Management?",* Retrieved from: https://www.thebalancesmb.com/what-is-construction-engineering-management-845371

Carr, R.I. (1997). "*Engineering and construction management: Leadership and opportunity."* Journal of Construction Engineering and Management, ASCE, 123 (3), 292-296.

Mapua University - Manila (2020), "*BS Construction Engineering and Management*", Retrieved from: http://cege.mapua.edu.ph/content/bs-construction-engineering-and-management

Purdue University (2020), "*What is Construction Engineering and Management*?", Retrieved from: https://engineering.purdue.edu/CEM/aboutus/what-is-cem